TICK HILL
mining company

Progressive Rehabilitation And Closure Plan

Tick Hill Gold Mine

EPML00820613

February 2025

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Requirement	Details
Title of the project	Tick Hill Gold Mine
Document title	Progressive Rehabilitation and Closure Plan
Version number	2.0
Document ID number	PRCP-EPML00772013-V2
Date of submission	28/02/2025
Tenure number(s)	ML7094, ML7096, ML7097
EA holder name	Tick Hill Mining Pty. Ltd.
EA holder contact details	9 Davis Rd, Ryan QLD 4825

DOCUMENT CONTROL

Type	Document number	Document Name	Document Date
Draft for client review	PRCP-EPML00772013-V2 (Rev A)	Tick Hill Gold Mine Progressive Rehabilitation and Closure Plan	31/01/2025
Updated draft following client review	PRCP-EPML00772013-V2 (Rev B)	Tick Hill Gold Mine Progressive Rehabilitation and Closure Plan	17/02/2025
Updated for DETSI submission	PRCP-EPML00772013-V2 (Rev 0)	Tick Hill Gold Mine Progressive Rehabilitation and Closure Plan	28/02/2025

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1 INTRODUCTION

Tick Hill Gold Mine (THGM or 'Site') is located approximately 40 km south of Duchess, 140 km southeast of Mount Isa and covers an area approximately 390 ha. THGM is managed under environmental authority EPML00863713 which permits mining and exploration activities across mining leases ML7094, 7096 and 7097. The site is currently non-operational, however in 1990 to 1994 was mined for gold, and 2020 to 2022 the tailings were extracted from the decommissioned TSF for reprocessing.

Version 1.0 of this transitional progressive rehabilitation and closure plan (PRCP) was submitted on 1 September 2023. A Queensland Government Department of Environment and Science[1] (DES) 'Information Request' Notice was received on 31 October 2023 requesting further information.

This PRCP (Version 2.0) has been submitted in response to the 19 February 2024 'Decision on request to extend the information response period' Notice (DES, 2024).

This PRCP has been prepared in accordance with the requirements of the 'Progressive rehabilitation and closure plans (PRCPs) Guideline (ESR/2019/4964, Version 3.01) published by DES (DETSI, 2024), and referred to as the 'PRCP Guidelines'.

The PRCP is comprised of two components:

- PRCP rehabilitation planning – provides a basis for the PRCP schedule
- PRCP schedule – presents the rehabilitation milestones (RM), milestone criteria, and associated timing. A standalone excel spreadsheet is provided separately.

This document fulfils the requirements for the rehabilitation planning part for Tick Hill Gold Mine. The purpose of the rehabilitation planning is to support and justify the development of the PRCP schedule, which has been submitted electronically (as a native excel file, as well as provided herein as Appendix A), and detail how progressive rehabilitation and closure will be carried out over the entire site, and on a rehabilitation and improvement basis (DETSI, 2024).

1.1 LAND OUTCOME DOCUMENTS

The Project is considered a transitional PRCP, as mining activities are in process or have already occurred. Land outcome documents were used to inform and guide this PRCP where relevant. Due, in part, to the rehabilitated nature of the site, and inactivity for the majority of years since gold mining ceased in 1995, the only land outcome documents currently applicable to THGM is the environmental authority (EA) EPML00820613 (dated 1 April 2022).

1.2 REHABILITATION OBJECTIVES

The overarching closure goal for THGM is to achieve a site that is safe, stable and non-polluting that can sustain the agreed post-mining land use/s (PMLU). This plan provides the strategies and controls to mitigate closure risks that will be implemented to achieve this goal.

Regarding rehabilitation and closure, Condition A16 of the current EA states that:

'*Land disturbance must be rehabilitated in accordance with the most recent edition of the administering authority's guideline* Rehabilitation requirements for mining projects.'

[1] It is noted that DES has been renamed as the Department of Environment, Science and Innovation (DESI). References will retain author name at time of document production.

However, the Rehabilitation requirements for mining projects (ESR/2016/1875) has been superseded by the PRCP Guidelines, therefore rehabilitation objectives have been based on the PRCP Guidelines (DETSI, 2024).

The intention of THGM is that the tailings material will be removed and relocated off-site to a third-party user. Therefore, the rehabilitation will include an engineered cover for the tailings storage facility (TSF) footprint. Additional disturbance areas will either undergo minor reshaping and revegetation; or directly revegetated to achieve the proposed PMLU.

The mining pit/void is proposed as a non-use management area (NUMA) and management milestones have been proposed to eliminate or reduce impact to sensitive receptors.

2 PROJECT PLANNING

2.1 SITE LOCATION AND TENEMENTS

THGM is in north-central Queensland, approximately 40km south of the township of Duchess, and approximately 140km southeast of Mt Isa. The site is accessible via the Duchess to Phosphate Hill Road which runs north-south 5 km to the east of the site. The partially unsealed Mount Isa Duchess Road is the main access to Mount Isa, and the sealed Cloncurry Duchess Road provides direct access to Cloncurry.

2.1.1 MINING TENEMENTS

The mining leases (ML) relevant to THGM are ML7097, ML7094, and ML7096. A summary of each is provided in Table 2-1 (noting that tenements are all the same size).

Table 2-1: Mining Tenements

Mining Lease	Granted	Expires	Area (ha)
ML7094	20/06/1991	30/06/2031	130
ML7096	20/06/1991	30/06/2031	130
ML7097	20/06/1991	30/06/2031	130
Total			390

2.2 SITE OWNERSHIP

2.2.1 MINE OWNERSHIP

The Site has had multiple owners since it was discovered in 1989. The current owners and Site information is provided in Table 2-2.

Table 2-2: Site Identification

Item	Details
Site owner	Tick Hill Mining Pty Ltd
Address	Tick Hill Gold Mine, Dajarra, QLD
Mine Leases	ML7094, ML7096, ML7097
Lot and plan number	Lot 13 on SP309109 (part), Lot 16 on SP309110 (part)
Area (mining lease)	390 ha lease area + 8.5 km road access
Zoning	Rural – Extractive and Mineral Resource
Local Government Authority	Cloncurry Shire
Coordinates (site centre)	-21.64645 Lat, 139.92561 Long
Current land use	Non-operational gold mine
Proposed future land use	Rehabilitated mining land

2.2.2 LANDHOLDERS

THGM is remotely located. The landholders are MDH Pty Ltd (MDH) being Stanbroke Station to the west and Chatsworth Station to the east. MDH is the lessee of the pastoral development. Carnaby Resources Pty Ltd (Carnaby) as the previous owners of THGM have an agreement for retention of infrastructure, and it is anticipated that this agreement will be transferred to THGM . Until this agreement has been confirmed, and for the purposes of this PRCP, it is assumed that all infrastructure at THGM will be rehabilitated.

2.3 BASELINE INFORMATION

This section provides the baseline knowledge of the Project prior to the commencement of mining activities. The technical reports which support this PRCP are provided as appendices where relevant.

2.3.1 TOPOGRAPHY

Terrain in proximity to the THGM is generally described as rolling to hilly with flat-top mesas. A ridge running north to south is located east of the THGM forming a notable geological feature, as evident in Figure 2-1.

The area of mine workings consists of generally flat plains with moderate hills and a gentle slope toward the northwest.

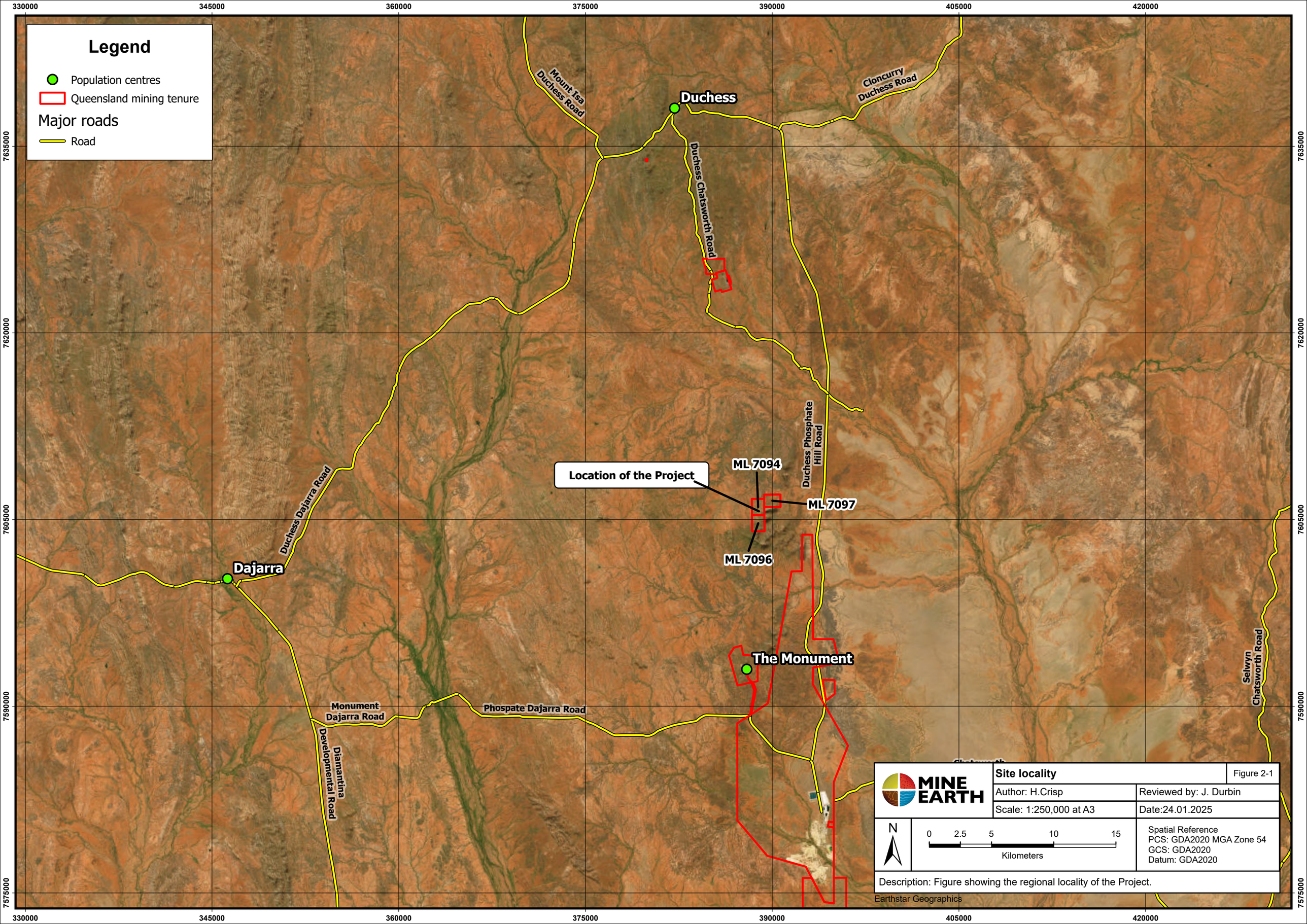
The site's elevation within the ML area ranges from 320 to 450 m Australian Height Datum (mAHD) although the former operational areas of the site are all between 320 and 360 mAHD.

2.3.2 CLIMATE

THGM is situated approximately 1,000 km west of the Coral Sea and approximately 370km south of the Gulf of Carpentaria, therefore the climate is considered 'Tropical Continental', defined as warm and mostly dry throughout the year; BSH - hot semi-arid climate on the Koppen climate classification. There are defined wet (summer) and dry (winter) seasons, although humidity varies throughout the year (BOM, 2023):

- Mild temperatures with low humidity (May to August).
- Hot temperatures with low humidity (September to December).
- Hot temperatures with high humidity (January to April).

The average daily temperatures range from 7°C to 24°C in the 'dry season' (April – September), and 17°C to 40°C in the 'wet season' (October to March) as confirmed by data obtained from the 'The Monument Airport'. During the wet season, the average rainfall is 47 mm per month whilst the average rainfall during the dry season is 8.8 mm per month (BOM, 2023).


Legend
Population centres
Queensland mining tenure
Major roads
Road
Duchess
Mount Isa Duchess Road
Cloncurry Duchess Road
Duchess Chatsworth Road
Duchess Phosphate Hill Road
Location of the Project
ML 7094
ML 7097
ML 7096
Duchess Dajarra Road
Dajarra
The Monument
Monument Dajarra Road
Phospate Dajarra Road
Diamantina Developmental Road
Selwyn Chatsworth Road
330000
345000
360000
375000
390000
405000
420000
7635000
7620000
7605000
7590000
7575000
MINE EARTH
Site locality
Figure 2-1
Author: H.Crisp
Reviewed by: J. Durbin
Scale: 1:250,000 at A3
Date:24.01.2025
N
0 2.5 5 10 15
Kilometers
Spatial Reference
PCS: GDA2020 MGA Zone 54
GCS: GDA2020
Datum: GDA2020
Description: Figure showing the regional locality of the Project.
Earthstar Geographics

2.3.3 GEOLOGICAL SETTING

The Tick Hill gold deposit is a high grade (22.5g/t) gold deposit located in the in the Mesoproterozoic (1900–1500 Ma) Mt Isa Inlier, northwest Queensland. The Mt Isa Inlier is one of Australia's foremost mineral provinces and is famous for its world-class Cu-Pb-Zn-Ag deposits (Mt Isa), SEDEX (Dugald River; Cannington), IOCG deposits (Ernest Henry; Starra), Mo deposits (Merlin), Co deposits (Walford Creek); and REE/U (Mary Kathleen) deposits.

During the Paleoproterozoic Era (2.5 to 1.6 billion years ago), the Mt Isa region experienced intense volcanic activity, resulting in the formation of large amounts of basalt and rhyolite. These volcanic rocks are important as they host significant mineral deposits, including copper, zinc, lead, silver, and gold (Laurie et al, 2012). The mineral deposits in the Mt Isa region were formed through a combination of volcanic activity, hydrothermal processes, and sedimentation. Historic volcanic activity released mineral rich fluids into the surrounding rocks which precipitated into mineral ore bodies located within underground fractures and faults.

Mineralization at Tick Hill is characterized by coarse grained gold associated with Bi-selenides, minor sulfides, and a general paucity of other metals except for a slight enrichment of Cu in the footwall to the ore zone. Alteration is characterized by early silicification and magnetite alteration that formed during the initial D_{1-2} events and may have coincided with the first stage of gold enrichment. During syn-D_3 (re-) mobilization of gold, alteration involved the destruction of magnetite, the emplacement of abundant laminar quartz veins, and the deposition of proximal albite, hematite, chlorite, amphibole, epidote overprinted by later K-feldspar, sericite, clay minerals and minor calcite. The ore zone is bounded by a strongly silicified zone and surrounded by a chlorite-epidote shell. The low pressure D_3 gold (re-} mobilization event involved an oxidized, S-under-saturated, acidic, saline aqueous fluid. In terms of alteration characteristics, the Tick Hill deposit shares similarities with IOCG deposits in the area. However, its high-grade gold-only nature, lack of Cu, and the presence of Bi-selenides makes it a unique deposit in the Mt Isa Inlier.

The high-grade gold-only Tick Hill deposit presents a unique mineralisation style in the Mt Isa Inlier. Gold is dominantly hosted within intensely silicified units affected by D_3 fracturing and associated alteration.

The Tick Hill ore body is hosted in fractured and silica-hematite-altered gneiss. The principle host rock to mineralization is a metasomatized quartz-feldspar mylonite that was labelled "galah stone" to denote its laminated pink and grey appearance. It was derived from sheared quartz-feldspar porphyry, pegmatite and/or calc-silicate metasediments (Laing, 1992; Tedman-Jones, 2001). To emphasise the metasomatic overprint of the mylonite and the presence of thin quartz-feldspar alteration selvedges along the mylonitic fabric, Laing (1992) proposed the term "quartz-feldspar laminite". In a later review of drill core, Tedman-Jones (2001) described the pervasive occurrence of dilation fractures and thin sheeted partings along S_1 mylonite planes and linked it to the introduction of K-Na feldspar metasomatism and gold.

2.3.4 HYDROGEOLOGY

A hydrogeological desktop review was undertaken in 2023 as part of the development of an Environmental Site Assessment (ESA) for THGM (EES, 2023). The review found groundwater located in fractured and weathered zones within hard-rock Proterozoic metasediments and igneous rocks. The regional aquifer was semi-confined to confined and of low yield (EES, 2023). Recharge was thought to occur from ephemeral surface watercourses and the limestone capped hills to the southeast of the mine (Cromer, 2020); (EES, 2023).

2.3.4.1 GROUNDWATER MONITORING NETWORK

A total of nine groundwater monitoring bores have been installed at THGM in 2012 (two), 2020 (four) and most recently in June 2023 (three). Data from groundwater sampling is available from 2012 through to the most recent sampling events in 2024 (EES, 2023; 2024).

2.3.4.2 GROUNDWATER LEVELS

The groundwater level fluctuates in response to changes in recharge rates, in turn due to seasonal and annual rainfall variability, and the open pit controls the local groundwater system in its immediate vicinity (Scott, 2020). Groundwater depths at THGM typically range between 15 and 30 meters below ground level (mbgl) (Cromer, 2020). Groundwater in the vicinity of THGM generally flows towards the open pit, which acts as a groundwater sink (Cromer, 2020).

It is estimated that the open pit loses groundwater through evaporation at an average rate of 1 L/s, which is replaced by groundwater flows towards the open pit (Cromer, 2020). The only area where groundwater flows did not appear to flow towards the pit was to the north of the WRD, at the western perimeter of the site (EES, 2023).

2.3.4.3 GROUNDWATER QUALITY PROPERTIES

Groundwater was found to be neutral to slightly alkaline, naturally elevated in salts and metals, with the pit water also being highly saline (EES, 2023). Drinking water quality criteria are typically exceeded for pH, salinity (TDS), chloride, sodium, fluoride, ammonia and nitrate. Fluoride is the only parameter that generally exceeds the stock watering criteria (EES, 2023). Assessment for the concentrations of metals in groundwater found that, while in exceedance of drinking water guidelines, there were no exceedances against stock watering criteria (EES, 2023). Nitrate and ammonia attributable to explosives residue was observed in several locations, downgradient from the WRD.

Concentrations of total cyanide were assessed due to presence in tailings. Cyanide concentrations in groundwater varied across groundwater bores at THGM. Low concentrations <0.004mg/L were generally found in all bores, with the exception of bores THGW001, THGW003 and THGW008, where concentrations exceeded screening criteria (>0.004 mg/L Total CN). The variation in concentration of cyanide in these bores (Bores 1, 3 and 8) was found to be consistent with the vertical gradation of cyanide concentration in groundwater sourced from infiltration from the tailing storage facility (TSF) to the south. It is highly likely that cyanide concentrations will steadily decrease over time and that cyanide expressing in pit water would be degraded by sunlight, as has already been occurring (EES, 2023).

2.3.5 HYDROLOGY AND FLUVIAL NETWORKS

There are several small and localised ephemeral drainage pathways surrounding THGM with flows being generally to the north and northwest. Following rainfall events, surface water generally flows into these drainage lines which ultimately discharge to Petticoat Creek, a larger ephemeral watercourse located approximately 1.5 km downstream of the site.

Petticoat Creek generally drains the area surrounding the mine and flows east into the Burke River, which then flows south into the Georgina River and ultimately terminates into Lake Eyre. Only small and localised ephemeral drainage pathways occur in proximity to THGM (as shown in Figure 2-2), with potential flows naturally to the north and northwest.

Historically disturbed areas of the THGM site are already rehabilitated, therefore any alteration of catchment flows would have occurred more than 30 years ago. Observations of the downstream receiving surface drainage lines show no evidence of negative impact or deterioration of condition resulting from any alterations undertaken. The residual void pit rim has an abandonment bund in place that is 10 m high and

20 m wide, that is significantly higher than the surrounds and will only capture the surface catchment within the bunded area.

The Queensland state mapping for flood risk areas also indicates that the THGM site is well outside of any mapped areas of concern as shown in Figure 2-3. This mapping has been sourced from the Interim Floodplain Assessment Overlay for the Georgina River Sub-Basin v1.0 (QRA, 2012), and is intended to show a spatial extent of where flooding has previously occurred; or has potential to occur in future but is not based on any flood model and do not represent a particular flood event. As such, the mapping is considered more conservative than the 0.1% AEP that is being taken as a 'floodplain' for PRCP purposes.

Further to this, previous risk assessments (Envirofin, 2020; EES, 2023) identified THGM as having no flood risk. As such, the 'flooding' requirements outlined by the PRCP guidelines (DES, 2023) have not been considered further in this PRCP.

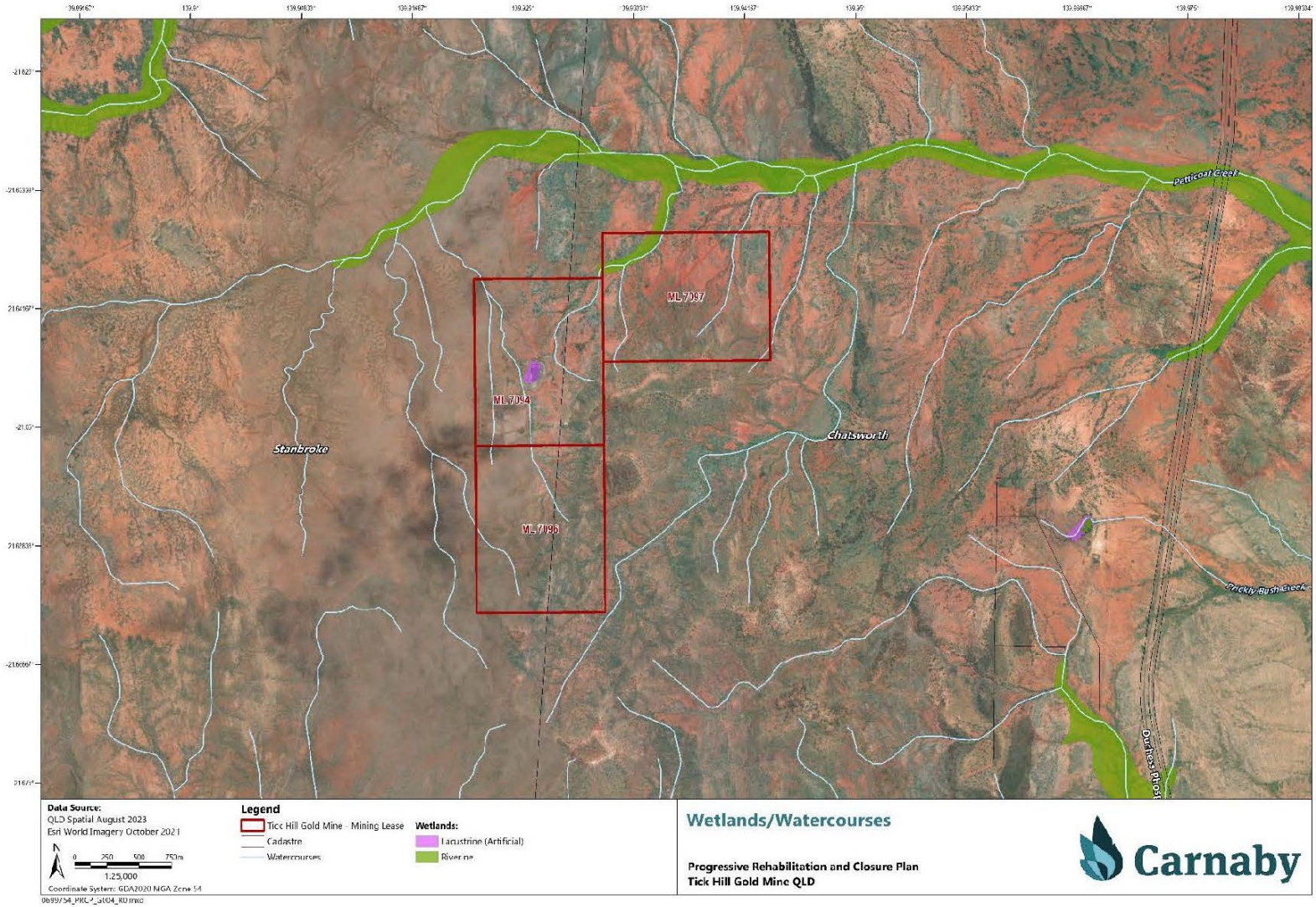


Figure 2-2: Watercourses and Wetlands (Carnaby, 2023)

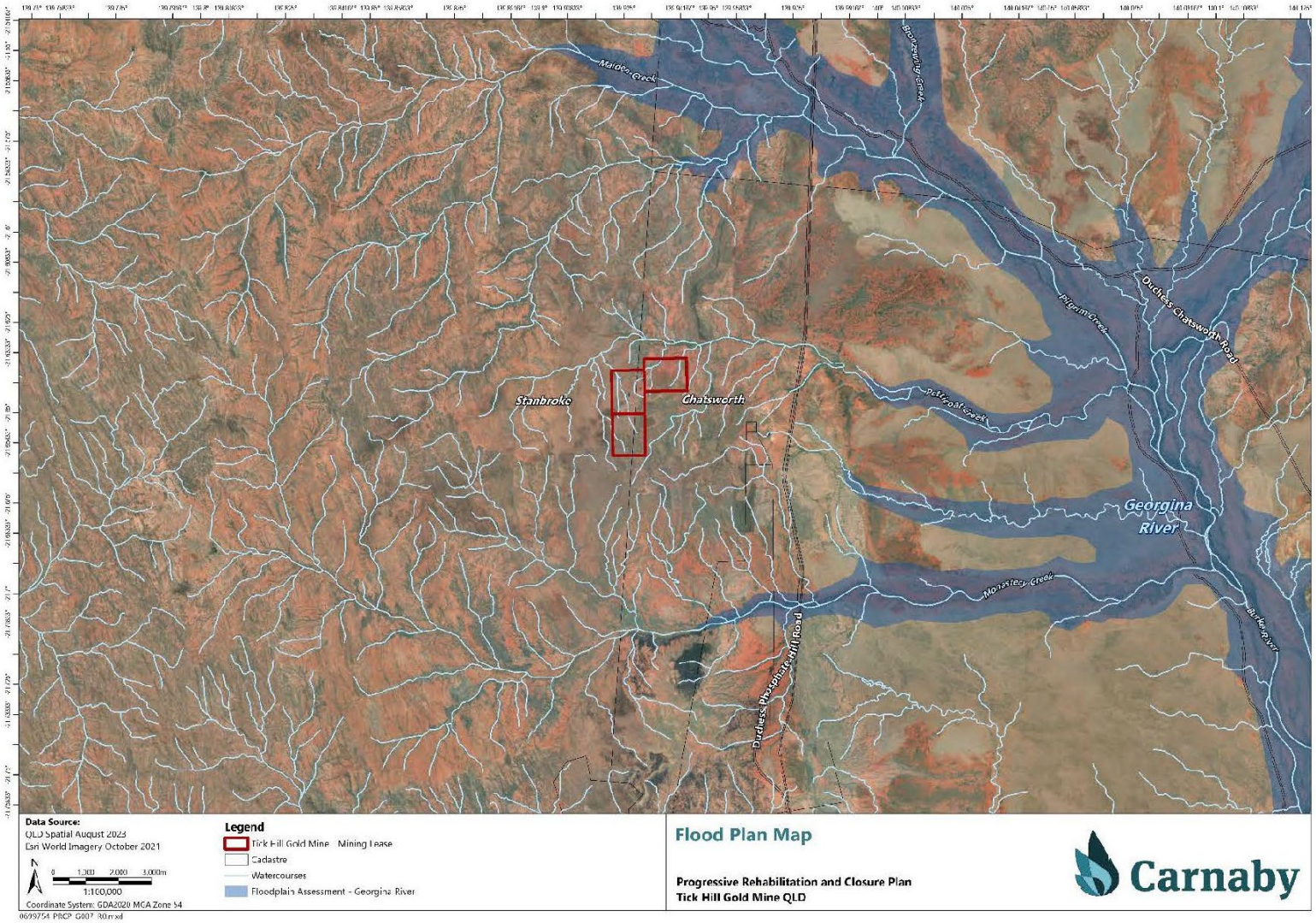


Figure 2-3: Flood Risk Assessment (Carnaby, 2023)

2.3.6 SOIL TYPES, PROPERTIES AND PRODUCTIVITY

Soil mapping for the site includes the 1:2M Atlas of Australian Soils (Northcote et. al. 1960- 1968) and the 1:1M Land Systems Survey of the Leichhardt-Gilbert Area (1964). The flatter sections in the north and west of the site are mapped as the Quamby land system which comprises sparsely timbered undulating plains. Soils associated with this land system are described as red smooth-ped earths. These soils are gradational red earths with no A2 horizon and alkaline smooth-ped whole columnar B horizon. The mesa hills in the southeast are the Merlin land system, which consists of stony spinifex country, gently undulating to undulating lands with occasional low mesas. Soils are earthy loams with uniform medium, porous coherent solum, and profile depth less than 0.6 m (EES, 2023). Soil mapping for the THGM site is provided as Figure 2-4.

Broadly undulating lands with granite outcrop occur on some ridge crests. The dominant soils are quartz-gravel-strewn moderately deep loamy red friable earths (Gn3.13), with the shallower type (Gn3.12) associated with some slopes consisting of gravel-strewn loamy red duplex soils (Dr2.12, Dr2.13) and gravel-strewn red clays (Uf6.31). On lower areas are deep brown or red-brown cracking clays (Ug5.32, Ug5.37). Shallow to moderately deep loamy red earths (Gn2.11, Gn2.12) and shallow gravelly loams (Um5.51) occur near rocky outcrops.

Surface soils, as identified by a 2024 field sampling and analysis program (provided in Appendix B), identified ‘Sandplains’, ‘Sand dunes’ and ‘Low rocky rises’ soil-landform associations (SLAs), based on collection of 16 samples, plus land system mapping, imagery and surface feature morphology. The Sand dunes SLA was not able to be sampled as the sand dunes currently form part of a habitat exclusion zone. The Sandplains and Low rocky rise SLAs are summarised as follows:

- Sandplains
  - Flat / low relief aeolian plains between longitudinal sand dunes
  - Thin aeolian sand surface layer over thin, weak crust
  - Deep sandy profiles, with increasing clay content with depth
  - Typically, no coarse fragments through top 0-20 cm of soil profile, with minor amounts of coarse fragments at varying depths within some profiles
  - Friable highly weathered lateritic layer consisting of ironstone pisoliths in a sandy matrix within some profiles at varying depths
  - Indurated calcrete layer at depth within some profiles
  - Soils characterised as Red deep sands (WA Soil Group 445) and Red sandy earths (WA Soil Group 463)
  - Soils are non-saline to moderately saline, non-sodic, potentially dispersive upon severe disturbance, have a low propensity to hard-set, have a very rapid hydraulic conductivity and are typically low in organic carbon and plant-available nutrients.
  - Concentrations of As and Se consistently measured above the average crustal abundance.
- Low rocky rises
  - Low relief rocky rises
  - Surface mantle of quartz and ironstone
  - Shallow surface soils over fractured/weathered and competent rock
  - High percentage of competent rock fragments through the surface soil profile

- Areas of outcropping competent rock present in some areas
- Soils characterised as Red shallow loams (WA Soil Group 522), Calcareous shallow loams (WA Soil Group 521) and Calcareous loamy earths (WA Soil Group 542)
- Soils ranged from non-saline to extremely saline, were typically non-sodic, potentially dispersive upon severe disturbance, have a low propensity to hard-set, have a moderately rapid hydraulic conductivity and are typically low in organic carbon and plant-available nutrients.
- Concentrations of As and Se consistently tested above the average crustal abundance (Mine Earth, 2025a).

The topsoil (0 to 20 cm) from all disturbance areas within the Sandplain, Sand dune and Low rocky rises SLAs is considered suitable as a surface rehabilitation material. If topsoil is sourced from these areas, Sandplain and Sand dune SLA material should be stockpiled separately to the topsoil collected from the Low rocky rises disturbance areas.

The 2024 sampling and analysis investigation (Mine Earth, 2025a), assessed 15 analogue (undisturbed) soil samples from five locations and found the soils to have the following attributes:

- Weakly to moderately structured 'clayey sand' to 'medium heavy clay' soils with variable coarse rock content (>2mm), up to 20%
- Low concentrations of plant-available nutrients and organic carbon
- Typically classified as non-sodic, with a low potential for clay dispersion
- Classified as non-saline. Soil pH range from pH 7.1 to pH 9.0, classified as neutral to strongly alkaline
- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance.

The erodibility of all the topsoils is likely to be relatively low, unless subject to concentrated surface water flow (Mine Earth, 2025a).

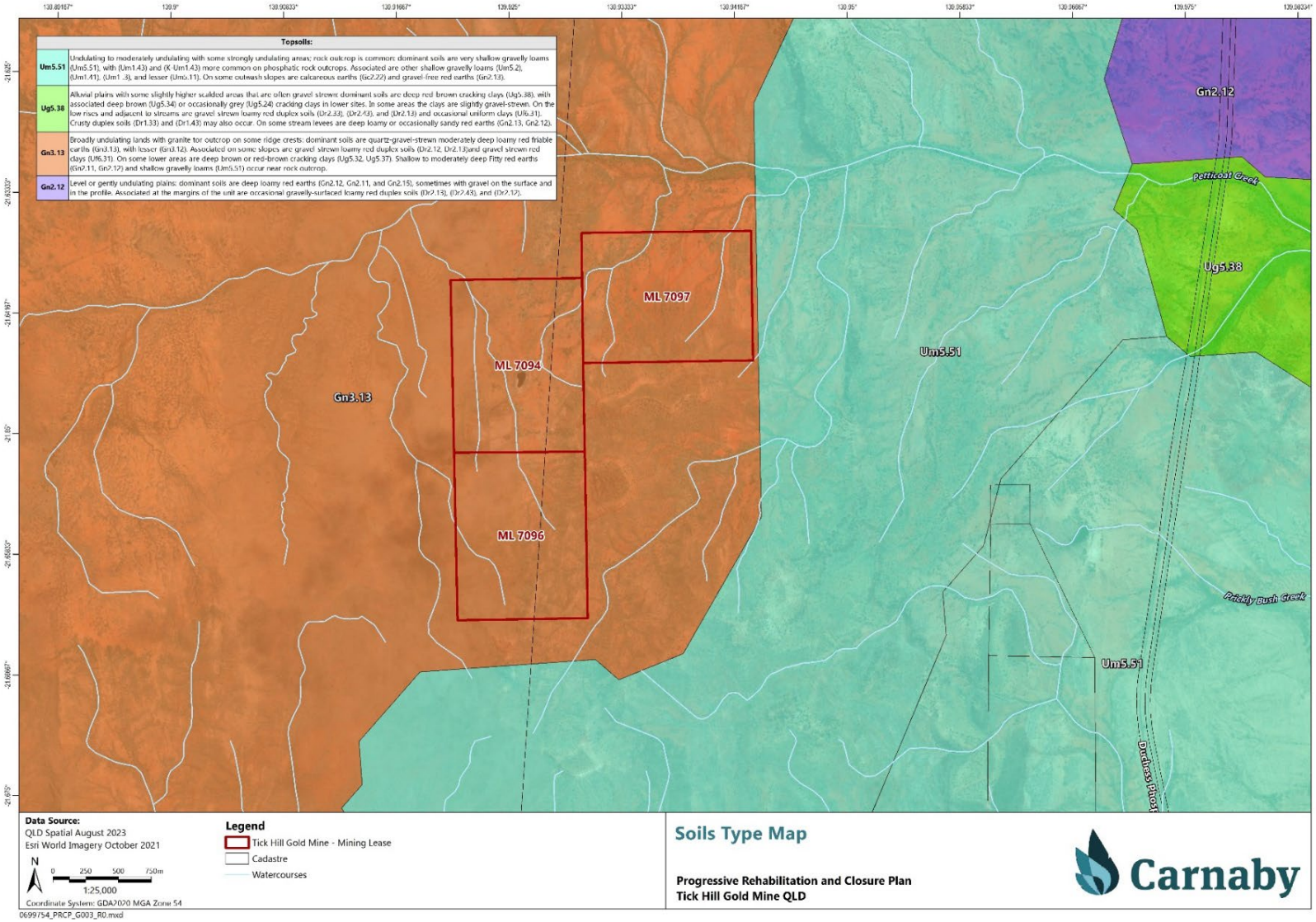


Figure 2-4: Soils in the Tick Hill area (Carnaby, 2023)

2.3.7 LAND STABILITY, SUITABILITY AND CAPABILITY

The surrounding land, and previous land use at THGM, has consistently been for low-intensity cattle grazing. The land has numerous drainage lines in the landscape, with cattle grazing resulting in minor disturbance to the land and the erosion of drainage banks. Red earths are known to be susceptible to water erosion, especially during high intensity rainfall events. The runoff from these soils can create surface flow, leading to the detachment and transportation of soil particles. This erosion process can result in gullies, rills, and sheet erosion, which can further contribute to land instability.

The erodibility tends to be worsened by cattle grazing. However, as the land will continue to be used for low-intensity cattle grazing, erosion is expected to remain as a minor issue, with only minor impact on the land stability. Since mining ceased in the 1990s, the land has been capable of maintaining its structural integrity and maintain sufficient vegetation growth to remain established overall. Surrounding lands are stable and considered moderately disturbed as the regional land use is grazing.

Five land suitability classes are defined as per the Guidelines for agricultural land evaluation in Queensland (DSITI & DNRM, 2015). Based on the 2013 THGM rehabilitation assessment, all soil units (either undisturbed or reused as a growth medium during rehabilitation) were unlikely to have significant agricultural value (either prior to or post-mining) and are likely classified as either:

- Class 3 – suitable land with moderate limitations – land which is moderately suited to a proposed use, but which requires significant inputs to ensure sustainable use; or
- Class 4 – marginal land with severe limitations on land use requiring major inputs to ensure sustainability. Such inputs may outweigh the returns from the land.

This assessment was based on the assumption that plant available water capacity (PAWC) was the highest-ranking limiting factor (SKM, 2013).

2.3.8 VEGETATION

2.3.8.1 NATIVE SPECIES

The vegetation reflects the region's climate and landscape. The site and surrounds are predominantly low open woodland consisting of scattered native trees and shrubs, and dominated by annual and perennial grasslands – including the naturalised Cloncurry buffel grass (*Cenchrus pennisetiformis*).

Dominant tree and shrub species throughout the area include Cloncurry box (*Eucalyptus leucophylla*), desert bloodwood (*Corymbia terminalis*), Whitewood (*Atalaya hemiglauca*), Chisholm's Wattle (*Acacia chisholmii*), Conkerberry (*Carissa lanceolata*), Native Cotton (*Gossypium australe*), and the naturalised Sweet Acacia (*Vachellia farnesiana* syn. *Acacia farnesiana*).

Dominant grass species include Spinifex (*Triodia pungens*), Long-head Spinifex (*Triodia longiceps*), Purple Three-awn Grass (*Aristida pruinosa*), Nine-leafed Grass (*Enneapogon polyphyllus*), and the naturalised Fountain Grass (*Cenchrus pennisetiformis*).

The colluvial slopes and central area of THGM consists predominantly of *Eucalyptus leucophylla* (Cloncurry box), desert bloodwood *(Corymbia terminalis*), and Whitewood (*Atalaya hemiglauca*). Open plains to the west are characterised by Tussock grasslands dominated by Mitchell grass (*Astrebla* spp.) and Feathertop Wiregrass (Aristida latifolia) (Queensland Government, 2024).

The remnant regional ecosystems (RE) around the THGM area are shown in Figure 2-5 and summarised in Appendix C. The species listed have guided the revegetation requirements remaining at site.

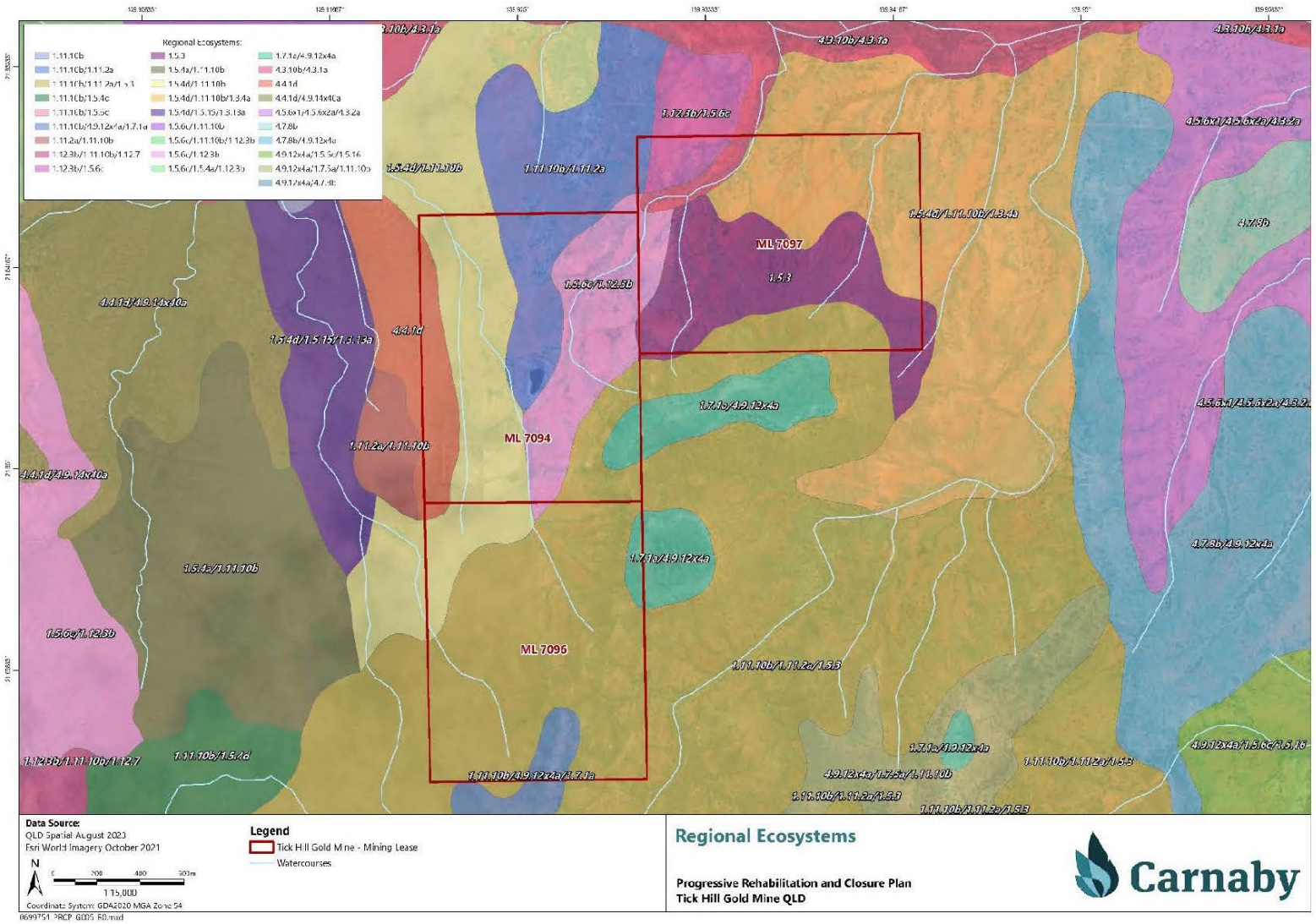


Figure 2-5: Regional Ecosystems of the Tick Hill Gold Mine area (Carnaby, 2023)

2.3.8.2 WEEDS

Kapok bush (*Aerva javanica*) and Buffel Grass (*Cenchrus ciliaris*) were the only introduced species identified in the 1999 flora survey (SKM, 1999). Recent site observations (2024) have also confirmed an abundance of Buffel Grass, however it appears to be at levels consistent with the surrounding area, as shown in Figure 2-6.

Figure 2-6: Buffel Grass at Tick Hill Gold Mine and surrounding area

Table 2-3 provides a list of weed species previously recorded at THGM. Note that buffel grass (*Cenchrus ciliaris*) is considered naturalised and not a weed species (DES, 2019).

Table 2-3: Weed species identified at Tick Hill Gold Mine

Pest plants	Common Name	Status under the Biosecurity Act
Acacia nilotica	Prickly Acacia	Category 3 restricted invasive plant
Parthenium hysterophorus	Parthenium	Category 3 restricted invasive plant
Parkinsonia aculeata	Parkinsonia	Category 3 restricted invasive plant
Ziziphus mauritiana	Chinee Apple	Category 3 restricted invasive plant
Cryptostegia grandiflora	Rubber Vine	Category 3 restricted invasive plant
Ricinus communis	Castor Oil Plant	Not a prohibited or restricted invasive plant under the *Biosecurity Act 2014*. However, by law, everyone has a general biosecurity obligation (GBO) to take reasonable and practical steps to minimise the risks associated with invasive plants under their control.
Cylindropuntia fulgida var. mamillata	Coral Cactus	Category 3 restricted invasive plant
Bryophyllum delagoense	Mother of Millions	Category 3 restricted invasive plant
Calotropis procera	Calotrope	Not a prohibited or restricted invasive plant under the *Biosecurity Act 2014*. However, by law, everyone has a general biosecurity obligation (GBO) to take reasonable and practical steps to minimise the risks associated with invasive plants under their control.
Prosopis spp.	Mesquite	Prohibited invasive plant

2.3.9 FAUNA

2.3.9.1 PEST SPECIES

Pest species within the Cloncurry Shire pose challenges to both the local population and the environment. The primary species of concern is the Feral Pig, known for its destructive foraging habits.

Table 2-4 outlines the known and most common pest species in the Cloncurry Shire and their status under the *Biosecurity Act 2014* (CSBP, 2018).

Table 2-4: Animal pest species at Tick Hill Gold Mine

Pest animals	Common Name	Status under the *Biosecurity Act 2014*
Canis lupus familiaris	Dog (other than a domestic dog)	Restricted invasive animal
Sus scrofa	Feral Pig	Category 3, 4 and 6 restricted invasive animal.
Felis catus and *Prionailurus bengalensis x Felis catus*	Cat (other than a domestic cat)	Category 3, 4 and 6 restricted invasive animal
Locusts including: *Chortoicetes terminifera* *Locusta migratoria* *Austracris guttulosa* *Gastrimargus musicus*	Locusts including: Australian plague locust Migratory locust Spur-throated locust Yellow-winged locust	All landholders are responsible for locust management as part of their general biosecurity obligation under the *Biosecurity Act 2014*.

2.4 SITE CONTEXT

This section provides information that has been collected and/or modelled since the site became operational. This information directly informs the approach to the rehabilitation and management methodology provided in Section 6.

2.4.1 SITE HISTORY

The site is currently non-operational, however from 1990 to 1994 it was mined for gold by Carpentaria Gold Ltd (A subsidiary of MIM Holdings Ltd). From 1995 to 2020, there were multiple exploration programs from numerous companies, however no active mining occurred. Minor operations have been undertaken between 2020 and 2022 to extract and reprocess tailings material from within the TSF with selected materials further transported offsite for processing. Most recently tailings reprocessing onsite has occurred with Blue Cap Mining as the operational contractor and Carnaby Resources maintaining the tenements and EA approval.

The THGM timeline of development is shown in Table 2-5.

Table 2-5: Timeline of Site Operations

Year	Event
1989	The Tick Hill gold deposit was discovered in September
1990	A Mining Lease Application was made in March
1991	The lease was granted in June

Year	Event
	Mining and construction of the plant and infrastructure began in early August Commissioning of the plant began in early December with the first gold poured by end of year
1992	Development of the underground mining operation in January First ore produced from underground in August
1995	Mine closure by Carpentaria Gold Ltd (subsidiary of MIM Holdings Ltd)
1995 to 2004	Further exploration by MIM Holdings Ltd
2004 to 2019	THGM divested to Diatreme Resources Limited (Diatreme), further exploration activities occurred
2019	THGM divested to Carnaby Resources Pty Ltd, further explorations activities occurred
2020 to 2021	Carnaby Resources obtained approval for reprocessing of tailings (with operations undertaken by BIMS Metals), including transport of tailings to Lorena Gold Mine offsite processing facility for extraction
2021 to 2022	Reprocessing of tailings onsite (with operations undertaken by Blue Cap mining) on behalf of Carnaby Resources Pty Ltd

A summary of the THGM features and approved disturbance areas as per the THGM EA (DESI, 2022), is provided in Table 2-6.

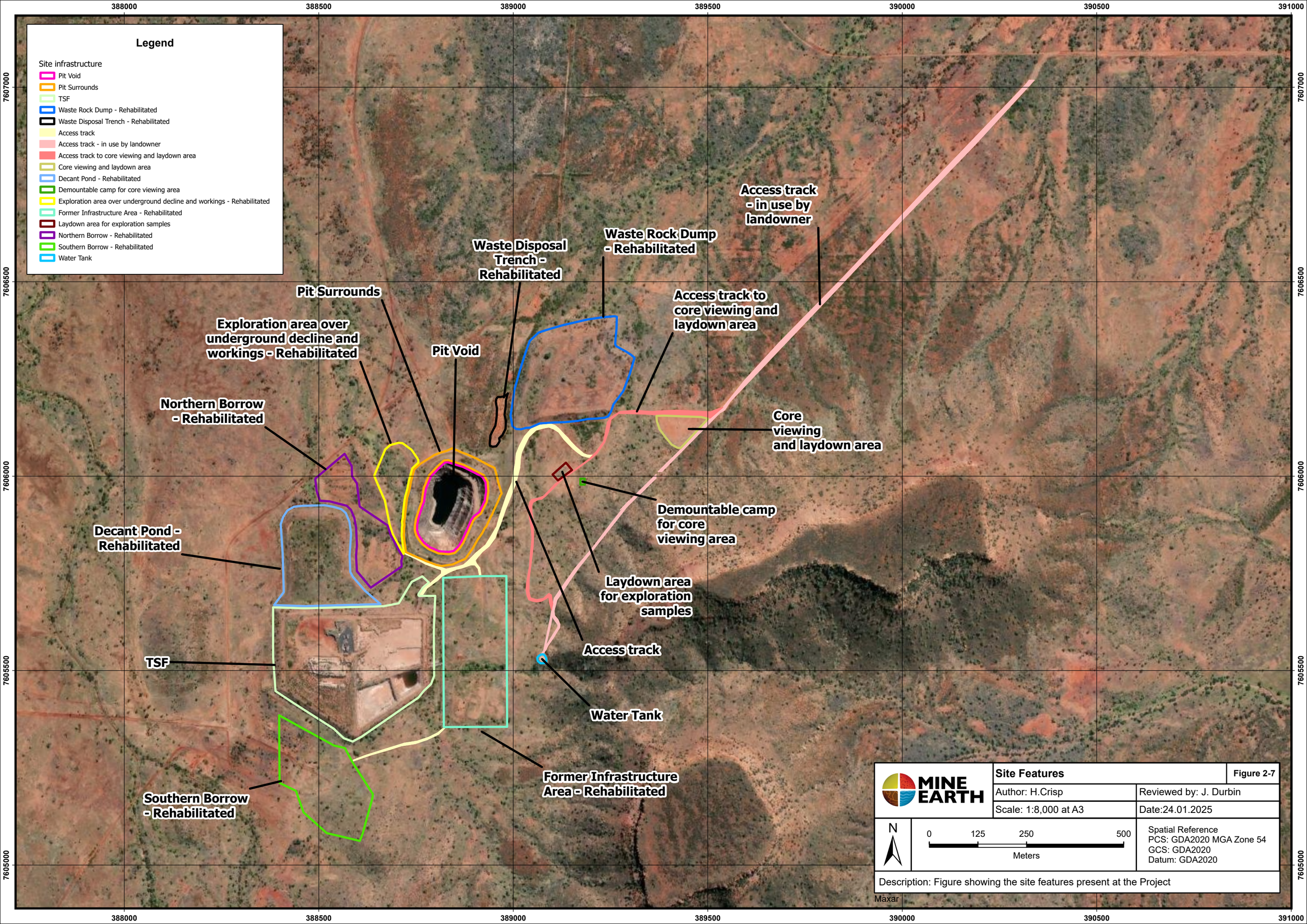
Table 2-6: Approved disturbance areas

Feature	Approved disturbance area (ha)
Waste rock dump	6.9
Tailings dam (including decant ponds)	10.89
Tailings dam reclamation area (part of the 17.4 ha of Tailings Dam)	6.51
Open Pit	3
Infrastructure (including processing plant area)	6.66
Borrow pit (part of infrastructure)	0.24
Access tracks	2.0
Borrow pits	13.9
Exploration	<1.0
Total	**51.0**

The main features of THGM are outlined below and locations shown in Figure 2-7:

- Open cut pit (70 m deep with approximately 25 m depth of water).
- Underground mining area under the open cut pit and extending to the west.
- WRD north-east of the open cut mine pit.
- Core yard.
- Water tank (landholder use).
- Administration and processing area.
- Decant pond.
- TSF south of the open cut mine pit.
- Groundwater monitoring bores.

The open cut mine pit is currently a pit lake (due to groundwater recovery) and the tailings within the TSF and decant ponds are dry. Most permanent infrastructure from the original mining operation has been removed. There are the remains of the underground working vent and cables, disconnected piping, shipping containers used for storage of maintenance equipment, water tank and the reprocessing plant stationed at the TSF.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Legend
Site infrastructure
Pit Void
Pit Surrounds
TSF
Waste Rock Dump - Rehabilitated
Waste Disposal Trench - Rehabilitated
Access track
Access track - in use by landowner
Access track to core viewing and laydown area
Core viewing and laydown area
Decant Pond - Rehabilitated
Demountable camp for core viewing area
Exploration area over underground decline and workings - Rehabilitated
Former Infrastructure Area - Rehabilitated
Laydown area for exploration samples
Northern Borrow - Rehabilitated
Southern Borrow - Rehabilitated
Water Tank
Access track - in use by landowner
Waste Rock Dump - Rehabilitated
Waste Disposal Trench - Rehabilitated
Pit Surrounds
Access track to core viewing and laydown area
Exploration area over underground decline and workings - Rehabilitated
Pit Void
Northern Borrow - Rehabilitated
Core viewing and laydown area
Demountable camp for core viewing area
Decant Pond - Rehabilitated
Laydown area for exploration samples
Access track
TSF
Water Tank
Former Infrastructure Area - Rehabilitated
Southern Borrow - Rehabilitated
MINE EARTH
Site Features
Figure 2-7
Author: H.Crisp
Reviewed by: J. Durbin
Scale: 1:8,000 at A3
Date:24.01.2025
N
0
125
250
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Meters
Spatial Reference
PCS: GDA2020 MGA Zone 54
GCS: GDA2020
Datum: GDA2020
Description: Figure showing the site features present at the Project
Maxar

2.4.2 CURRENT OPERATION

Following the previous tailings reprocessing operation, the current proposed operation under existing approvals involves the removal of all remaining in situ tailings from the TSF to a facility located offsite in Mount Isa. The operation will be undertaken with a truck and shovel method loading onto a road-train and then transported to Mount Isa along the Mount Isa – Cloncurry Highway via Cloncurry, (as the majority of this route is sealed). It is expected that all tailings material from the TSF will be removed and relocated from site. The duration of this operation is not yet known; however, it is anticipated to take less than two years to complete.

The WRD, decant pond, pit, and old processing infrastructure area are not required for this operation, therefore there are no plans to disturb these areas during removal of the tailings material.

2.4.3 PIT

2.4.3.1 PHYSICAL

The pit is an internally draining mining pit with a footprint of approximately 3 ha and depth of 70 m with water level approximately 25 m from the base of the void as shown in Figure 2-8. The pit straddles a low ridge near the base of the Tick Hill mesa (i.e. the open pit occurs on a local drainage divide).

The pit area is 5.8 ha in total and consists of the pit lake, pit walls (angles range from 56-65°), and the offset area from the crest of the pit to the outer batter toe of the abandonment bund. The catchment area is restricted to the area within the pit crest (3 ha) and the area outside the crest (2.8 ha). A perimeter bund, barbed wire fence and signage have been erected in a location aligning to the maximum extent of the NUMA, to restrict public and livestock access to the area.

The pit appears to be in good condition given the duration of exposure, with little erosional or weathering effects which is a good indication of a reasonably high quality rock mass. A section of the west wall ramp has failed into the pit and the west wall has slipped however this was most likely due to the crown pillar extraction following cessation of operations (WKG, 2020). This previous slippage is all contained within the abandonment bund.

2.4.3.2 HYDROGEOLOGICAL

Several investigations into the groundwater conditions at THGM have been completed (EES, 2023; 2024), to improve the conceptual understanding of the groundwater and TSF interaction, as well as refine the groundwater inputs to the void model. The reports from this investigation are provided in Appendix D and Appendix E. These investigations found the following:

- Baseline conditions reflect the current state in terms of groundwater flow characteristics and level. In summary:
  - Local/ regional geology is highly fractured, resulting in hard rock aquifers with unconfined conditions. Typically only a single aquifer is present
  - Depth to the groundwater table ranges from 15 - 21mbgl, with low bore yields (<0.5 - 1.3l/s).
- The hydrogeological model indicates that the pit acts as a groundwater sink and will continue to do so under a wide range of climatic conditions (EES, 2024).
- No plausible rainfall scenario was identified which raised the pit water level to either the level of the surrounding water-table, or to the top of the pit. Long term pit water level modelled under various rainfall scenarios is shown in Figure 2-9.

- The pit water level is controlled by the limited rainfall runoff due to the small catchment area around the pit.
- No sensitive receptors were identified that might be impacted by either groundwater quality (EES, 2023), or mine pit water quality (EES, 2024).

Groundwater contours developed from monitoring information to illustrate the drawdown occurring are shown in Figure 2-10, with corresponding conceptual hydrogeological cross-sections provided in Figure 2-11 and Figure 2-12.

Figure 2-8: Tick Hill Gold Mine pit (WKG, 2020)

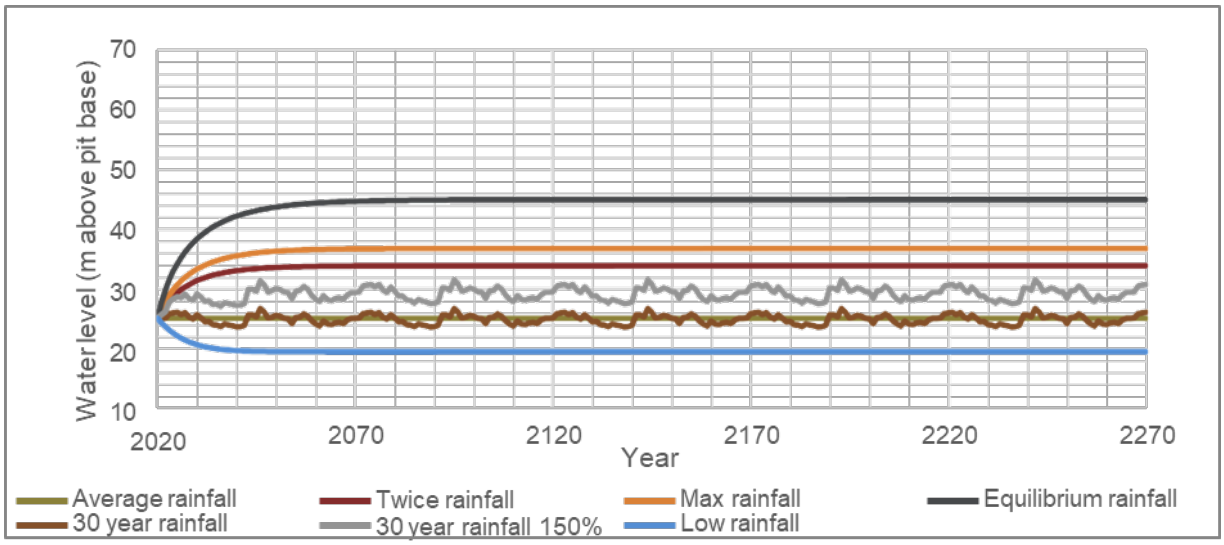


Figure 2-9: Long term pit water level under various rainfall scenarios (EES, 2024)

The groundwater and pit water chemistry are summarised as:

- Groundwater at THGM is naturally elevated in salts and metals which make it unsuitable for potable use without treatment:
  - Low concentrations of total cyanide are found across the site. The cyanide impact to groundwater between the TSF and open pit is stable, with concentrations likely to steadily decrease over time. It is not expected that cyanide impacted groundwater will adversely impact pit water quality to any significant extent and cyanide in pit water will be degraded by sunlight. Further, removal of tailings from the TSF and rehabilitation of the TSF will eliminate the main source of cyanide (tailings) and it is anticipated to therefore reduce the release of cyanide to the shallow groundwater and limit cyanide discharge to the pit
  - Nitrate and ammonia attributed to explosive residue was observed in several locations, including bore THGW004, down gradient of the WRD.
- Comparison of groundwater composition between monitoring bores and the pit indicates the following:
  - Salinity of groundwater bores is generally correlated with depth, indicating that the deeper aquifer is less saline
  - The pit is more saline than all bores except one - THGW008 which is located between the TSF and the Pit
  - The pit has higher concentrations of sodium, magnesium, potassium, chloride and sulfate than most bores
  - The pit has lower or mid-range concentrations of calcium, ammonia, bicarbonate, nitrate, phosphate and fluoride compared to most bores.

To understand the pit salt water balance, the current pit water quality provides the best available indication of how the various water sources combine to influence pit water composition. In order to determine how this would change into the future, a mass balance was developed using the pit water inflow (20.6 m^3/day) and estimate for groundwater inflow salinity.

This was modelled from the initial filling using modelled salt accumulation results, along with actual measurements of pit salinity between 2012 and 2023. Individual ion and metal concentrations were modelled with a direct concentration/ dilution from the 2021 to 2023 pit water quality results. The pit water quality model was then extended for 250 years using in the PHREEQC V3 software (EES, 2024). Modelled concentrations of gypsum, calcium sulfate, calcite, dolomite, calcium carbonate, magnesium carbonate, carbonate, Goethite, Iron (III) hydroxide, ferric iron compounds, and ferrous iron compounds, are provided in Appendix E.

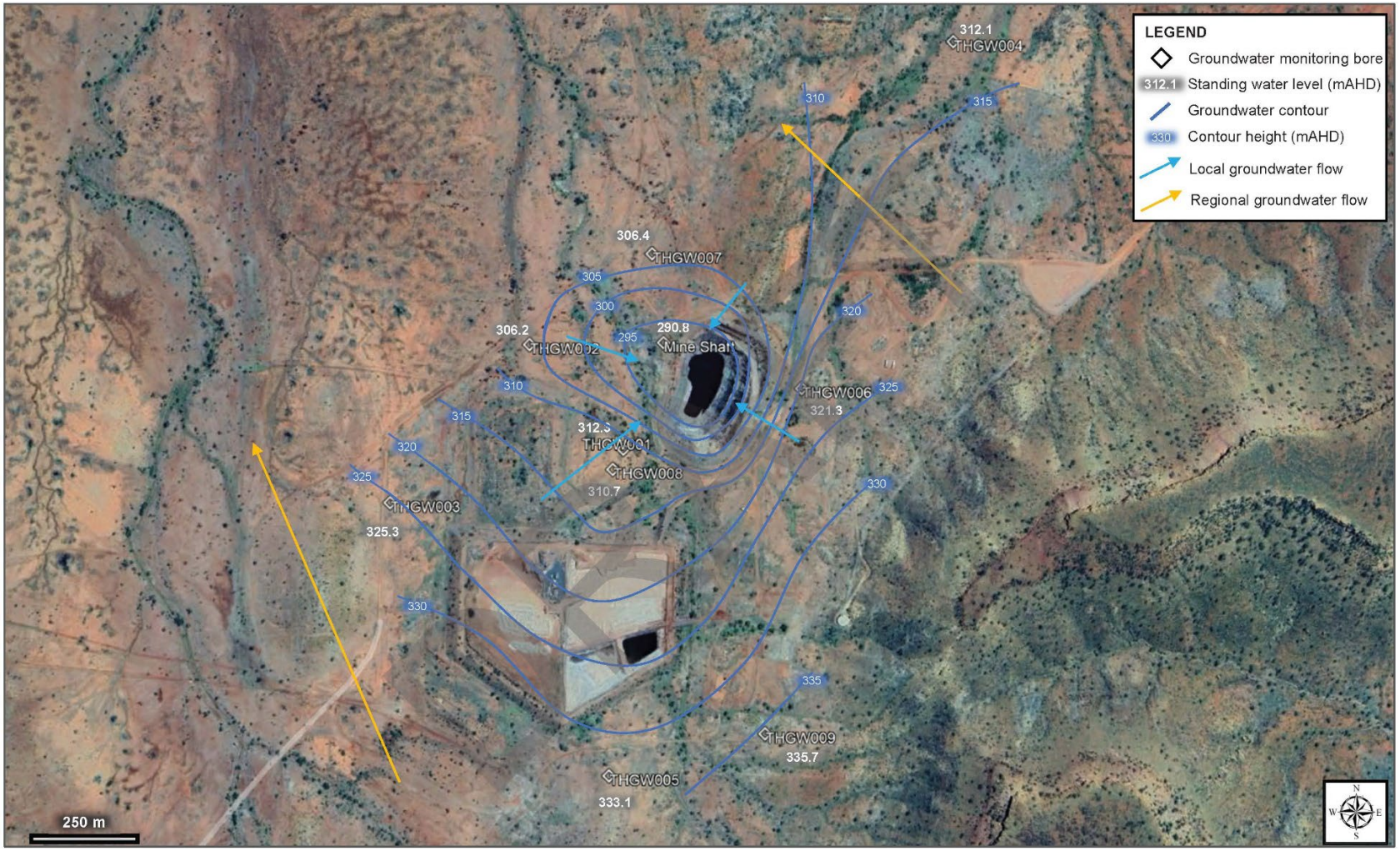


Figure 2-10: Groundwater drawdown (EES, 2024)

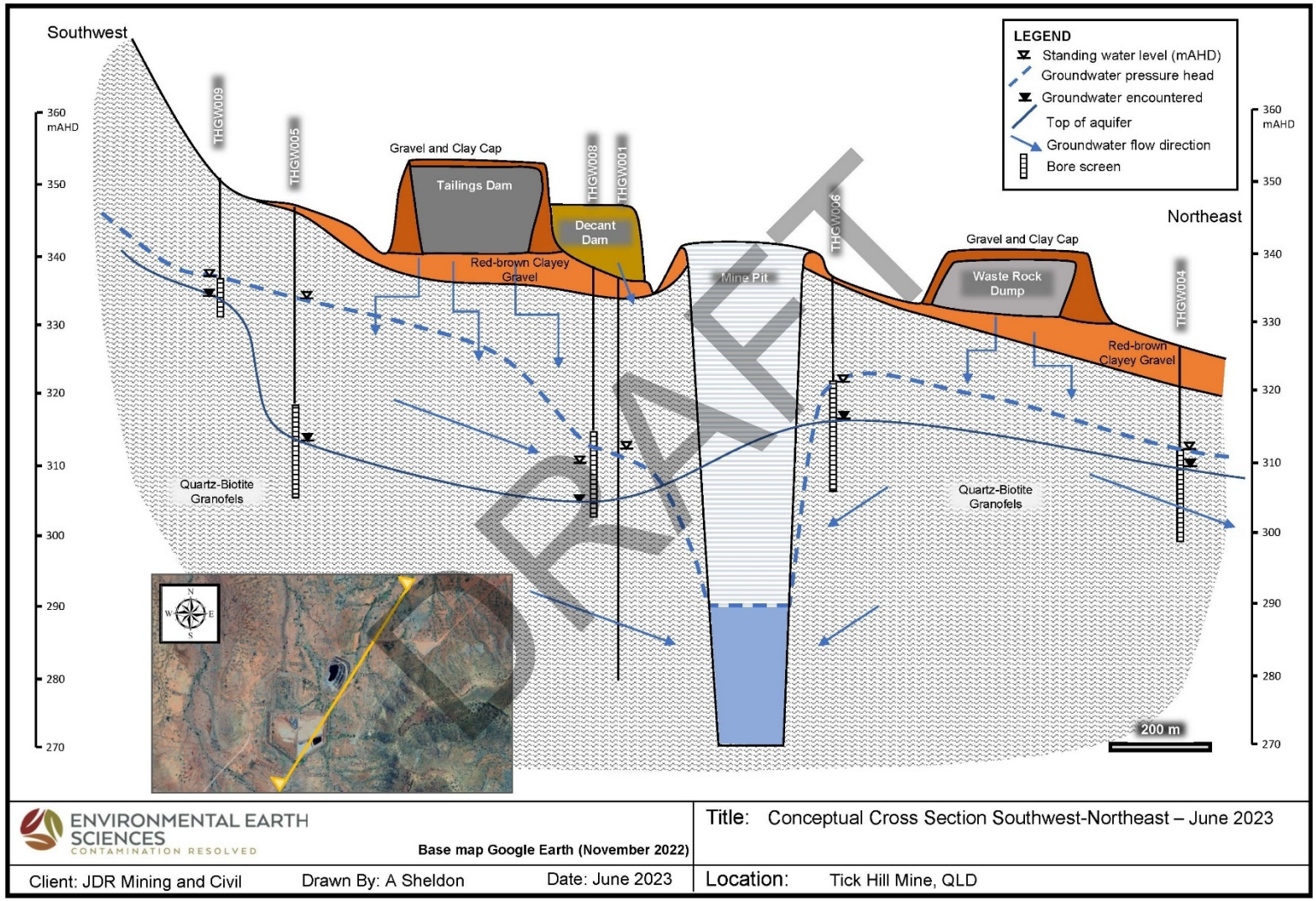


Figure 2-11: Conceptual Cross Section Southwest-Northeast (EES, 2024)

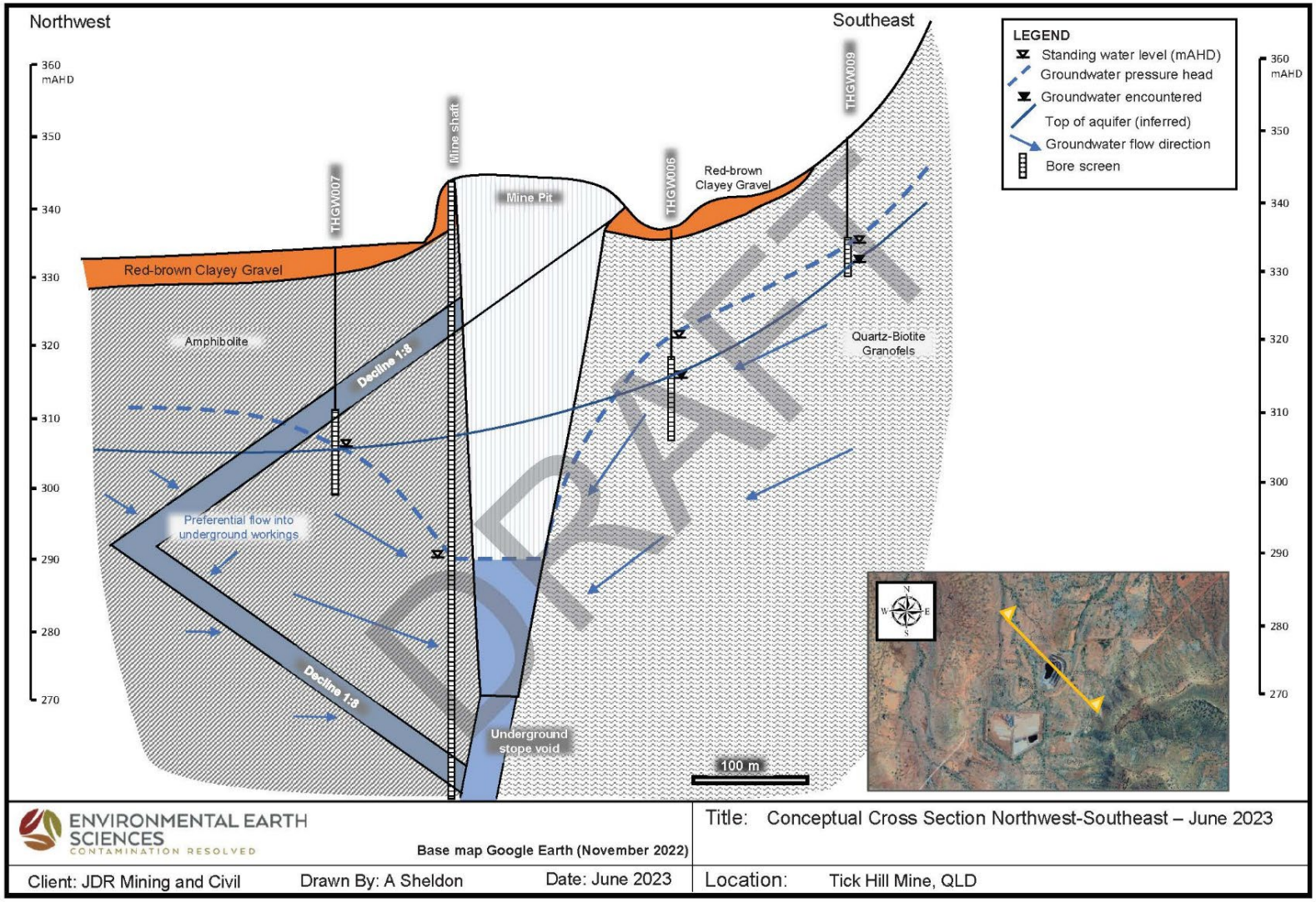


Figure 2-12: Conceptual Cross Section Northwest-Southeast (EES, 2024)

2.4.4 TAILINGS STORAGE FACILITY

The TSF was constructed as a 'turkey nest' structure with waste rock overlaying a clay lined floor (approximately 0.5 m thick) and clay cut off cores in the walls (except upstream/southern wall) in compliance with regulatory guidelines at the time construction occurred. The TSF comprises two separate cells which drained to the north into a (now capped) decant pond that enabled the re-use of water during operations. Table 2-7 provides a design and operational summary of the TSF. Images of the TSF during operations and in 2024 are provided in Figure 2-13 and Figure 2-14 respectively.

Table 2-7: TSF summary

Feature	Summary
Structure type and details	• Above ground turkey nest structure. Referable dam with no external catchment • Maximum landform elevation of 352 m RL, TSF embankment height 10.5 m • Surface area in eastern cell is 4.4 ha, and western cell is 4.5 ha
Capacity	600,000 m^3
Embankment and base details	• Outer embankment walls and an inner cell wall • Installed with a 500 mm clay liner in the base, and walls with clay core • Clay materials used for lining sourced from borrow pits/scrapes on site • Outer embankment walls at a batter angle of 1:3 and are higher than the cell surface; likely constructed in single stages
Cellular details	• Two cells, ranging from 6-10 m depth, flat topped, with cell surface lower than perimeter embankment • Tailings material recently (2020-2022) removed from Eastern cell • Western cell tailings remain; topsoil removed and stockpiled in the TSF precinct
Cover system	• Consisted of a waste rock mulch, covered with topsoil. • Validated depth between 700mm-1000mm; less distinct topsoil cover of 100mm • Not designed to prevent/ restrict water infiltration; designed as a non-enhanced store and release cover • Both cells were originally capped/seeded as per initial rehabilitation • Clay/topsoil cover materials sourced from on-site borrow pits/scrapes
Design Storage Allowance	For the previously proposed tailings reprocessing operation, total DSA volume of 29.5 ML required for each cell (noting area disturbed is being staged), as per CCA (ATC Williams, 2022)
Water Management	• Decant pond constructed to same specification as the TSF • Currently rehabilitated • Total capacity (historically) of 93,000 m^3
Spillway location	• Constructed drain located on the northern end of the eastern cell • Runoff for all of structure directed to this location • Full supply level (at spillway location) at 346.7 m RL
Leak detection systems	Nothing installed
Seepage collection systems	Nothing installed
Tailings material	• Tailings have low sulfide-sulfur composition and excess acid neutralisation capacity resulting in negative NAPP values through the profile • Material considered NAF or PAF-LC at worst, and do not contain high risk PAF material. Risk of generating AMD or NMD was low • Potential for seepage from the TSF was understood to be very low, and directed to the open cut/ residual void (PSM, 2020)
Rehabilitation performance	• Previously capped and seeded; low scrubby vegetation is well established on areas not yet cleared • TSF batter slopes all well vegetated and in good condition
Current disturbance	• 2 ha has been disturbed for reprocessing of residue • Disturbed capping material stockpiled on undisturbed part of TSF

Rehabilitation of the TSF involved placement of a waste rock cover (as a rocky mulch layer) up to 1.0 m thick, followed by application of stockpiled topsoil. The surface and batters of the TSF and the stormwater drainage structures were assessed in 2013 and were considered to be well stabilised and did not present an erosion and stream sedimentation hazard (Envirofin, 2020).

The 2013 rehabilitation assessment provided the following summary of the TSF rehabilitation (SKM, 2013):

- Vegetation has covered the surface of the tailings dam and the batters relatively evenly.
- At the time of inspection, there were no visible signs of scouring, slumping or bulging of any of the batters or the toe of the embankments.
- There were also no signs of sink holes or slumping on the top surface.
- The spillway showed no signs of erosion, and the wire rock protection was intact and in good condition.
- It has a very low residual risk associated with instability and scouring. Based on the performance in the last 17 years, it is reasonable to expect that stability will be maintained in the future and scour will not become an issue.

The 2024 soil sampling campaign (to improve baseline and rehabilitation material knowledge) also observed that all TSF batters and the spillway were well vegetated with no visible erosion rills or gullies.

Topsoil and growth media (topsoil plus subsoil) removed as part of the previous tailings extraction and reprocessing has been stockpiled on the surface of the TSF western cell.

Following removal and relocation of the tailings material, capping material will be placed over the compacted clay floor and seeded with shallow-rooted species as agreed with the landowner.

Figure 2-13: TSF during operations looking east (Carnaby, 2023)

Figure 2-14: TSF in 2024 looking west

2.4.4.1 GEOCHEMICAL CHARACTERISATION

The expected geochemistry of tailings (and potential for AMD, salinity, and other contaminants) influences how they need to be contained and subsequently rehabilitated. A summary of the tailings material characterisation is provided in Section 2.4.5.

In general, the processing waste (and tailings materials in particular) can be regarded as having very low acid generation potential, and low total metals – meaning low risk of neutral metalliferous drainage (NMD). It has been highlighted that a few analytes have been elevated (such as copper and cyanide), resulting in extensive further investigations to understand the geochemical risk posed by these components. Further detail of these investigations is provided in Section 2.4.6, and as Appendix B.

It is also noted that available pit, surface water and groundwater quality analysis do not reflect AMD or NMD conditions, which would be expected to be apparent by now given the long time since operations have ceased (almost 30 years).

2.4.4.2 GEOTECHNICAL AND RHEOLOGICAL CHARACTERISATION

The TSF has been in place, and non-operational for tailings storage, for almost 30 years. During this time, the batters have remained stable and have revegetated well. As an entirely rehabilitated structure, the likelihood of failure was assessed as being low with respect to harm to humans, general environmental harm and general economic loss or property damage (Envirofin, 2020). This consequence category assessment was completed in accordance with the 'Manual for Assessing Consequence Categories and Hydraulic Performance of Structures' (DES, 2016).

Considering physical properties, both the embankment and cover layers are dry and compacted. As part of planning for the reclamation/reprocessing of the TSF, heavy machinery (drill rigs) operated on the TSF, effectively testing the material's resistance to deformation and stability under loading conditions. No stability issues were noted, even though sampling completed in 2022 reported that the tailings were saturated at a depth between 4 and 5 m (EES, 2023). Reclamation of tailings residue material has also shown materials to be dry and compact.

It was considered that the geotechnical and rheological requirements associated with the PRCP guideline are not relevant to the THGM situation and have not been considered further.

2.4.4.3 LEAK DETECTION AND SEEPAGE MANAGEMENT

Leak detection and seepage management measures were not previously installed at THGM, however it is well understood that seepage reports to the residual void (which is a NUMA) and is currently contained within the mine tenement.

2.4.5 WASTE ROCK DUMP

The WRD was decommissioned following cessation of mining in 1998. Kinhill (1991a) undertook waste rock analysis, including kinetic column leaching, and determined that the structure would not present an acid rock drainage (ARD) risk, therefore the decommissioning design did not include capping. However, recent investigative drilling found that there was at least a 0.5 m cover of non-waste material. A summary of the WRD is provided in Table 2-8.

The WRD drains through a small sediment trap to a drainage line which reports to Petticoat Creek, and Envirofin (2020) suggests that drainage from the WRD is not resulting in any downstream environmental harm.

The 2013 assessment (SKM, 2013) found that the structure was stable and summarised the rehabilitation of the WRD as:

- Vegetation has covered the surface of the waste rock dump and the batters.
- At the time of inspection, there were no visible signs of slumping or bulging of any of the batters or the toe of the embankment. There were also no signs of sink holes or slumping on the top surface.
- The surface of the WRD is showing evidence of termite activity.
- The flat-top surface is not graded towards the spillway and a number of erosion sites are evident on slopes, however most sites of erosion appear to be stable and exhibit hard-panning and concreting of particles long the edges of eroded gullies.
- Some scouring had occurred in the drainage path 10 m west of the western WRD batter; however it was considered unlikely that possible further scouring of the drainage path will negatively impact the stability of the toe of the waste rock dump since the scouring depth would need to be approximately a further 3 m in order to do so.

The assessment in 2013 (SKM, 2013) observed a number of erosion sites evident on the slopes. The 2024 soil sampling campaign (to improve baseline and rehabilitation material knowledge) also observed that there were some visible minor erosion rills and gullies on the northern batter, however they appeared stable and well vegetated.

Table 2-8: WRD summary

Feature	Summary
Structure type and details	• Constructed in 5 m lifts • Capped with rock mulch and topsoil • Waste rock material was confirmed as inert prior to placement • At times, there is minor water ponding on the southern side where a drainage line meets the WRD • No evidence of acid scalding or seepage around the perimeter of the WRD • Soil sampling indicated material was non-saline, slightly alkaline, with elevated phosphorus, very low nitrogen and organic carbon, and no evidence of metal concentration. Results support the use of the area for grazing
Rehabilitation	• Batters are well vegetated and stable, only with minor scour observed on the northern side • WRD is stable and becoming integrated into the surrounding landscape

2.4.6 MINE WASTE MANAGEMENT

The only areas where mine waste has been placed on the THGM site are the WRD area and the TSF. Given that both areas were rehabilitated almost 30 years ago, it is expected that any mineral waste risks or concerns would have been apparent by now. As such, review of the receiving environment surface and groundwater quality provides the strongest indication of any underlying mine waste issues. Extensive

investigations have also been completed into potential cyanide migration from the TSF to the surrounding groundwater system, of which the latest assessment and understanding is provided in Appendix D. This has also been the focus of more recent geochemical investigations and sampling efforts.

The remainder of this section is a compilation of the information available as to mine waste characterisation, as a compilation of relevant historical information, noting that the tailings material will be relocated offsite and the remaining structure capped. Enhancements to the cover system on the TSF are planned, as per Section 6.2.

2.4.6.1 CHARACTERISATION AND POTENTIAL HAZARDS

The Tick Hill gold deposit was hosted in the middle Proterozoic Corella formation, locally made up of banded calcsilicates, quartzites and amphibolites. Originally these were sediments of evaporitic, detrital and possibly igneous origin, that had been metamorphosed to mid-amphibolite facies. An estimated 90% of the original gold occurred in highly strained pink quartz-feldspar laminates, with the remainder occurring in the surrounding quartzitic schists and amphibolites. The quartz-feldspar laminates varied in width from 1 to 150 cm and often carried visible grains of gold of up to 2 mm in size.

The orebody contained virtually no accessory or pathfinder minerals, with only very minor pyrite and chalcopyrite. The ore and host geology therefore comprise a low sulfidation mineralising system with native gold, accessory silver and minor copper and cobalt. This reflected in the groundwater and pit water chemistry which has detectable copper, cobalt, arsenic, and selenium.

Available geochemical characterisation data have been sourced from previous reports and other sources from 1993 to more recent sampling completed (in 2020). The results presented herein also correlate with available pit water and groundwater analysis, which after almost 30 years do not reflect AMD or NMD conditions.

Acid generation potential overall has been consistently very low with occasional elevated samples (less than 7%). The majority of post oxidation pH from test samples were alkaline to strongly alkaline reflecting high neutralisation capacity from the predominant carbonate and bicarbonate rich host rock. Of all samples taken, the highest oxidisable sulfur level recorded has been 0.1%. Under relevant guidelines (AMIRA, 2002), most samples were classified as non-acid forming materials (NAF), with the exception of one sample which was classifies as uncertain (UC). The tailings indicated negative NAPP values through the profile and based on sulfide sulfur, were classified as NAF.

A conservative NAPP calculation using Total Sulfur results in very weak acidity, <1kg H2SO4/t (0.91mg/kg TS), in one sample. The NAG testing showed weak acidity at pH 7 and a NAG pH of 4.2 which would be neutralised by the excess ANC in the bulk of the tailings mass.

Total metal concentrations have been low to very low at all sampling depths, consistent with early geology descriptions of the orebody. Test work indicates that the TSF wall material (as representative of overburden) was very low in sulfur, macronutrients (N,P,K), oxidisable sulfur (inferred sulfides) and strongly alkaline. The tailings materials were also low in macronutrients, strongly alkaline, and contains moderate levels of oxidisable sulfur (inferred sulfides) with low peroxide pH. With exception of slightly elevated copper levels (which were still within normal background levels), the material contained low levels of other metals.

Scott (2020) noted that metals concentrations for the Decant pond were slightly elevated compared to concentrations for tailings material for copper, lead, and zinc, but not enriched compared to average crustal abundance. As such, the potential for metalliferous drainage was considered to be low overall.

The tailings cation composition was strongly dominated by magnesium over calcium, and overall cation concentrations are moderate, so the potential for calcium and magnesium carbonate and bicarbonate dissolution by AMD generated acid was very low. As a result, the potential for saline mine drainage was also considered to be low. In summary, acid base accounting analysis for THGM shows that tailings and waste rock samples predominantly exhibit the following negligible geochemical risk characteristics:

- Alkaline to strongly alkaline pH and oxidised pH.
- Low total sulfur, sulfide levels < 0.1%.
- Low NAG fizz ratings.
- High Acid Neutralising Capacity (ANC).
- Negative to strongly negative NAPP values.
- ANC: MPA ratios are low (5th percentile of 2.4).
- Below detection limits NAG values.

Slightly elevated concentrations of copper have been noted in the tailings, as has moderately high free cyanide levels (and total nitrogen- cyanide proxy), increasing with sampling depth. Free and weak acid dissociable (WAD) cyanide concentrations have been shown to have decayed significantly over the time since decommissioning; and are now below relevant limits of reporting.

However, reclamation of tailings materials will further reduce the potential risk of seepage of cyanide and cyanide compounds from un-reclaimed tailings to groundwater. Improvement of the cover system on the TSF will also reduce the risk of infiltration through to the underlying tailings waste material.

2.4.6.2 SAMPLING AND ANALYSIS REGIME

Geochemical investigation at THGM has been completed in several campaigns over time, dating from 1993 during the operational period of the site to more recent sampling completed in 2020. Details of each sampling campaign completed is provided in Table 2-9. Further to this, as a mineral mine, characterisation of the orebody itself is considered to be complementary to direct sampling to understand the potential geochemical hazards from placed tailings.

It is noted that each campaign has reinforced previous findings, to provide a deeper understanding of the mine waste. On the basis of the sampling and analysis trends discussed above, the tailings and waste rock at THGM were considered very low risk and kinetic leaching has not been considered necessary (Scott, 2020).

Table 2-9: Tick Hill Gold Mine geochemical sampling campaigns

Campaign/Report Name and Date	Material Type	Number of Samples Taken	Suite of Analysis
Carpentaria Gold (1993)	• TSF wall material • Tailings	• 2 samples	• Acid-base accounting • pH and EC, Sulfur • Major cations and anions
Dames and Moore (circa 1994)	• Tailings • Decant Pond	• 58 samples over 17 sites, at 3 depths	• Acid-base accounting • pH, EC pHox • Oxidisable sulfur/sulfate • Major cations and anions • Total metals
Diatreme Resources Metallurgical Testwork (2015)	• Tailings • Waste Rock	• 2 composited samples, plus 14 discrete samples at 12 locations • 8 samples	• Acid-base accounting • pH and EC • oxidisable sulfur/sulfate • Major cations and anions • Total metals

Campaign/Report Name and Date	Material Type	Number of Samples Taken	Suite of Analysis
Carnaby Resources (May 2020)	• Tailings • Waste Rock	• 7 samples, followed by an additional 13 depth samples • 8 samples, at a range of depths	• Acid-base accounting • pH and EC • Sulfur • Major cations and anions • Total metals • Cyanide speciation

A total of 112 samples have been taken, and it is estimated that approximately 700,000m^3 of material (such as tailings and waste) has been moved for the THGM operation. This equates to one sample for every ~6 tonnes of material moved, which is considered a very high sampling resolution meets contemporary standards in terms of coverage, as well as testing methods employed. Long-term surface and groundwater water monitoring is also available to supplement the waste characterisation. As such, there is a very comprehensive understanding of the mine waste and associated geochemical concerns for THGM, with low uncertainty.

2.4.6.3 CLASSIFICATION OF MINE WASTE STREAMS

All mined material for THGM has been classified based on acid-forming potential. This is based on Australian and international leading practice guidance (AMIRA, 2002; INAP, 2018), which sorts waste into three classes. These classes are:

- Non-Acid Forming (NAF)
- Potentially Acid Forming (PAF)
- Neutral Metalliferous Drainage generating (NMD) metal leaching under near neutral leaching conditions.

Classes are defined by reference to total sulfur concentration, NAG pH and NAPP, and metal leaching capacity (for release of metal contaminants of concern).

2.4.6.4 CONTAMINANTS OF CONCERN

A detailed Environmental Site Assessment (ESA) (Appendix D) completed a thorough investigation of contamination relevant to THGM. This involved a review of historical aerial photographs and reports, investigation of site ownership and mining activities, consideration of relevant government registers, analysis of past monitoring results and supplementary sampling. This allowed for an understanding of contaminant sources for THGM and activities with potential to result in land, air or water contamination. The following chemicals or contaminants were identified as of potential concern, and subject to investigation within the ESA (EES, 2023):

- Cyanide (CN) – cyanide leach process and residual cyanide in tailings
- Heavy metals – metals from within processed ore and tailings, from workshops, batteries, and degraded site infrastructure
- Petroleum hydrocarbons (TRH) – with fuel and oil storage
- Benzene, toluene, ethyl benzene, xylenes and naphthalene (BTEXN) – fuel storage
- Per- and Poly-fluoroalkyl substances (PFAS) – fire suppression
- Polychlorinated biphenyls (PCBs) – transformer oil
- Organochlorine pesticides (OCPs)– pest control
- Acids, alkalis & other reagents – gold ore processing
- Nitrogen compounds – explosive residue

- Nutrients in effluent and soil.

2.4.6.5 SOURCE – PATHWAY – RECEPTOR CONCEPTUAL SITE MODEL

A conceptual site model (CSM) of the site can be formed by considering the geophysical characteristics at play, the contaminant source, potential receptors, and the pathways to the receptors. Potential for environmental harm can occur due to soil, airborne, surface water bound or groundwater contamination This is an iterative process which may be updated as more information becomes available.

As part of the ESA provided in Appendix D, a preliminary CSM was developed, then investigation undertaken to improve the understanding of the source-pathway-receptor interactions, as well as further the understanding of potential contaminants of concern. A summary for this iterative investigation for each aspects of the relevant source – pathway – receptor concerns for THGM is summarised in Table 2-10.

The source-pathway-receptor model determined that there is no risk to receptors due to the groundwater contamination identified on site. However, it was considered that the exposed tailings material does not meet conditions for long term site management and required containment (EES, 2023). Long-term containment requirements for the TSF were previously considered in Section 2.4.4. Section 6.2 provides the rehabilitation and closure requirements to address the long-term management and containment of the TSF.

Figure 2-15 and Figure 2-16 provide schematic cross-sectional views of the site identifying the potential sources, pathways and receptor connections regarding waste material and the void/underground areas respectively.

Table 2-10: Conceptual site model (EES, 2023)

	Preliminary CSM Concern	Investigation result
Source	Release of fuel or chemicals associated with historical mine operations and ore processing	No evidence to suggest concern
	Release of fuel or chemicals associated with recent tailings reprocessing	No evidence to suggest concern
	Release of tailings from the TSF	Tailings metals and cyanide are within relevant criteria for these materials Current nature of exposed tailings does not meet long term site management requirements
	Leaching of cyanide, metals or other contaminants from the TSF or WRD	With the exception of cyanide and nitrogen compounds, exceedances are considered to be naturally occurring and related to the natural lithology of the aquifer
Pathway	Dermal/ inhalation/ ingestion exposure to contaminants or groundwater by site workers and visitors	Confirmed that seepage and groundwater migration occurs from WRD and TSF to aquifer
	Direct contact or uptake by flora or terrestrial fauna	No evidence to suggest concern
	Overland flow resulting in runoff to local soil and waterways	No evidence to suggest of concern
	Impacted groundwater migrating towards local waterways	Not of concern, as ESA confirmed that groundwater inflows to pit
	Use of impacted groundwater for stock watering	Not of concern, given highly localised nature of groundwater migration and distance to known stock watering bores

	Preliminary CSM Concern	Investigation result
Receptor	Impact to neighbouring grazing property and surrounding areas Site workers and visitors	Dilution and degradation of cyanide (in the open pit) reduces concentration to below criteria Groundwater is accessed via direct pumping only Groundwater impacts are restricted to within the mine tenure boundary, due to the pit being a sink
	Impact to watercourses north and west of the site draining to Petticoat Creek	No evidence to suggest concern, as no GDEs or groundwater discharge zones identified
	Impact to off-site receptors	Not of concern, as pit water is not intended to be used for stock watering Noted that wildlife may consume water directly from the mine pit, and also that pit water may be used as dust suppression during tailings relocation activities.

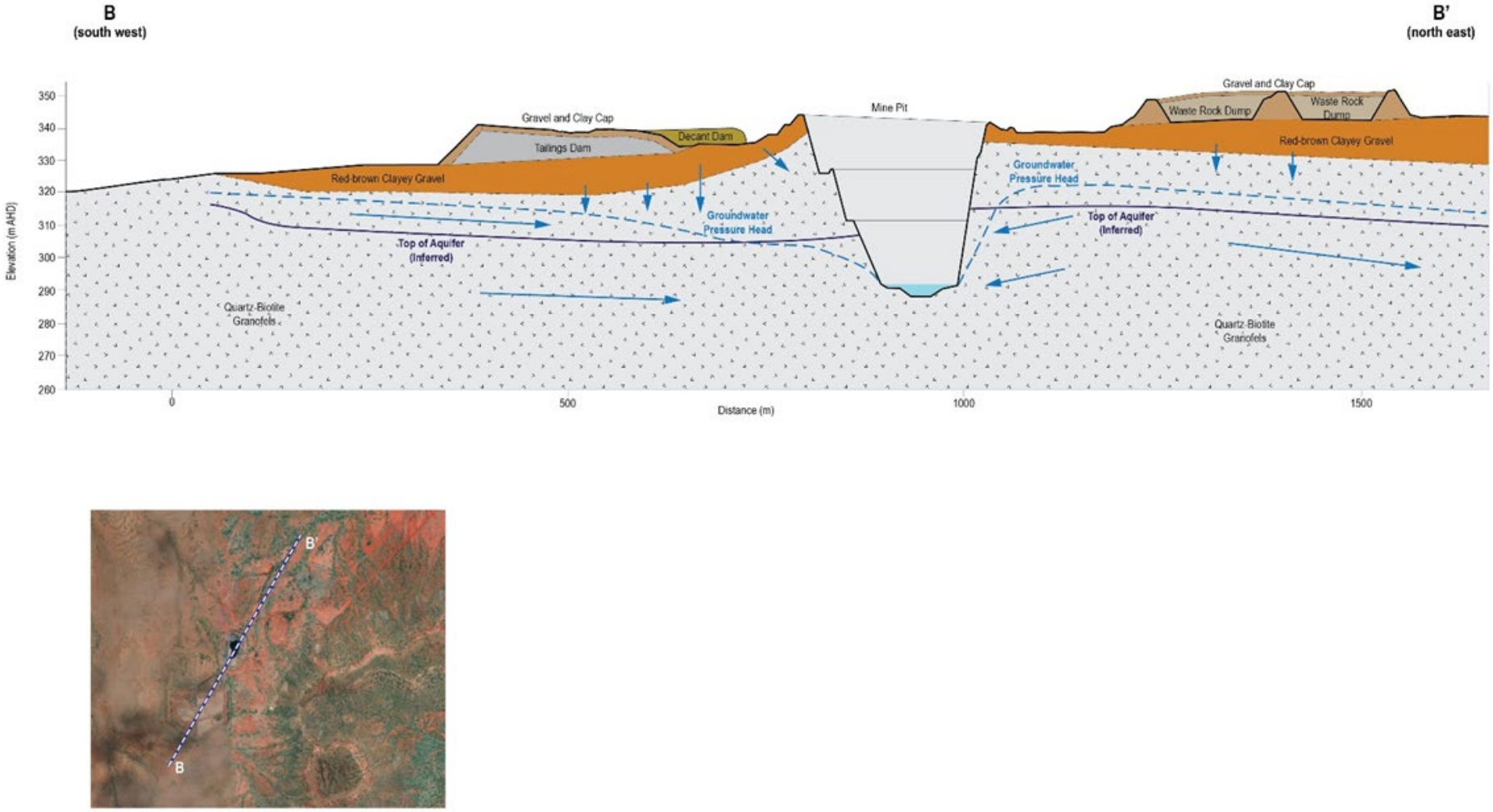


Figure 2-15: Conceptual site model – waste material (Carnaby, 2023)

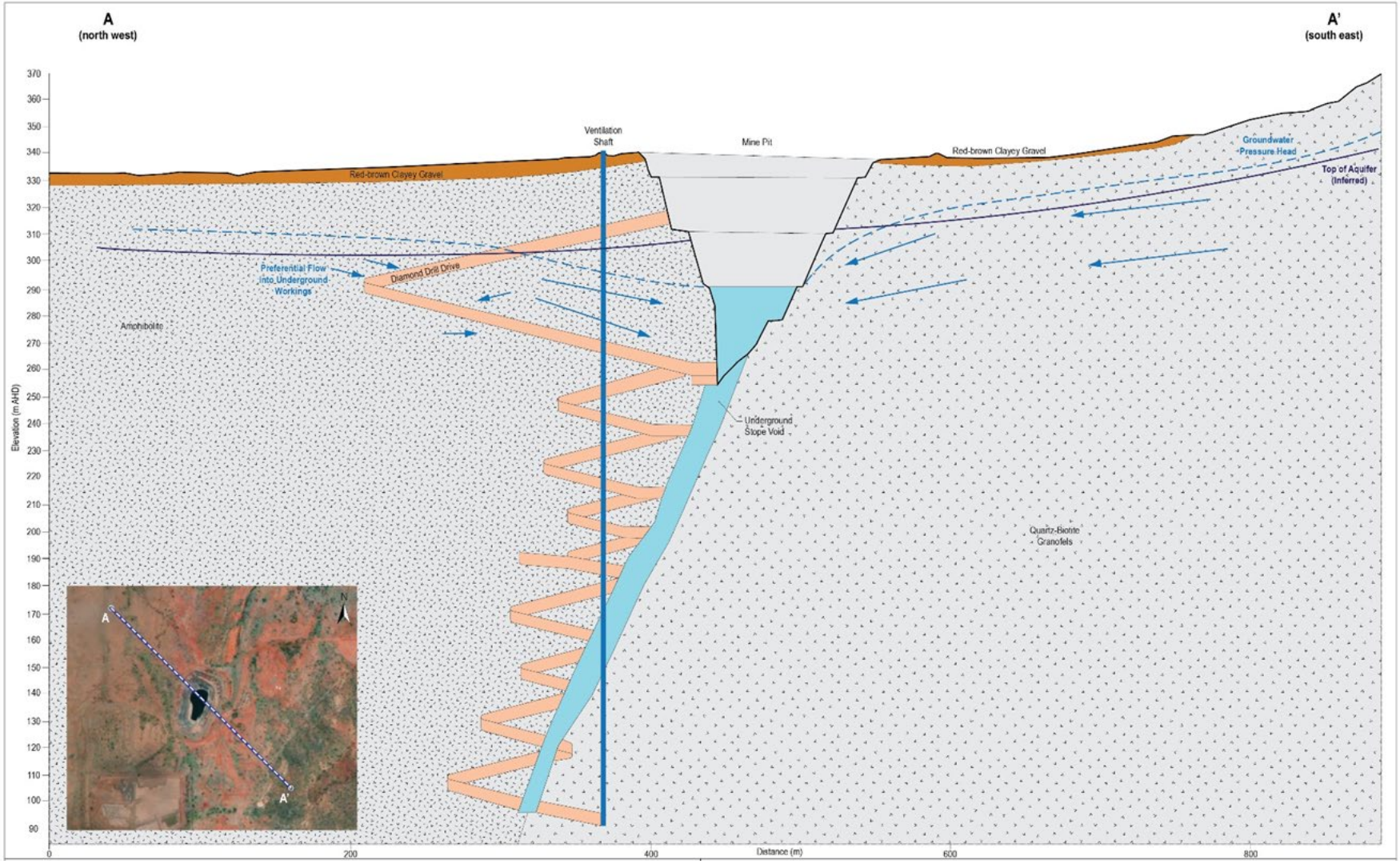


Figure 2-16: Conceptual site model – void and underground (Carnaby, 2023)

2.4.7 BORROW PITS

The THGM EA describes borrow pits in the vicinity of the TSF (typically of 300 mm depth), with an approved disturbance of 13.9 ha. However, the 2018-2020 Plan of Operations, stated that borrow pits could not be identified within the areas, and "... reports also indicated that to the extent that the borrow pits were located within the mining lease areas, they have been rehabilitated".

Diatreme stated that no information to delineate the area of the borrow pits was identified in the information library provided by MIM (at the time) and Diatreme suspect that the original location of the borrow pits is outside the area of the mining leases. (Diatreme, 2017a).

The location of the borrow pits could not be readily identified during the 2013 site inspection (SKM, 2013) as the profile and vegetation type and density in these areas was observed to be similar to the surrounding undisturbed areas, suggesting successful rehabilitation of these areas.

Therefore, for the purposes of the PRCP, two borrow pit locations have been proposed; one to the northeast of the decant pond, and one directly to the south. These two borrow pits have a footprint of approximately 7.8 ha in total and will be used as required for TSF capping and site rehabilitation.

2.4.8 WATER MANAGEMENT

As detailed in Section 2.3.5, THGM is drained by several ephemeral watercourses which flow to the north and northwest. The open pit lake retained as part of the residual void NUMA is the only permanent water holding body on site. There is an abandonment bund in place around the NUMA extent, so that all external catchment is separated from the void catchment and remains in the receiving environment. Further information on the void is provided in Section 2.4.3.

During operations, the Decant pond would have held water, however as part of closure activities conducted from 1995, the surface was reshaped and capped with rocky mulch and is now free-draining. Capping of the TSF was also completed as part of the initial 1995 site closure, however the eastern cell capping has recently been removed to access tailings for reprocessing. Today, the TSF and Decant Pond remain dry, except for short periods of time after a rain event.

A water tank remains in use and supplies stock water for the surrounding area (under an agreement with the landholder). Water is sourced from a borefield 15 km east of site. The only current water infrastructure on site is the pipeline that supplies the water tank. The pipeline runs north-east from the tank around the hill to the north-east. The pipeline is subject to the same landowner agreement as the supply tank.

During its time in operations, THGM was a zero-discharge site, with all infrastructure sized for full containment and no authorisation for mine water releases.

2.4.8.1 REGULATED STRUCTURES

A Consequence Category Assessment (CCA) was undertaken for the previously proposed tailings reprocessing operation. During operations, the TSF was assessed as a regulated structure due an overall consequence category of 'Significant'. The rating was a result of a 'Significant' rating for Failure to Contain – Overtopping, and Failure to Contain – Dam Break (ATC Williams, 2022). The CCA report is provided in Appendix F.

This rating requires for additional Design Storage Allowance volume to be made available during the reprocessing operations. However, as all the tailings material is planned to be relocated offsite during

operations, and the TSF rehabilitated with a cover system, it is anticipated that the consequence category for the TSF after closure to be low based on the Consequence Category guidelines (DES, 2016).

2.4.9 DESIGN FOR CLOSURE

Transitional PRCPs are not required to demonstrate how aspects of the mine site have been designed for closure for existing or approved disturbance, however, any expansion to an existing site must demonstrate how it has been designed for closure.

THGM is under a transitional PRCP and has no current expansions to the existing site, therefore this section is not applicable to this transitional PRCP.

2.5 EXISTING SITE REHABILITATION STATUS

The THGM features were rehabilitated following cessation of operations in 1995, with minor rehabilitation undertaken following exploration works between approximately 2014 to 2024. Recent tailings reprocessing activities have re-disturbed the TSF and access roads, resulting in 28 ha of the site still rehabilitated from the original 51 ha of disturbance approved.

Whilst rehabilitation of the previous mining disturbance was considered successful, there has always been recognition that additional resources exist at THGM and as such, no effort to certify existing rehabilitation, or to relinquish the current MLs has occurred.

Rehabilitation activities previously undertaken at THGM include:

- Surface infrastructure removed other than water line and storage reservoir
- Roads deep ripped and seeded
- Processing area reshaped and seeded
- Roads other than major access track seeded
- Tailings dam capped and seeded
- Decant pond capped and seeded
- Borrow pits backfilled and seeded
- Waste rock dump walls battered and seeded
- Waste rock dump capped and seeded
- Final void bunded and fenced (Envirofin, 2020).

The following sections provide a summary of the rehabilitation monitoring that has been undertaken at THGM since 1999 and was based on the following two primary sources:

- Sinclair Knight and Merz (SKM) report titled 'Tick Hill Rehabilitation Survey. Flora and Fauna Survey' (SKM, 1999).
- An Interim Rehabilitation Report (SKM, 2013) was commissioned by then owners Xstrata, to produce a Final Rehabilitation Report to relinquish the THGM MLs. This is provided in Appendix F.

The following sections provide a summary of these document findings (plus observational commentary from more recent site visits where applicable), regarding site stability, ecology, exploration, and progressive rehabilitation. Soils and rehabilitation material characterisation and balance information is provided in 6.5.

2.5.1 GENERAL SITE STABILITY

The 2013 SKM report (SKM, 2013) summarised the general rehabilitation status as physically stable and that preliminary limit equilibrium stability analyses of the tailings dams, decant pond and waste rock dumps indicated that the design and construction was adequate to maintain long term stability.

Stability analyses for the tailings dam, decant pond and waste rock dump resulted in a factor of safety (FoS) of 1.0 for earthquakes and greater than 1.5 for all other scenarios as shown in Table 2-11.

Table 2-11: Stability analyses results for landform features

Feature	Factor of Safety			
	Long term	Long term cutoff	Earthquake	Earthquake cutoff^
TSF	1.8	1.5	1.57	1.0
Decant Pond	1.77	1.5	1.53	1.0
WRD	2.4	1.5	2.09	1.0

^Note: Cutoff from USACE (1970)

The report also stated that the tailings dam, decant pond and waste rock dump are expected to be stable over the long term and comply with the decommissioning/rehabilitation criteria of the (at the time) DEHP's Code of environmental compliance for Mining Lease Projects January 2001 - Version 0.' (Diatreme, 2017b).

More recent site observations during exploratory works 2020-2022 plus the 2024 soil and rehabilitation material characterisation sampling campaign (Mine Earth, 2025a) have identified stable landforms and there is no mention in recent documentation of any batter, bank, or containment failures or erosion features that warrant further investigation.

2.5.2 ECOLOGY

Two surveys focused on rehabilitation have been undertaken since the former gold mine ceased operations in 1995:

- 1999 SKM flora and fauna survey (SKM, 1999)
- 2013 SKM Interim Rehabilitation Report that included:
  - flora and fauna survey with the same methodology as the 1999 survey
  - baseline BioCondition survey to assess the condition, health, or ecological integrity of the habitats on site (SKM, 2013).

The following sections provide a summary of these survey's findings.

2.5.2.1 1999 SKM SURVEY

The rehabilitation flora and fauna survey was undertaken in 1999 by SKM assessing a reference (analogue) colluvial slope site, the rehabilitated WRD, and the TSF plateaux. Abundance and richness of plant, invertebrate and vertebrate taxa were used as ecological indicators to assess the similarity of rehabilitated and reference sites on the Tick Hill mine lease.

The survey was undertaken in January and August 1999. Survey locations were established at five reference sites and two rehabilitated sites (WRD and TSF plateau). Overall, the survey concluded that:

- The results of this survey were promising (e.g. the seasonal consistency in vertebrate assemblages) although further seasonal surveys over time would confirm the relationship between the sites. The high seasonal changes in plant species richness and ground cover on the tailings dam and the

invertebrate assemblages on the tailings dam and rock dump suggests that the development of a greater proportion of perennial vegetation and some change to substrate characteristics (probably related) may be required to provide ongoing rehabilitation success.

- While different in composition to reference sites, rehabilitation sites generally showed an acceptably high diversity and abundance of various organisms. (SKM, 1999)

The results tended to focus upon seasonal variation, however, were found to be 'promising' and are summarised below:

- Plant species and invertebrate order composition and abundance showed that the rehabilitation sites were different to the reference sites in both winter and summer
- Invertebrate order richness was as high or higher on the rehabilitated sites as the reference sites
- Seasonal changes in plant and invertebrate richness and abundance were greater at the rehabilitation sites than the colluvial slope reference site
- There were generally more reptile, bird and mammal species at reference sites than at rehabilitation sites, and there was a similar change in community composition between summer and winter
- Plant species richness declined between summer to winter on the rehabilitated sites; however multidimensional scaling showed that, while there were differences between the reference and rehabilitated sites, the overall trend in seasonal variation was similar between summer and winter
- Vertebrate species composition showed that the TSF fauna resembled the colluvial slope reference site although less rich in species. Furthermore, both these sites showed a similar seasonal change in vertebrate faunal community structure. In contrast, the vertebrate fauna at the WRD site did not show a marked seasonal change (SKM, 1999).
- The TSF fauna monitoring results indicated similar seasonal variation to the background site and WRD and was similar in winter to the background site. This suggests that while there is a large degree in variation between the sites, particularly in vegetative composition, the rehabilitated areas are performing as an integral part of faunal habitat (Envirofin, 2020).

2.5.2.2 2012-2013 SKM SURVEY

The 2013 flora and fauna rehabilitation survey replicated the 1999 survey methodology and also included an initial baseline BioCondition survey that was undertaken concurrently and included assessing vegetation condition using the Queensland Government's BioCondition Assessment Manual available at the time (DERM, 2012).

Terrestrial flora results indicate the rehabilitation in terms of establishing a self-sustaining vegetation cover suitable for soil stabilisation and grazing has been successful.

There was a reduction in ground cover between 1999 and 2012 at a reference site, however no significant changes between survey years were detected at the other reference or rehabilitated survey locations. The percentage of bare ground appears to have no significant change between the 1999 and 2012 surveys, indicating the amount of plant material (live plus dead) has remained reasonably constant.

The following 2013 BioCondition survey results were summarised as:

- Native grass and other ground cover species richness was consistently lower than the benchmark at all survey locations, including the reference sites. This may have been factor of the very dry conditions resulting in a general paucity of fertile material making differentiation and detection of species difficult.
- Tree canopy cover was below the benchmark at the rock dump, and surprisingly also on the colluvial slope, as this site appeared to have been subject to very little disturbance.
- Organic litter cover was higher than the benchmark at all sites, presumably due to the abundance of dead Buffel grass adding to the litter layer.

Importantly, all other indicators measured using the BioCondition methodology were within the ranges specified in the BioCondition benchmark document (DERM, 2012).

Visual observation of the previously disturbed mine areas indicates that the current ground cover is self-sustaining, and cover densities are sufficient to prevent soil erosion (SKM, 2013).

The rehabilitation in 2013 (SKM, 2013) was assessed against the completion criteria of the environmental permitting at the time, and was found to have achieved all criteria against the relevant rehabilitation objectives:

- Vegetation cover to minimise erosion.
- Establish specified self-sustaining natural vegetation and/or grazing land.

2.5.2.3 REVEGETATION OVER TIME

Further to the results from 1999 and 2013 (plus observations during 2020-2024), Figure 2-17 provides a comparison of TSF vegetation cover between 2005 and 2024 (Google Earth, 2024). Note the 2024 image where vegetation (dark areas) can clearly be seen establishing directly on tailings material within the eastern cell.

2.5.3 SOILS

In July 2024, a material sampling and analysis program was undertaken to improve knowledge of the THGM soil and growth media (Mine Earth, 2025a). The materials sampled were considered a valuable source of potential rehabilitation / cover materials for use in mine closure. The samples included were from the WRD, tailings and tailings cover material, stockpiled topsoil, potential borrow material locations, decant pond cover and embankment material, plus analogue soils from five locations. The findings of this assessment are summarised below:

- Chemical characteristics of the materials, while variable, were generally within the range exhibited by the analogue soils within the Project area
- Potential sources of rehabilitation / cover material sampled were generally non-saline, low in plant-available nutrients (similar to analogue soils) and, as evidenced by field observations, were capable of supporting the growth of local vegetation species
- Physical characteristics of the materials were variable, reflecting the range of particle sized distributions present. Hydraulic conductivity of the materials (at 95% of MDD) was highly variable, with drainage classifications ranging from 'Extremely slow' to 'Very rapid'
- Water retention characteristics of the potential sources of rehabilitation / cover material (<2mm fraction) were also variable, with the water content at field capacity (i.e. the amount of water held in the materials after gravity induced drainage has ceased) and the plant-available water content (PAW) ranged from 'low' to 'moderate'
- Results for the WRD samples were variable, with PAW contents ranging from 9.7 to 20.4% (i.e., low to moderate), again reflective of the variable particle size distribution of the WRD samples
- Root growth was classified as either 'many' or 'abundant' in the topsoil layer of all analogue sites as well as all of the rehabilitated sites, except where material had been removed and stockpiled on the TSF (Mine Earth, 2025a). This is a good indicator that the rehabilitated areas are able to support revegetation and are on a trajectory to sustain the required PMLU vegetation types in the long term.

Based on the above summary, the material sampled would not require ameliorants to support and sustain revegetation. The use of fertiliser may assist with plant growth; however it would also likely encourage weed growth which may become problematic.

Appendix B provides detailed characterisation of all the analogue and rehabilitated area samples tested.

During the environmental assessment site visit in 2023, no evidence of soil or sediment contamination was observed on site (EES, 2023).

May 2006

September 2006

October 2021

October 2022

June 2024

Figure 2-17: Imagery of the Tick Hill TSF vegetation cover over time (Google Earth, 2024)

2.5.4 EXPLORATION

Various exploration campaigns have occurred at Tick Hill since 1995, however there is only minor evidence of historical exploration disturbance on site. This includes rehabilitated drill holes, costeans, and access tracks. Rehabilitation of exploration drilling involved the following:

- Upon completion of drilling, a plastic hole plug was pushed approximately 1.0 m down the hole (typically using the drill rod)
- Back filling the drill holes with drill chips and drill material (Envirofin, 2020).

Any future exploration works will be rehabilitated using the same approach.

2.5.5 PROGRESSIVE REHABILITATION

Progressive rehabilitation will be considered wherever possible, including potential progressive rehabilitation of the TSF. At this point in time however, it is expected that minimal opportunities will arise for progressive rehabilitation prior to closure execution. Therefore it is currently planned that the majority of rehabilitation works will be conducted following final transport of tailings material from site.

Table 2-12 provides a summary of the site features, operational status and progressive rehabilitation balance.

Table 2-12: Progressive rehabilitation

Mine Feature Name*	Approved disturbance area (ha)	Revised Features	Operational Status	Areas rehabilitated (ha)	Areas not yet rehabilitated (ha)
Waste rock dump	6.9	Waste rock dump	Decommissioned and rehabilitated	6.9	0.0
Tailings dam (including decant ponds)	10.89	Decant pond	Decommissioned and rehabilitated	5.0	6.2
Tailings dam reclamation area (part of the 17.4 ha of Tailings Dam)	6.51	Tailings dam	Operational^	0.0	6.2
Open Pit#	3.0	Open Pit	Decommissioned	0.0	0#
Infrastructure (including processing plant area)	6.7	Infrastructure (including processing plant area)	Decommissioned and rehabilitated	7.0	1.1
Borrow pit (part of infrastructure)	0.2	Borrow pit (part of infrastructure)	Decommissioned and rehabilitated	0.2	0.0
Access tracks	2.0	Access tracks	Operational	0.0	3.1
Borrow pits	13.9	Borrow pits	Decommissioned and rehabilitated	7.9	0.0
Exploration	<1	Exploration	Decommissioned and rehabilitated	1.7	0.0
				28.6	16.6
Total PMLU area	48.0			45.2	
Total NUMA area	5.8			5.8	
Total area (PMLU + NUMA)	**51.0**			**51.0**	

Notes:

*As listed in EA EPML00820613

^Assumes area within TSF embankment only will be disturbed

#Area is a NUMA so will not be rehabilitated

3 COMMUNITY CONSULTATION

3.1 STAKEHOLDERS

The key focus of community engagement for the PRCP is the directly affected landowners in the vicinity of the mine and other affected groups include traditional owners, local government, and local businesses. It is the intention of Tick Hill Mining to continue stakeholder engagement in the same manner as previous owners Carnaby Resources.

For the purpose of consultation frequency, key stakeholder groups for THGM have been categorised into tiers according to their level of impact and engagement. Figure 3-1 and Table 3-1 provide the identification and level of impact and engagement of relevant THGM stakeholders.

It is noted that none of the stakeholders are considered sensitive receptors, as they are not in proximity to the THGM site (i.e. they are greater than 500 m away), and as such, are not likely to be directly affected by any operational, rehabilitation or closure activities at the site.

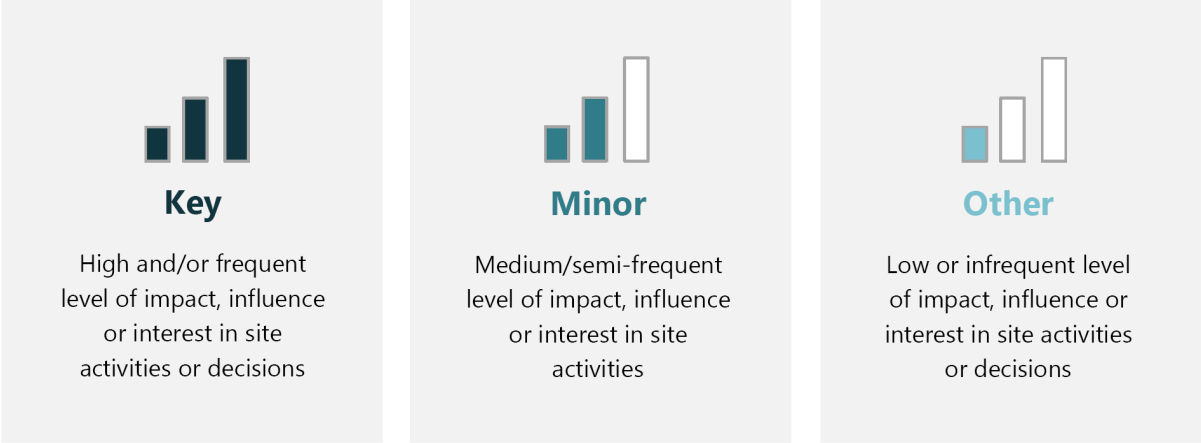


Figure 3-1: Stakeholder classification

Table 3-1: Stakeholder Identification and Categorisation

Category	Identification	Level of impact and engagement
Landholders M.D.H Pty Ltd	Stanbroke Station	Key
	Chatsworth Station	Key
Community	Duchess	Other
	Dajarra	Other
	The Monument	Other
	Cloncurry	Other
	Mt Isa	Other

Category	Identification	Level of impact and engagement
Business operators and employees in the locality	Duchess Hotel	Minor
	Camps/caravan parks	Other
	Schools/daycare	Other
	Hospitality (restaurants, pubs, bars)	Other
	General stores and markets.	Other
Traditional Owners	Yulluna People	Minor
	Kalkadoon Tribal Council	Other
	Kalkadunga Association in Mt Isa	Other
Government	Local: Cloncurry Mayor	Other
	State Department of: • Environment, Tourism, Science, and Innovation • Natural Resources and Mines, Manufacturing and Regional and Rural Development • State Development, Infrastructure and Planning • Transport and Main Roads • Women, Aboriginal and Torres Strait Islander Partnerships and Multiculturalism • Local Government, Water and Volunteers	Other

3.2 HISTORY OF STAKEHOLDER CONSULTATION

A register of previous stakeholder and community consultation has been provided as Appendix H.

Given the small number of stakeholders, the remote nature of the region and the limited site activities, THGM adopt a bespoke approach to stakeholder consultation. This means that the methods, frequency and format of engagement is tailored to the stakeholder, but generally an informal and 'neighbourly' approach, whereby THGM personnel engage freely in a direct manner as required.

For example, a key stakeholder is the landholder - MDH Pty Ltd (MDH), being the operator of Stanbroke Station and Chatsworth Station. The owners of THGM have a formal agreement in place with MDH, the latest being from 13th of October 2021. This agreement spells out responsibilities and rights for operating pastoral activities within the THGM mining leases now, and outlines obligations for both parties now and into the future. There are commitments around ensuring current access and land management activities continue post relinquishment. There are also statements regarding environmental harm and having controls in place, division and access of water and the maintenance of the water pipeline. Communication between both parties has been face to face in a cooperative manner.

In contrast, consultation with parties such as the wider community, business operators, traditional owners and the government have been primarily transactional and targeted towards achieving a specific purpose.

Information has been shared during these transactions, according to the interests and queries of the stakeholders. This may have been because of support for exploration programs, approvals and compliance requirements or other specific purposes.

3.3 COMMUNITY CONSULTATION PROCESSES

Through the community consultation process, THGM will achieve the following objectives:

- Identify, notify and engage the community regarding rehabilitation and closure of THGM, ensuring that the communities wishes in regard to PMLUs are being considered;
- Provide ongoing community consultation throughout the life of the operation to ensure impacts related to mine rehabilitation and closure are communicated and understood;
- Collaborate with the community to identify rehabilitation and closure opportunities and constraints that could influence effectiveness of final land outcomes; and
- Provide a platform for comments and feedback mechanism to ensure closure and rehabilitation goals and expectations are effectively communicated and addressed.

Further detail of ongoing consultation processes and methods is as detailed in Appendix H.

4 POST-MINING LAND USE

The current and adjacent land uses at THGM include low-intensity cattle grazing and some mineral exploration activities. Historically, mining activities and cattle grazing have been the predominant land use. There are two proposed PMLU:

- **Low-intensity grazing** that consists predominantly of native species across the majority of the site
- **Tussock grassland** on the TSF footprint to prevent negatively impacting the proposed TSF capping and cover system.

It is intended that some assets (tracks, water tank, etc.) are to be retained by the landowner following lease relinquishment, however until there is a formal asset transition agreement in place, these assets will require rehabilitation.

The following sections provide the regulatory context, justification, and description of the proposed PMLUs.

4.1 PMLU DEVELOPMENT

A PMLU is defined under Section 112 of the *Environmental Protection Act 1986* (EP Act) as "the purpose for which the land will be used after all relevant activities for the PRCP carried out on the land have ended". Determining the appropriate PMLUs is a critical first step in mine rehabilitation planning. It supports and informs the remainder of the proposed PRCP, including rehabilitation and management strategies, and the PRCP schedule.

Mining is considered as a temporary land use and therefore, it is important to consider a future land use that aligns with social, economic, environmental expectations for the site, as per Section 126C(1)(d) of the EP Act.

The justification for the identified PMLUs is provided in Section 4.1.1.

Criteria for all PMLUs to be adopted for THGM will align to the requirements of the EP Act as described. The EP Act and Regulations contain several additional sections that need to be complied with, as outlined in Sections 4.1.2 and 0.

4.1.1 POST-MINING LAND USE CONTEXT

THGM is remotely located in north-central Queensland. THGM is located approximately 40 km south of the township of Duchess and approximately 140 km southeast of Mt Isa. THGM is currently operated by a non-resident workforce which also service other small operations in the area.

The nearest township is Duchess, a historic location that currently has a population of less than 30 people. This includes the Duchess Hotel, where THGM personnel stay when on site. The town is surrounded by several large grazing properties including Mayfield Station and Stradbroke Station.

Mount Isa and Cloncurry are the nearest regional centres, with both towns over 100 km away by road. The remoteness of the site and the low stocking rates achievable in the region (given the marginal grazing value of the land) suggest that an alternative to the pre-mining PMLU is likely to be sustainable.

The pre-mining land use was low density cattle grazing which is consistent with the general area surrounding THGM. The land has previously been, and is still, leased by Stanbroke Pty Ltd, on a rolling term lease, on a pastoral holding tenure.

There are no obvious tourism or sport opportunities or attractions, the site is not located near a major power network that may support renewable energy production, and there is a lack of local infrastructure required to support a future industrial precinct or opportunity. Additionally, almost all the permanent infrastructure from the original mining operation has been removed. A summary of the PMLU options and selection is provided in Table 4-1.

The proposed PMLU are consistent with the community consultation outcomes (section 4.1.4), relevant planning schemes and strategies (section 4.1.5), plus local and regional cultural heritage aspects (section 4.1.6).

Table 4-1: PMLU selection summary (preferred options shaded green)

PMLU	Description	Selection	Justification
Low-intensity grazing	Revegetation using predominantly native species (trees, shrubs, and grasses)	Yes	Directly aligns with adjacent land uses
Tussock grassland	As above without using deep-rooted species (to maintain TSF cover integrity). Barriers in place to exclude livestock.	Yes	Aligns with vegetation and appearance of adjacent land uses
Cropping / agriculture	Cropping, higher-intensity agriculture, or horticulture	No	Land not suitable. Also limited infrastructure including proximity to general utilities
Tourism	Nature-based tourism	No	Limited infrastructure, population, or alignment with planning schemes
Alternative Energy	Solar, wind or similar alternative energy production	No	Lack of infrastructure including proximity to major power grid/network
Sport	Mountain biking, golf course, etc.	No	Limited infrastructure, population, or alignment with planning schemes

4.1.2 SECTION 111A OF THE EP ACT

In order for a proposed PMLU to be accepted, the PRCP schedule must demonstrate that the land can be rehabilitated to a stable condition in accordance with the following definition from Section 111A of the EP Act:

Land is in a stable condition if:

a) The land is safe and structurally stable; and

b) There is no environmental harm being caused by anything on or in the land; and

c) The land can sustain a PMLU.

This PRCP provides detail of how the above requirements can be achieved for the nominated PMLUs. The background context explains how historically rehabilitated areas inform the transitional, and previously approved, PMLU to be adopted for THGM. Clarity is provided as to how this historic information informs the acceptable land outcomes for the site.

4.1.3 EP REGULATION

The EP Regulations require that each PMLU:

a) Is viable, having regard to the use of land in the surrounding region, and

b) Satisfies at least one of the following:

   i. The use is consistent with how the land was used before a mining activity was carried out on the land;

   ii. The use is consistent with a development approval relating to the land;

   iii. The use is consistent with a use of the land, other than a use that is mining, permitted under a State or Commonwealth Act, including, for example, a planning instrument under the Planning Act; and

   iv. The use will deliver, or is aimed at delivering, a beneficial environmental outcome.

4.1.3.1 TRANSITIONAL PRCP CONTEXT

As previously noted, THGM has an existing EA for mining activities, and has received a transition notice to submit a proposed PRCP that meets the requirements in Sections 126C and 126D of the *Environmental Protection Act 1994* (EP Act).

The PRCP Guideline (DETSI, 2024) highlights that the rehabilitation reforms will not be retrospective, and outcomes agreed in existing approvals will be maintained and preserved. To clarify what has previously been agreed for THGM, approved land outcomes have been explored. These pre-approved land outcomes may be either PMLU or Non-Use Management Areas (NUMA) and will be taken as pre-approved if contained in a 'land outcome document'.

Land outcome documents are defined in Section 750 of the EP Act and are limited to:

a) an EA;

b) a document made under a condition of an EA that:

   i. relates to the management or rehabilitation of land (e.g. rehabilitation and closure plan or residual void management plan); and

   ii. was provided to the administering authority, and had not been superseded, before 30 November 2018; and

   iii. before 15 January 2019, the administering authority had not notified the EA holder that the document was insufficient.

c) a document made under a condition of an EA that:

   iv. relates to the management or rehabilitation of land (e.g. rehabilitation and closure plan or residual void management plan); and

   v. was provided to the administering authority between 20 November 2019 and 30 November 2021; and

   vi. within 20 business days after receiving the document, the administering authority had not notified the EA holder that the document was insufficient.

d) a report evaluating an EIS under section 34D of the *State Development and Public Works Organisation Act 1971*;

e) an EIS assessment report; or

f) a written agreement between the EA holder and the State that is in force on 30 November 2018.

Of the list of potential land outcome documents, only an EA exists for THGM (as per item (a)).

However it is important to note, the EA is partial in nature to only the restricted areas and activities that are currently authorised for the site with limited information as to suitable rehabilitation outcomes for the site.

As such, in developing this PRCP, an approach has been taken to view the previously completed rehabilitation as an intrinsic part of the landscape given the works have nearly 30 years of demonstrated performance. Future rehabilitation efforts for the THGM site will be targeted to ensure consistency with the previously completed rehabilitation.

This approach is further supported by considering the Estimated Rehabilitation Cost (ERC) for the site. Both the spatial information to reflect the historical Rehabilitation Areas (RA) and land outcomes have consistently been provided to DETSI as part of ERC calculations to enable lodgement of Financial Assurance (FA) for the site. As such, the administering authority can be said to be aware of the existence of the rehabilitated areas associated with THGM (including a residual void, as well as rehabilitated WRD area and TSF) and have not previously raised concern about these land outcomes being unsuitable or not authorised. Furthermore, it is understood that DES Compliance Officers have historically inspected the site and the historic rehabilitation.

Further to this, this PRCP illustrates how these historic areas meet a stable condition in line with the contemporary definition and meaning as per Section 111A of the EP Act. The proposed land outcomes are considered to be appropriate within the context of the surrounding environmental, social, and economic context. Further, all land outcomes, including both PMLU and NUMA, will be managed so that achievement of completion criteria can be demonstrated to ultimately relinquish the MLs.

The proposed PMLUs are described in the following parts of this section.

4.1.4 COMMUNITY CONSULTATION FOR PMLU

As outlined in Section 3, the planned PMLU's for THGM have previously been discussed with interested and affected parties, as well as sensitive receptors. It is again noted that the site effectively completed rehabilitation and closure activities almost 30 years ago, and as such, the current arrangement represents an overall post-mining scenario. It is currently the case that the few nearby neighbours utilise the retained infrastructure for their own operations, and agreements have already been entered into to formalise this arrangement.

Current agreements will be amended to reflect any further rehabilitation and closure activities to be completed for the site. It is understood that the key PMLU outcomes will be as already adopted for the rehabilitated mining landforms associated with the site. Consultation has also indicated that neighbouring pastoral operations are likely to agree to a transfer of ownership for existing infrastructure such as access to water and pipeline/pumping facilities.

It has been communicated and is accepted by the community that the residual void will remain with the existing barriers (fence/bunds/rock) in place.

4.1.5 ALIGNMENT WITH RELEVANT STRATEGIES AND PLANS

4.1.5.1 CLONCURRY SHIRE PLANNING SCHEME 2016

Under the Cloncurry Shire Planning Scheme 2016, State Planning Policy and the North-West Regional Plan, the project area has been zoned as 'Rural Land'. The Cloncurry Shire Planning Scheme 2016 states that the purpose of the rural zone is to:

- Provide for rural uses and activities
- Provide for other uses and activities that are compatible with existing and future rural uses and activities, as well as in line with the character and environmental features of the zone
- Maintain the capacity of land for rural uses and activities by protecting and managing significant natural resources and processes.

Furthermore, the Cloncurry Shire Planning Scheme 2016 actively promotes the interplay between mining and low-intensity cattle grazing within the Strategic Frameworks which underpins the regulatory framework within the Scheme. The pursuit of economic opportunities associated with the mining sector are actively encouraged by Cloncurry Shire Council.

The proposed PMLUs are considered appropriate given the surrounding land use are predominately grazing and native vegetation. Given the existing rehabilitated areas have been in place since before the development of these planning schemes, the uses are already part of the character and features of the zone. The return of most of the site to native vegetation and low-intensity grazing will provide beneficial environmental, social and economic outcomes for the region.

4.1.5.2 NORTH-WEST REGIONAL PLAN 2010-2031

The vision for the northwest region is that the '...North West region has a robust, diverse and sustainable economy and well-planned and coordinated infrastructure and services, built through the economic benefits of mining and agricultural industries. It is a place where people choose to live and visit due to its liveability, well-managed natural resources and the community's strong sense of cultural identity' (Queensland Government, 2010).

The North-West Regional Plan presents a set of strategic directions for 2010-2031, and these were reviewed and considered when developing the PMLU for THGM. The PMLUs are consistent with the strategic directions as listed:

- Creating a more sustainable future.
- Protecting regional landscapes and supporting regional production values.
- Creating liveable communities.
- Promoting a dynamic, robust, and diversified economy.
- Providing infrastructure and services.
- Integrating land use, economic activity, and transport infrastructure.
- Adapting to climate change.
- Managing mining growth (Queensland Government, 2010).

4.1.5.3 A STRATEGIC BLUEPRINT FOR QUEENSLAND'S NORTH WEST MINERALS PROVINCE

A Strategic Blueprint for Queensland's North West Minerals Province: supporting strong and prosperous regional communities ('the Blueprint') was produced by the Queensland Government (2017) and is the pre-cursor to the 2019 North West Queensland Economic Diversification Strategy. The proposed PMLU aligns with the following strategic priorities for the Blueprint:

- Facilitating continued resources sector development
- Diversifying the regional economy and creating employment opportunities
- Working with businesses and communities to deliver integrated and appropriate services.

4.1.5.4 NORTH WEST QUEENSLAND ECONOMIC DIVERSIFICATION STRATEGY

The 2019 North West Queensland Economic Diversification Strategy provides a 'plan of action' across four key sectors: resources, agriculture, tourism, and business and industry (DSDMIP, 2019).

A key opportunity in the resource sector is the 'retreatment of mine waste (tailings)' which is currently the primary operation of the site. Additionally, 'innovative technologies' is listed as another opportunity and there are potential alternative industrial uses for the tailings material that are currently being investigated (no further information currently available). The PMLU is consistent with the future economic strategy of the region and directly aligned to several opportunities identified in the report.

4.1.6 LOCAL AND REGIONAL CULTURAL HERITAGE

There were no statutory constraints from Indigenous Land Use Agreements, potential site management plans (contaminated land) or registered heritage places.

4.1.7 CONTAMINATED LAND MANAGEMENT

The Environmental Site Assessment report produced for this PRCP and as an Environmental Evaluation of the site (EES, 2023) (Appendix C) provided the following summary of contaminated land (separate from mine waste contamination):

- No evidence of soil or sediment contamination was observed on site.
- No hydrocarbons or benzene, toluene, ethyl benzene, xylenes and naphthalene (BTEXN) compounds were detected in groundwater at the site.
- Per- and poly-fluoroalkyl substances (PFAS) was detected in most groundwater monitoring bores, and PFAS detections were consistent with the requirement for fire suppression at the mining operation. However, as PFAS with screening criteria were only detected in the mine shaft bore, the potential for off-site impact is considered negligible.
- Perfluorooctanesulfonic acid (PFOS) exceeded the 99% ecological protection criteria at the mine shaft bore but was not detected at any other location. No other exceedances were observed.

It is noted that Lot 13 on SP309109 is on the Environmental Management Register (EMR), as a result of the following notifiable activities occurring, likely associated with the mining operation:

- Engine reconditioning works
- Landfill
- Petroleum product or oil storage
- Mine wastes.

When land is listed on the EMR for a notifiable activity (as is the case for THGM), it is an indication that the land may be contaminated but it does not mean it needs to be remediated or is not suitable for its current land use. This will depend on the nature, extent, and risks of any contamination on the land, which can be determined by engaging a suitably qualified person to carry out a site investigation. This has been considered when proposing the PMLU's.

Lot 16 on SP309110 is not listed on either the EMR or the Contaminated Land Register (CLR).

A review of the monitoring data at closure will determine whether further investigation and/or a Site Management Plan will be required when relinquishment of the MLs is being considered.

4.2 DESCRIPTION OF EACH PMLU

The low-intensity grazing and tussock grassland PMLUs are described in Sections 4.2.1 and 4.2.2 with their locations shown in Figure 4-1.

4.2.1 LOW-INTENSITY GRAZING

This PMLU applies to all site areas except the TSF and the pit footprint. This PMLU aligns directly with adjacent land uses and will target:

- Open woodland grazing environment that achieves the level of Land Class Suitability 3 as per Guidelines for agricultural land evaluation in Queensland (DSITI & DNRM, 2015).
- Native tree, shrub, grass and forb species. The species list will align with the relevant RE in the area (dependent upon seed availability).
- Preferential revegetation of native pasture species to promote low-intensity grazing (e.g. Mitchell grass, bluegrass, and ribbon grass); however naturalised species, such as Cloncurry Buffel grass will be used as necessary to establish ground cover and provide erosional stability.
- The return of the site to grazing land will also provide beneficial environmental outcomes as it will provide both habitat and ecosystem services to native fauna in the area.

4.2.2 TUSSOCK GRASSLAND

This PMLU applies to the TSF footprint and is designed to maintain the long-term integrity of the TSF cover system. The PMLU will consist of the following:

- Native grass, forb, and shrub seed species as the low-intensity grazing PMLU to reduce the opportunity for deeper-rooted species to recolonise the area.
- Additionally, this PMLU will have barriers erected in place (bunds, rocks, fences) to prevent cattle/grazing access but allow safe passage of native fauna.

4.3 REHABILITATION AREAS

The site disturbance areas have been grouped into areas that require a similar rehabilitation treatment that are targeting the same PMLU. The Rehabilitation Areas proposed are summarised in Table 4-2 and shown in Figure 4-2. The rehabilitation and management methodologies for these areas are provided in Section 6.

Table 4-2: Rehabilitation Area summary

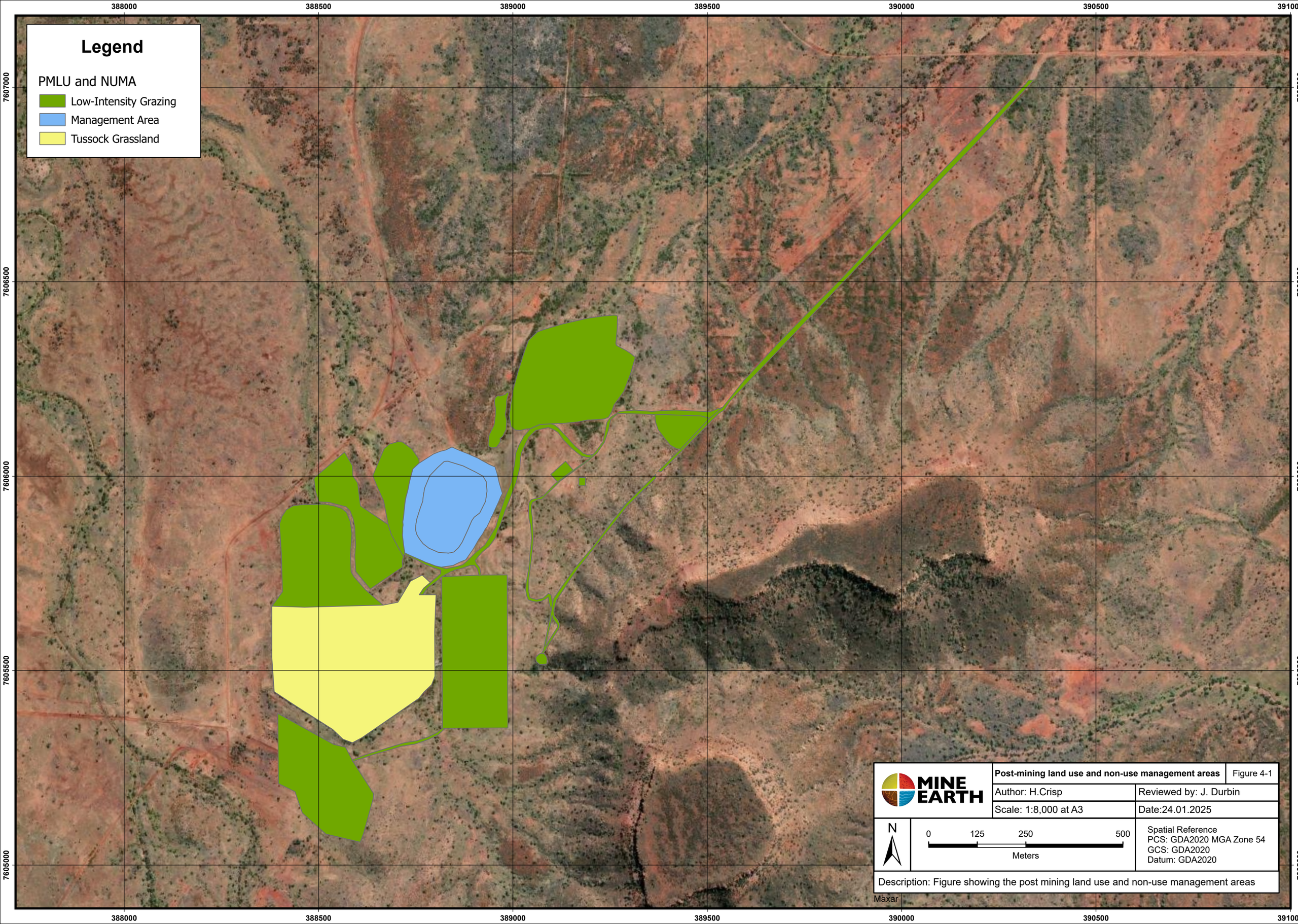
No.	Rehabilitation Area	PMLU	Disturbance	Rehabilitated (ha)	Yet to be rehabilitated (ha)	Area (ha)
RA1	TSF	Tussock grassland	TSF footprint (eastern + western cells)	0^	12.4	12.4
RA2	WRD and TSF Decant Pond	Low-intensity grazing	WRD and TSF Decant Pond	11.8	0	11.8
RA3	Infrastructure	Low-intensity grazing	Infrastructure area, ROM, laydown, waste disposal trench, borrow	15.1	1.1	16.1*

No.	Rehabilitation Area	PMLU	Disturbance	Rehabilitated (ha)	Yet to be rehabilitated (ha)	Area (ha)
			pits, water tank, miscellaneous areas			
RA4	Roads and tracks	Low-intensity grazing	Access tracks	0	3.0	3.0
RA5	Exploration, decline and underground workings	Low-intensity grazing	Exploration pads	1.7	0	1.7
Total				**28.6**	**16.6**	**45.1**

Notes:

^ Not all TSF has been recently disturbed, however, it is expected that the majority of TSF will be disturbed during tailings relocation activities

* 16.1 due to rounding up of input values



MINE EARTH

Post-mining land use and non-use management areas	Figure 4-1
Author: H.Crisp	Reviewed by: J. Durbin
Scale: 1:8,000 at A3	Date:24.01.2025

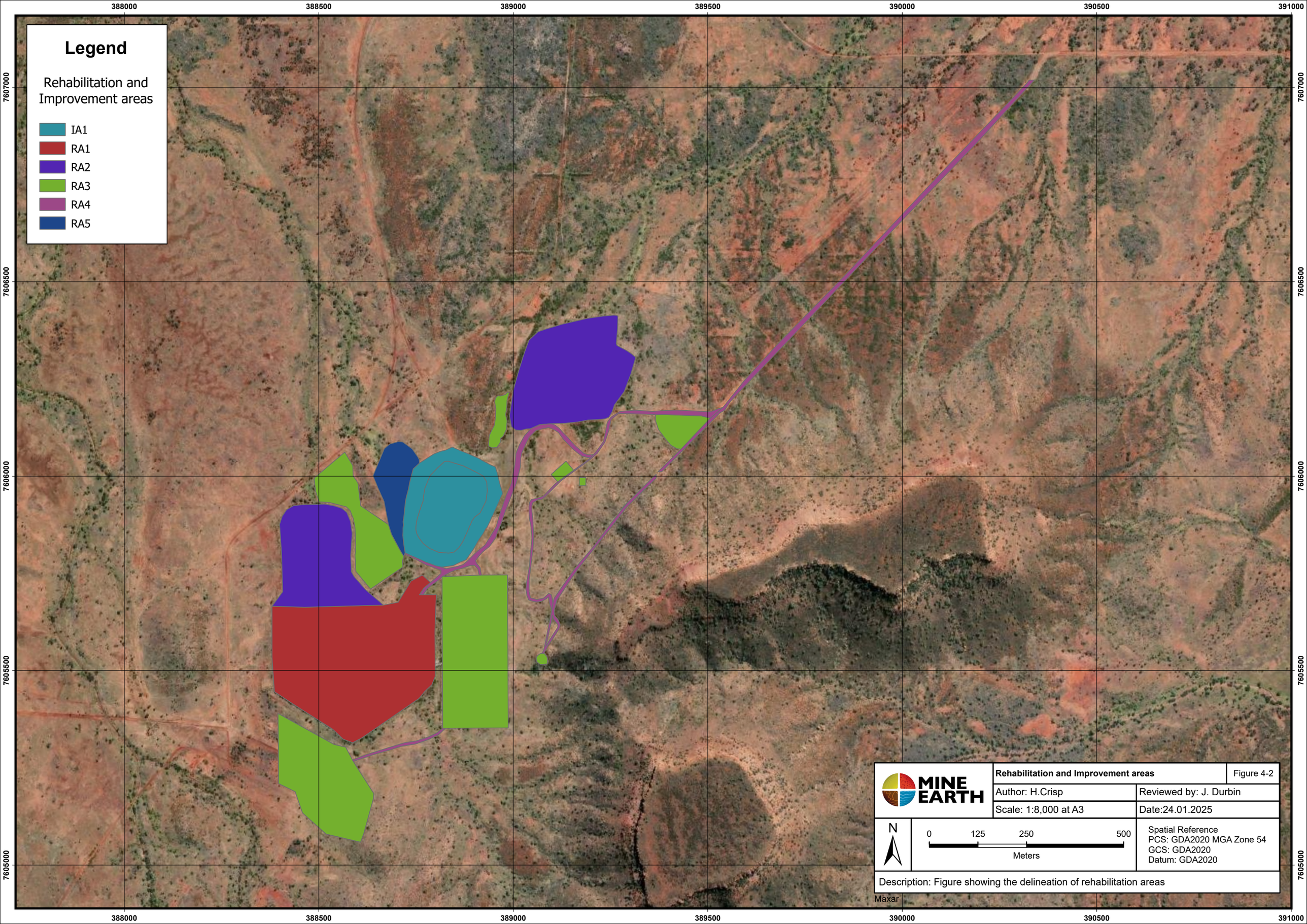
N

0 125 250 500

Meters

Spatial Reference
PCS: GDA2020 MGA Zone 54
GCS: GDA2020
Datum: GDA2020

Description: Figure showing the post mining land use and non-use management areas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Rehabilitation and Improvement areas
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7605500
7605000
MINE EARTH
Rehabilitation and Improvement areas
Figure 4-2
Author: H.Crisp
Reviewed by: J. Durbin
Scale: 1:8,000 at A3
Date:24.01.2025
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Meters
Spatial Reference
PCS: GDA2020 MGA Zone 54
GCS: GDA2020
Datum: GDA2020
Description: Figure showing the delineation of rehabilitation areas
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4.4 REHABILITATION MILESTONES AND CRITERIA

Rehabilitation milestones have been developed for THGM with due consideration for the advanced state of its rehabilitation.

Greater than 50% of disturbed areas on site have been rehabilitated, however the rehabilitation milestones developed for THGM still include the relevant steps necessary to achieve rehabilitation outcomes, i.e. from infrastructure removal through to achievement of a stable condition.

Criteria to measure the achievement of these milestones were developed using the following inputs:

- Risk assessment (acknowledging that all residual risks were assessed as 'low', so the 'moderate' current risks were used to assist milestone development)
- Monitoring data (e.g. groundwater, ecological)
- Recent site investigations (e.g. soils, rehabilitation material)
- Recent modelling studies (e.g. TSF cover design, long-term pit water behaviour).

Wherever possible, monitoring or investigation data from site locations were used to inform the criteria.

Table 4-3 summarises the relationship between rehabilitation milestones, rehabilitation areas, and the PMLU at THGM.

Table 4-4 provides the rehabilitation milestones and criteria as presented in the PRCP Schedule (Appendix A).

Table 4-3: Rehabilitation Milestones, rehabilitation areas and post-mining land uses

Post-Mining Land Use	Rehabilitation Areas	Milestone #	Milestone Activities
Tussock grassland	RA1: TSF	RM1	Infrastructure decommissioning and removal, remediation of contaminated land
		RM2	Minor earthworks and general reshaping
		RM3	Installation of cap / cover on tailings dam
		RM4	Placement of growth medium
		RM6	Revegetation (Tussock grassland)
		RM7	Achievement of surface requirements
		RM8	Achievement of a stable condition
Low-intensity grazing	RA2: WRD and TSF Decant Pond	RM7	Achievement of surface requirements
		RM8	Achievement of a stable condition
	RA3: Infrastructure	RM1	Infrastructure decommissioning and removal, remediation of contaminated land
		RM2	Minor earthworks and general reshaping
		RM4	Placement of growth medium
		RM5	Revegetation (Low-intensity grazing)
		RM7	Achievement of surface requirements
		RM8	Achievement of a stable condition
	RA4: Roads, tracks	RM1	Infrastructure decommissioning and removal, remediation of contaminated land

Post-Mining Land Use	Rehabilitation Areas	Milestone #	Milestone Activities
		RM2	Minor earthworks and general reshaping
		RM4	Placement of growth medium
		RM5	Revegetation (Low-intensity grazing)
		RM7	Achievement of surface requirements
		RM8	Achievement of a stable condition
	RA5: Exploration	RM1	Infrastructure decommissioning and removal, remediation of contaminated land
		RM2	Minor earthworks and general reshaping
		RM4	Placement of growth medium
		RM5	Revegetation (Low-intensity grazing)
		RM7	Achievement of surface requirements
		RM8	Achievement of a stable condition

Table 4-4: Rehabilitation Milestones and criteria

#	Rehabilitation Milestone	Milestone criteria
RM1	Infrastructure decommissioning and removal, Remediation of contaminated land	(a) With the exception of any infrastructure to remain as part of the PMLU or where infrastructure is agreed to be retained by the landholder as evidenced by a signed landholder agreement, the following are complete: i) All buildings demolished and removed ii) All roads decommissioned and removed iii) All boreholes decommissioned (cut and cap method) (b) All rubbish and demolition waste has been removed from the mining lease (c) Contaminated land assessment undertaken by an appropriately qualified person and indicates that contamination has been remediated or is acceptable for the proposed post-mining land use
RM2	Minor earthworks and general reshaping	(a) All major earthworks completed with slopes no greater than 20° and a surface which is free draining with the exception of minor ponding (b) Minor earthworks undertaken to reshape, reduce compaction and scarify areas for revegetation (c) Erosion and sediment control systems placed where needed
RM3	Installation of cap / cover on tailings dam	(a) Certification from an appropriately qualified person that the TSF cover system functions as it was designed including: (b) Review of cover system design, to achieve a net percolation of less than 10% (c) Cover to include 0.3 m compacted clay material plus either ≥1 m of WRD material or ≥1 m of borrow material (or other design as produced by a suitably qualified engineer)
RM4	Placement of growth medium	(a) Growth medium placed at a depth of ≥100 mm where material is available (b) Following growth medium placement, shallow ripping completed at a depth of greater than 100mm (except TSF to be ripped at no more than 100 mm)
RM5	Revegetation (Low-intensity grazing)	(a) Native seed mix applied at a rate ≥5 kilograms per hectare (kg/ha) (b) Key native species are recorded (e.g. *Corymbia terminalis, Eucalyptus leucophylla, E. leucophloia, Acacia* spp. and *Triodia* spp.) (c) Mean native plant frequency > 25 per 10 m^2 (d) Ground cover (live and dead material) is >25%
RM6	Revegetation (Tussock grassland)	(a) Native seed mix contains only shallow-rooted species (e.g. grasses and forbs) (b) Native seed mix applied at a rate ≥5 kilograms per hectare (kg/ha) (c) Mean native plant frequency >50 per 10m^2. (d) Ground cover (live and dead material) is >25%
RM7	Achievement of surface requirements	(a) Weed cover % (not including naturalised species) is within 20% of analogue site weed cover % (b) Mean native plant frequency >50 per 10m^2 (c) Ground cover (live and dead material) is >50% (d) Key native species are recorded in 'Low-intensity grazing'; grass and forb species only are recorded in 'Tussock grassland' (e) No active areas of rill or gully erosion and drainage follows appropriate drainage paths (f) Evidence of native fauna within revegetated areas
RM8	Achievement of a stable condition	(a) A rehabilitation performance review with at least three monitoring events has been completed using the methodology outlined in Section 3.7 of the PRCP

#	Rehabilitation Milestone	Milestone criteria
		(b) No evidence of seepage from any landforms beyond the boundary of the Mining Lease (c) Proportion of Category 3 restricted invasive plant species, as defined by the *Biosecurity Act 2014*, and Weeds of National Significance (WONS), as defined by the "Australian Weeds Strategy 2017 to 2027", are not >10% of total vegetative groundcover (d) Vegetation cover and composition (averaged over monitoring events) are comparable to analogue monitoring locations (i.e. ≥70% of analogue values) (e) Surface water quality results from the pit and the reclaimed TSF footprint (or as the EA requires) comply with: i) pH 6.5-9.0 ii) <10,000 µS/cm EC iii) Suspended solids <4,000 mg/L iv) total cyanide <0.004 mg/L (f) Groundwater quality results from monitoring locations THGW001 to THGW009, plus Mine Shaft bores comply with: i) pH 6.5-9.0 ii) <10,000 µS/cm EC iii) Total dissolved solids <4,000 mg/L iv) <0.004 mg/L total cyanide (g) Overall erosion risk is classified as 'Low' or 'Moderate' as defined by NCST (2009) Australian Soil and Land Survey Field Handbook (4th edition) (NCST, 2024) (h) Geotechnical stability of the pit walls and area behind western pit wall have been assessed by a suitably qualified geotechnical engineer as stable in the long term (i) Hazard and Safety Assessment completed by an appropriately qualified person demonstrates hazards in the rehabilitation area are similar to hazards in neighbouring unmined landscapes subject to a similar PMLU.

5 NON-USE MANAGEMENT AREA

The only proposed NUMA onsite is the pit void area. The pit void area is 3.0 ha and pit surrounds is approximately 2.8 ha, totalling 5.8 ha that is included as the NUMA. The NUMA area is shown in Figure 4-1.

The following sections provide further information on the pit NUMA.

5.1 REGULATORY

The EA EPML00820613 is the only land outcome document for this PRCP, and this EA allows a maximum pit disturbance area of 3.0 ha. The location of the pit is also evident in Figures 1a, 1b, and 2 of the EA.

The administering authority (DETSI) has authorised the existence of a residual void at THGM for almost 30 years and has not requested additional rehabilitation activities to ensure the area is safe, stable, and non-polluting. This is deemed as acknowledgement that the land outcomes are pre-approved for transitional PRCP purposes.

5.2 CONTEXT TO LAND

The closure of the THGM has been previously discussed, as needed, with interested and affected parties over time. Overall, there are few stakeholders who are aware of the residual void, given that it is confined to the area of the resource tenure, in a remote location.

The intent for the pit has always been that it would be retained as a permanent residual void. There is continued exploration interest in the site such that removing the void through backfilling would potentially sterilise the existing resource (or at least make cost prohibitive) to access in the future.

Current compensation and land access agreements reflect that the void will be retained and fenced. These agreements will be amended to reflect any further rehabilitation and closure activities to be completed for the site and to explicitly address future requirements for access to the residual void if a safe arrangement can be made. However, the primary objective for the residual void NUMA is to ensure the current management measures such as fencing and bunding continue to remain in place, so the area remains safe.

The strategies and plans outlined in Section 4.1.5 for PMLUs are just as relevant to the residual void NUMA. The Cloncurry Shire Planning Scheme 2016, State Planning Policy and the North-West Regional Plan all support land uses and outcomes that are compatible with existing and future rural uses and activities, as is the case for the residual void NUMA.

There are no local and regional cultural heritage aspects of relevance to the residual void NUMA. Further, there are no statutory constraints related to potentially contaminated land particularly relevant to the Residual Void NUMA.

The presence of the void has a strong influence on the local groundwater behaviour, as the evaporative demand from the open pit lake results in groundwater being continually drawn toward the pit lake, creating an evaporative sink. This is having a positive impact on the local environmental values and is eliminating a potentially greater risk if the residual void was not in place (had been backfilled) and the area became a source of potential contamination.

The residual void also mitigates the risk of environmental harm associated with elevated concentrations of cyanide seeping from the adjacent TSF (EES, 2023). The groundwater sink establishes a passive groundwater reticulation 'remediation system' that draws the cyanide to the surface of the void lake where it is degraded in sunlight. If the residual void lake was not in place, it is possible that the cyanide would continue to be present in the localised groundwater aquifer and potentially migrate beyond the immediate area and the ML boundaries.

5.3 MANAGEMENT MILESTONES AND CRITERIA

Since cessation of operations in 1995, management of the void has included monitoring and maintenance on the abandonment bund, fencing and access points, plus monitoring of surrounding groundwater. These activities will be continued until ML relinquishment.

The proposed management milestones, milestone references, and milestone criteria for the void improvement area are provided in Table 5-1. Table 5-2 provides the rehabilitation milestones and criteria as presented in the PRCP Schedule (Appendix A).

Table 5-1: Milestones for the non-use management area

Non-Use Management Area (NUMA)	Improvement Areas (IA)	Milestone #	Milestone Activities Required
Residual Void	IA1: Residual Open Pit Void	MM1	Maximum extent
		MM2	Achievement of surface requirements
		MM3	Achievement of sufficient improvement
		MM4	Management of crest zone

Table 5-2: Management milestones and criteria

#	Management milestone	Milestone criteria
MM1	Maximum extent	(a) Maximum NUMA extent no greater than 6ha in size and 70 m in depth.
MM2	Achievement of surface requirements	(a) Confirmation that fencing and abandonment bunds are erected around the perimeter and intact. (b) Warning signage posted at no less than 500 m intervals around perimeter. (c) Adequacy of sealed underground entry at top of pit verified by an appropriately qualified person.
MM3	Achievement of sufficient improvement	(a) At the time of relinquishment of the Mining Lease, certification by an appropriately qualified person body that: i) Residual void water quality and quantity will not cause environmental harm outside relevant tenure boundary ii) Residual void acts as a groundwater sink to the surrounding aquifer system iii) Residual void is safe for humans and livestock iv) The long-term stability of the underground mine layout, and the suitability of all life of mine seals. (b) Water levels within the residual void do not reach the maximum operational WSL (water surface level) of 305 m AHD.
MM4	Management of crest zone	(a) Certification that the area of crest cracking remains within abandonment bund. (b) Geotechnical review completed to verify that pit void is safe, stable and non-polluting.

6 REHABILITATION AND MANAGEMENT METHODOLOGY

6.1 VOID CLOSURE

This section provides the approach to managing the void area to minimise environmental harm in the long term. The residual void has been in a non-operational state for almost 30 years, and it has attained an equilibrium state in this time. There are limited options to design for alternate closure outcomes, or minimise final void area and volume without creating greater disturbance or undesirable environmental impact.

6.1.1 FINAL VOID CONFIGURATION AND DESIGN

The initial pit design was to minimise the residual void extent as much as practical within the constraints of the mining operation (Lewins, 1993). The steep nature of the pit walls and water quality have guided the NUMA designation.

The configuration of the THGM residual void is outlined in Table 6-1. The 3D pit design plan is in Figure 6-1, and a photo showing the void with abandonment bund within the landscape is provided in Figure 6-2.

Table 6-1: THGM Final Void Configuration

Feature	Detail
Land Outcome	NUMA (Residual Void)
Extent of area (to outer edge of abandonment bund)	5.8 ha
Details of pit walls	5 m wide benches at ~20 m intervals. Wall slopes at angle of repose in hard rock
Vertical depth from base to crest, and top elevation	70 m, 340 mAHD
Width across crest	230 m L x 160 m W
Average height and base width of abandonment bund	10 m H and 20 m W
Depth of water body (at equilibrium) and elevation at base	~25 m @265 m AHD
Pit lake surface area and elevation at water surface	0.8 ha @290 m AHD
Exposed pit catchment area (between pit crest and bund)	2.8 ha
Area within pit crest	3.0 ha

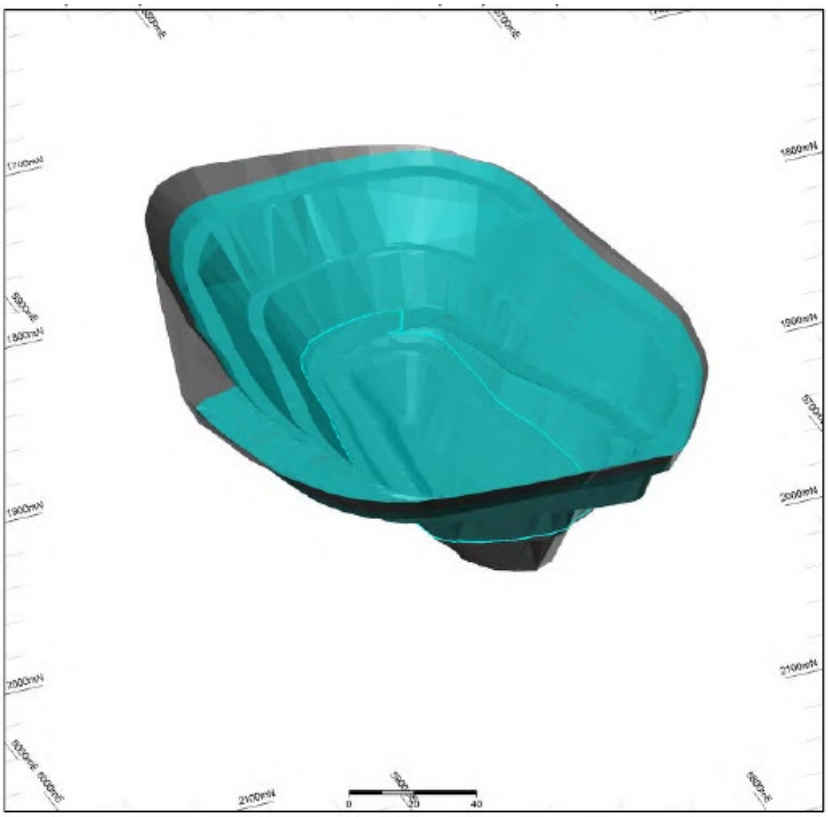


Figure 6-1: 3D model of pit void area

Figure 6-2: Pit area context within the landscape

6.1.2 GEOTECHNICAL STABILITY

The mine pit void has been monitored by an appropriately qualified geotechnical specialist over the years of non-mining. In 2020 a detailed geotechnical study of THGM was undertaken for a potential commercial-in-confidence expansion project (WKG, 2020). This report provided some information on the existing pit, however focused primarily on an altered pit shape and therefore only relevant pages from this report have been provided in Appendix J to maintain confidentiality.

The WKG report (WKG, 2020) did include a pit wall inspection (including the potential failure zone on the north-west wall), inspection of available cores previously drilled, plus review of historical information and records. This study found the following:

- Discontinuity shape/roughness and alteration/infill have not been recorded previously and are thus not expected. Rock quality designation generally agrees with comments regarding shear zones or core loss. This suggests that the initial understanding of the geotechnical characteristics of the TGHM void remain valid.
- Site inspection indicated that the pit was in good condition given the duration of exposure, with little erosional or weathering effects. This was deemed to be indicative of a reasonably high-quality rock mass.
- The observed slippage on the western wall ramp was deemed to be due to crown pillar extraction, above the old underground workings. This failure was likely to have occurred in weathered material and considered to be related to tensile stress forming in the remaining ground bridging above the stopes. Monitoring was established behind the west wall crest, with movement of 1cm recorded over time.
- The current western, northern and southern pit wall are at a batter face angle of 65°, with berm widths of 4m, and an overall slope angle of 52.5°. The current eastern pit wall is at a batter face angle of 56°, with berm widths of 5 m, and an overall slope angle of 44°.
- The geotechnical model calculated rock quality ranging from poor to good, which agreed with direct observations of the pit.

It is noted that entire open pit/residual void area (including the area of slippage on the western wall), is fully contained within the NUMA extent and within the existing abandonment bund. Fencing and signage is also installed to prevent vehicular access and deter livestock access.

6.1.3 VOID WATER QUALITY AND BALANCE

The THGM void is currently at an equilibrium level, with the water level in the pit at approximately 25 m from the pit base of the 70 m pit. Water levels have not fluctuated substantially for many years and have remained within the range of several metres. Water levels in the pit are primarily influenced by rainfall and runoff inputs, evaporative losses and groundwater inflow.

There has been sampling of the void water over time, since operations ceased at THGM. Samples were collected in 2012, 2017, 2020, 2022, 2023, and 2024. The most relevant environmental value for void waters is for stock water, and it is noted that there have been instances of exceedances of ANZECC (2000) stock water guidelines include pH (marginal), aluminium, fluoride, selenium and lead.

Pit water is also strongly alkaline and low/moderate in sulfate as would be expected with a primarily oxide resource with minimal pyritic elements. Increasing levels of cations, sulfate and chloride have also been noted over time, potentially resulting from the extended drought conditions in the region, or perhaps indicative of void water salinity increases over time.

The water chemistry of a mine pit after closure is influenced by a variety of physical, chemical, and environmental factors. Understanding these factors is required for predicting and managing water quality in closed mine pits and ensuring long-term environmental safety. Key factors that were considered to understand the long-term pit water behaviour included:

- Geochemistry of the surrounding rocks including acid metalliferous drainage (AMD) and acid neutralising minerals (e.g. carbonate minerals)
- Groundwater and surface water interactions including influx of groundwater and surface water runoff

- Pit lake hydrodynamics including stratification and mixing
- Climate and precipitation including rainfall and evaporation
- Presence of biological activity including microbial processes and algal growth
- Mining waste and tailings including residual tailings and waste rock piles
- Remediation efforts such as water treatment and material capping (EES, 2024).

Recent modelling demonstrates that the pit water acts as a groundwater sink, is not going to cause harm to environmentally sensitive receptors and will not overtop under extreme rainfall events. Therefore, the management requirements for the pit area include:

- Ongoing monitoring and maintenance of the abandonment bund
- Ongoing monitoring and maintenance of the fence and signage around the pit area
- Ongoing monitoring confirming integrity of the sealed underground entry at the top of pit
- Ongoing monitoring of the geotechnical stability of the area within the abandonment bund
- Ongoing monitoring confirming water levels do not exceed 305 m AHD.

Management milestones and milestone criteria relevant to these management requirements are provided in Section 5.3.

6.2 TAILINGS STORAGE FACILITY

Once the TSF material removal and relocation operation has ceased, the TSF area will undergo the following treatment:

- Identify and demarcate any remaining tailings material areas
- Refine the final landform shape based on remaining tailings material
- Ensure tailings material has been covered by inert waste material
- Reprofile embankment batters into the disturbed TSF area in alignment with proposed cover design
- Cover the disturbed area with an engineered capping system to reduce net percolation
- Apply growth media
- Rip and seed with shallow-rooted species
- Fence area
- Monitor vegetation establishment and development

The following sections provide further information on the capping system and revegetation of the area.

6.2.1 TSF COVER DESIGN SYSTEM

Following the 2024 rehabilitation materials characterisation investigation (Mine Earth, 2025a), a TSF cover design was developed based on the chemical and physical properties of potential rehabilitation materials available on site. The cover modelling was undertaken to indicate the types and potential quantities of on-site material required to reduce net percolation to less than 10%. Review and refinement of the cover design and material sources will be undertaken to understand optimal cost and constructability efficiencies. The modelling report is provided in Appendix I.

The design basis for the engineered cover included:

- Improving current cover performance
- Reducing net percolation to 10% or less
- Final surface able to sustain tussock grassland PMLU

- Target a store-and-release design due to the hot arid climate
- Use material available on site (rather than synthetic barriers such as HDPE)
- Prioritising use of site material over import of material from off-site sources

Water balance and solute transfer/salt dynamic models were developed to support the vadose modelling required to determine the net percolation of various cover material combinations. 1D SEEP/W transient flow analysis was used to model the six different cover scenarios shown in Table 6-2.

The model was run assuming no vegetation which is a conservative approach as vegetation will increase evapotranspiration and subsequently reduce infiltration. The model was set up for 3650 days (10 years) and four hours increments (21,900 steps) were used to run the model (Mine Earth, 2025b).

The base material refers to the existing material below the clay lined base of the TSF. The compacted clay layer parameters (soil characteristics, compaction equipment employed, strength of underlying materials, etc.) were estimated and these will require verification prior to construction.

Compacted clay at a thickness of 0.3 m was deemed a sufficient thickness for a cover. When the thickness was modelled at 0.5 m, there was only a minor net percolation reduction achieved as shown in Table 6-2. The thickness of the material layer in the cover system is not as significant in reducing net percolation as the properties and constructability of the materials (Mine Earth, 2025b).

Table 6-2: TSF cover model scenarios

Scenario name	Base material (m)	Compacted clay (m)	Borrow pit material (m)	Waste rock material (m)	Existing tailings over material (m)	Growth media[1] (m)
0.5CCL+1.5BM+0.2GM	5	0.5	1.5			0.2
0.3CCL+1.5BM+0.2GM	5	0.3	1.5			0.2
0.3CCL+1BM+0.2GM	5	0.3	1			0.2
0.3CCL+1WR+0.2GM	5	0.3		1		0.2
0.3CCL+1TC+0.2GM[2]	5	0.3			1	0.2

Notes: 1. The growth media thickness may reduce once final construction materials have been identified and further assessed.
2. Existing cover system used as baseline in model

The results from the modelling found that all scenarios except the existing cover system achieve a net percolation less than the targeted 10%, as shown in Table 6-3.

Table 6-3: Average annual water balance component of all modelled scenarios

Scenario name	Rainfall[1] (mm)	Infiltration (mm)	Evaporation[1] (mm)	Runoff / Ponding (mm)	Net percolation (%)
0.5CCL+1.5BM+0.2GM	411	36.4	252.6	121.9	4.60%
0.3CCL+1.5BM+0.2GM	411	39.6	250.2	212.1	5.57%
0.3CCL+1BM+0.2GM	411	41	249	121	6.36%
0.3CCL+1WR+0.2GM	411	13	264.8	133.2	1.56%
0.3CCL+1TC+0.2GM[2]	411	79	266.7	65.3	15.49%

Notes: 1. Average rainfall data for analyses period (1981, 1984, 2004-2006, 2008-2010, 2012 and 2013); refer Mine Earth (2025b) for further information.
2. Existing cover system used as baseline in model

The material from the WRD outperforms all other cover scenario analyses with net percolation as low as 1.56%. By replacing the cover, there is at least a 50% reduction in the seepage as indicated by the analysed cover scenarios.

Salinities in cover material including tailings were very low and are not likely to affect vegetation growth. This is evidenced by the existing vegetation on the exposed eastern cell, visible during field sampling, in aerial imagery, and also the soil profile description recording 'abundant root growth' (Mine Earth, 2025a).

The embankments will be shaped to accommodate the required cover design once this has been refined and confirmed.

Information on TSF revegetation is provided in Section 6.6.

6.3 LANDFORM AND COVER DESIGN

Two main landforms have been constructed at THGM: the TSF (including decant pond) and the WRD. It is not confirmed whether the current WRD configuration will remain or whether material will be required for TSF capping. If WRD material is utilised, the remaining WRD landform will be reprofiled to match or improve existing slope angles and geometries, include a 2m cover over exposed sections, tie into the existing topography, and maintain existing drainage paths wherever possible.

The following section considers the landform design and cover system for the TSF.

Landform design was undertaken for both structures when the initial rehabilitation activities occurred (~1995), and the rehabilitated structures have persisted in a safe and structurally stable state since this time. Both areas are well-vegetated in a manner which is consistent with, and becoming integrated into, the surrounding vegetated landscape.

The 'landform design' requirements outlined by the PRCP guidelines (DES, 2023) are intended to explore and predict future landform stability to ensure long-term acceptable performance of landform features.

These requirements are not relevant to the THGM context, given there are no new landforms to be designed, placed or rehabilitated. As such, the requirements of the PRCP guideline as they relate to landform design are not considered to be applicable and have not been considered further.

Cover design specific to the TSF is provided in Section 6.2.1.

6.4 MINE WASTE

Section 2.4.5 provides the background to THGM waste material sampling, characterisation, and storage. The bulk of the waste materials have already been placed when the site was active, almost 30 years ago. The remaining active areas are limited to part of the TSF. The residue tailings material within the TSF is being relocated offsite, therefore there are no specific handling or placement requirements for the management and mitigation of waste streams at Tick Hill.

Capping requirements for the TSF have been outlined in Section 6.2.

6.5 SOIL AND CAPPING MATERIAL ASSESSMENT

An understanding of media suitability (quantity and quality of materials) is required to plan for closure activities and rehabilitation material characterisation was undertaken in 2024 (Mine Earth, 2025a). This report is also provided in Appendix B.

As the site approaches closure, the rehabilitation material inventory and balance will be reviewed to refine and confirm alignment with proposed rehabilitation activities occurring. Additional sampling may be completed to confirm or improve understanding of the quality of materials. This will ensure selection of the best source of growth media and capping materials for rehabilitation, while optimising the location of material. This will also confirm the quality and quantity of materials to provide additional assurance of rehabilitation success.

The areas requiring rehabilitation include the TSF (capping and revegetation), minor infrastructure and access tracks (revegetation) subject to infrastructure retention agreement with MDH and THM.

6.5.1 REHABILITATION MATERIAL CHARACTERISTICS

This section provides the findings from several material characterisation investigations, with the topsoil stockpile and potential borrow locations shown in Figure 6-3.

Information on the rehabilitation material balance is provided in Section 6.5.2.

6.5.1.1 GROWTH MEDIA

Growth media stockpiled on the TSF western cell consists of approximately 14,400 m^3. The material was sampled and analysed in 2023 and 2024 and was summarised as:

- pH indicates that soils are moderately alkaline, with values above pH 8 for all sites
- Predominantly single grained soil with up to 40% coarse rock material, clay content up to 29%
- Non-sodic (ESP was low for all samples) indicating the soils are not dispersive
- Low concentrations of plant-available nutrients and organic carbon, similar to analogue soils
- Classified as non-saline
- Cation exchange capacity at the high end of the desirable range
- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance, within the range measured for the analogue soils
- Less than 5 mg/kg cyanide for all samples
- Field observations indicate the stockpiled topsoil material supports the growth of local vegetation.

Further rehabilitation material balance information is provided in Section 6.5.2.

6.5.1.2 SUBSOIL (STORE AND RELEASE) MATERIAL

It is proposed to install a store and release-type TSF cover including a 1-1.5 m layer of material over a compacted clay layer as described in Section 6.2.1. The source for this material includes the WRD, Decant Pond cover and embankment material, plus borrow material from either the northern or southern borrow pits. Information on these various potential rehabilitation material sources is provided below.

Waste rock material

- Single grained to weakly aggregated oxide waste rock with variable coarse competent rock content

- Substantial variability in the texture of the soil sized fraction, with clay content ranging from 2% to 24%
- Samples classified as non-sodic or sodic, with potential for partial clay dispersion in some samples
- Variable hydraulic conductivity (at the measured 95% MDD), with drainage classifications of 'extremely slow' to 'very rapid'
- Variable soil water retention characteristics, field capacity and plant-available water content of the soil sized fraction (>2mm) ranging from low to moderate
- Classified as non-saline. Soil pH classified as strongly alkaline
- Low concentrations of plant-available nutrients and organic carbon, similar to analogue soils
- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance, within the range measured for the analogue soils.
- Field observations indicate the waste rock supports the growth of local vegetation.

Decant cover material

- Weakly structured to single grained oxide waste rock material with a loose consistence and up to 70% coarse fragment content
- Variable sodicity, ranging from non-sodic to highly sodic. High propensity for clay dispersion
- Drainage classifications (at 95% MDD) of 'very slow' to 'extremely slow'
- Moderate field capacity and plant-available water content
- Classified as slightly saline. Soil pH classified as strongly alkaline
- Low concentrations of plant-available nutrients and organic carbon, similar to analogue soils
- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance, within the range measured for the analogue soils
- Field observations indicate the decant cover material supports the growth of local vegetation.

Decant embankment material

- Weakly structured soil with a loose consistence, approximately 20% clay and 40% coarse fragments
- Minor propensity for clay dispersion upon severe disturbance
- Drainage classification (at 95% MDD) of 'extremely slow'
- Moderate field capacity and plant-available water content
- Field observations indicate the decant embankment material supports the growth of local vegetation.

Borrow area material

- Single grained to massively structured sandy clay material (up to 22% clay) with variable coarse fragment content, up to 31%
- Non-sodic, with a low propensity for clay dispersion
- Drainage classification (at 95% MDD) of 'extremely slow'
- Moderate field capacity and plant-available water content
- Classified as non-saline. Soil pH classified as neutral
- Low concentrations of plant-available nutrients and organic carbon, similar to analogue soils
- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance, within the range measured for the analogue soils
- Field observations indicate the potential borrow material supports the growth of local vegetation

The characterisation assessments above demonstrate the findings that materials sampled as part of 2024 investigation were considered a valuable source of potential rehabilitation / cover materials for use in mine closure (Mine Earth, 2025a).

6.5.1.3 LOW PERMEABILITY LAYER FOR CAPPING

A low permeability layer is proposed in the TSF cover design (Section 6.2.1). This layer is based on material with a higher clay percentage – such as that found in the borrow pit areas (up to 22% clay). Once placed, it is intended that the clay layer be compacted by the operating machinery at the time. Further refinement of compaction requirements will be required with the TSF cover final design to be completed prior to construction.

In order of preference, the following potential material locations have been identified:

- Northern borrow area – previously opportunistically stripped for clay materials used to construct the Decant and TSF. Recent testing suggests material still contains up to 29% clay increasing with depth
- Southern borrow area – also understood to have been utilised as a suitable source of natural clay materials in the past. Recent testing suggests material still contains up to 29% clay increasing with depth
- Decant pond – previously constructed clay core dam wall structure as a potential source of clay material. An estimated total of 15,000 m^3 is available however cross-contamination with decant pond material may have occurred to a level that is deemed unusable. Further investigation will be undertaken once a final cover design is confirmed.

6.5.1.4 SUITABILITY OF SOILS TO SUPPORT PMLU OUTCOMES

The suitability of growth media materials to support the establishment of native plant or grazing species has been assessed. This has considered a range of common plant nutrition indicators, with sufficiency criteria developed from a range of reference texts against which the growth media quality was investigated. It is also noted that in the arid surrounds of THGM, it is common to have undisturbed environments with skeletal or minimal topsoil (<100 mm).

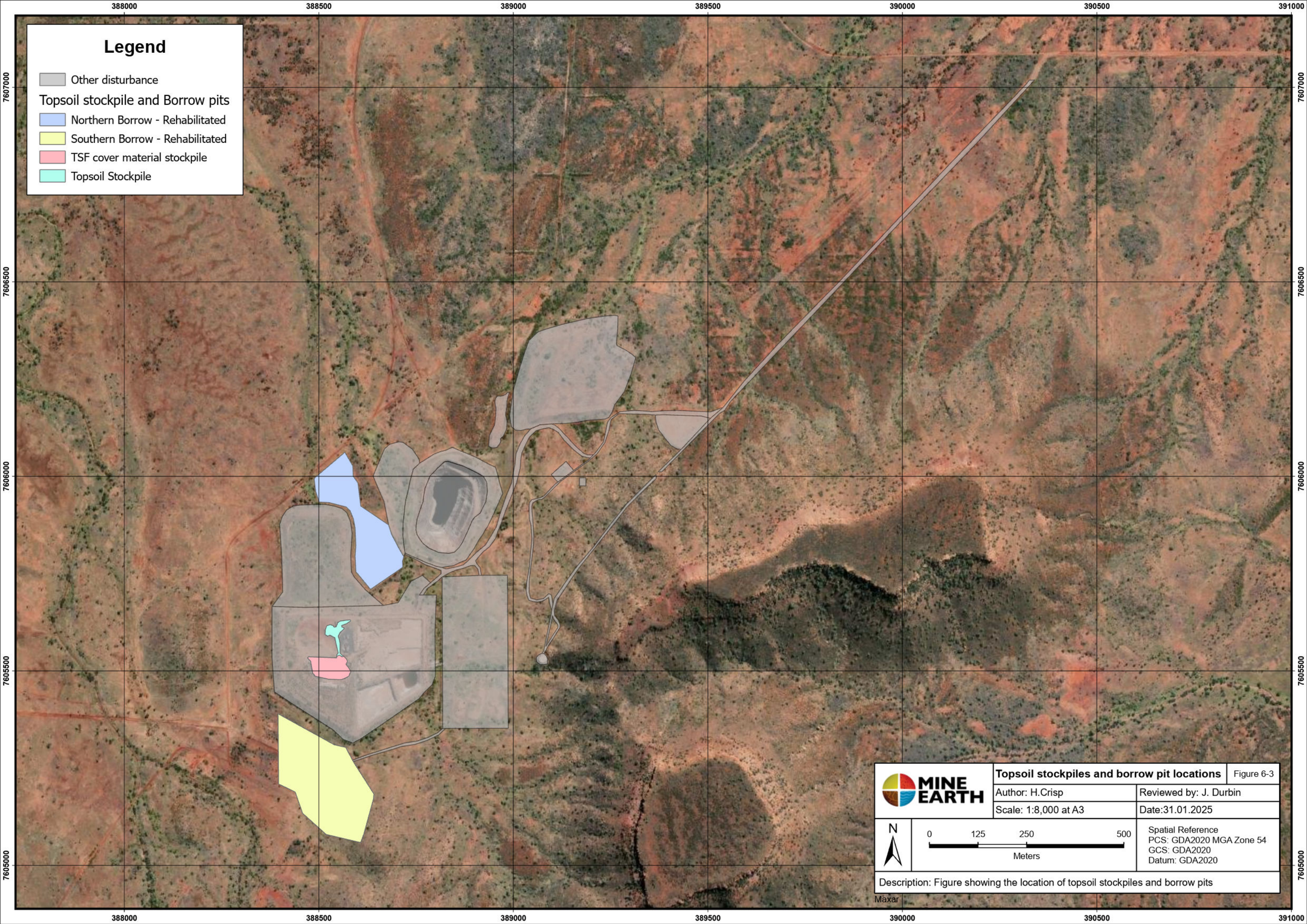
As such, it is considered that topsoil is not essential to ensuring rehabilitation success for the proposed PMLUs. Review of the suitability of capping materials will occur immediately prior to rehabilitation works, by an appropriately qualified person, and may require additional sampling to confirm suitability for the intended use.

6.5.1.5 NEED FOR AMELIORANTS AND FERTILISERS

Growth media materials stockpiled for use do have some quality limitations but are generally acceptable for use as is. Given that the cation exchange capacity (and saturation rates for Ca and Mg) are at the higher end of the range, fertiliser application are not likely to improve plant response. It is considered that the current nutrient status is approaching potential fertility for the bioregion.

The addition of organic material (e.g., hay mulch) may be worthwhile, however it is noted that the presence of a grassy cover crop, and high biomass annual and perennial grass species in the seed mixture, would likely bolster organic carbon anyhow. Use of top surface/growth media materials from borrow areas (which incorporate the ground vegetation also stripped) are also likely to improve additional organic material.

Review of the required ameliorants and fertilisers for each rehabilitation area, and borrow source, will occur immediately prior to rehabilitation works, by an appropriately qualified person. This may require some additional sampling to confirm the suitability of material for their intended use as a growth media or capping material.


Legend
Other disturbance
Topsoil stockpile and Borrow pits
Northern Borrow - Rehabilitated
Southern Borrow - Rehabilitated
TSF cover material stockpile
Topsoil Stockpile
388000
388500
389000
389500
390000
390500
391000
7607000
7606500
7606000
7605500
7605000
MINE EARTH
Topsoil stockpiles and borrow pit locations
Figure 6-3
Author: H.Crisp
Reviewed by: J. Durbin
Scale: 1:8,000 at A3
Date:31.01.2025
N
0
125
250
500
Meters
Spatial Reference
PCS: GDA2020 MGA Zone 54
GCS: GDA2020
Datum: GDA2020
Description: Figure showing the location of topsoil stockpiles and borrow pits
Maxar

6.5.2 REHABILITATION MATERIAL BALANCE

A preliminary soil resource inventory has been developed to provide an indicative volume of topsoil and subsoil (store and release) materials likely to be available for salvage from the previously disturbed areas. The volumes have been calculated based on the information derived from the soil survey conducted, aerial and landscape photography, site topography and the conceptual project disturbance layout, and include a 10% soil loss factor during salvage / stockpiling operations.

The disturbance area requiring a growth media layer across the site is 12.5 ha. Placing topsoil at 100 mm depth will require a volume of approximately 25,000 m^3. Utilising material won from other areas such as the borrow material location will provide sufficient material to adequately provide a topsoil/growth media layer on all areas to be rehabilitated.

It should be noted that this is a conservative calculation as access tracks and laydown areas only require ripping and seeding as it is likely there is some residual *in-situ* topsoil or subsoil material remaining on surface. This approach has been used successfully for previous infrastructure areas rehabilitated on the site.

A nominal stripping depth of 0.2 m was utilised for topsoil calculations and a nominal salvage depth from 0.2 to 1.0 m for subsoil (store and release). Clay material from the borrow areas is assumed to be salvaged from a depth of 1.0 to 1.5 m. At this time it is not planned to disturb previously undisturbed areas to access rehabilitation material.

Competent rock material is not required in closure current rehabilitation activities, however there is a considerable volume within the WRD if this material was required.

The inventory has considered use of borrow material for the TSF capping material as all materials (growth media, store and release material, and clay material) are all available in these two locations. Additionally, the borrow areas are preferred as it is estimated that they contain a greater volume of clay material than other areas.

This rehabilitation material balance will be updated as the Project footprints are finalised and the actual volume of topsoil salvaged from each disturbance area is identified. This should then be updated within the inventory and balanced against the volume of soil required for rehabilitation works, to facilitate optimal application of soil resources to rehabilitation areas. Table 6-4 provides a summary of the rehabilitation material balance and Table 6-5 presents the material requirements. Further information on the material characterisation is provided in Appendix B. Information on rehabilitation material requirements regarding the TSF cover are provided in Section 6.2.1 and Appendix I.

Table 6-4: Rehabilitation material available

Feature	Approximate area available (ha)	Topsoil volume (m^3) [1]	Subsoil material (m^3)[2]	Clay material (m^3)[3]	Potential growth media (m^3)[4]
Borrow Pits (northern and southern)	7.8	14,040	56,160[5]	35,100	42,120
Decant Pond	5	9,000	9,000	13,500	27,000
Tailings cover[6]	8	14,400	0	0	43,200
Waste Rock	6.9	12,420	55,200	0	37,260
Total	**27.9**	**49,860**	**127,600**	**48,600**	**149,580**

1. Assumes average topsoil salvage depth of 0.2m and 10% soil loss factor during salvage / stockpiling operations.
2. Additional subsoil material available if required, assumes average subsoil salvage depth of 0.2 to 1.0 m and 10% soil loss factor during salvage / stockpiling operations
3. Assumes salvage depth of 1.0-1.5 m and 10% soil loss factor during salvage / stockpiling operations.
4. Based on 1:2 ratio of topsoil:subsoil material
5. Additional material is available laterally and/or at depth
6. Includes blend of topsoil and upper-layer tailings cover material

Table 6-5: Rehabilitation material required

Feature requiring rehabilitation	Area (ha)	Growth media (m^3)	Store and release cover material (m^3)	Clay material (m^3)
TSF	8	16,000	120,000	24,000
Roads and tracks	3.5	7,000	0	0
Infrastructure	1	2,000	0	0
TOTAL	**12.5**	**25,000**	**120,000**	**24,000**

6.6 REVEGETATION

A plan for revegetation is summarised in this section and is focused on the remaining disturbed areas at THGM, where rehabilitation (and revegetation) activities are required.

6.6.1.1 REVEGETATION OBJECTIVES

The revegetation objective at THGM is to establish self-sustaining ecosystems that achieve their respective PMLUs. The goals for revegetation at THGM are:

- Rehabilitated areas support revegetation of plant species known to occur on similar landforms and on similar soils
- Local native species are preferred for revegetation
- Vegetation is sustained after rehabilitation and closure activities are completed
- Grazing capacity of the post-mining land area is the same or better than the surrounding grazing areas.

6.6.1.2 PLANT SPECIES SELECTION

For the areas to be revegetated at THGM, both pasture plant species and native understory species that are considered appropriate for use. It is noted that all infrastructure areas are to be returned to a Grazing Native Vegetation PMLU, and as such, pasture species are preferrable. In addition, the areas requiring revegetation to a Native Vegetation PMLU at THGM is limited to the TSF, and for this location, seeding of tree and shrub species is not desirable due to potential negative impact on the cover system. For this area, a mixture of pasture and native understorey species are preferred.

The selection of suitable flora species has considered regulatory constraints relevant to the site, the surrounding land use, and the capacity of the available growth media resources at the time of revegetation to support the selected species. It will allow for a resilient vegetation adapted to the conditions, while providing habitat and grazing values.

Table 6-6 presents a list of preferred plant species used in revegetation. It is intended that THGM will consider this list as options to be selected from, to make up an intended seeding rate of ≥ 5 kg/ha.

Table 6-6: Seed Mix for THGM

Post-mining Land-Use	Rehabilitation Areas	Scientific Name	Common Name	Vegetation Type
Low-intensity grazing	RA2, RA3, RA4, RA5	*Acacia cambagei*	Gidgee	Tree
		Acacia chisholmii	Chisholm's Wattle	Shrub
		Acacia excelsa subsp. angusta	Ironwood	Tree
		Acacia ligulata	Sandhill Wattle	Shrub
		Atalaya hemiglauca	Whitewood	Tree
		Corymbia aparrerinja	Ghost Gum	Tree
		Corymbia terminalis	Bloodwood	Tree
		Eucalyptus leucophloia	Snappy Gum	Tree
		Eucalyptus leucophylla	White-leaf Mallee	Shrub/Small Tree
		Grevillea striata	Beefwood	Tree
		Ventilago viminalis	Supplejack	Shrub/Small Tree
		Atriplex spp.	Saltbush	Shrub
		Salsola kali	Soft Roly-poly	Shrub
Low-intensity grazing and Tussock Grassland	RA1, RA2, RA3, RA4, RA5	*Aristida contorta*	Bunched Kerosene Grass	Grass
		Astrebla elymoides	Hoop Mitchell Grass	Grass
		Astrebla lappacea	Curly Mitchell Grass	Grass
		Astrebla pectinata	Barley Mitchell Grass	Grass
		Astrebla squarrosa	Bull Mitchell Grass	Grass
		Bothriochloa ewartiana	Desert Bluegrass	Grass
		Cenchrus ciliaris	Buffel Grass	Grass
		Chrysopogon fallax	Golden Beard Grass	Grass
		Dichanthium sericeum	Queensland Bluegrass	Grass
		Echinochloa esculenta	Japanese/Shirohie Millet	Grass
		Enneapogon spp.	Bottlewasher Grass	Grass
		Eulalia aurea	Silky Browntop	Grass
		Iseilema spp.	Flinders Grass	Grass
		Panicum decompositum	Native Millet	Grass
		Stylosanthes scabra	Stylo	Grass
		Themeda triandra	Kangaroo Grass	Grass
		Triodia pungens	Spinifex	Grass
		Urochloa mosambicensis	Sabi Grass	Grass
		Boerhavia schomburgkiana	Tar Vine	Forb
		Calotis spp.	Daisy Burrs	Forb
		Glycine falcata	Native Glycine	Forb
		Indigofera spp.	Indigos	Forb
		Ipomoea lonchophylla	Cow Vine	Forb

Post-mining Land-Use	Rehabilitation Areas	Scientific Name	Common Name	Vegetation Type
		Malvastrum americanum	Malvastrum	Forb
		Medicago spp.	Burr Medic	Forb
		Psoralea tenax	Emu Foot	Forb
		Solanum esuriale	Potato Bush	Forb

6.6.1.3 REVEGETATION ACTIVITIES

The steps to revegetating all disturbed areas, except the TSF surface, are as follows:

- Complete general earthworks and erosion structures in the area to be revegetated
- Place growth media at a depth of ≥100mm where material is available
- Shallow ripping completed at a depth of greater than 100 mm on all areas requiring revegetation except TSF. The TSF is to be ripped at no more than 100 mm to reduce potential damage to the cover system
- Seeding using the seed mixes outlined in Section 6.6.1.2 and presented in Table 6-6

The additional considerations necessary for revegetating the TSF surface are provided in Section 6.6.1.4.

6.6.1.4 TSF REVEGETATION

Revegetation of the TSF is as per Section 6.6.1.3, however growth media depth would preferentially be 100 – 200 mm depth. Additionally, and importantly to maintain the integrity of the engineered cover system, it is proposed that the TSF area is revegetated with only shallow-rooted species – predominantly grasses and forbs, with no tree and shrub species included in the seed mix.

There is a potential for deep-rooted species such as shrubs and trees to reduce integrity of the TSF cover that subsequently promotes infiltration. Grasses are already known to colonise the TSF at THGM, and the further selection of native grass species will support natural colonisation.

Additionally, and to maintain integrity of the engineered cover, shallow ripping at no more than 100 mm depth, will be undertaken following placement of the capping material. Seeding will take place after this.

6.7 UNDERGROUND

Infrastructure and activities to support underground mining at THGM occurred in a region to the north-west of the residual void and commenced in 1992 with the installation of a ventilation shaft. This shaft was blind drilled from surface to 250 m depth, with a finished diameter of 2.6m. Once drilling and lining was completed, the shaft was equipped with a ladderway and air, water, and drainage lines from the surface to the base depth of the shaft.

Return air circuits were established and supported subsequent development of the underground decline. The surface portal was established 25 m below the surface, off the open cut haul road at the top of the pit. The decline is designed at 4.5 m wide and 4.8m high, with an overall slope of 1.8. The underground stope void is continuous with the base of the open cut pit/ residual void.

As part of closure activities that occurred in 1995, the portal to the underground has been sealed off. Potential access via the base of the pit is also restricted due to the recovery of a 25 m deep pit lake.

Detail of the underground workings is shown in a conceptual site model for THGM provided in Section 2.4.6.5 as Figure 2-16.

6.7.1 REMOVAL AND DECOMMISSIONING OF INFRASTRUCTURE

Given that sealing has already occurred, the portal will be retained as part of the sealing structure. It is also proposed for the vent shaft to be retained, as it is the key mechanism by which the water level in the final void can be managed. These have both been in place 'as is' since 1995 and are located within the NUMA extent.

6.7.2 SURFACE IMPACTS

No ground subsidence has been evident over the area mined, which consists of both the open void and the decline to the north-west. Given that underground mining ceased, and the mine closed in 1995, it is expected that any surface subsidence would be apparent by now. No further ground subsidence is expected at THGM. No water ponding above the underground workings is evident, and there is no apparent impact on stream flows due to THGM.

However, the surface area associated with underground mining has been allocated to a unique rehabilitation area and will be subject to monitoring to verify that no surface impacts (such as subsidence) are occurring prior to relinquishment.

6.7.3 SURFACE CRACKING

It is noted that historical slippages have occurred on the north-western face of the residual void, including a section of the pit crest, due to removal of the crown pillar as part of the underground workings. This has resulted in minor cracking, which is wholly contained within the abandonment bund.

THGM have sought advice from an appropriately qualified geotechnical specialist, with the conclusion that, given that the area is wholly within the current abandonment bund, it poses little risk to the safety of people or animals, and did not warrant intervention (WKG, 2020). This area will be subject to ongoing monitoring to verify that the surface cracking area is following current predictions, prior to relinquishment.

6.7.4 VEGETATION IMPACTS

Subsidence above the underground mining areas has either not occurred, or has not resulted in any direct visual indicators, such as impacts on vegetation. Vegetation cover and composition is observed to be generally similar to outside of the surface areas above the underground workings. Grazing practices are considered more likely to have had a greater impact on vegetation than the underground workings.

6.8 BUILT INFRASTRUCTURE

All remaining infrastructure utilised by THGM will either be decommissioned, demolished, salvaged and/or disposed, except where formally retained by an appropriate stakeholder (e.g., tracks, tanks and pipelines), where it is consistent with the PMLU after the completion of rehabilitation and closure for the site. Demolition planning and execution will be undertaken in accordance with relevant standards, policies and legislation requirements, and will include investigation of the site and surrounding aspects.

All infrastructure is to be decommissioned, removed from the site, and the associated disturbance rehabilitated at closure, unless written approval by landowner/new landowner is obtained. There is an expectation that infrastructure such as pumps, pipelines, bores, tanks, tracks and fences will remain at closure and be handed over to the relevant landholder. However, until the agreement is confirmed and for the purposes of this PRCP, all infrastructure will be rehabilitated. Once infrastructure has been removed, any areas of contamination will be remediated, and the areas will then be revegetated as per the requirements of the PMLU.

7 RISK ASSESSMENT

The objective of the PRCP risk assessment is to identify and assess potential failures or risks that could lead to rehabilitation and closure activities not achieving a stable condition. Consideration has also been given to the risk of management measures proposed for the NUMAs not being effective, resulting in environmental harm. The assessment also provides a framework for mitigating those risks before they become an issue.

7.1 RISK FRAMEWORK

7.1.1 RISK IDENTIFICATION

Risk identification refers to the process of detecting, recognising, and describing sources of risks. Therefore, characterising potential hazards, threats or uncertainties that could negatively impact the completion of milestones and affect the success of the post closure and rehabilitation outcomes. Risks identified have also included those that are out of THGM's control such as weather. Once the risks have been identified, potential consequences, flow-on and cumulative effects have been examined.

As the PRCP Guideline states, 'the objective of this step is to create a comprehensive list of risks based on events, which may impede, enhance, delay or accelerate the rehabilitation of land to a stable condition or the potential for environmental harm and inability of a NUMA being safe and structurally stable'.

7.1.2 RISK ANALYSIS

Risk analysis involves the systematic assessment and evaluation of the identified risks to determine their potential impact. The analysis identifies a cause and/or source of risk and a magnitude of consequence. The analysis then helps to prioritize risks based on their significance and provides a basis for decision making and risk mitigation strategies. The analysis finally elaborates on assumptions made to gain a high level of confidence for the risk outcome.

7.1.3 RISK EVALUATION

Once an analysis has been completed for the identified risks, they have been prioritised and managed accordingly. This step involves comparing the level of risk found during the analysis process and using this to determine the need of risk treatment.

7.1.4 RISK TREATMENT

Risk treatment refers to the process of selecting and implementing measures to address and mitigate identified risks. The treatment option has been selected after consideration of multiple factors including cost benefit, regulatory obligations, social responsibility, and protection of the surrounding environment. The PRCP Guideline states, 'the risk treatment step in the risk assessment must detail:

- The reasons for selecting the treatment option;
- Those responsible for the approval and implementation of the plan;
- Proposed actions;
- Resource requirements;
- Performance measures and constraints;
- Reporting and monitoring requirements; and
- Timing and scheduling'.

7.2 RISK ASSESSMENT

The risk assessment refers to the specific rehabilitation and management milestones as proposed within the PRCP schedule. This process has considered how potential risks, controls and events could affect the ability of land being rehabilitated to a stable condition; or being managed as a NUMA.

This has influenced the milestones and milestone criteria, as well as informed the timing and scheduling of activities for the PRCP schedule. The results of the risk assessment are as provided in Table 7-1.

7.3 REHABILITATION TRIALS

THGM rehabilitated the site almost 30 years ago, and hence the successful performance of the rehabilitated areas has been shown through observation and monitoring. Rehabilitation and revegetation processes were actively trialled through on-ground application.

Further dynamic adjustments will be made for the remaining rehabilitation areas, with the benefit of this further experience as to positive practice both from the site, but also from leading practice experience and knowledge of those specialists involved. In addition, the findings from monitoring of completed rehabilitation areas at THGM will inform ongoing rehabilitation practices for the site.

Table 7-1: THGM closure risk assessment

Item No.	Milestone Reference	Identification	Potential risk event/ incident	Cause	Consequence	Likelihood	Current Level of Risk	Treatment Plan (new or improved controls)	Reasons for Selecting Treatment Option	Responsibility	Proposed Actions	Consequence	Likelihood	Level of Residual Risk	Resource Requirements	Performance Measures and Constraints	Reporting and Monitoring	Timing and Scheduling
1	MM1	Maximum extent	Maximum NUMA extent becomes greater than 6ha in size and 70 m in depth exceeding criteria.	Ongoing erosion, extreme flooding event, highwall collapse.	2 - Minor / Short Term Impact	E - Rare	3 Low	Continue to undertake geotechnical review and assessment as needed to inform void stability and capability, triggered in response to changes in pit conditions. Maintain geotechnical observation / monitoring until tenure relinquishment.	Assessment will confirm void stability from a specialist.	THGM	Existing geotechnical assessment confirms that failure/slippage areas are wholly contained within abandonment bund. No anticipated concerns with void stability and capability.	1 - No Impact	E - Rare	1 Low	Appropriately Qualified Person - geotechnical Void and underground designs and details	Geotechnical assessment report	Initial report and ongoing monitoring.	Report before relinquishment and as required monitoring.
2	MM2	Achievement of surface requirements	Sealed underground entry at top of pit subsides, creating an opening to the underground.	Original seal may not meet contemporary standards. Erosion or pit wall failures may cause opening to subside.	2 - Minor / Short Term Impact	C - Possible	8 Moderate	Verification of formerly sealed underground entry at top of pit to confirm suitability of seals, by an appropriately qualified person. Confirmed that sealed underground entry is wholly within NUMA extent, and as such area is restricted.	Verification by an AQP will confirm suitability of seals.	THGM	Arrange specialist to inspect and report on the sealed underground entry for stability, and develop additional control measures if required.	2 - Minor / Short Term Impact	E - Rare	3 Low	Appropriately Qualified Person - geotechnical Void and underground designs and details	Geotechnical assessment report	Initial report and ongoing monitoring.	Report before relinquishment and as required monitoring.
3	MM2	Achievement of surface requirements	Fencing, signage and gates are damaged, or non-existent, causing injury to human, cattle and/or wildlife via falling into pit void.	Fencing is damaged during nearby rehabilitation efforts or access attempts by vehicle or personnel. Gates are left open, other factor e.g, vegetation, animals or weather events damage fencing, signage and gates allowing humans, cattle and wildlife to freely walk into restricted pit void area.	1 - No Impact	D - Unlikely	2 Low	Maintain existing fence, gates and signage around the void. Warning signage posted adjacent to access tracks.	Existing treatment is effective and should be maintained.	THGM	Undertake inspections of fencing, gates and signage, and report and maintain	1 - No Impact	E - Rare	1 Low	Appropriately Qualified Person	Inspection Checklist	Ongoing monitoring on an ad hoc basis, and/or during annual rehabilitation monitoring.	Prior to relinquishment.
4	MM3	Achievement of sufficient improvement	Mine pit water has potential to cause impact to groundwater. Consequently impacting nearby human or ecological receptors.	Seepage or inflow from pit into surrounding groundwater system.	2 - Minor / Short Term Impact	E - Rare	3 Low	ESA completed in 2023 confirms that Pit Void currently acts as a groundwater sink, based on current pit water chemistry and water balance. Also confirmed that pit will continue to act as a groundwater sink under all feasible climate change scenarios. Location of potential impact (base of weathering) also well known and used as a pit level control trigger. No current known nearby receptors.	No further actions required.	THGM	Alert if water is increasing to the base of weathering.	1 - No Impact	E - Rare	1 Low	Qualified surveyor. Database for reporting results.	Report results to Carnaby Resources.	Maintain records.	Annual
5	MM4	Management of crest zone	Geotechnical failure/ slippage. Major structural slope failure causing impacts outside of predicted zone of influence (exclusion / safety fence) and impacting land use or intercepting overland flow from an adjoining watercourse/ floodplain.	Obtain causes of failure modes from geotechnical engineer, e.g. insufficient buttressing, failure along fault plane, etc.	3 - Moderate / Medium Term Impact	D - Unlikely	9 Moderate	Geotechnical review confirmed that pit crest cracking due to removal of the crown pillar from underground workings, and unlikely to result in further failure. Confirm signoff from AQP that design and rehabilitation treatment, including applied safety zone (fenced area), meets design intent and is considered to be geotechnically safe and stable Maintain geotechnical observation / monitoring until tenure relinquishment	Sign-off provides pathway for design intent (including consideration of slope failure) to be met	THGM	Continue geotechnical reviews as needed to inform void stability and capability, triggered by change in pit conditions.	2 - Minor / Short Term Impact	E - Rare	3 Low	Appropriately Qualified Person - geotechnical	Inspection report	Maintain records	As required
6	RM1	Infrastructure decommissioning and removal, Remediation of contaminated land	Temporary infrastructure decommissioning is left behind with potential residual contamination.	Inappropriate handling/disposal of hazardous materials Lack of clarity regarding asset decommissioning prescription Lost opportunities for recycling and reuse	2 - Minor / Short Term Impact	D - Unlikely	5 Low	Identify any infrastructure items requiring special treatment, e.g. process chemicals, hazardous substances, energised assets Waste to be disposed using a legally acceptable option	Plan selected to facilitate comprehensive removal of infrastructure and appropriate waste disposal pathway	THGM	Arrange inspection of areas once removal has taken place to confirm treatment plan has been met	1 - No Impact	D - Unlikely	2 Low	Appropriately Qualified Person	Sign-off by Inspection Agent	Maintain records	As required
7	RM1	Infrastructure decommissioning and removal, Remediation of contaminated land	Unknown contaminated land area not meeting target remediation outcome	Contamination not identified, and/or inadequate contamination clean up.	2 - Minor / Short Term Impact	D - Unlikely	5 Low	No evidence of soil or sediment contamination was observed on site. Ensure capping is sufficient at tailings and the waste facility to stop potential contamination.	Aim to prevent potential contamination liabilities are avoided	THGM	Arrange contaminated land assessment undertaken by an appropriately qualified person, and indicates that contamination unsuitable for the post-mining land use is occurring.	2 - Minor / Short Term Impact	E - Rare	3 Low	Appropriately Qualified Person	Sign-off by Inspection Agent	Maintain records, monitor annually with rehabilitation monitoring.	Prior to relinquishment.
8	RM1	Infrastructure decommissioning and removal, Remediation of contaminated land	Boreholes are not decommissioned/rehabilitated leading to groundwater contamination with fertilisers, pesticides or other pollutants. Abandoned boreholes can also cause a physical hazard to humans and wildlife, and may cause sinkholes in the environment.	Existing boreholes are left unmaintained and/or abandoned.	2 - Minor / Short Term Impact	D - Unlikely	5 Low	All boreholes decommissioned (cut and cap method).	The decommissioning process remove the hazard.	THGM	Arrange to have all boreholes decommissioned (cut and cap method), prior to relinquishment.	2 - Minor / Short Term Impact	E - Rare	3 Low	Drill rig, specialist equipment and people to undertake borehole decommissioning works.	Sign-off and inspection post works.	Completion report	Prior to relinquishment.
9	RM2	Infrastructure retention for handover	Infrastructure is retained without clear no transfer of ownership. There has been no upkeep of infrastructure. Upon relinquishment ensure the agreements are valid.	Lack of agreements.	2 - Minor / Short Term Impact	E - Rare	3 Low	Permanent infrastructure has been removed (except roads and water infrastructure) unless useful and desirable to landowner.	Currently already a process in place.	THGM	Ensure any infrastructure not retained is removed prior to transfer of ownership, except where an agreement is in place. Undertake inspection, any infrastructure that has not been removed must have an agreement in place.	1 - No Impact	E - Rare	1 Low	Appropriately Qualified Person	Sign-off by responsible manager.	Maintain records	Prior to relinquishment.
10	RM4	Installation of cap / cover on tailings dam	Contamination to surrounding environment from insufficient capping of tailings.	Tailings landform design inadequate.	2 - Minor / Short Term Impact	C - Possible	8 Moderate	Modify tailings cover design to prevent infiltration.	Design will be modified to prevent infiltration, thus reducing migration of contaminants to surrounds.	THGM	Modify tailings design to prevent infiltration. Incorporate an LPL into cover for area disturbed.	2 - Minor / Short Term Impact	E - Rare	3 Low	Appropriately Qualified Person - with experience in geochemistry and cover design Quality assurance processes (Surveyor)	Sign-off by an appropriately qualified person	Quality assurance processes (Surveyor) Signoff on completed Tailings Dam rehabilitation.	Once capping of Tailings Dam is complete.
11	RM5	Placement of growth medium	Growth medium quality not suitable for vegetation establishment, revegetation failure or reduced growth Decline in soil structure, nutrient bank and soil biota	Limited pre-existing biological resource Insufficient salvage of topsoil resource Decline in condition of stockpiled resource Incorrect amelioration applied	2 - Minor / Short Term Impact	C - Possible	8 Moderate	Amelioration (fertiliser, pH adjustment) in accordance with laboratory testing results.	Laboratory testing determines amelioration required	THGM	Scope and arrange testing of growth medium at time of rehabilitation . Growth medium placed at a depth of ≥150mm. Soil ameliorants and fertilisers applied as required to address soil limitations identified. Shallow ripping completed at a depth of greater than 100mm after growth medium placement.	2 - Minor / Short Term Impact	E - Rare	3 Low	Appropriately Qualified Person Soil Scientist	Sampling and analysis.	Action any areas that indicate unsuitable amelioration has taken place	As per rehabilitation schedule
12	RM8	Achievement of a stable condition	Downstream water quality is effected by surface runoff quality causing downstream impacts.	Sediment or contaminant migration from mine affected areas, resulting in impact to receiving environment.	2 - Minor / Short Term Impact	E - Rare	3 Low	Appropriate capping of tailings dam and rehabilitation waste rock dump. Revegetation of all surface disturbance areas as per PMLU outcomes. Review of regional and downstream surface and groundwater quality does not indicate any impact or migration of contaminants off site.	Capping and rehabilitation will appropriately manage surface run-off.	THGM	Confirm suitability of tailings capping for reducing infiltration. Have AQP inspect rehabilitation once complete.	1 - No Impact	E - Rare	1 Low	Appropriately Qualified Person As-constructed plan for Tailings Dam.	Sign-off by an appropriately qualified person	Maintain rehabilitation records	Once capping and rehabilitation is complete.
13	RM8	Achievement of a stable condition	Extreme rainfall event, causing rehabilitation failures. Extending relinquishment timing.	Climate change or natural variability	2 - Minor / Short Term Impact	D - Unlikely	5 Low	Maintain rehabilitation monitoring and maintenance program to achieve rehabilitation success criteria. Follow standard design criteria.	Monitoring and maintenance allows for timely correction if required.	THGM	Scope and arrange annual rehabilitation monitoring Action all areas that require maintenance	2 - Minor / Short Term Impact	E - Rare	3 Low	Appropriately Qualified Person	Rehabilitation Monitoring Report	Rehabilitation Monitoring	As required
14	RM8	Achievement of a stable condition	Extended drought, causing revegetation failure, accelerated erosion, and /or wild fire. Extending relinquishment timing.	Climate change or natural variability	2 - Minor / Short Term Impact	D - Unlikely	5 Low	Maintain bushfire management measures, use appropriate species mix, maintain fire breaks around establishing rehabilitation areas. Select drought tolerant native species (preferably sourced locally) within the seed mix.	Plan provides for resilience of site rehabilitation in face of bushfire risk or drought	THGM	Establish vegetation communities that are resilient to drought and fire. Maintain firebreaks.	2 - Minor / Short Term Impact	E - Rare	3 Low	Appropriately Qualified Person	Composition of species within rehabilitated areas Exclusion of fire until the vegetation community is mature	Rehabilitation Monitoring Monitor firebreaks	As required
15	RM8	Achievement of a stable condition	Rehabilitation that is not comparable to analogue monitoring locations (so as to meet criteria).	Impact from stock, pests, weeds, erosion, contaminants or natural disaster.	2 - Minor / Short Term Impact	E - Rare	3 Low	Maintain annual maintenance and monitoring program and implement maintenance or remedial activities as required. Exclude stock from areas where native vegetation is proposed as the PMLU. Manage stocking rates for areas proposed to have a PMLU of grazing.	Ongoing monitoring will identify poorly performing rehabilitation early.	THGM	Implement rehabilitation monitoring	1 - No Impact	E - Rare	1 Low	Appropriately Qualified Person	Sign-off suitably qualified person	Rehabilitation Monitoring	As required

8 MONITORING AND MAINTENANCE

Rehabilitation monitoring for THGM has been previously undertaken irregularly but at intervals that demonstrate progression towards the desired closure outcomes for the site.

No baseline assessments are available to illustrate the initial conditions of the site as mining commenced in the early 90's. The baseline assessment would normally include information on vegetation, soil quality, water quality, and wildlife populations. These data serve as a pre-mining reference point for measuring the success of rehabilitation efforts in future. As an alternative, areas of rehabilitation will be compared to analogue sites.

The primary objective of the rehabilitation monitoring program is to produce concise and targeted rehabilitation datasets using scientifically robust and repeatable methods which demonstrate compliance to the PMLUs and provide evidence that the milestone criteria have been met. Rehabilitation monitoring allows for adaptive management, meaning that the collected data are used to adjust and refine the rehabilitation strategies and techniques. If any issues or challenges are identified through monitoring, appropriate corrective measures can be implemented promptly to ensure the desired outcomes are achieved. The program will demonstrate that the rehabilitation at THGM complies with regulatory requirements and is satisfactory for relinquishment.

8.1 MONITORING METHODOLOGIES

Monitoring will be conducted at various frequencies (depending upon the aspect), and then reducing in frequency as monitoring data demonstrates that the site is on a trajectory towards achieving rehabilitation milestones.

A combination of field-based, desktop and spatial, and post-processing GIS-based rehabilitation monitoring will be used to gain a thorough understanding of the rehabilitation performance in a whole-of-site context. The outcomes of the monitoring will be used to determine the performance of the rehabilitation, in terms of meeting of being on trajectory to achieve milestone criteria.

Rehabilitation areas will be assessed against the milestone criteria and regularly reviewed to determine progress towards achieving relevant criteria and progressing towards the subsequent milestone.

The monitoring will include, but is not limited to, identification and/or assessment of:

- Adequacy and appropriateness of infrastructure decommissioning including mine rubbish and other waste (tyres, bulk containers, etc.)
- Adequacy of constructed TSF cover
- Ecological aspects including weed presence
- Erosion (rill, gully and tunnel) on rehabilitated areas
- Stability and functioning of erosion and sediment control and water management structures
- Groundwater and surface water quality
- Geotechnical stability of pit walls
- Safety hazards

The monitoring events are to be completed by appropriately qualified persons to provide independent appraisal of performance, and to inform aftercare and maintenance activities required for rehabilitated areas.

The timing for all monitoring disciplines is provided in the monitoring schedule provided in Section 8.2.

8.1.1 ECOLOGICAL MONITORING

8.1.1.1 ANALOGUE SITES

Previously used 'Colluvial slope' and 'Plains' reference sites utilised in the 2012/13 rehabilitation BioCondition assessment (SKM, 2013), and shown in Figure 8-1, will be used as a point of comparison to assess ecological performance of the rehabilitated areas with regard to groundcover, productivity, weed proportion, and species mix and composition. BioCondition assessment will continue to be utilised.

8.1.1.2 VEGETATION SURVEY

The discrete point sampling method used in SKM's 1999 and 2013 flora surveys (SKM, 1999; 2013) is proposed as it is quantitative, time-efficient and relatively objective, ensuring repeatability between different operators. Additionally, it will maintain data consistency and improve confidence when analysing and comparing data over time.

Transects previously monitored at the WRD, TSF, mine infrastructure area (plus the two reference locations) will continue to be utilised. At each location three 100 m transects will be set up, and along each transect the following assessment will be undertaken:

- Recorded every 1 m: ground cover percentage (live or dead plant material, or bare ground)
- Recorded every 10 m in a 1 m x 1 m quadrat:
  - Native species frequency and identification recorded
  - Weed species cover percentage plus presence of declared weed species
- Opportunistic sightings of fauna or evidence of fauna presence (scats, tracks, burrows, nests, etc.)

8.1.1.3 BIOCONDITION ASSESSMENT

The Queensland Government BioCondition assessment framework is a simple, rapid assessment approach that evaluates ecosystem health by measuring vegetation structure, species composition, and ecological function against reference sites (Eyre, 2015). The monitoring data is then compared to Queensland Government benchmark data for regional ecosystem in the area; for THGM, this is the Northwest Highlands Regional Ecosystem Technical Descriptions document.

Monitored data is then assessed against this benchmark data and used to inform rehabilitation progression towards achievement of rehabilitation milestones. The rehabilitated areas data will be compared with the reference site data using the benchmarking attributes. It is not expected that all the BioCondition benchmark attributes will be achieved, as the PMLUs for THGM are not a return to native ecosystems; however the rehabilitated areas will be targeting data within an acceptable range of the reference sites.

Ecological monitoring will be undertaken following the end of the wet season when the presence of diagnostic parts (flowers, seeds, etc.) for many grasses, annuals, and other species are optimal for identification.

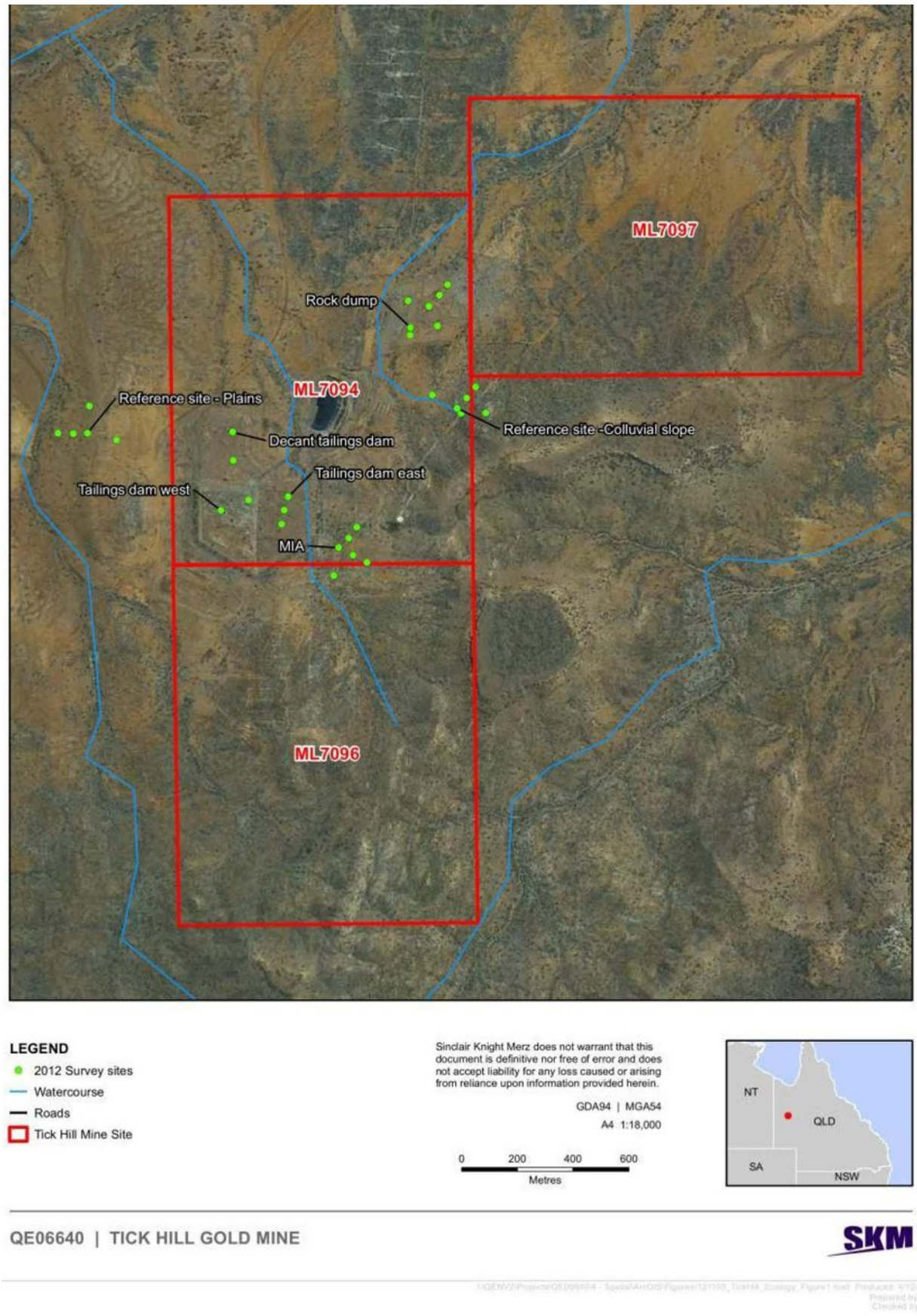


Figure 8-1: Ecological monitoring points (SKM, 2013)

8.1.2 GROUNDWATER MONITORING

Groundwater monitoring will be conducted as per the EA, and will include monitoring of the following 11 bores : THGW001, THGW002, THGW003, THGW004, THGW005, THGW006, THGW007, THGW008, THGW009, Pit Water, and Mine Shaft bore. Location of these bores is shown in Figure 2-10.

Parameters and contaminant limits to be assessed are provided in the EA. In accordance with the EA, all monitoring will be undertaken with the requirements of the latest version of the following documents unless otherwise approved by the administering authority:

- for waters and aquatic environments, the Queensland Government's Monitoring and Sampling Manual 2009 – Environmental Protection (Water) Policy 2009
- for groundwater, Groundwater Sampling and Analysis – A Field Guide (2009:27 GeoCat#6890.1) and Australian Standard AS/NZS 5667.11:1998 Water Quality – Sampling – Guidance on sampling of groundwaters
- for subterranean aquatic fauna, the Guideline for the Environmental Assessment of Subterranean Aquatic Fauna.

Where contaminant limits are not yet determined, data shall be assessed against revised tables provided in the 2023 ESA Groundwater addendum (supporting this PRCP).

8.1.3 SURFACE WATER MONITORING

Surface water monitoring will be undertaken annually following wet season rainfall due to the ephemeral nature of the waterways on site. The monitoring sites consist of the open cut pit and reclaimed TSF footprint for the parameters listed in the EA (as per Condition A24 of the EA).

8.1.4 EROSION MONITORING

Erosion monitoring will be conducted with the ecological monitoring and will be conducted in the following way:

- For newly constructed landforms, monitoring along the 100 m transect used for ecological monitoring will involve recording the presence, state, type, and severity of erosion based on the Australian Soil and Land Survey Field Handbook (NCST, 2024)
- For landforms constructed circa 1994 (WRD, Decant Pond, TSF outer embankments), observational monitoring is proposed during the ecological monitoring.

Rehabilitation monitoring is to be undertaken following the end of the wet season to allow for an accurate assessment of erosion features and an understanding of the movement of water across the rehabilitated landscape following the previous wet season.

8.1.5 GEOTECHNICAL AND SAFETY MONITORING

A geotechnical engineer (or similar appropriately qualified person) will assess the pit wall and constructed landforms following closure and prior to relinquishment for signs of movement that may negatively impact the stability of the features and safety of humans and animals in the areas.

A combination of photographs, satellite imagery, plus existing monitoring equipment (i.e. tell-tale measure) will be used to assess movement as determined at the time.

Safety aspects to be monitored include visual observations of abandonment bund condition, exclusion fence and signage around the pit area.

8.2 MONITORING SCHEDULE

The monitoring program and schedule for THGM is provided in Table 8-1.

It should be noted that the monitoring program may not run its full course if the site achieves the relevant criteria within 15 years, and rehabilitation certification is attained.

Table 8-1: Tick Hill Gold Mine monitoring program and schedule

RM #	Rehabilitation Milestone	Aspect	Monitoring Methodology	Frequency	Contingency / Maintenance	Reporting	Review
RM1	Infrastructure decommissioning and removal, remediation of contaminated land	Infrastructure	Document review of legal agreements for retention of any infrastructure. On site inspection to review: • Confirm removal of agreed infrastructure. • Review and confirm contaminated land status aligns to PMLU and/or landowner agreement • Geotechnical stability of pit walls and constructed landforms • Safety hazards	Annual	• Arrange decommissioning. • Arrange landowner agreement. • Arrange contaminated land assessment. • Investigate non-compliant results as required • Update documentation and mapping as required	Internal	Upon completion of inspection. At formalisation of landowner agreement
		Geotechnical Safety	• Geotechnical stability of pit walls and constructed landforms • Safety hazards	Annual	• Identify and mitigate geotechnical and safety hazards.		
RM2	Minor earthworks and general reshaping	Earthworks	On site inspection to review: • Constructed landform slopes angles • Surfaces are observed to be free-draining (with allowance for minor ponding) • Erosion structures constructed and functioning appropriately	Annual	• Reshape landform to design prior to topsoiling	Internal	Annual
RM3	Installation of cap / cover on tailings dam	Earthworks	• Document / design review • Visual inspection and ground survey following construction	Following TSF cover construction	• Arrange appropriately qualified person to undertake a review of cover system design report and construction report	Internal	Following TSF cover construction
RM4	Placement of growth medium	Revegetation	Visual inspection during or following construction for: • Growth media application • Evidence of ripping	Following construction	• Arrange appropriately qualified person to undertake a review of rehabilitation design including growth media source and mix (if blended with subsoil). • Reapply growth media if deficient	Internal	Following construction
RM5	Revegetation (Low-intensity grazing)	Revegetation	Inspection of revegetated areas for: • Key species germination success • Mean plant frequency • Ground cover (live and dead material) • Presence of declared weeds	Years 1, 3, 6, 10, 15	• Identify cause and reseed if necessary. • Implement weed management.	Internal	Annual
RM6	Revegetation (Tussock grassland)	Revegetation	Inspection of revegetated areas for: • Germination success and presence of shallow-rooted species only • Mean plant frequency • Ground cover (live and dead material) • Presence of declared weeds	Years 1, 3, 6, 10, 15	• Identify cause and reseed and/or remove deep-rooted species as necessary. • Implement weed management. •	Internal	Annual
RM7	Achievement of surface requirements	Revegetation	Inspection of revegetated areas for: • Presence of key native species and shallow-rooted species in relevant target PMLUs • Mean plant frequency • Ground cover (live and dead material) • Presence of declared weeds • Weed cover % • Native fauna evidence/presence	Years 1, 3, 6, 10, 15	• Arrange appropriately qualified person(s) to undertake inspection of rehabilitated areas • Identify cause and reseed and/or remove deep-rooted species as necessary. • Implement weed management.	Internal	Annual
		Water	Review: • Surface water quality at the open cut pit and on the reclaimed TSF footprint comply with nominated criteria. Parameters to be monitored are pH, electrical conductivity, suspended solids, and total cyanide • Groundwater quality at 'THGW001' – 'THGW009' bores plus 'Mine Shaft' (10 locations) comply with nominated criteria. Parameters to be monitored are pH, electrical conductivity, suspended solids, and total cyanide	Years 1, 3, 6, 10, 15	• Arrange appropriately qualified person(s) to review results and/or identify and mitigate potential causes		
		Erosion	• Erosion risk as defined by Australian Soil and Land Survey Field Handbook (NCST, 2024)	Years 1, 3, 6, 10, 15	• Identify erosion cause and remediate impacted area and/or erosion control structures		
		Geotechnical Safety	• Geotechnical stability of pit walls and constructed landforms • Safety hazards	Years 1, 5, 10, 15	• Identify and mitigate geotechnical and safety hazards.		

RM #	Rehabilitation Milestone	Aspect	Monitoring Methodology	Frequency	Contingency / Maintenance	Reporting	Review
RM8	Achievement of a stable condition	Revegetation	Inspection to assess: • Rehabilitated landforms can sustain agreed PMLU Inspection of revegetated areas for: • Presence of key native species and shallow-rooted species in relevant target PMLUs • Mean plant frequency • Ground cover (live and dead material) • Presence of declared weeds • Weed cover % • Native fauna evidence/presence	Years 7, 10, 15	• Arrange appropriately qualified person(s) to undertake inspection of rehabilitated areas. • Identify cause and reseed and/or remove deep-rooted species as necessary. • Implement weed management. • Identify erosion cause and mitigate impacted area and/or erosion control structures. • Identify and mitigate geotechnical and safety hazards.	Internal, administrating authority	Annual
		Water	• Seepage from mining activities is not present beyond ML boundary • Surface water quality at the open cut pit and on the reclaimed TSF footprint comply with nominated criteria. Parameters to be monitored are pH, electrical conductivity, suspended solids, and total cyanide • Groundwater quality at 'THGW001' – 'THGW009' bores plus 'Mine Shaft' (10 locations) comply with nominated criteria. Parameters to be monitored are pH, electrical conductivity, suspended solids, and total cyanide	Years 1, 3, 6, 10, 15	• Arrange appropriately qualified person(s) to review results and/or identify and mitigate potential causes		
		Erosion	• Erosion risk as defined by Australian Soil and Land Survey Field Handbook (NCST, 2024)	Years 1, 3, 6, 10, 15	• Identify erosion cause and remediate impacted area and/or erosion control structures		
		Geotechnical Safety	• Geotechnical stability of pit walls and constructed landforms • Safety hazards	Years 1, 5, 10, 15	• Identify and mitigate geotechnical and safety hazards.		

8.3 REPORTING AND REVIEW

8.3.1 QUALITY ASSURANCE AND DATA MANAGEMENT

All monitoring will be undertaken by appropriately qualified personnel.

Data will be collected for storage in a database and will be reviewed by appropriately qualified personnel and evaluated for the purpose of trending, reporting, and future reference.

8.3.2 REPORTING

Annual rehabilitation monitoring summary reports for internal purposes will be prepared to capture and collate and enable ongoing comparison of the data. These reports will present analyses of monitoring results and assess the rehabilitation progress over time as well as against success criteria.

8.3.3 MONITORING PROGRAM REVIEW

The THGM monitoring program will be reviewed every five years or sooner in response to changes in the PRCP or schedule, the data demonstrate that the milestone criteria are not practical, or changes to the EA.

9 REFERENCES

AMIRA. (2002, May). ARD Test Handbook. Project P387A. Prediction & Kinetic Control of Acid Mine Drainage . Melbourne: AMIRA International. Ian Wark Research Institute. Environmentla Geochemistry International Pty Ltd.

ATC Williams. (2022). *Tick Hill Mine Tailings Reclamation Project - Consequence Category Assessment. Doc. No: 120100.01-R02 Rev 1.* Brisbane: ATC WIlliams.

BOM. (2023). *Climate of Mount Isa*. Retrieved from Bureau of Meteorology: http://www.bom.gov.au/qld/mt_isa/climate.shtml

Carnaby. (2023). *Progressive Rehabilitation and Closure Plan Tick Hill Gold Mine. Vers 1.00 Submitted 1 September 2023.* Brisbane: Carnaby Resources Limited.

Cromer. (2020). *Tick Hill Gold Mine Site Conceptual Hydrogeological Model.* Hobart: William C Cromer Pty Ltd.

DERM. (2012). *BioCondition A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual. Version 2.1.* Brisbane: Queensland Herbarium, Queensland Government, Department of Environment and Resource Management.

DES. (2016). *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures. ESR/2016/1933, March 2016, version 5.01.* Brisbane: Department of Environment and Science (DES), Queensland Government.

DES. (2019, April). Regional Ecosystem Technical Descriptions. Brisbane: Queensland Government, Department of Environment and Science.

DES. (2024, February 19). Decision on request to extend the information response period. *2024.* Brisbane, Queensland: Queensland Government.

DESI. (2022). *Environmental authority EPML00820613. 1 April 2022.* Brisbane: Queensland Government.

DETSI. (2024, April 04). *Statutory guideline. Progressive rehabilitation and closure plan (PRC plans). Version 3.01. 16 September 2024.* Brisbane: Queensland Government. Department of Environment, Tourism, Science and Innovation.

Diatreme. (2017a). *Tick Hill Gold Project Plan of Operations Care and Maintenance. 1 July 2018 to 30 June 2020.* Cairns: Diatreme Resources Limited.

Diatreme. (2017b, September 19). *RE: Financial Assurance for Environmental Authority EPML00820613.* Cairns: Diatreme Resources Limited.

DSDMIP. (2019). *North West Queensland Economic Diversification Strategy.* Brisbane: State of Queensland, Department of State Development, Manufacturing, Infrastructure and Planning.

DSITI & DNRM. (2015). *Guidelines for agricultural land evaluation in Queensland (2nd edn). Queensland Government (Department of Science, Information Technology and Innovation and Department of Natural Resources and Mines), Brisbane, Queensland.* Brisbane: Queensland Government

(Department of Science, Information Technology and Innovation and Department of Natural Resources and Mines).

EES. (2023). *Environmental Site Assessment – Tick Hill Gold Mine, QLD. 13 July 2023. 722092. Version 1*. Brisbane: Environmental Earth Sciences.

EES. (2024). *Hydrogeological Model: Tick Hill Gold Mine, Qld. 724050. Version 0.1*. Brisbane: Environmental Earth Sciences.

Envirofin. (2020). *Tick Hill Tailings Reclamation Project. EA Amendment Application Supporting Information. CR0002v2. 10 August 2020.*

Eyre, T. K. (2015). BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual. Version 2.2. . Brisbane, Qld, Australia: Queensland Herbarium, Department of Science, Information Technology, Innovation and Arts. .

Google Earth. (2024, September). Google Earth Pro (Version 7.3.6.9796) [Software]. Google LLC. https://earth.google.com/. Google Earth.

Hutton, L. J., Denaro, T. J., Dhnaram, C., & Derrick, G. M. (2012). Mineral Systems in the Mount Isa Inlier.

INAP. (2018). Global Acid Rock Drainage Guide (GARD Guide). International Network for Acid Prevention (INAP).

Laing, W. (1992). *The metasomatic development of the quartz-feldspar laminate gold host rock at Tick Hill, Illustrated. Report to MIM Exploration Pty Ltd., ISAMISREP.010; Record No. 30862, Mt Isa exploration office.* Mount Isa.

Le, T. X., Dirks, P. H., Sanislav, I. V., Huizenga, J. M., Cocker, H. A., & Manestar, G. N. (2021). Geological setting and mineralization characteristics of the Tick Hill Gold Deposit, Mount Isa Inlier, Queensland, Australia. *Ore Geology Reviews*, Volume 137.

Lewins, J. (1993). *Tick Hill Gold Mine Development and Operation; Carpentaria and Mt Isa Regional Development Forum AUSIMM, dated August 1993.* Mount Isa: AusIMM.

Mine Earth. (2025a). *Tick Hill Gold Mine - Material Characterisation*. Perth: Mine Earth.

Mine Earth. (2025b). *Tick Hill TSF Cover Modelling Report*. Perth: Mine Earth.

NCST. (2024). *Australian Soil and Land Survey Field Handbook. Fourth Edition*. Melbourne: CSIRO - National Committee on Soil and Terrain.

QRA. (2012). *Interim Floodplain Assessment Overlay for the Georgina River Sub-Basin v1.0*. Queensland Reconstruction Authority. Produced for the Department of Environment and Resource Management.

Queensland Government. (2010). *North West Regional Plan planning for a stronger, more liveable and sustainable community*. Brisbane: Queensland Government.

Queensland Government. (2017). *A Strategic Blueprint for Queensland's North West Minerals Province: supporting strong and prosperous regional communities*. Brisbane: Queensland Government.

Queensland Government. (2024, September 24). *Search regional ecosystem descriptions*. Retrieved from Queensland Government: https://apps.des.qld.gov.au/regional-ecosystems/

Scott. (2020). *Tailings Environmental Geochemistry Review. Supporting Document for Environmental Authority EPML00820613 Amendment.* Brisbane: PA Scott Consulting .

SKM. (1999). *Tick Hill Rehabilitation Survey. Flora and Fauna Survey.* Townsville.

SKM. (2013). *Tick Hill Gold Project – Interim Rehabilitation Report (Rev1). April 2013.* Brisbane: SKM.

Tedman-Jones, C. (2001). *Tick Hill core relogging review (Internal report to MIM Exploration Pty Ltd. Misc.2001/010, Record No. 30764). Mount Isa Exploration Office*. Mount Isa.

WKG. (2020). *Tick Hill Geotechnical Pre-Feasibility Study for Carnaby Resources Limited. PRJ008. July 2020*. WK Geotechnical (WKG).

APPENDICES

APPENDIX A PRCP SCHEDULE

Post-mining land uses (PMLU)						
Rehabilitation area				RA1		
Relevant activities				Tailings Storage Facility		
Total rehabilitation area size (ha)				12.3		
Commencement of first milestone: RM1				1/04/2027		
PMLU				Tussock grassland		
Date area is available	10/12/26	10/12/28	10/12/33	10/12/xxxx	10/12/xxxx	10/12/xxxx
Cumulative area available (ha)	12.3	12				
Milestone completed by	10/12/28	10/12/33	10/12/38	xx/xx/xxxx	xx/xx/xxxx	xx/xx/xxxx
Milestone Reference	**Cumulative area achieved (ha)**					
RM1	12.3					
RM2	12.3					
RM3	12.3					
RM4	12.3					
RM6		12.3				
RM7			12.3			
RM8			12.3			

Post-mining land uses (PMLU)						
Rehabilitation area				RA2		
Relevant activities				WRD and TSF Decant Pond		
Total rehabilitation area size (ha)				11.8		
Commencement of first milestone: RM1				10/12/2026		
PMLU				Low-intensity grazing		
Date area is available	10/12/26	10/12/28	10/12/33	10/12/xxxx	10/12/xxxx	10/12/xxxx
Cumulative area available (ha)	11.8	11.8				
Milestone completed by	10/12/28	10/12/33	10/12/38	xx/xx/xxxx	xx/xx/xxxx	xx/xx/xxxx
Milestone Reference	**Cumulative area achieved (ha)**					
RM7	11.8					
RM8			11.8			

Post-mining land uses (PMLU)						
Rehabilitation area				RA3		
Relevant activities				Infrastructure		
Total rehabilitation area size (ha)				15.8		
Commencement of first milestone: RM1				10/12/2026		
PMLU				Low-intensity grazing		
Date area is available	10/12/26	10/12/28	10/12/33	10/12/xxxx	10/12/xxxx	10/12/xxxx
Cumulative area available (ha)	15.8	15.8	15.8			
Milestone completed by	10/12/28	10/12/33	10/12/38	xx/xx/xxxx	xx/xx/xxxx	xx/xx/xxxx
Milestone Reference	**Cumulative area achieved (ha)**					
RM1	15.8					
RM2	15.8					
RM4	15.8					
RM5		15.8				
RM7			15.8			
RM8			15.8			

Post-mining land uses (PMLU)						
Rehabilitation area				RA4		
Relevant activities				Roads, tracks		
Total rehabilitation area size (ha)				3.5		
Commencement of first milestone: RM1				10/12/2026		
PMLU				Low-intensity grazing		
Date area is available	10/12/26	10/12/28	10/12/33	10/12/xxxx	10/12/xxxx	10/12/xxxx
Cumulative area available (ha)	3.5	3.5	3.5			
Milestone completed by	10/12/28	10/12/33	10/12/38	xx/xx/xxxx	xx/xx/xxxx	xx/xx/xxxx
Milestone Reference	**Cumulative area achieved (ha)**					
RM1	3.5					
RM2	3.5					
RM4	3.5					
RM5		3.5				
RM7			3.5			
RM8			3.5			

Post-mining land uses (PMLU)						
Rehabilitation area				RA5		
Relevant activities				Exploration, decline and underground workings		
Total rehabilitation area size (ha)				1.7		
Commencement of first milestone: RM1				10/12/2026		
PMLU				Low-intensity grazing		
Date area is available	10/12/26	10/12/28	10/12/33	10/12/xxxx	10/12/xxxx	10/12/xxxx
Cumulative area available (ha)	1.7	1.7				
Milestone completed by	10/12/28	10/12/33	10/12/38	xx/xx/xxxx	xx/xx/xxxx	xx/xx/xxxx
Milestone Reference	**Cumulative area achieved (ha)**					
RM1	1.7					
RM2	1.7					
RM4	1.7					
RM5	1.7					
RM7		1.7				
RM8			1.7			

Non-use management areas						
Improvement area				RA1		
Relevant activities				Residual Void NUMA (void and surrounds including abandonment bund)		
Total rehabilitation area size (ha)				5.8		
Commencement of first milestone: MM1				10/12/2026		
NUMA				Residual void		
Date area is available	10/12/25	10/12/26	10/12/33	10/12/xxxx	10/12/xxxx	10/12/xxxx
Cumulative area available (ha)	5.8	5.8				
Milestone completed by	10/12/26	10/12/33	10/12/38	xx/xx/xxxx	xx/xx/xxxx	xx/xx/xxxx
Milestone Reference	**Cumulative area achieved (ha)**					
MM1	5.8					
MM2		5.8				
MM3			5.8			
MM4			5.8			

Milestone r	Rehabilitation milestone	Milestone criteria
RM1	Infrastructure decommissioning and removal, remediation of contaminated land	(a) With the exception of any infrastructure to remain as part of the post-mining land use (PMLU) or where infrastructure is agreed to be retained by the landholder as evidenced by a signed landholder agreement, the following are complete: (i) All buildings demolished and removed (ii) All roads decommissioned and removed (iii) All boreholes decommissioned (cut and cap method) (b) All rubbish and demolition waste has been removed from the mining lease (c) Contaminated land assessment undertaken by an appropriately qualified person and indicates that contamination has been remediated or is acceptable for the proposed post-mining land use
RM2	Minor earthworks and general reshaping	(a) All major earthworks completed with slopes no greater than 20° and a surface which is free draining with the exception of minor ponding (b) Topsoil stripped and stockpiled where relevant (c) Minor earthworks undertaken to reshape, decompact and scarify areas for revegetation (d) Erosion and sediment control systems placed where needed
RM3	Installation of cap / cover on tailings dam	(a) Certification from an appropriately qualified person (AQP) that the TSF cover system functions as it was designed including: (i) Review of cover system design, to achieve a net percolation of less than 10% (ii) Cover to include 0.3m compacted clay material plus either ≥1m of WRD material or ≥1m of borrow material (or other design as produced by a suitably qualified engineer)
RM4	Placement of growth medium	(a) If topsoil not used, growth medium used will support land suitability Class 3 or Class 4 (b) Growth medium placed at a depth of ≥100mm where material is available (c) Following placement of growth medium, shallow ripping completed at a depth of greater than 100mm (except TSF to be ripped at no more than 100mm)
RM5	Revegetation (Low intensity grazing)	(a) Seed mix applied at a rate ≥5 kilograms per hectare (kg/ha) (b) Key native species are recorded (e.g. *Corymbia terminalis, Eucalyptus leucophylla, E. leucophloia, Acacia spp.* and *Triodia* spp.) (c) Mean native plant frequency >25/10m^2 (d) Ground cover (live and dead material) is >25%
RM6	Revegetation (Tussock grassland)	(a) Only shallow-rooted species (e.g. grasses and forbs) are used in the seed mix (b) Native seed mix applied at a rate ≥5 kilograms per hectare (kg/ha) (c) Mean native plant frequency >50/10m^2. (d) Ground cover (live and dead material) is >25%
RM7	Achievement of surface requirements	(a) Weed cover % (not including naturalised species) is within 20% of analogue site weed cover % (b) Mean plant frequency >50/10m^2 (c) Ground cover (live and dead material) is >50% (d) Key native species are recorded in 'Low intensity grazing'; grass and forb species only are recorded in 'Tussock grassland' (e) No active areas of rill or gully erosion and drainage follows appropriate drainage paths (f) Evidence of native fauna within revegetated areas
RM8	Achievement of a stable condition	(a) A rehabilitation performance review with at least three monitoring events has been completed using the methodology outlined in Section 3.7 of the PRCP (b) No evidence of seepage from any landforms beyond the boundary of the Mining Lease (c) Proportion of Category 3 restricted invasive plant species, as defined by the Biosecurity Act 2014, and Weeds of National Significance (WONS), as defined by the "Australian Weeds Strategy 2017 to 2027", are not >10% of total vegetative groundcover (d) Vegetation cover and compositon (averaged over monitoring events) are comparable to analog monitoring locations (i.e. ≥70% of analog values) (e) Surface water quality results from monitoring locations THSWR01 ref, THSW01, THSW02, and THSWPC01 DS comply with: (i) pH 7.0-8.0 (ii) EC <500 µS/cm (iii) Suspended solids <4,000 mg/L (iv) total cyanide <0.004 mg/L (f) Groundwater quality results from monitoring locations THGW001 to THGW009, plus Pit Water and Mine Shaft bores comply with: (i) pH 6.5-9 (ii) <10,000 µS/cm EC (iii) Total dissolved solids <4,000 mg/L (iv) <0.004 mg/L total cyanide (g) Overall erosion risk is classified as 'Low' or 'Moderate' as defined by NCST (2009) Australian Soil and Land Survey Field Handbook (3rd edition) (h) Geotechnical stability of the pit walls and area behind western pit wall have been assessed by a suitably qualified geotechnical engineer as stable in the long term (i) Hazard and Safety Assessment completed by an appropriately qualified person demonstrates hazards in the rehabilitation area are similar to hazards in neighbouring unmined landscapes subject to a similar PMLU.

Milestone reference	Management milestone	Milestone criteria
MM1	Maximum extent	(a) Maximum NUMA extent no greater than 6ha in size and 70m in depth.
MM2	Achievement of surface requirements	(a) Confirmation that fencing and abandonment bunds are erected around the perimeter and in tact. (b) Warning signage posted at no less than 500 m intervals around perimeter. (c) Adequacy of sealed underground entry at top of pit verified by an appropriately qualified person.
MM3	Achievement of sufficient improvement	(a) At the time of relinquishment of the Mining Lease, certification by an appropriately qualified person body that: (i) Residual void water quality and quantity will not cause harm not cause environmental harm outside of the relevant tenure boundary (ii) Residual void acts as a groundwater sink to the surrounding aquifer system; (iii) Residual void is safe for humans and livestock; and (iv) The long-term stability of the underground mine layout, and the suitability of all life of mine seals. (b) Water levels within the residual void do not reach the maximum operational WSL (water surface level) of 305m AHD
MM4	Management of crest zone	(a) Certification that the area of crest cracking remains within abandonment bund. (b) Geotechnical review completed to verify that pit void is safe, stable and non-polluting.

APPENDIX B MATERIALS CHARACTERISATION

Tick Hill Project - Materials Characterisation

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28 January 2025

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Appendices

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Executive Summary

Mine Earth was commissioned by Tick Hill Mining Pty Ltd to conduct an assessment of soil, waste rock and tailings materials for the Tick Hill Gold Mine (THGM), located approximately 110km southeast of Mt Isa in western Queensland.

The assessment of the physical and chemical characteristics of soil resources, waste rock and tailings materials was conducted to address the identified knowledge gaps, to identify potential use of available materials for rehabilitation / mine closure, and to provide data to facilitate relevant landform modelling and closure design parameters.

The objectives of the assessment were to:

- Characterise the physical and chemical characteristics of soil, waste rock and tailings materials within the THGM Project area
- Interpret the field-based information and analytical results, and develop recommendations for potential use of soil and waste rock resources as a source of rehabilitation / cover material for mine closure.

Material Types

The following materials from the Project area were sampled and analysed as part of this assessment:

- In situ, analogue soils
- Waste rock
- Tailings material
- Tailings cover material
- Stockpiled topsoil
- Potential soil borrow material
- Decant cover material
- Decant embankment material

The collected samples were analysed for a range of physical and chemical parameters which influence their suitability as a growth medium / surface rehabilitation material. Additional physical analyses were conducted on selected materials to provide data for modelling and preparation of rehabilitation / closure designs.

Material Characteristics

A summary of the characteristics of each material type, based on the field observations and laboratory analysis program is presented as follows:

Analogue soils

- Weakly to moderately structured ‘clayey sand’ to ‘medium heavy clay’ soils with variable coarse rock content (>2mm), up to 20%
- Non-saline, with a neutral to moderately alkaline pH
- Low concentrations of plant-available nutrients and organic carbon
- Typically classified as non-sodic, with a low potential for clay dispersion
- Classified as non-saline. Soil pH range from pH 7.1 to pH 9.0, classified as neutral to strongly alkaline

- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance

Waste rock

- Single grained to weakly aggregated oxide waste rock with variable coarse competent rock content
- Substantial variability in the texture of the soil sized fraction, with clay content ranging from 2% to 24%
- Samples classified as non-sodic or sodic, with potential for partial clay dispersion in some samples
- Variable hydraulic conductivity (at the measured 95% MDD), with drainage classifications of 'extremely slow' to 'very rapid'
- Variable soil water retention characteristics, field capacity and plant-available water content of the soil sized fraction (>2mm) ranging from low to moderate
- Classified as non-saline. Soil pH classified as strongly alkaline
- Low concentrations of plant-available nutrients and organic carbon, similar to analogue soils
- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance, within the range measured for the analogue soils
- Field observations indicate the waste rock supports the growth of local vegetation

Tailings

- Moderately structured material 'near surface', massive structure from approximately 0.5m depth, with a firm consistence
- Soil texture classified as a Sandy Loam, with approximately 12% clay
- Classified as sodic, however Emerson Test indicates a low propensity for clay dispersion
- Drainage classification (at the measured 95% MDD) of 'moderately slow'
- High water holding capacity (field capacity) and plant-available water content
- Classified as non-saline. Soil pH classified as moderately alkaline
- Low concentrations of plant-available nutrients and organic carbon, similar to analogue soils
- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance, within the range measured for the analogue soils
- Field observations indicate the tailings material supports the growth of local vegetation

Tailings cover material

- Compacted oxide waste rock with variable coarse rock % (up to approx. 80%). Clay content of the soil sized fraction ranging from 9 to 12%
- Non-sodic, with a low propensity for clay dispersion
- Drainage classifications (at 95% MDD) of 'moderate' to 'moderately rapid'
- Low water holding capacity (field capacity) and plant-available water content
- Classified as non-saline. Soil pH classified as moderately alkaline
- Low concentrations of plant-available nutrients and organic carbon, similar to analogue soils
- Classified as non-saline. Soil pH classified as strongly alkaline

- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance, within the range measured for the analogue soils
- Field observations indicate the tailings cover material supports the growth of local vegetation

Stockpiled topsoil

- Predominantly single grained soil with up to 40% coarse rock material, clay content up to 29%
- Non-sodic, with a low propensity for clay dispersion
- Low concentrations of plant-available nutrients and organic carbon, similar to analogue soils
- Classified as non-saline. Soil pH classified as moderately alkaline
- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance, within the range measured for the analogue soils
- Field observations indicate the stockpiled topsoil material supports the growth of local vegetation

Potential borrow material

- Single grained to massively structured sandy clay material (up to 22% clay) with variable coarse fragment content, up to 31%
- Non-sodic, with a low propensity for clay dispersion
- Drainage classification (at 95% MDD) of 'extremely slow'
- Moderate water holding capacity (field capacity) and plant-available water content
- Classified as non-saline. Soil pH classified as neutral
- Low concentrations of plant-available nutrients and organic carbon, similar to analogue soils
- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance, within the range measured for the analogue soils
- Field observations indicate the potential borrow material supports the growth of local vegetation

Decant cover material

- Weakly structured to single grained oxide waste rock material with a loose consistence and up to 70% coarse fragment content
- Variable sodicity, ranging from non-sodic to highly sodic. High propensity for clay dispersion
- Drainage classifications (at 95% MDD) of 'very slow' to 'extremely slow'
- Moderate water holding capacity (field capacity) and plant-available water content
- Classified as slightly saline. Soil pH classified as strongly alkaline
- Low concentrations of plant-available nutrients and organic carbon, similar to analogue soils
- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance, within the range measured for the analogue soils
- Field observations indicate the decant cover material supports the growth of local vegetation

Decant embankment material

- Weakly structured soil with a loose consistence, approximately 20% clay and 40% coarse fragments

- Minor propensity for clay dispersion upon severe disturbance
- Drainage classification (at 95% MDD) of ‘extremely slow’
- Moderate water holding capacity (field capacity) and plant-available water content
- Field observations indicate the decant embankment material supports the growth of local vegetation

Suitability of materials for use as a rehabilitation / cover material

The materials sampled as part of this investigation are considered a valuable source of potential rehabilitation / cover materials for used in mine closure. The chemical characteristics of the materials, while variable, were generally within the range exhibited by the analogue soils within the Project area. The potential sources of rehabilitation / cover material sampled are generally non-saline, low in plant-available nutrients (similar to analogue soils) and, as evidenced by field observations, are capable of supporting the growth of local vegetation species.

The physical characteristics of the materials were variable, reflecting the range of particle sized distributions present. Hydraulic conductivity of the materials (at 95% of MDD) was highly variable, with drainage classifications ranging from ‘Extremely slow’ to ‘Very rapid’. The water retention characteristics of the potential sources of rehabilitation / cover material (<2mm fraction) were also variable, with the water content at field capacity (i.e. the amount of water held in the materials after gravity induced drainage has ceased) and the plant-available water content (PAW) ranging from ‘low’ to ‘moderate’. The results for the waste rock samples were variable, with PAW contents ranging from 9.7 to 20.4% (i.e., low to moderate), again reflective of the variable particle size distribution of the waste rock samples.

The relevant material characteristics presented in this report are being utilised in a concurrent investigation, modelling the potential performance of the materials as a cover for the TSF (Mine Earth 2025).

Introduction

1. Introduction

The Tick Hill gold mine (THGM) is located approximately 110km south-southeast of Mount Isa (Figure 1). Operations ceased in 1994. The site was held in care and maintenance under various owners until recent investigations and attempts to re-commercialise the Project through tailings reprocessing.

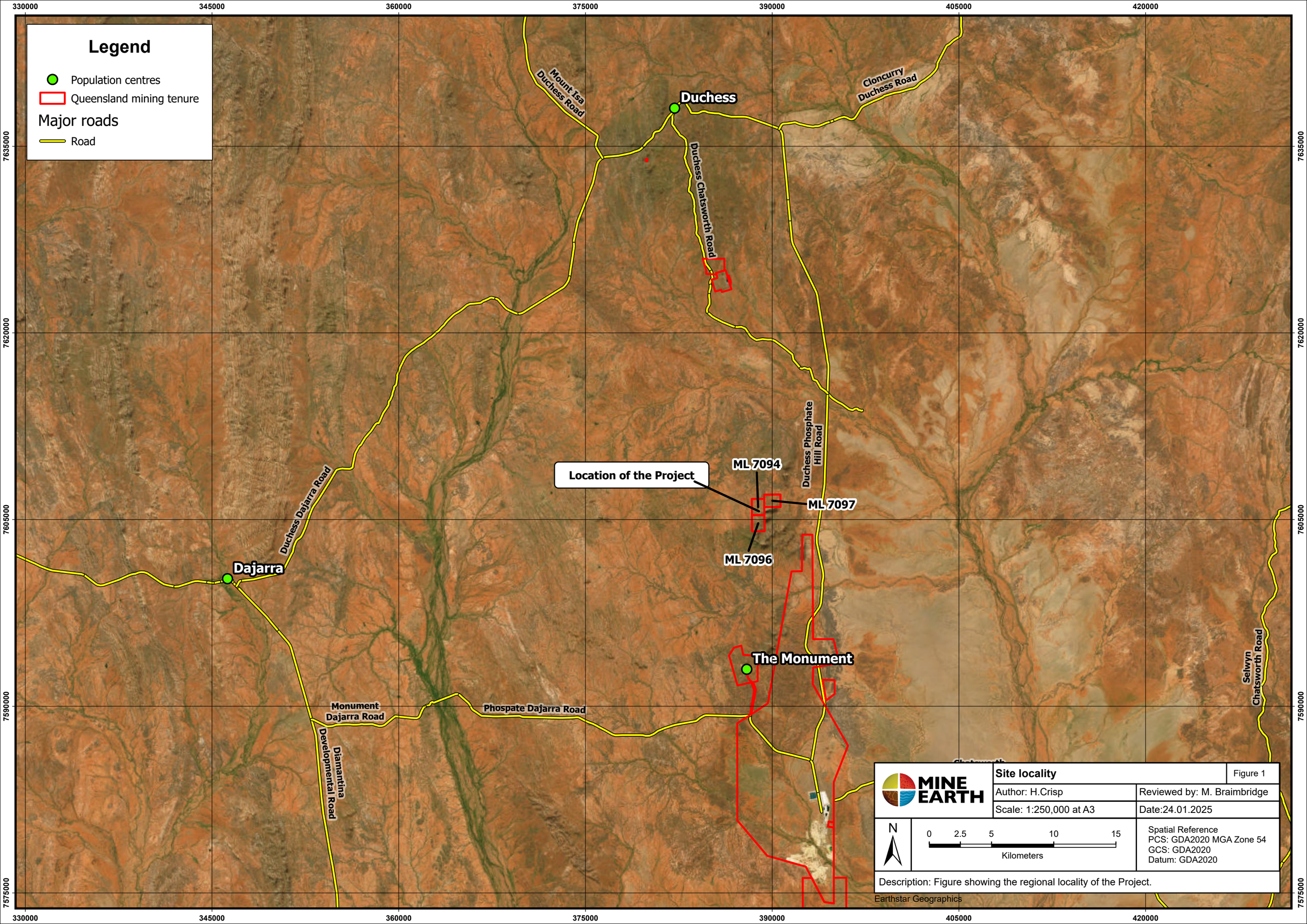
Site features include an open cut pit, tailings storage facility (TSF) that is partially capped, waste rock dump (WRD), run of mine (ROM) pad, topsoil stockpiles, processing area plus hardstand areas for workshops and administrative buildings (Figure 2).

Following cessation of operations, the site was decommissioned, infrastructure demolished and removed, and ground disturbance was rehabilitated. Rehabilitation at the site has not been certified and therefore requires a Progressive Rehabilitation and Closure Plan (PRCP) to present the rehabilitation, monitoring and maintenance requirements to achieve rehabilitation milestones and criteria.

The assessment of the physical and chemical characteristics of soil resources, waste rock and tailings materials was conducted to address identified knowledge gaps pertaining to material characteristics, to identify potential use and / or limitations of available materials for rehabilitation / mine closure, and to provide data to facilitate relevant landform modelling and closure design parameters.

This report includes:

- A description of the materials and methods used during the sampling and analysis stages.
- A summary of the field-based observations of the materials sampled and photographs of each sampling location.
- Analysis and discussion of the physical and chemical characteristics of the sampled materials.
- Recommendations for suitability / potential use of the soil and waste rock materials as a potential rehabilitation / closure resource.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Population centres
Queensland mining tenure
Major roads
Road
Duchess
Mount Isa Duchess Road
Cloncurry Duchess Road
Duchess Chatsworth Road
Duchess Phosphate Hill Road
Duchess Dajarra Road
Dajarra
Location of the Project
ML 7094
ML 7097
ML 7096
The Monument
Monument Dajarra Road
Phospate Dajarra Road
Diamantina Developmental Road
Selwyn Chatsworth Road
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345000
360000
375000
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405000
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7635000
7620000
7605000
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MINE EARTH
Site locality
Figure 1
Author: H.Crisp
Reviewed by: M. Braimbridge
Scale: 1:250,000 at A3
Date:24.01.2025
N
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Kilometers
Spatial Reference
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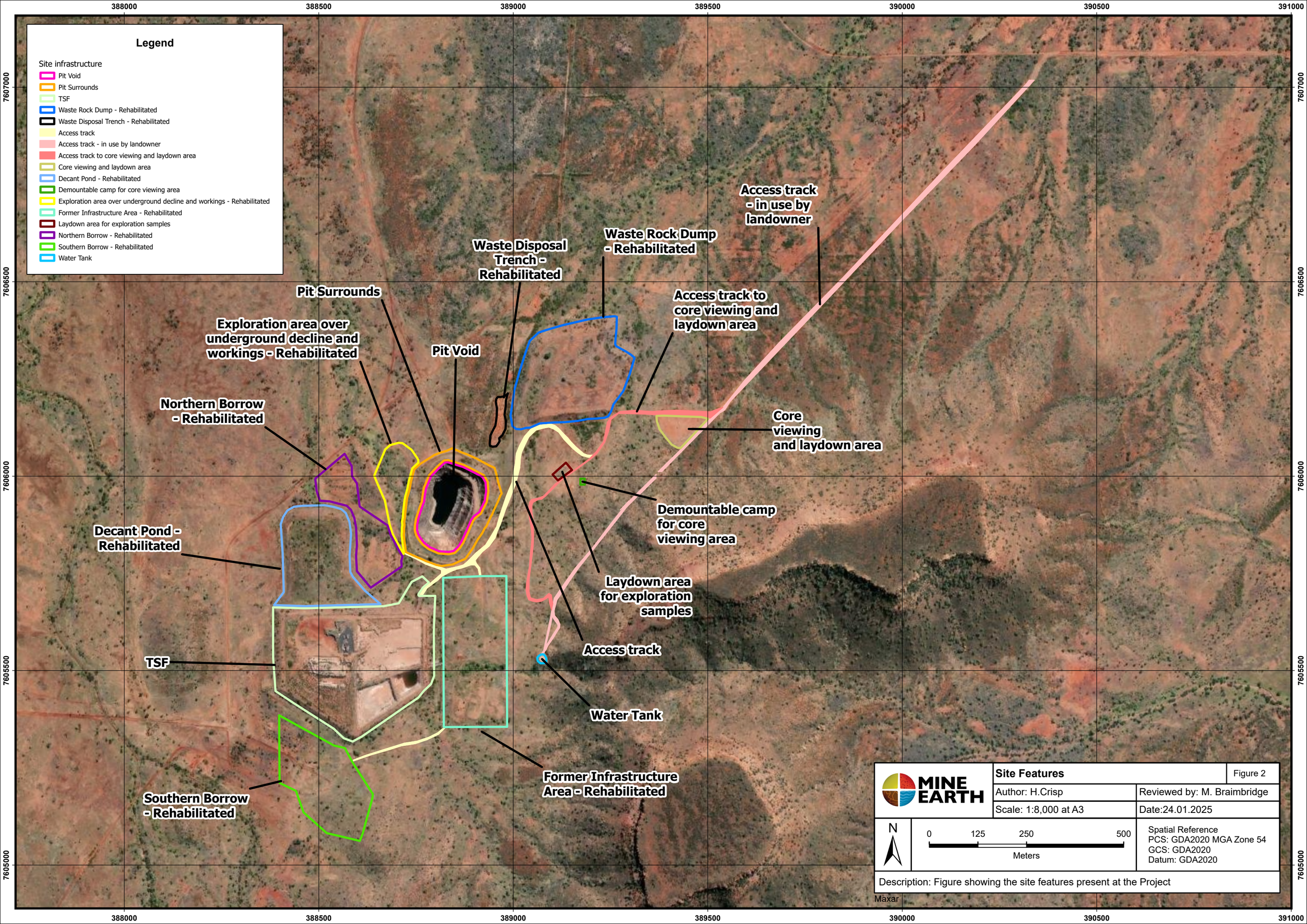
GCS: GDA2020
Datum: GDA2020
Description: Figure showing the regional locality of the Project.
Earthstar Geographics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Legend
Site infrastructure
Pit Void
Pit Surrounds
TSF
Waste Rock Dump - Rehabilitated
Waste Disposal Trench - Rehabilitated
Access track
Access track - in use by landowner
Access track to core viewing and laydown area
Core viewing and laydown area
Decant Pond - Rehabilitated
Demountable camp for core viewing area
Exploration area over underground decline and workings - Rehabilitated
Former Infrastructure Area - Rehabilitated
Laydown area for exploration samples
Northern Borrow - Rehabilitated
Southern Borrow - Rehabilitated
Water Tank
Access track - in use by landowner
Waste Rock Dump - Rehabilitated
Waste Disposal Trench - Rehabilitated
Pit Surrounds
Access track to core viewing and laydown area
Exploration area over underground decline and workings - Rehabilitated
Pit Void
Northern Borrow - Rehabilitated
Core viewing and laydown area
Demountable camp for core viewing area
Decant Pond - Rehabilitated
Laydown area for exploration samples
Access track
TSF
Water Tank
Former Infrastructure Area - Rehabilitated
Southern Borrow - Rehabilitated
MINE EARTH
Site Features
Figure 2
Author: H.Crisp
Reviewed by: M. Braimbridge
Scale: 1:8,000 at A3
Date:24.01.2025
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Meters
Spatial Reference
PCS: GDA2020 MGA Zone 54
GCS: GDA2020
Datum: GDA2020
Description: Figure showing the site features present at the Project
Maxar

Materials and methods

2. Methods and Materials

2.1 Sampling regime

Samples of in situ, analogue soils, stockpiled soil resources, potential borrow materials, existing decant and tailings cover materials, and waste rock from the waste rock dump were collected by Mine Earth and Tick Hill Mining Pty Ltd representatives from 19 locations within the Project area in July 2024 (Figure 5), comprising a total of 24 samples.

The sampling locations and sample details for each material type are summarised as follows:

- In situ analogue soils (5 sampling locations) collected from 2 to 3 depth intervals through the soil profile
- Waste rock (3 sampling locations) composited from depths up to 1.0m on the WRD
- Tailings material (2 sampling locations) composited from depths up to 0.6m on the TSF where tailings are exposed
- Tailings cover material (2 sampling locations) composited from depths up to 0.6m in the existing TSF cover material
- Stockpiled topsoil (2 sampling locations) composited from depths up to 0.7m in existing topsoil stockpiles on the TSF
- Potential borrow material (2 sampling locations) composited from depths up to 1.0m within areas previously identified as a potential source of borrow material
- Decant cover material (2 sampling locations) composited from depths up to 0.5m in the existing decant cover material
- Decant embankment material (1 sampling location) composited from depths up to 0.5m on the existing decant embankment

Details of sample locations, soil profile descriptions, photographs of the materials and surrounding landscape / vegetation at each location are included in Appendix A.

2.2 Test work and procedures

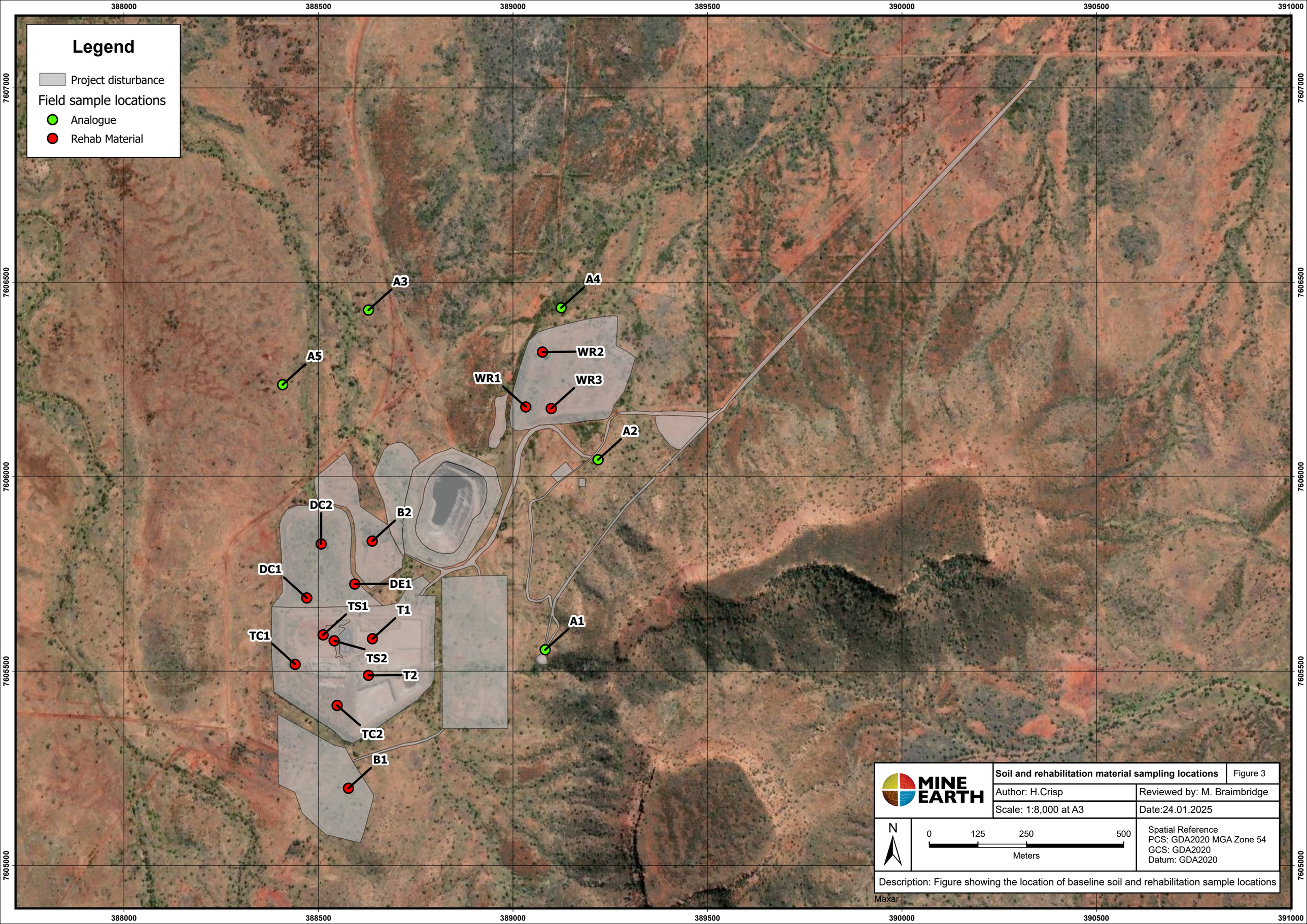
Laboratory test work on the sampled materials was conducted at the Trilab laboratory (soil physical parameters) and the ALS Laboratory (soil chemical parameters) in Brisbane.

The collected samples were analysed for a range of physical and chemical parameters which influence their suitability as a growth medium / surface rehabilitation material. Additional physical analyses were conducted on selected materials to provide data for modelling and preparation of rehabilitation / closure designs. The analysis suite included:

- Physical characteristics:
    - Soil texture and particle size distribution (Including coarse rock fraction >2 mm)
    - Emerson Aggregate test to indicate soil structural stability and potential for clay dispersion upon saturation
    - Hydraulic conductivity
    - Soil water retention characteristics and plant-available water
    - Atterberg limits
    - Maximum dry density and optimum moisture content

- Chemical characteristics:
    - Soil pH and electrical conductivity.
    - Plant-available nutrients (N, P, K, S).
    - Total organic carbon (to indicate organic matter content).
    - Exchangeable cations, effective cation exchange capacity (eCEC) and exchangeable sodium percentage (ESP).
    - Total metal concentrations.

All physical soil test work was conducted in accordance with standard analytical procedures to assess potential soil erodibility and soil properties related to the support of plant growth (Rayment & Lyons, 2010). Descriptions of relevant soil classification categories are detailed in Appendix B. All external laboratory results for the soils sampled are provided in Appendix C.


Legend
Project disturbance
Field sample locations
Analogue
Rehab Material
A3
A4
A5
WR2
WR1
WR3
A2
DC2
B2
DC1
DE1
TS1
T1
TC1
TS2
T2
A1
TC2
B1
388000
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MINE EARTH
Soil and rehabilitation material sampling locations
Figure 3
Author: H.Crisp
Reviewed by: M. Braimbridge
Scale: 1:8,000 at A3
Date:24.01.2025
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Meters
Spatial Reference
PCS: GDA2020 MGA Zone 54
GCS: GDA2020
Datum: GDA2020
Description: Figure showing the location of baseline soil and rehabilitation sample locations
Maxar

Results

3. Results

The results from the laboratory analysis program are presented in the following sections. A summary of the field-based observations and photographs from each sampling location is provided in Appendix A.

3.1 Soil physical characteristics

The physical characteristics of the soils, waste rock and tailings materials, as identified by the field sampling and laboratory analysis program are discussed in the following sections.

3.1.1 Soil texture

Soil texture describes the proportions of sand, silt and clay (the particle size distribution) within the <2 mm fraction of a soil. The particle size distribution and resulting textural class of a soil is an important factor influencing most physical, and many chemical and biological, properties. Soil structure, water holding capacity, hydraulic conductivity, soil strength, fertility, erodibility, and susceptibility to compaction are some of the factors closely linked to the texture of a soil material.

There was a wide range of soil textures recorded for the sampled materials, ranging from 'coarse sand' (approximately 2% clay), for the soil sized fraction of the one of the waste rock samples (WR3) to 'medium clay' (49% clay) for one of the analogue soil samples (A3, 10-20cm depth) (Table 1).

The highest clay contents were consistently recorded for the analogue soil samples. The tailings materials recorded clay contents of 11% and 12%, with the texture of the tailings classified as 'sandy loam'. There was substantial variability in the texture of the waste rock materials, with the clay content ranging from 2% to 24% (Table 1).

3.1.2 Soil structure

Soil structure describes the arrangement of solid particles and void space in a soil. It is an important factor influencing the ability of soil to support plant growth, store and transmit water and resist erosional processes. A well-structured soil is one with a range of different sized aggregates; with component particles bound together to give a range of pore sizes facilitating root growth and the transfer of air and water.

Soil structure can be influenced by the particle size distribution, chemical composition, and organic matter content of a soil. Soil structure is often influenced by root growth, vehicle compaction and, with respect to reconstructed soil profiles, the methods of soil handling and deposition. When a soil material is disturbed, the breakdown of aggregates into primary particles can lead to structural decline (Moore, 1998). This can result in hard-setting and crusting at the soil surface and a 'massive' soil structure at depth, potentially reducing the ability of seeds to germinate, roots to penetrate the soil matrix and water to infiltrate to the root zone.

There were a range of soil structures exhibited for the sampled materials, ranging from loose, single grained material, to moderately structured, aggregated soils, to massive, dense material with no aggregation. (Appendix A).

3.1.3 Structural stability

The structural stability of a soil and its susceptibility to structural decline is complex and depends on the net effect of several properties, including the amount and type of clay present, organic matter content, soil chemistry and the nature of disturbance. Soil aggregates that slake and, particularly those that disperse, indicate a weak soil structure that is easily degraded. These soils should be seen as potentially problematic when used as a rehabilitation medium, particularly if left exposed at the surface.

The Emerson Aggregate Test identifies the potential slaking and dispersive properties of soil aggregates. The dispersion test identifies the properties of the soil materials under a worst-case scenario, where severe stress is applied to the soil material. Generally, samples allocated into Emerson Classes 1 and 2 are those most likely to exhibit dispersion of the clay sized fraction and therefore be the most problematic. A description of the Emerson test classifications is provided in Appendix B.

The Emerson test results for the materials identified as potential sources of rehabilitation material are detailed in Table 1. Emerson test classifications and the associated potential for dispersion of the clay fraction for the materials were variable. Emerson Class 2 was recorded for samples of the decant cover (DC2) and waste rock (WR2), indicating that those materials are susceptible to partial dispersion of the clay fraction. The variability of the waste rock materials was again indicated by the variable propensity for dispersion, with the individual samples classified as Emerson Class 2, 5 and 6 (Table 1).

Table 1 Soil texture, clay content, % coarse rock (>2mm) and Emerson Test Class

Sample ID	Sample description	Depth interval (cm)	Soil texture (<2mm soil fraction)	Clay content (%)	% Coarse material (>2mm)	Emerson Class[1]
A1	Analogue	0-10	Sandy Loam	19	11	-
		10-20	Clayey Sand	9	19	-
A2	Analogue	0-10	Sandy Loam	19	20	-
		10-20	Light Clay	42	7	-
		40-50	Sandy Loam	14	10	-
A3	Analogue	0-10	Light Medium Clay	43	4	-
		10-20	Medium Clay	49	3	-
		40-50	Medium Clay	45	2	-
A4	Analogue	0-10	Light Medium Clay	48	2	-
		10-20	Medium Clay	44	2	-
		40-50	Light Medium Clay	38	2	-
A5	Analogue	0-10	Light Clay	33	4	-
		10-20	Medium Heavy Clay	38	12	-
		40-50	Medium Heavy Clay	49	6	-
B1	Potential borrow material	0-70	Sandy Clay Loam	22	31	6
B2	Potential borrow material	0-100	Sandy Clay Loam	20	24	3
DC1	Decant cover	20-50	Sandy Loam	9	4	3
DC2	Decant cover	20-50	Medium Heavy Clay	31	14	2
DE1	Decant embankment	20-50	Sandy Clay Loam	20	40	3
T1	Tailings	0-60	Sandy Loam	12	0	5

Sample ID	Sample description	Depth interval (cm)	Soil texture (<2mm soil fraction)	Clay content (%)	% Coarse material (>2mm)	Emerson Class[1]
T2	Tailings	0-60	Sandy Loam	11	0	4
TC1	Tailings cover	5-50	Sandy Loam	12	24	5
TC2	Tailings cover	20-60	Sandy Loam	9	73	5
TS1	Stockpiled topsoil	0-70	Medium Clay	28	11	-
TS2	Stockpiled topsoil	0-70	Light Clay	29	3	-
WR1	Waste rock	20-150	Medium Clay	26	40	6
WR2	Waste rock	20-100	Sandy loam	4	50	2
WR3	Waste rock	10-100	Coarse Sand	2	60	5

[1] Class 2 – partial dispersion of natural aggregate
Class 3 - aggregate slakes but does not disperse, complete or partial dispersion of remoulded soil
Class 4 - Dry aggregate slakes but does not disperse; remoulded soil does not disperse; carbonates and gypsum are present
Class 5 - aggregate slakes but does not disperse, no dispersion of remoulded soil, soil:water suspension remains dispersed
Class 6 - Dry aggregate slakes but does not disperse; remoulded soil does not disperse; carbonates and gypsum are absent; 1:5 suspension remains flocculated

3.1.4 Hydraulic conductivity

Hydraulic conductivity (K_{sat}) refers to the saturated permeability of soil, or the ability of water to infiltrate and drain through the soil matrix and is dependent on soil properties such as texture and structure (Moore, 2004). Freely draining soils with high K_{sat} values will generally be less susceptible to surface runoff and erosion. Slow draining soils with low K_{sat} values, are more likely to experience waterlogging, increased surface runoff and erosion.

It should be noted that the laboratory assessment of K_{sat} was conducted on samples packed to 95% of their maximum dry density (Section 3.1.7). The K_{sat} of these materials in the field may be substantially higher if the materials are placed at a lower bulk density.

The hydraulic conductivity of the tested samples was highly variable, reflecting the wide range of soil textures / clay content (Table 2). Drainage classes were determined according to their K_{sat} (Hunt, N and Gilkes, R, 1992). The majority of samples recorded drainage classifications of 'Extremely slow' to 'Moderately slow'. The highest K_{sat} values were recoded for individual samples of the tailings cover (TC2) and waste rock (WR3), which recorded drainage classifications of 'Moderately rapid' and 'Very rapid' (Table 2).

Table 2 Saturated hydraulic conductivity (K_{sat})

Sample ID	Sample description	Sample depth interval (cm)	K_{sat} (m/s)	Drainage Class[1]
B1	Potential borrow material	0-70	2.4×10^{-8}	Extremely slow
B2	Potential borrow material	0-100	9.3×10^{-9}	Extremely slow
DC1	Decant cover	20-50	2.3×10^{-7}	Very slow
DC2	Decant cover	20-50	3.6×10^{-10}	Extremely slow

Sample ID	Sample description	Sample depth interval (cm)	K_{sat} (m/s)	Drainage Class[1]
DE1	Decant embankment	20-50	1.4×10^{-9}	Extremely slow
T1	Tailings	0-60	3.3×10^{-6}	Moderately slow
T2	Tailings	0-60	1.5×10^{-6}	Moderately slow
TC1	Tailings cover	5-50	1.0×10^{-5}	Moderate
TC2	Tailings cover	20-60	3.1×10^{-5}	Moderately rapid
WR1	Waste rock	20-150	7.2×10^{-9}	Extremely slow
WR2	Waste rock	20-100	1.8×10^{-8}	Extremely slow
WR3	Waste rock	10-100	6.8×10^{-5}	Very rapid

[1] (Hunt, N and Gilkes, R, 1992)

3.1.5 Soil water retention

The water holding capacity at saturation (0kPa) field capacity (approx. 30kPa) and wilting point (approx. 1500kPa) of the tested samples was assessed to provide an indication of the amount of water held in the materials after gravity induced drainage has ceased (i.e. field capacity) and the % volume likely to be available to vegetation (field capacity minus wilting point), known as the plant-available water content (PAW) (Table 3). The soil water characteristic curves for each material tested are provided in Appendix C.

It should be noted that, as the water retention test work is conducted on the <2 mm size fraction, it does not take into account the percentage of coarse rock material present.

The water retention characteristics of the materials tested was again variable, reflecting the wide range of soil textures / clay contents (Table 3). The tailings cover samples recorded the lowest PAW content, with the tailings material having the largest PAW capacity. The waste rock results were variable, with PAW contents ranging from 9.7 to 20.4%, again reflective of the variable particle size distribution of the waste rock samples.

Table 3 Soil water retention characteristics

Sample ID	Sample description	Gravimetric soil water (%) at measured tension points						
		0 kPa	10 kPa	33 kPa	100 kPa	500 kPa	1500 kPa	PAW % [1.]
T1	Tailings	44.3	33.3	30.9	6.2	3.8	2.3	31.0
T2	Tailings	39.7	32.4	29.9	5.6	3.5	1.6	30.8
TC1	Tailings cover	13.5	10.6	9.4	4.8	3.4	2.4	8.2
TC2	Tailings cover	11.8	9.2	8.1	3.0	2.2	1.5	7.6
WR1	Waste rock	37.5	30.4	28.7	19.4	12.8	10.0	20.4
WR2	Waste rock	35.5	24.8	23.4	18.2	9.0	6.7	18.1
WR3	Waste rock	13.4	10.4	9.2	1.8	1.1	0.7	9.7
B1	Potential borrow material	35.0	30.1	28.0	15.5	13.2	10.2	19.9

Sample ID	Sample description	Gravimetric soil water (%) at measured tension points						
		0 kPa	10 kPa	33 kPa	100 kPa	500 kPa	1500 kPa	PAW % [1.]
B2	Potential borrow material	36.1	32.2	30.0	20.7	12.7	10.0	22.2
DC1	Decant cover	27.3	25.2	22.7	7.6	3.9	2.5	22.7
DC2	Decant cover	32.2	26	23.2	22.3	13.1	10.3	15.8
DE1	Decant embankment	36.6	30.8	26.0	24.9	15.4	12.3	18.5

1. Plant available water (PAW) is the water content of the soil at Saturation (0 kPa) minus wilting point (1500 kPa).

3.1.6 Atterberg Limits

The Atterberg Limits identify the soil water content at which the soil fraction transitions between solid, semi-solid, plastic and liquid states (Table 4). The percentage linear shrinkage of the ROM material identifies the potential for shrink / swell of the material upon wetting / drying. The range of linear shrinkage values recorded for the materials tested ranged from 4% for one of the tailings cover samples to 18% for one of the potential borrow material samples. This range is considered a low to moderate shrink / swell capacity, with the potential borrow material likely to exhibit shrinkage and cracking upon wetting / drying cycles.

Table 4 Atterberg Limits for selected samples

Sample ID	Sample description	Atterberg Limits			
		Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)
TC1	Tailings cover	26	17	9	7.0
TC2	Tailings cover	23	17	6	4.0
WR2	Waste rock	34	20	14	7.5
WR3	Waste rock	Non-attainable	Non-attainable	Non-plastic	Non-attainable
B1	Potential borrow material	36	19	17	10.0
B2	Potential borrow material	44	21	23	18.0
DC1	Decant cover	Non-attainable	Non-attainable	Non-plastic	Non-attainable
DC2	Decant cover	41	21	20	11.5
DE1	Decant embankment	45	20	25	14.5

3.1.7 Maximum Dry Density

The maximum dry density (MDD) and moisture content at the MDD (Optimum moisture %), for the sampled materials are detailed in Table 5. The highest MDD values were consistently recorded for the waste rock and tailings cover materials, with the lowest MDD recorded for the tailings sample.

Table 5 Maximum dry density (MDD) and optimum moisture content of selected samples

Sample ID	Sample description	Maximum dry density (t/m^3)	Optimum moisture (%)
T2	Tailings	1.57	15.1
TC1	Tailings cover	2.21	8.0
TC2	Tailings cover	2.19	8.4
WR1	Waste rock	1.98	10.7
WR2	Waste rock	2.06	10.8
WR3	Waste rock	2.04	7.4
B1	Potential borrow material	1.88	12.5
B2	Potential borrow material	1.84	13.8
DC1	Decant cover	1.88	9.7
DC2	Decant cover	1.88	13.5
DE1	Decant embankment	1.86	14.1

3.2 Soil chemical characteristics

3.2.1 Soil pH and Electrical Conductivity

Soil pH (H_2O) measures the acidity or alkalinity of the soil in relation to suitability for plant growth. Ratings for soil pH, based on the Land Evaluation Standards for Land Resource Mapping categories (van Gool, 2005) are provided in Appendix B.

Individual soil pH (H_2O) values for each sample are presented in Table 6, with the average for each material type presented in Figure 6. Soil pH values were variable across the sample materials, with individual soil pH (H_2O) values ranging from pH 7.1 (classified as 'neutral') to pH 9.6 ('strongly alkaline'). The pH of the analogue soils ranged from pH 7.1 to pH 9.0, indicating that the majority of the potential cover / rehabilitation materials have pH values within the range exhibited by the analogue soils. Exceptions were the samples of the tailings cover material, which recorded the most alkaline soil pH values (Table 6 and Figure 6).

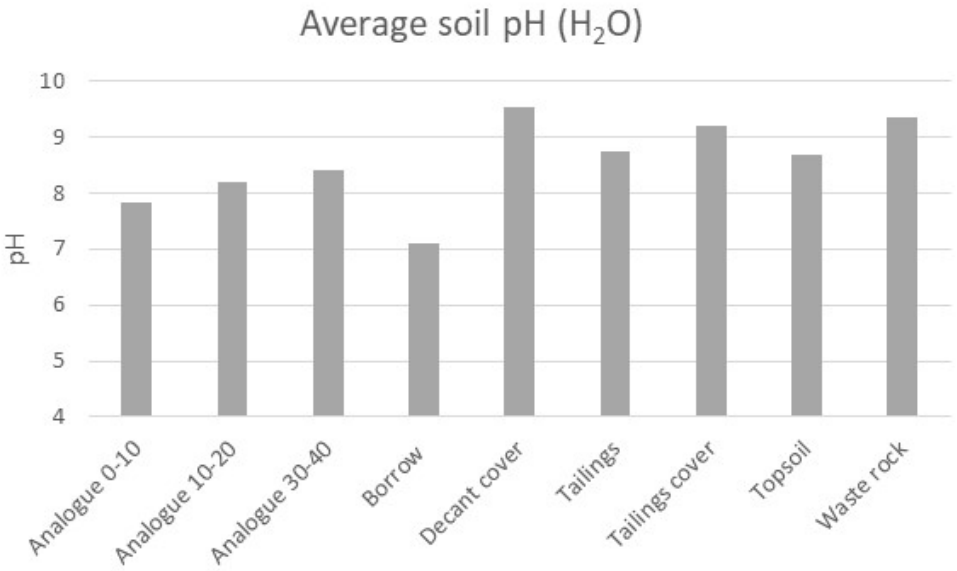


Figure 4 Average soil pH (H_2O) values for sampled materials

Electrical conductivity (EC) is a measurement of the soluble salts in soils or water. Soil salinity results from natural processes of landscape evolution, hydrological processes, and rainfall (Hunt, N and Gilkes, R, 1992). Soil electrical conductivity classes, based on the standard USDA and CSIRO electrical conductivity categories are provided in Appendix B

Individual EC values for each sample are presented in Table 6, with the average EC for each material type presented in Figure 7. The individual soil EC values of the materials sampled ranged from 0.008 dS/m (classed as non-saline) to 0.374 dS/m (slightly saline). On average, all materials apart from the decant cover samples were classified as non-saline (Figure 7). Salinity is considered unlikely to be a limiting factor to the use of the sampled materials as a rehabilitation / cover material.

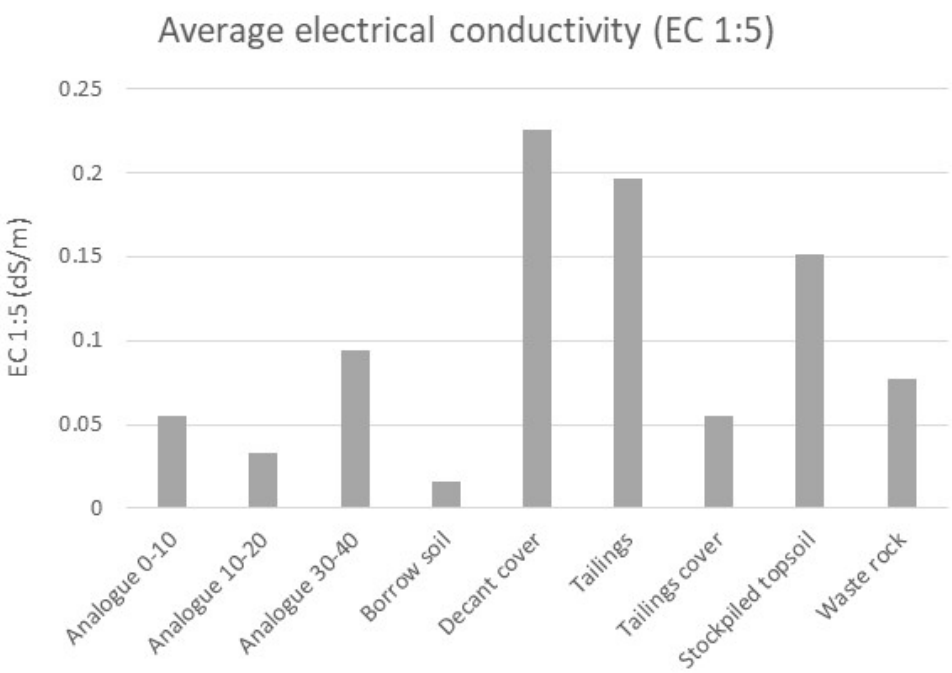


Figure 5 Avergae electrical conductivity (dS/m) for sampled materials

3.2.2 Soil Nutrients

The most important macro-nutrients for plant growth are nitrogen (N), Phosphorus (P), potassium (K) and sulphur (S). These nutrients are largely derived from the soil mineral component and organic matter. Native plant species have a number of physiological adaptations that enable them to be productive in areas where the supply of macronutrients is limited. Therefore, the use of analogue sites is an effective way to baseline the soil nutritional requirements of native plant species within the Project area.

3.2.2.1 Nitrogen

Most (>98%) N in soils is organic (Moore, 1998). Plant-available forms of inorganic N (nitrate and ammonium) are produced via mineralisation of soil organic matter. The plant-available N concentrations of the materials sampled were all very low, with all concentrations of ammonium (NH_4^+) below the limit of reporting (Table 6). The concentrations of N in the form of nitrate (NO_3^-) ranged from below detection (<1 mg/kg) to 4.1 mg/kg, with no apparent correlation with material type.

3.2.2.2 Phosphorus

Phosphorus is essential for the growth of vegetation as it plays a key role in the formulation of energy producing organic compounds. Adequate P nutrition enhances many aspects of plant physiology, including the fundamental processes of photosynthesis, nitrogen fixation, flowering, fruiting (including seed production), and maturation (Brady, N. and Weil, R., 2002).

The plant-available P concentrations of the material sampled were all low, ranging from below the limit of reporting (<5 mg/kg) to 10 mg/kg (Table 6).

3.2.2.3 Potassium

Potassium (K) plays a critical role in a number of plant physiological processes. Adequate amounts of K have been linked to improved drought tolerance, better resistance to certain fungal diseases and greater tolerance to insect pests (Brady, N. and Weil, R., 2002).

The plant-available K concentrations of the materials sampled were variable, ranging from below the limit of reporting (<5 mg/kg) to 927 mg/kg (Table 6). These values range between a low and high rating (low rating: <90 mg/kg, high rating: >200 mg/kg (Moore, 2004)). The plant-available K concentrations of the majority of the potential rehabilitation / cover materials were within the range of values recorded for the analogue soils.

3.2.3 Soil Organic Matter

The organic matter content of soil is an important factor influencing many physical, chemical, and biological soil characteristics. Directly derived from plants and animals, its functions in soil include supporting the micro and macro fauna and flora populations, increasing the water retention capacity, buffering pH and improving soil structure.

The organic matter content of the materials sampled was determined as a measure of the soil organic carbon percentage (SOC%). The SOC% of all materials sampled was low, as is typical of most highly weathered soils, ranging from below the limit of reporting (<0.5%) to 1.1% (Table 6).

Table 6 Electrical conductivity, soil pH, plant-available macronutrient and organic C % of sampled materials

Sample ID	Sample description	Depth interval (cm)	EC (1:5) (dS/m)	pH (H_2O)	Plant-available nutrients (mg/kg)				Org C (%)
					NH_4^+	NO_3^-	P	K	
A1	Analogue	0-10	0.070	8.6	<20	0.5	<5	377	<0.5
		10-20	0.025	8.7	<20	<0.1	<5	101	<0.5
A2	Analogue	0-10	0.042	7.1	<20	1.4	10	424	1.0
		10-20	0.012	7.5	<20	0.5	<5	334	0.5
		40-50	0.008	7.6	<20	0.1	<5	<100	<0.5
A3	Analogue	0-10	0.028	7.6	<20	0.8	<5	633	0.6
		10-20	0.078	8.7	<20	0.1	<5	250	<0.5
		40-50	0.083	8.7	<20	<0.1	<5	232	<0.5
A4	Analogue	0-10	0.083	8.5	<20	0.3	<5	927	0.8
		10-20	0.036	8.3	<20	0.2	<5	694	<0.5
		40-50	0.084	8.4	<20	0.1	<5	555	<0.5
A5	Analogue	0-10	0.053	7.3	<20	4.0	10	840	1.1
		10-20	0.015	7.8	<20	0.4	<5	290	1.1
		40-50	0.200	9.0	<20	0.5	<5	166	0.7
B1	Potential borrow material	0-70	0.016	7.1	<20	0.7	9	387	0.6
DC1	Decant cover	20-50	0.077	9.5	<20	<0.1	<5	221	<0.5
DC2	Decant cover	20-50	0.374	9.6	<20	4.1	<5	557	<0.5
T1	Tailings	0-60	0.175	8.9	<20	<0.1	<5	163	<0.5
T2	Tailings	0-60	0.219	8.6	<20	1.1	<5	381	<0.5
TC1	Tailings cover	5-50	0.055	9.2	<20	<0.1	<5	446	<0.5
TS1	Stockpiled topsoil	0-70	0.205	8.7	<20	3.2	<5	528	<0.5
TS2	Stockpiled topsoil	0-70	0.098	8.7	<20	1.9	<5	391	<0.5
WR1	Waste rock	20-150	0.110	9.2	<20	<0.1	<5	280	<0.5
WR3	Waste rock	10-100	0.045	9.5	<20	<0.1	<5	138	<0.5

3.2.4 Exchangeable Cations and Exchangeable Sodium Percentage

Exchangeable cations, held on clay surfaces and within organic matter, are an important source of soil fertility and can influence the physical properties of soil. Generally, if cations such as Ca2+, Mg2+ and K+ are dominant on the clay exchange surfaces, the soil will typically display increased physical structure and stability, leading to increased aeration, drainage and root growth (Moore, 2004). If Na cations (Na+) are dominant on exchange surfaces and the exchangeable sodium percentage (ESP) exceeds more than 6% of the total exchangeable cations, then the soil is considered to be 'sodic', which can lead to poor physical properties (i.e. dispersion, hard setting and erosion in clay-rich soils). ESP values over 15% are classified as 'highly sodic'.

Exchangeable cation concentration, effective cation exchange capacity (eCEC) and ESP results for the sampled materials are detailed in Table 7. The exchangeable cation results were variable, with the concentration of Mg and Na below the limit of reporting for many of the analogue soils and potential rehabilitation / cover materials. The eCEC values ranged from approximately 1.2 to 18.6, considered to be 'low' to 'moderate'. The majority of the materials were classified as non-sodic, indicating a low propensity for dispersion of the clay fraction, with the exception of one of the decant cover samples (DC2), classified as highly sodic (Table 7). This correlates with the Emerson Test Class 2 recorded for sample DC3 (Section 3.1.3), indicating a propensity for partial dispersion upon saturation.

Table 7 Exchangeable cations, effective cation exchange capacity (eCEC) and exchangeable sodium percentage (ESP) of selected samples. Shading of ESP values denotes non-sodic, sodic and highly sodic classifications

Sample ID	Sample description	Depth interval (cm)	Exchangeable cations (meq/100g)				eCEC (meq/100g)	ESP (%)
			Ca	K	Mg	Na		
A1	Analogue	0-10	10	0.5	<0.2	<0.2	<10.7	0.9
		10-20	3.3	<0.2	<0.2	<0.2	<3.6	2.8
A2	Analogue	0-10	11.8	4.2	0.4	0.7	17.1	4.1
		10-20	4.2	1.4	0.3	<0.2	<6.0	1.7
		40-50	1.9	0.6	<0.2	<0.2	<2.7	3.7
A3	Analogue	0-10	6.9	2.7	0.6	<0.2	<10.3	1.0
		10-20	7.5	2.6	<0.2	<0.2	<10.3	1.0
		40-50	10.6	3.4	0.2	<0.2	<14.3	0.7
A4	Analogue	0-10	5.4	1.8	0.4	<0.2	<7.7	1.3
		10-20	5.7	2.2	0.5	<0.2	<8.5	1.2
		40-50	6	2.3	0.4	<0.2	<8.8	1.1
A5	Analogue	0-10	3	2	0.4	<0.2	<5.5	1.8
		10-20	6.9	4.2	0.2	0.4	<11.7	3.4
		40-50	9.2	7.1	<0.2	2.2	<18.6	11.8
B1	Potential borrow material	0-70	20.3	6.9	0.8	0.6	28.6	2.1
DC1	Decant cover	20-50	1	0.9	<0.2	<0.2	<2.1	4.8
DC2	Decant cover	20-50	3.1	3.7	0.2	2.1	9.1	23.1
T1	Tailings	0-60	1.1	<0.2	<0.2	<0.2	<1.4	7.1
T2	Tailings	0-60	0.9	<0.2	<0.2	<0.2	<1.2	8.3
TC1	Tailings cover	5-50	1.4	0.5	<0.2	<0.2	<2.1	4.8
TS1	Stockpiled topsoil	0-70	4.3	1.8	0.3	<0.2	<6.5	1.5
TS2	Stockpiled topsoil	0-70	5	2.6	0.3	<0.2	<8.0	1.3

Sample ID	Sample description	Depth interval (cm)	Exchangeable cations (meq/100g)				eCEC (meq/100g)	ESP (%)
			Ca	K	Mg	Na		
WR1	Waste rock	20-150	3.6	3.4	<0.2	0.4	<7.5	5.3
WR3	Waste rock	10-100	1.1	<0.2	<0.2	<0.2	<1.4	7.1

3.2.5 Total metal / metalloid concentrations

The total concentration of selected metals / metalloids was measured for selected samples, with the results presented in Table 8. The soils samples were digested using a hydrochloric and nitric acid mixture and read using inductively couple plasma mass spectroscopy (ICP-MS). As a point of comparison, the average crustal abundance (ACA) (Reimann, C. and de Caritat, P, 1998) for each metal is also provide in Table 6.

Of note are the high baseline concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance. The metals / metalloid concentrations were consistent across the analogue and potential rehabilitation / cover materials sampled and are unlikely to have any implications for material management or rehabilitation.

Table 8 Total metal / metalloid concentrations for selected samples. Concentrations above the ACA are denoted in bold font

Site #	Depth (cm)	Total metal / metalloid concentrations (mg/kg)														
		As	Cd	Cr	Co	Pb	Se	Ba	Be	B	Cu	Mn	Ni	V	Zn	Hg
A1	0-10	<5	**120**	<1	<50	<1	**26**	14	**7**	<5	**195**	20	<5	68	11	<0.1
	10-20	<5	**10**	<1	<50	<1	<2	<2	<5	<5	**51**	<2	<5	6	<5	<0.1
A2	0-10	<5	**10**	<1	<50	<1	**5**	2	<5	<5	**54**	2	<5	13	<5	<0.1
	10-20	<5	**20**	<1	<50	<1	**12**	4	<5	<5	**43**	4	<5	33	<5	<0.1
	40-50	<5	**30**	<1	<50	<1	**16**	8	**6**	<5	**63**	8	<5	33	<5	<0.1
A3	0-10	<5	**80**	<1	<50	<1	**17**	7	**11**	<5	**185**	9	<5	49	7	<0.1
	10-20	<5	**40**	<1	<50	<1	**8**	4	<5	<5	**97**	4	<5	25	<5	<0.1
	40-50	<5	**110**	<1	<50	<1	**20**	8	**12**	<5	**193**	10	<5	58	7	<0.1
A4	0-10	<5	**130**	<1	<50	<1	**31**	13	**20**	<5	**194**	16	<5	76	11	<0.1
	10-20	<5	**80**	<1	<50	<1	**31**	8	**10**	<5	**150**	12	<5	74	6	<0.1
	40-50	<5	**60**	<1	<50	<1	**23**	6	**6**	<5	**98**	9	<5	46	<5	<0.1
A5	0-10	<5	**80**	<1	<50	<1	**17**	9	**11**	<5	**268**	9	<5	49	9	<0.1
	10-20	<5	**90**	<1	<50	<1	**20**	9	**12**	<5	**283**	11	<5	62	8	<0.1
	40-50	<5	**130**	<1	<50	<1	**16**	9	**9**	<5	**246**	9	<5	53	6	<0.1
B1	0-10	<5	**30**	<1	<50	<1	**17**	7	**6**	<5	**112**	8	<5	41	6	<0.1
DC1	0-10	<5	**20**	<1	<50	<1	**7**	11	**34**	<5	**62**	7	<5	12	5	<0.1
DC2	0-10	<5	**180**	<1	<50	<1	**9**	10	**79**	<5	**112**	10	<5	21	9	<0.1
T1	0-10	<5	**30**	<1	<50	<1	**17**	17	**95**	<5	**75**	15	<5	18	11	<0.1
T2	0-10	<5	<10	<1	<50	<1	**10**	9	**37**	<5	**44**	9	<5	9	7	<0.1
TC1	0-10	<5	**20**	<1	<50	<1	**12**	7	**9**	<5	**107**	10	<5	22	10	<0.1
TS1	0-10	<5	**30**	<1	<50	<1	**8**	6	**19**	<5	**64**	6	<5	16	<5	<0.1
TS2	0-10	<5	**100**	1	<50	<1	**26**	13	**34**	<5	**197**	16	<5	68	10	<0.1
WR1	0-10	<5	**140**	<1	<50	<1	**11**	13	**9**	<5	**80**	7	<5	38	5	<0.1
WR3	0-10	<5	<10	<1	<50	<1	**3**	<2	**10**	<5	**30**	<2	<5	<5	<5	<0.1
Average crustal abundance[1]		**1.7**	**0.1**	**126**	**24**	**14.8**	**0.12**	**584**	**2.4**	**11**	**25**	**716**	**56**	**98**	**65**	**0.04**

1. Bold values denotes concentration above ACA (Reimann, C. and de Caritat, P, 1998)

Conclusions and recommendations

4. Conclusions and recommendations

4.1 Material characteristics

A summary of the characteristics of each material type, based on the field observations and laboratory analysis program is presented as follows:

Analogue soils

- Weakly to moderately structured 'clayey sand' to 'medium heavy clay' soils with variable coarse rock content (>2mm), up to 20%
- Low concentrations of plant-available nutrients and organic carbon
- Typically classified as non-sodic, with a low potential for clay dispersion
- Classified as non-saline. Soil pH range from pH 7.1 to pH 9.0, classified as neutral to strongly alkaline
- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance

Waste rock

- Single grained to weakly aggregated oxide waste rock with variable coarse competent rock content
- Substantial variability in the texture of the soil sized fraction, with clay content ranging from 2% to 24%
- Samples classified as non-sodic or sodic, with potential for partial clay dispersion in some samples
- Variable hydraulic conductivity (at the measured 95% MDD), with drainage classifications of 'extremely slow' to 'very rapid'
- Variable soil water retention characteristics, field capacity and plant-available water content of the soil sized fraction (>2mm) ranging from low to moderate
- Classified as non-saline. Soil pH classified as strongly alkaline
- Low concentrations of plant-available nutrients and organic carbon, similar to analogue soils
- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance, within the range measured for the analogue soils.
- Field observations indicate the waste rock supports the growth of local vegetation

Tailings

- Moderately structured material 'near surface', massive structure from approximately 0.5m depth, with a firm consistence
- Soil texture classified as a Sandy Loam, with approximately 12% clay
- Classified as sodic, however Emerson Test indicates a low propensity for clay dispersion
- Drainage classification (at the measured 95% MDD) of 'moderately slow'
- High field capacity and plant-available water content
- Classified as non-saline. Soil pH classified as moderately alkaline
- Low concentrations of plant-available nutrients and organic carbon, similar to analogue soils
- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance, within the range measured for the analogue soils.

- Field observations indicate the tailings material supports the growth of local vegetation

Tailings cover material

- Compacted oxide waste rock with variable coarse rock % (up to approx. 80%). Clay content of the soil sized fraction ranging from 9 to 12%
- Non-sodic, with a low propensity for clay dispersion
- Drainage classifications (at 95% MDD) of 'moderate' to 'moderately rapid'
- Low field capacity and plant-available water content
- Classified as non-saline. Soil pH classified as moderately alkaline
- Low concentrations of plant-available nutrients and organic carbon, similar to analogue soils.
- Classified as non-saline. Soil pH classified as strongly alkaline
- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance, within the range measured for the analogue soils.
- Field observations indicate the tailings cover material supports the growth of local vegetation

Stockpiled topsoil

- Predominantly single grained soil with up to 40% coarse rock material, clay content up to 29%
- Non-sodic, with a low propensity for clay dispersion
- Low concentrations of plant-available nutrients and organic carbon, similar to analogue soils
- Classified as non-saline. Soil pH classified as moderately alkaline
- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance, within the range measured for the analogue soils
- Field observations indicate the stockpiled topsoil material supports the growth of local vegetation

Potential borrow material

- Single grained to massively structured sandy clay material (up to 22% clay) with variable coarse fragment content, up to 31%
- Non-sodic, with a low propensity for clay dispersion
- Drainage classification (at 95% MDD) of 'extremely slow'
- Moderate field capacity and plant-available water content
- Classified as non-saline. Soil pH classified as neutral
- Low concentrations of plant-available nutrients and organic carbon, similar to analogue soils
- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance, within the range measured for the analogue soils
- Field observations indicate the potential borrow material supports the growth of local vegetation

Decant cover material

- Weakly structured to single grained oxide waste rock material with a loose consistence and up to 70% coarse fragment content
- Variable sodicity, ranging from non-sodic to highly sodic. High propensity for clay dispersion

- Drainage classifications (at 95% MDD) of ‘very slow’ to ‘extremely slow’
- Moderate field capacity and plant-available water content
- Classified as slightly saline. Soil pH classified as strongly alkaline
- Low concentrations of plant-available nutrients and organic carbon, similar to analogue soils
- Generally low concentrations of total metals, with elevated concentrations of cadmium (Cd), selenium (Se), beryllium (Be) and copper (Cu), relative to the average crustal abundance, within the range measured for the analogue soils
- Field observations indicate the decant cover material supports the growth of local vegetation

Decant embankment material

- Weakly structured soil with a loose consistence, approximately 20% clay and 40% coarse fragments
- Minor propensity for clay dispersion upon severe disturbance
- Drainage classification (at 95% MDD) of ‘extremely slow’
- Moderate field capacity and plant-available water content
- Field observations indicate the decant embankment material supports the growth of local vegetation

4.2 Suitability of materials for use as a rehabilitation / cover material

The materials sampled as part of this investigation are considered a valuable source of potential rehabilitation / cover materials for used in mine closure. The chemical characteristics of the materials, while variable, were generally within the range exhibited by the analogue soils within the Project area. The potential sources of rehabilitation / cover material sampled are generally non-saline, low in plant-available nutrients (similar to analogue soils) and, as evidenced by field observations, are capable of supporting the growth of local vegetation species.

The physical characteristics of the materials were variable, reflecting the range of particle sized distributions present. Hydraulic conductivity of the materials (at 95% of MDD) was highly variable, with drainage classifications ranging from ‘Extremely slow’ to ‘Very rapid’. The water retention characteristics of the potential sources of rehabilitation / cover material (<2mm fraction) were also variable, with the water content at field capacity (i.e. the amount of water held in the materials after gravity induced drainage has ceased) and the plant-available water content (PAW) ranging from ‘low’ to ‘moderate’. The results for the waste rock samples were variable, with PAW contents ranging from 9.7 to 20.4% (i.e., low to moderate), again reflective of the variable particle size distribution of the waste rock samples.

5. References

Brady, N. and Weil, R. (2002). *The Nature and Properties of Soils - Thirteenth Edition.* New Jersey: Prentice Hall.

Cochrane, H. R., & Alymore, L. A. (1997). Assessing management induced changes in the structural stability of hardsetting soils. *Soil and Tillage Research*.

Hunt, N and Gilkes, R. (1992). *Farm monitoring handbook, a practical down-to-earth manual for farmers and other land users.* Perth: The University of Western Australia.

Mine Earth (2025) Tick Hill Cover Modelling. Unpublished report prepared for Tick Hill Mining Pty Ltd

Moore, G. (2004). *Soilguide. A handbook for understanding and managing agricultural soils. Bulletin No. 4343.* Perth: Agriculture Western Australia.

Rayment, G. E., & Lyons, D. J. (2010). *Soil Chemical Methods - Australasia.* CSIRO.

Reimann, C. and de Caritat, P. (1998). *Chemical Elements in the Environment.* Berlin: Springer.

van Gool, D. T. (2005). *Land evaluation standards for land resource mapping.* Agriculture Western Australia.

Appendix A

Sample site descriptions

MINE EARTH

Site Ref:	Analogue 1	**Datum:**	GDA94 z54
Site Description:	Analogue soil site – hill foot slope, adjacent to road cutting	**Easting:**	389082.2
		Northing:	7605553.6

Plate A1: Soil profile at Site A1

Soil profile description:

0-10cm: Weakly structured red to brown soil with a loose consistence and approximately 30% coarse fragments, 2 to 80mm in size. Root growth classified as 'many'.

10 to 20cm: Single grained, loose grey soil within fractured, partly weathered rock. Rock fraction approx. 50%. Root growth classified as 'few'. Excavator refusal at 20cm.

Soil surface:
Weak soil crust with scattered coarse fragments. No visual signs of surface erosion present.

Vegetation:
Buffel Grass, sparse shrubs and small trees.

Plate A2: Vegetation at Site A1

Site Ref:	Analogue 2 (A2)	**Datum:**	GDA94 z54
Site Description:	Analogue soil site – flat	**Easting:**	389218.0
		Northing:	7606042.2

Plate A3: Soil profile at Site A2

Soil profile description:

0-10cm: Weakly structured brown to red soil with a loose consistence and approximately 60% coarse fragments, 2 to 50mm in size. Root growth classified as 'many'.

10-30cm: Weakly structured brown to red soil with a firm consistence and approximately 20% coarse fragments, 2 to 50mm in size. Root growth classified as 'many'.

30-60cm (base of excavation): Massive sandy clay horizon with approx. 20% coarse fragments, 2 to 50mm in size. Root growth classified as 'few'.

Soil surface:
Weak soil crust with coarse fragment lag. No visual signs of surface erosion present.

Vegetation:
Buffel Grass, sparse shrubs and small trees.

Plate A4: Vegetation at Site A2

Site Ref:	Analogue 3 (A3)	**Datum:**	GDA94 z54
Site Description:	Analogue soil site - flat	**Easting:**	388627.7
		Northing:	7606427.0

Plate A5: Soil profile at Site A3

Soil profile description:

0-20cm: Moderately structured red to brown soil with a loose consistence and approximately 50% coarse fragments, 2 to 50mm in size. Root growth classified as 'many'.

20-70cm (base of excavation): Weakly structured brown to red soil with a firm consistence and approx. 20% coarse fragments, 2 to 50mm in size. Root growth classified as 'many', decreasing to 'few' with depth.

Soil surface:
Weak soil crust with coarse fragment lag. Minor evidence of surface erosion present.

Vegetation:
Buffel Grass, sparse shrubs and small trees.

Plate A6: Vegetation at Site A3

Site Ref:	Analogue 4 (A4)	**Datum:**	GDA94 z54
Site Description:	Analogue soil site - flat	**Easting:**	389123.1
		Northing:	7606432.8

Plate A7: Soil profile at Site A4

Soil profile description:

0-20cm: Moderately structured red to brown soil with a loose consistence and approximately 50% coarse fragments, 2 to 30mm in size. Root growth classified as 'abundant'.

20-70cm (base of excavation): Weakly structured to massive brown to red soil with a firm consistence and approximately 30% coarse fragments, 2 to 50mm in size. Root growth classified as 'many', decreasing to 'few' with depth.

Soil surface:
Weak soil crust with coarse fragment lag. Minor evidence of surface erosion present.

Soil surface:
Buffel Grass, shrubs and small trees.

Plate A8: Vegetation at Site A4

Site Ref:	Analogue 5 (A5)	**Datum:**	GDA94 z54
Site Description:	Analogue soil site - flat	**Easting:**	388407.1
		Northing:	7606235.1

Plate A9: Soil profile at Site A5

Soil profile description:

0-40cm: Moderately structured red to brown soil with a loose consistence and approximately 40% coarse fragments, 2 to 30mm in size. Root growth classified as 'abundant'.

40-70cm (base of excavation): Moderately structured red to brown soil with a loose to firm consistence and approximately 30% coarse fragments, 2 to 50mm in size. Root growth classified as 'many', decreasing to 'few' with depth.

Soil surface:
Weak soil crust with coarse fragment lag.

Vegetation:
Buffel Grass, shrubs and small trees.

Plate A10: Vegetation at Site A5

Site Ref:	Borrow 1 (B1)	**Datum:**	GDA94 z54
Site Description:	Potential borrow area	**Easting:**	388576.2
		Northing:	7605197.4

Plate A11: Soil profile at Site B1

Soil profile description:

0-20cm: Single grained red to brown soil with a loose consistence and approximately 60% coarse fragments, 2 to 30mm in size. Root growth classified as 'many'.

20-70cm (base of excavation): Massive red to brown soil with a moderate consistence and approximately 30% coarse fragments, 2 to 30mm in size. Increase in clay content with depth. Root growth classified as 'many', decreasing to 'few' with depth.

Soil surface:
No surface crust, coarse fragment lag.

Vegetation:
Buffel Grass, native grasses, scattered shrubs and small trees.

Plate A12: Vegetation at Site B1

Site Ref:	Borrow 2 (B2)	**Datum:**	GDA94 z54
Site Description:	Potential borrow area	**Easting:**	388637.3
		Northing:	7605832.9

Plate A13: Soil profile at Site B2

Soil profile description:

0-10cm: Weakly structured red to brown soil with a loose consistence and approximately 40% coarse fragments, 2 to 20mm in size. Root growth classified as 'many'.

10-100cm: Moderately structured to massive sandy clay with a firm consistence and approx. 25% coarse fragments

>100cm: Massive sandy clay. Rock fragments increasing in size and abundance.

Soil surface:
No surface crust, coarse fragment lag.

Vegetation:
Native grasses, Buffel grass, scattered shrubs and small trees.

Plate A14: Vegetation at Site B2

Site Ref:	Decant cover 1 (DC1)	**Datum:**	GDA94 z54
Site Description:	In situ decant cover material	**Easting:**	388469.0
		Northing:	7605686.9

Plate A15: Soil profile at Site DC1

Soil profile description:

0-20cm: Brown, weakly structured to single grained with a loose consistence and approximately 60% coarse fragments, 2 to 40mm in size. Root growth classified as 'abundant'.

20-50cm: Mottled, brown, weakly structured to single grained oxide material with a loose consistence and approximately 70% coarse fragments, 2 to 50mm in size. Root growth classified as 'many', decreasing with depth.

>50cm: Tailings.

Soil surface:
Weak surface crust

Vegetation:
Buffel grass, scattered shrubs and small trees.

Plate A16: Vegetation at Site DC1

Site Ref:	Decant cover 2 (DC2)	**Datum:**	GDA94 z54
Site Description:	In situ decant cover material	**Easting:**	388506.0
		Northing:	7605825.6

Plate A17: Soil profile at Site DC2

Soil profile description:

0-20cm: Red to brown, moderately structured soil with a loose consistence and approximately 60% coarse fragments, 2 to 40mm in size. Root growth classified as 'abundant'.

20-50cm: Mottled, brown, weakly structured to single grained oxide material with a loose consistence and approximately 70% coarse fragments, 2 to 50mm in size. Root growth classified as 'many', decreasing with depth.

>50cm: Tailings.

Soil surface:
Weak soil crust

Vegetation:
Buffel grass, scattered shrubs and small trees.

Plate A18: Vegetation at Site DC2

Site Ref:	Decant embankment 1 (DE1)	**Datum:**	GDA94 z54
Site Description:	In situ decant embankment material	**Easting:**	388506.0
		Northing:	7605825.6

Plate A19: Soil profile at Site DE1

Soil profile description:

0-20cm: Red to brown, weakly structured soil with a loose consistence and approximately 30% coarse fragments, 2 to 40mm in size. Root growth classified as 'abundant'.

20-50cm: Brown, weakly structured soil with a loose consistence and approximately 30% coarse fragments, 2 to 50mm in size. Root growth classified as 'many', decreasing with depth.

Soil surface:
No surface crust.

Vegetation:
Buffel grass, scattered shrubs.

Plate A20: Vegetation at Site DE1

Site Ref:	Tailings 1 (T1)	**Datum:**	GDA94 z54
Site Description:	In situ tailings	**Easting:**	388637.9
		Northing:	7605581.9

Plate A21: Soil profile at Site T1

Soil profile description:

0-20cm: Silty, light brown to grey tailings, moderate structure with a firm consistence. Abundant root growth.

20-60cm (base of excavation): Silty, light brown to grey tailings, moderate structure decreasing to massive structure with depth. Firm consistence. Root growth classified as 'many', decreasing to 'few' with depth.

Soil surface:
Loose surface, minor signs of erosion.

Vegetation:
Sparse grasses and shrubs.

Plate A22: Vegetation at Site T1

Site Ref:	Tailings 2 (T2)	**Datum:**	GDA94 z54
Site Description:	In situ tailings	**Easting:**	388627.7
		Northing:	7605487.8

Plate A23: Soil profile at Site T2

Soil profile description:

0-30cm: Silty, light brown to grey tailings, moderate structure with a firm consistence. Abundant root growth.

30-60cm (base of excavation): Silty, light brown to grey tailings, moderate structure decreasing to massive structure with depth. Firm consistence. Root growth classified as 'many', decreasing to 'few' with depth.

Soil surface:
Predominantly loose, friable surface, minor signs of erosion.

Vegetation:
Scattered small shrubs

Plate A24: Vegetation at Site T2

Site Ref:	Tailings cover 1 (TC1)	**Datum:**	GDA94 z54
Site Description:	In situ tailings cover material – cleared area of TSF surface	**Easting:**	388439.3
		Northing:	7605515.8

Plate A25: Soil profile at Site TC1

Soil profile description:

0-50cm: Thin topsoil layer extending to approximately 5cm depth, overlying compacted soil / oxide material with approximately 80% rock fragments.

Soil surface:
Disturbed from vegetation / topsoil clearing.

Vegetation:
None.

Plate A26: Vegetation at Site TC1

Site Ref:	Tailings cover 2 (TC2)	**Datum:**	GDA94 z54
Site Description:	In situ tailings cover material – vegetated area of TSF surface	**Easting:**	388547.2
		Northing:	7605410.4

Plate A27: Soil profile at Site TC2

Soil profile description:

0-20cm: Well structured, reddish brown topsoil layer with approximately 25% rock fragments. Abundant root growth.

20-60cm: Predominantly single grained soil / oxide waste material with approximately 80% rock fragments. Root growth classified as 'many', decreasing to 'few' with depth.

Soil surface:
Predominantly loose, friable surface. Approximately 25% rock fragment cover.

Vegetation:
Buffel grass and scattered small shrubs

Plate A28: Vegetation at Site TC2

Site Ref:	Topsoil 1 (TS1)	**Datum:**	GDA94 z54
Site Description:	Stockpiled topsoil – salvaged from TSF surface	**Easting:**	388511.1
		Northing:	7605591.7

Plate A29: Soil profile at Site TS1

Soil stockpile description:

0-70cm: Reddish brown, predominantly single grained soil with approximately 20% rock fragments. Root growth classified as 'few'.

Soil surface:
Weak surface crust, minor surface erosion

Vegetation:
Scattered shrubs and grasses

Plate A30: Vegetation at Site TS1

Site Ref:	Topsoil 2 (TS2)	**Datum:**	GDA94 z54
Site Description:	Stockpiled topsoil – salvaged from TSF surface	**Easting:**	388539.6
		Northing:	7605576.5

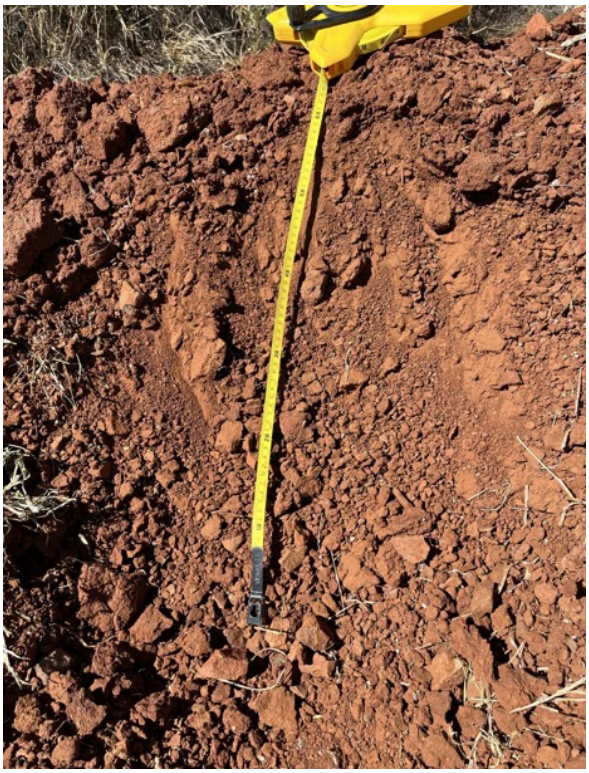


Plate A31: Soil profile at Site TS2

Soil stockpile description:

0-70cm: Reddish brown, predominantly single grained soil with some weak to moderate aggregates. Approximately 40% rock fragments. Root growth classified as 'few'.

Soil surface:
Weak surface crust, minor surface erosion

Vegetation:
Scattered shrubs and grasses

Plate A32: Vegetation at Site TS2

Site Ref:	Waste rock 1 (WR1)	**Datum:**	GDA94 z54
Site Description:	WRD batter – upper lift	**Easting:**	389032.1
		Northing:	7606177.9

Plate A33: Soil profile at Site WR1

Soil profile description:

0-20cm: Reddish brown, predominantly single grained topsoil with some weak aggregates. Approximately 30% rock fragments. Root growth classified as 'many'.

20-150cm: Brown to grey oxide waste rock, single grained matrix with weak to moderate aggregates and approximately 40% gravel sized coarse fragment. Root growth classified as 'few', decreasing with depth.

Soil surface:
Predominantly loose, friable surface. Approximately 30% rock fragment cover.

Vegetation:
Scattered shrubs, small tress and grasses

Plate A34: Vegetation at Site WR1

Site Ref:	Waste rock 2 (WR2)	**Datum:**	GDA94 z54
Site Description:	WRD - upper surface	**Easting:**	389075.0
		Northing:	7606319.0

Plate A35: Soil profile at Site WR2

Soil profile description:

0-20cm: Brown, aggregated topsoil material with weak to moderate aggregates. Approximately 25% rock fragments. Root growth classified as 'abundant'.

20-100cm: Brown to grey oxide waste rock, single grained matrix with some weak to moderate aggregates and approximately 40% coarse fragments. Root growth classified as 'many', decreasing with depth.

Soil surface:
Predominantly loose, friable surface. Approximately 20% rock fragment cover.

Vegetation:
Scattered shrubs and grasses

Plate A36: Vegetation at Site WR2

Site Ref:	Waste rock 3 (WR3)	**Datum:**	GDA94 z54
Site Description:	WRD - upper surface	**Easting:**	389097.5
		Northing:	7606173.7

Plate A37: Soil profile at Site WR3

Soil profile description:

0-10cm: Reddish brown, predominantly single grained topsoil with some weak aggregates. Approximately 10% rock fragments. Root growth classified as 'many'.

10-100cm: Brown to grey oxide waste rock with fresh competent waste rock throughout (approximately 60% coarse material, but variable). Root growth classified as 'few', decreasing with depth.

Soil surface:
Predominantly loose, friable surface. Approximately 20% rock fragment cover.

Vegetation:
Sparse grasses.

Plate A38: Vegetation at Site WR3

Appendix B

Soil Classifications

MINE EARTH

Emerson Dispersion Test Classes (Moore 1998)

Class	Description
Class 1	Dry aggregate slakes and completely disperses
Class 2	Dry aggregate slakes and partly disperses
Class 3a	Dry aggregate slakes but does not disperse; remoulded soil disperses completely
Class 3b	Dry aggregate slakes but does not disperse; remoulded soil partly disperses
Class 4	Dry aggregate slakes but does not disperse; remoulded soil does not disperse; carbonates and gypsum are present
Class 5	Dry aggregate slakes but does not disperse; remoulded soil does not disperse; carbonates and gypsum are absent; 1: suspension remains dispersed
Class 6	Dry aggregate slakes but does not disperse; remoulded soil does not disperse; carbonates and gypsum are absent; 1:5 suspension remains flocculated
Class 7	Dry aggregate does not slake; aggregate swells
Class 8	Dry aggregate does not slake; aggregate does not swell

Soil Electrical conductivity classes (based on standard USDA and CSIRO categories)

EC (1:5) (dS/m)						
Salinity class	**Sand**	**Sandy loam**	**Loam**	**Clay loam**	**Light / medium clay**	**Heavy clay**
Non-saline	<0.13	<0.17	<0.20	<0.22	<0.25	<0.33
Slightly saline	0.13 – 0.26	0.17 – 0.33	0.20 – 0.40	0.22 – 0.44	0.25 – 0.50	0.33 – 0.67
Moderately saline	0.26 – 0.52	0.33 – 0.67	0.40 – 0.80	0.44 – 0.89	0.50 – 1.00	0.67 – 1.33
Very saline	0.52 – 1.06	0.67 – 1.33	0.80 – 1.60	0.89 – 1.78	1.00 – 2.00	1.33 – 2.67
Extremely saline	>1.06	>1.33	>1.60	>1.78	>2.00	>2.67

Soil pH classes

	Soil pH rating						
	Very strongly acid (Vsac)	**Strongly acid (Sac)**	**Moderately acid (Mac)**	**Slightly acid (Slac)**	**Neutral (N)**	**Moderately alkaline (Malk)**	**Strongly alkaline (Salk)**
pH_w	<5.3	5.3 – 5.6	5.6 – 6.0	6.0 – 6.5	6.5 – 8.0	8.0 – 9.0	>9.0
pH_{Ca}	<4.2	4.2 – 4.5	4.5 – 5.0	5.0 – 5.5	5.5 – 7.0	7.0 – 8.0	>8.0

Appendix C

Laboratory Test Certificates

MINE EARTH

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PERMEABILITY BY CONSTANT HEAD TEST REPORT

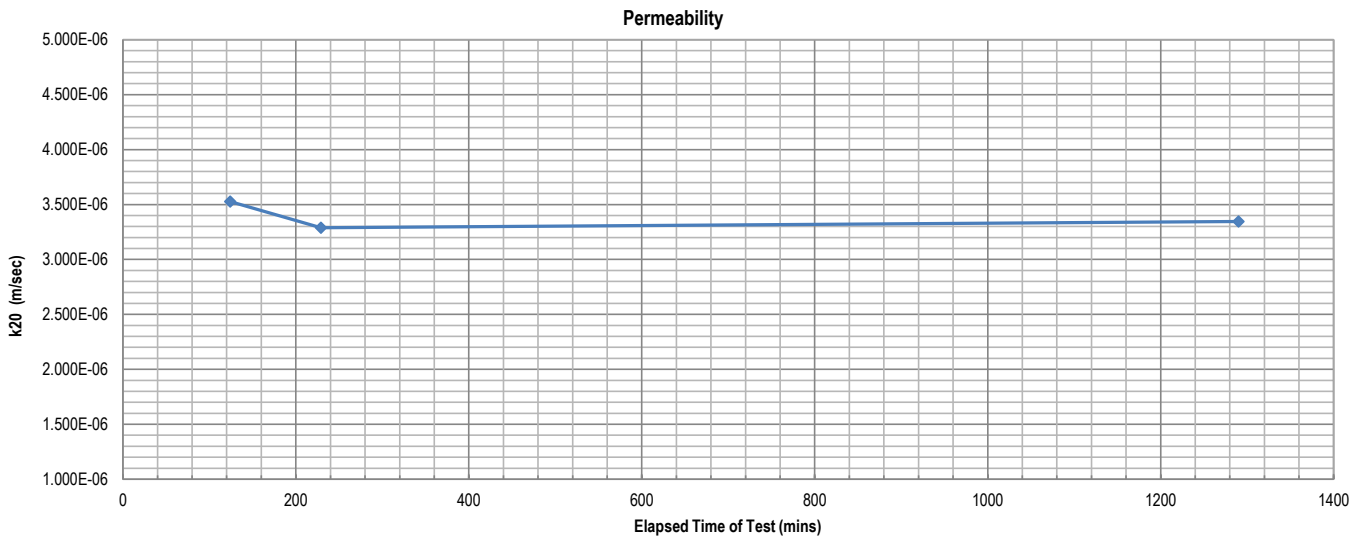
Test Method AS 1289 6.7.1, 5.1.1

Client	Mine Earth	**Report No.**	24090390-CPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	8/10/2024
		Report Date	25/10/2024
Project	TCK-2405		
Client ID	T1	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.58**	Hydraulic Gradient	**2.3**
Optimum Moisture Content (%)	**5.8**	Surcharge (kPa)	**2.9**
Placement Moisture Content (%)	**6.2**	Head Pressure Applied (kPa)	**2.65**
Moisture Ratio (%)	**107.0**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**1.59**	Percentage Material Retained/Sieve Size (mm)	**0 % / 19 mm**
Density Ratio (%)	**94.6**	Sample Height and Diameter (mm)	**116.52 / 101.51 mm**

PERMEABILITY $k_{(20)}$ = **3.3×10^{-06} (m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing

*NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Tested at Trilab Brisbane Laboratory

Approved Signatory

Michael Hamilton

Michael Hamilton

Laboratory No. 9926

The results of calibrations and tests performed apply only to the specific instrument or sample at the time of test unless otherwise clearly stated.
Reference should be made to Trilab's "Standard Terms and Conditions of Business" for further details.
Trilab Pty Ltd ABN 25 065 630 506

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090390-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090390
Client ID	T1
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**5**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

Accredited for compliance with ISO/IEC 17025 - Testing

*NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Tested at Trilab Brisbane Laboratory

Approved Signatory

Michael Hamilton

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

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ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

www.biotrack.com.au
781 Mt Glorious Rd Highvale 4520

Certificate of Analysis

Signatory:

Phone: +617 3289 7179 Bio-Track Pty Ltd ABN 91 056 237 275

Test Code/Name	**[449] Moisture Retention Curve - Soil**		
Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- Moisture Content calculated using Moisture Tension Plate
- Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)

Note: particles ≥ 10mm diameter have been removed prior to measurement. Results for samples with particles ≥ 10mm diameter have been rescaled assuming particles ≥ 10mm are functionally impervious.

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Results Summary			**%Moisture Grav. @ Specified Moisture Tension Points**								
S#	**SampleID**	**≥ 10mm grav. proportion**	**0 kPa (0 Bar)**	**10 kPa (0.1 Bar)**	**33 kPa (0.33 Bar)**	**100 kPa (1 Bar)**	**300 kPa (3 Bar)**	**500 kPa (5 Bar)**	**1000 kPa (10 Bar)**	**1500 kPa (15 Bar)**	**Available Water % Grav.**
1	24090390	0	44.3	33.3	30.9	6.5	*NM	3.8	*NM	2.3	31.0
2	24090391	0	39.7	32.4	29.9	5.6	*NM	3.5	*NM	1.6	30.8
3	24090392	0.43	13.5	10.6	9.4	4.8	*NM	3.4	*NM	2.4	8.2
4	24090393	0.54	11.8	9.2	8.1	3.0	*NM	2.2	*NM	1.5	7.6
5	24090394	0	37.5	30.4	28.7	19.4	*NM	12.8	*NM	10.0	20.4
6	24090395	0	35.5	24.8	23.4	18.2	*NM	9.0	*NM	6.7	18.1
7	24090396	0.43	13.4	10.4	9.2	1.8	*NM	1.1	*NM	0.7	9.7
8	24090397	0	35.0	30.1	28.0	15.5	*NM	13.2	*NM	10.2	19.9
9	24090398	0	36.1	32.2	30.0	20.7	*NM	12.7	*NM	10.0	22.2
10	24090399	0	27.3	25.2	22.7	7.6	*NM	3.9	*NM	2.5	22.7
11	24090400	0	32.2	26.0	23.2	22.3	*NM	13.1	*NM	10.3	15.8
12	24090401	0	36.6	30.8	26.0	24.9	*NM	15.4	*NM	12.3	18.5

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Certificate of Analysis

Signatory:

Phone: +617 3289 7179 Bio-Track Pty Ltd ABN 91 056 237 275

Test Code/Name	**[449] Moisture Retention Curve - Soil**		
Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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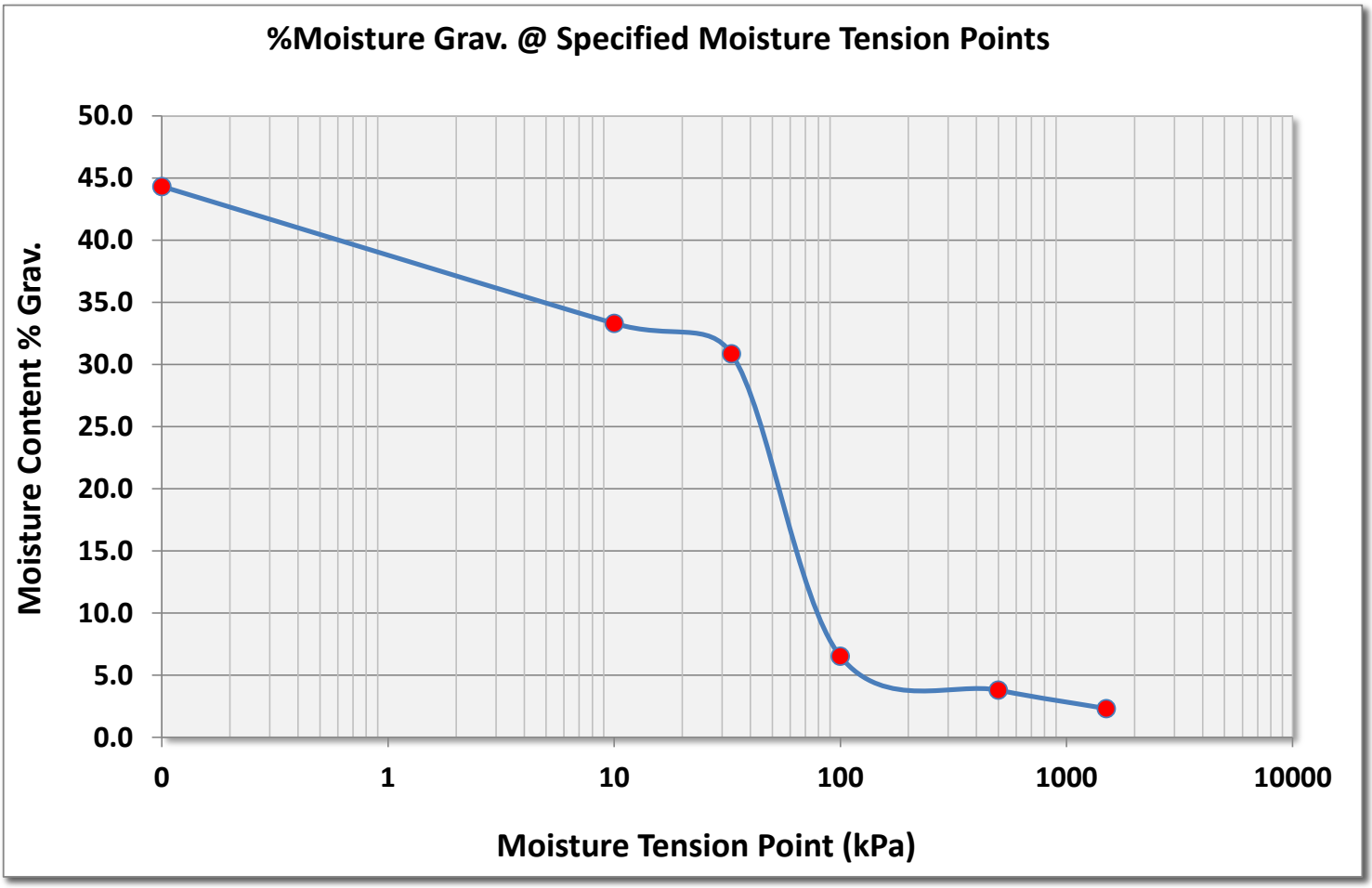
SampleID/Results	**%Moisture @ Specified Moisture Tension Points**										
24090390	**0 kPa (0 Bar)**	**1 kPa (0.01 Bar)**	**10 kPa (0.1 Bar)**	**33 kPa (0.33 Bar)**	**50 kPa (0.5 Bar)**	**100 kPa (1 Bar)**	**300 kPa (3 Bar)**	**500 kPa (5 Bar)**	**1000 kPa (10 Bar)**	**1500 kPa (15 Bar)**	**Available Water % Grav.**
%Moisture Grav.	44.3	*NM	33.3	30.9	*NM	6.5	*NM	3.8	*NM	2.3	31.0



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Certificate of Analysis

Signatory:

Phone: +617 3289 7179 Bio-Track Pty Ltd ABN 91 056 237 275

Test Code/Name	[449] Moisture Retention Curve - Soil		
Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
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Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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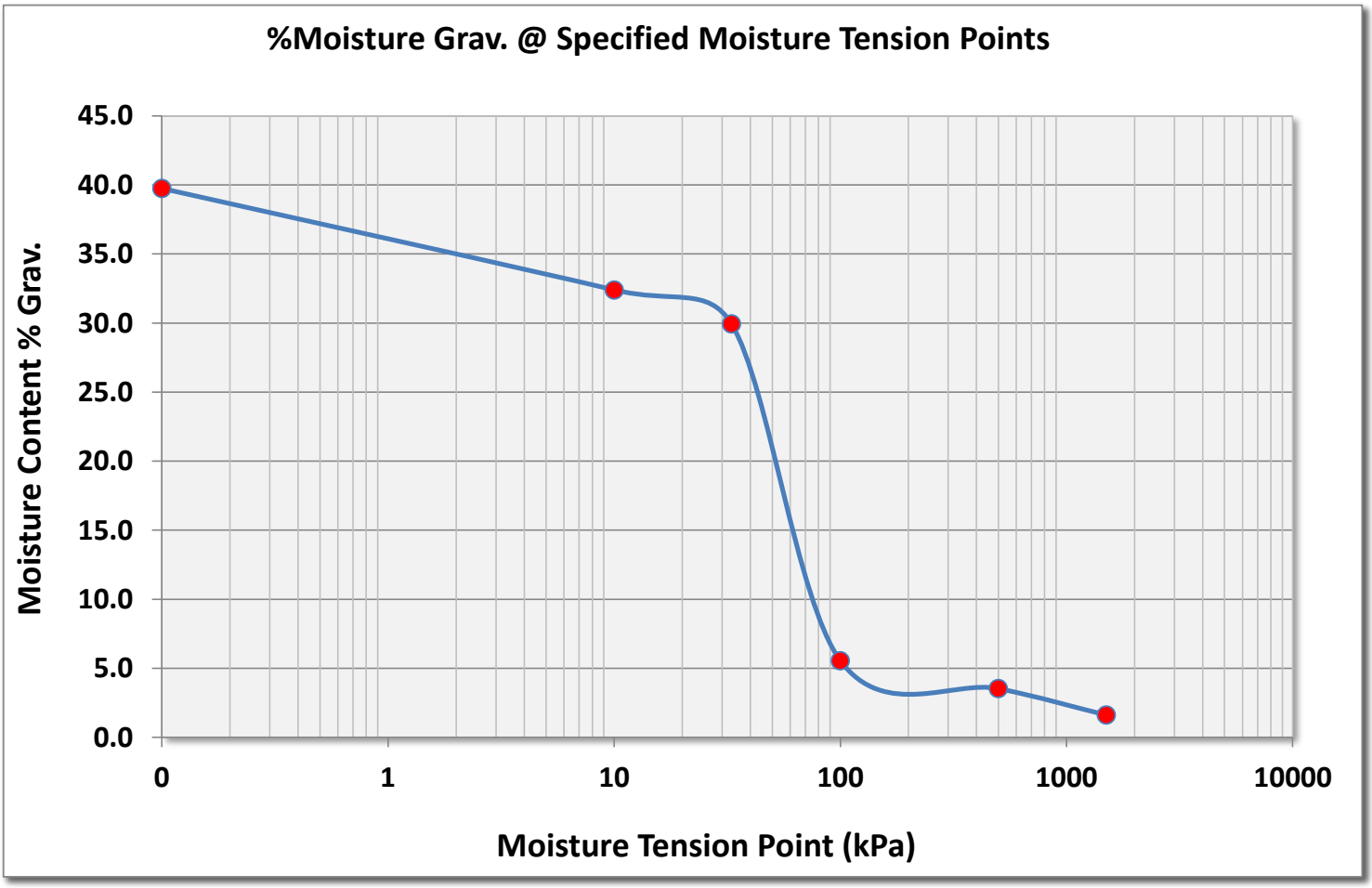
SampleID/Results	%Moisture @ Specified Moisture Tension Points										
24090391	0 kPa (0 Bar)	1 kPa (0.01 Bar)	10 kPa (0.1 Bar)	33 kPa (0.33 Bar)	50 kPa (0.5 Bar)	100 kPa (1 Bar)	300 kPa (3 Bar)	500 kPa (5 Bar)	1000 kPa (10 Bar)	1500 kPa (15 Bar)	Available Water % Grav.
%Moisture Grav.	39.7	*NM	32.4	29.9	*NM	5.6	*NM	3.5	*NM	1.6	30.8



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Test Code/Name	[449] Moisture Retention Curve - Soil		
Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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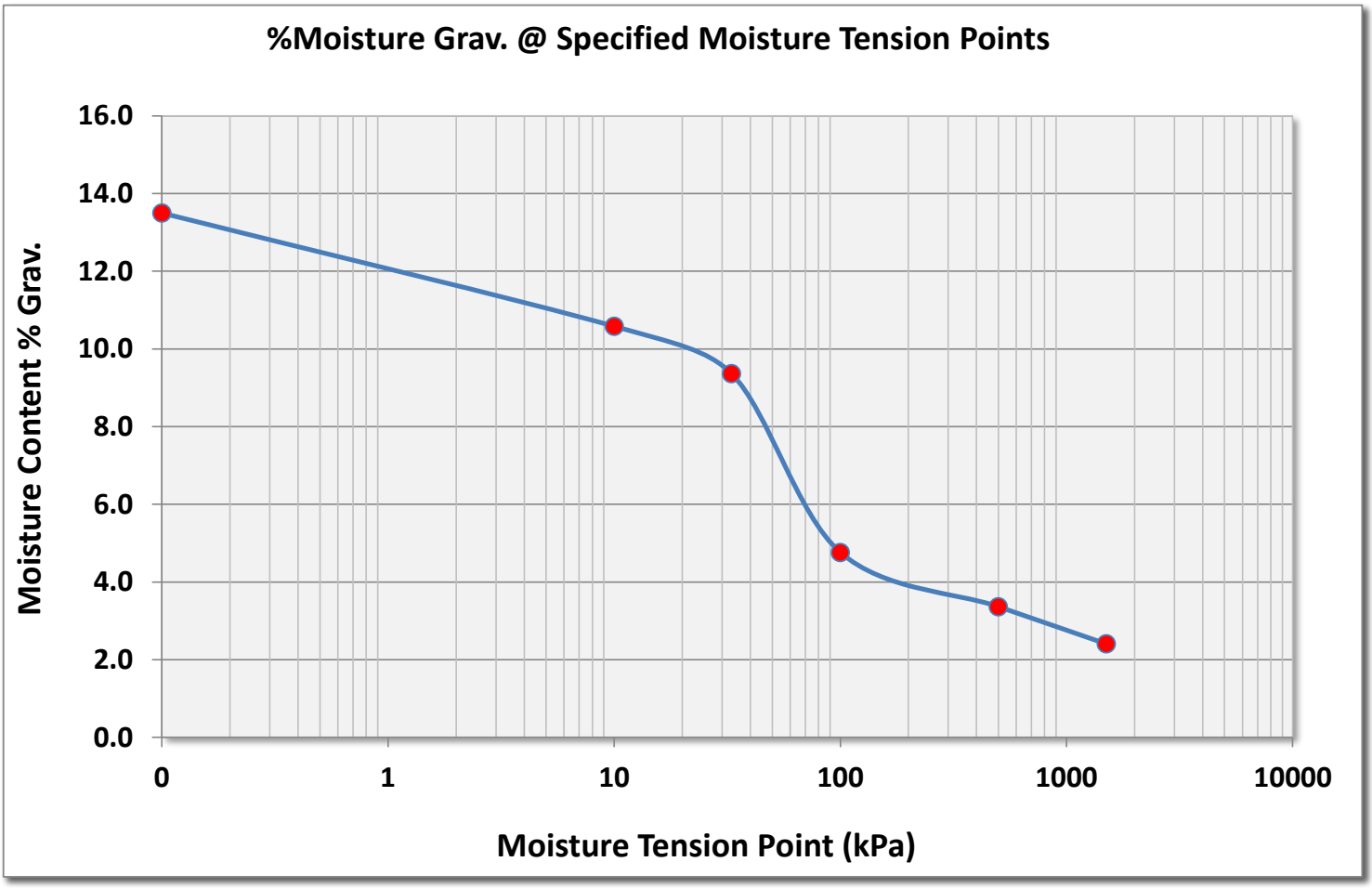
SampleID/Results	%Moisture @ Specified Moisture Tension Points										
24090392 [1]	0 kPa (0 Bar)	1 kPa (0.01 Bar)	10 kPa (0.1 Bar)	33 kPa (0.33 Bar)	50 kPa (0.5 Bar)	100 kPa (1 Bar)	300 kPa (3 Bar)	500 kPa (5 Bar)	1000 kPa (10 Bar)	1500 kPa (15 Bar)	Available Water % Grav.
%Moisture Grav.	13.5	*NM	10.6	9.4	*NM	4.8	*NM	3.4	*NM	2.4	8.2



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Test Code/Name	**[449] Moisture Retention Curve - Soil**		
Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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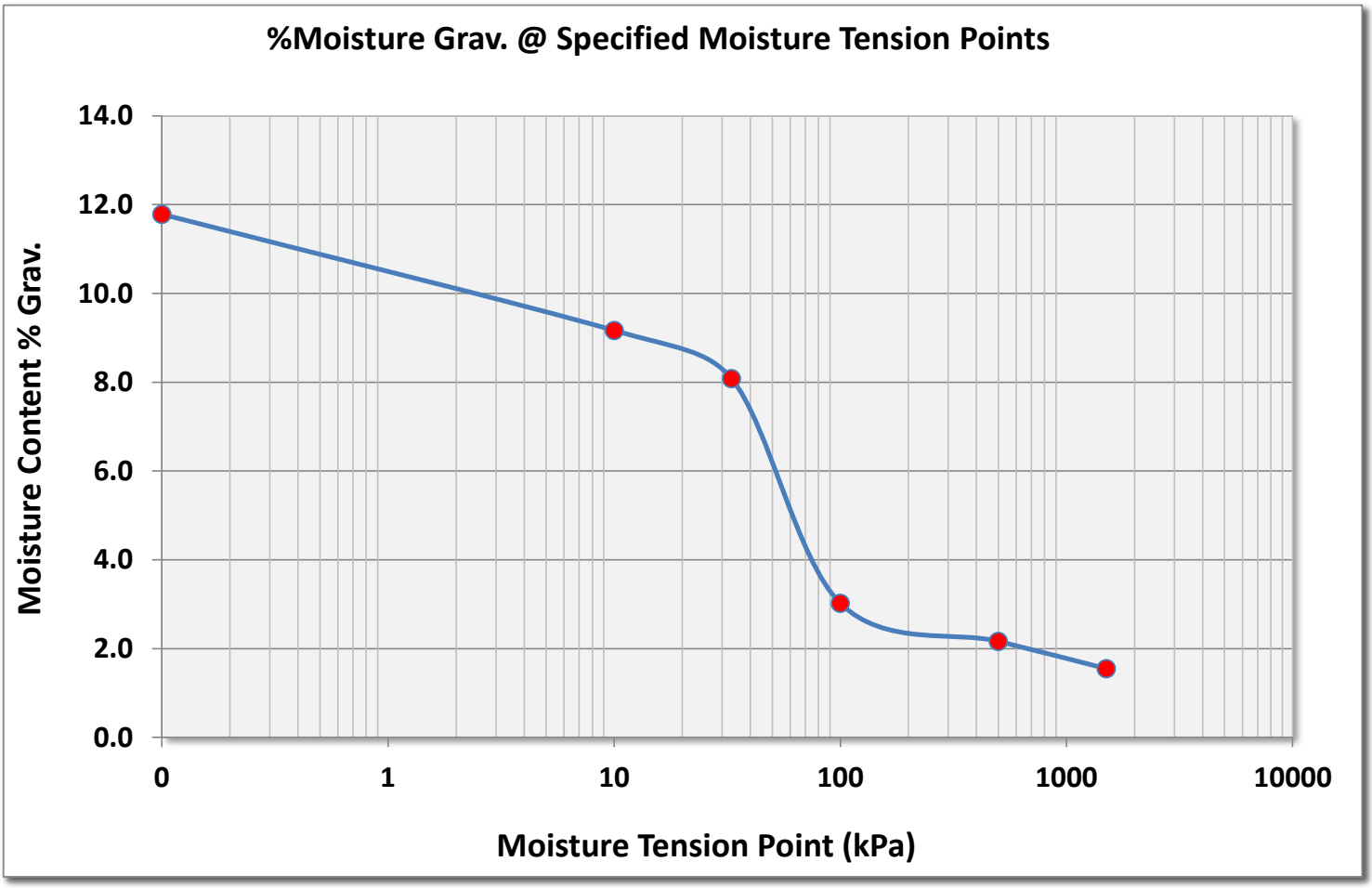
SampleID/Results	**%Moisture @ Specified Moisture Tension Points**										
24090393 [1]	**0 kPa (0 Bar)**	**1 kPa (0.01 Bar)**	**10 kPa (0.1 Bar)**	**33 kPa (0.33 Bar)**	**50 kPa (0.5 Bar)**	**100 kPa (1 Bar)**	**300 kPa (3 Bar)**	**500 kPa (5 Bar)**	**1000 kPa (10 Bar)**	**1500 kPa (15 Bar)**	**Available Water % Grav.**
%Moisture Grav.	11.8	*NM	9.2	8.1	*NM	3.0	*NM	2.2	*NM	1.5	7.6



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Test Code/Name	[449] Moisture Retention Curve - Soil		
Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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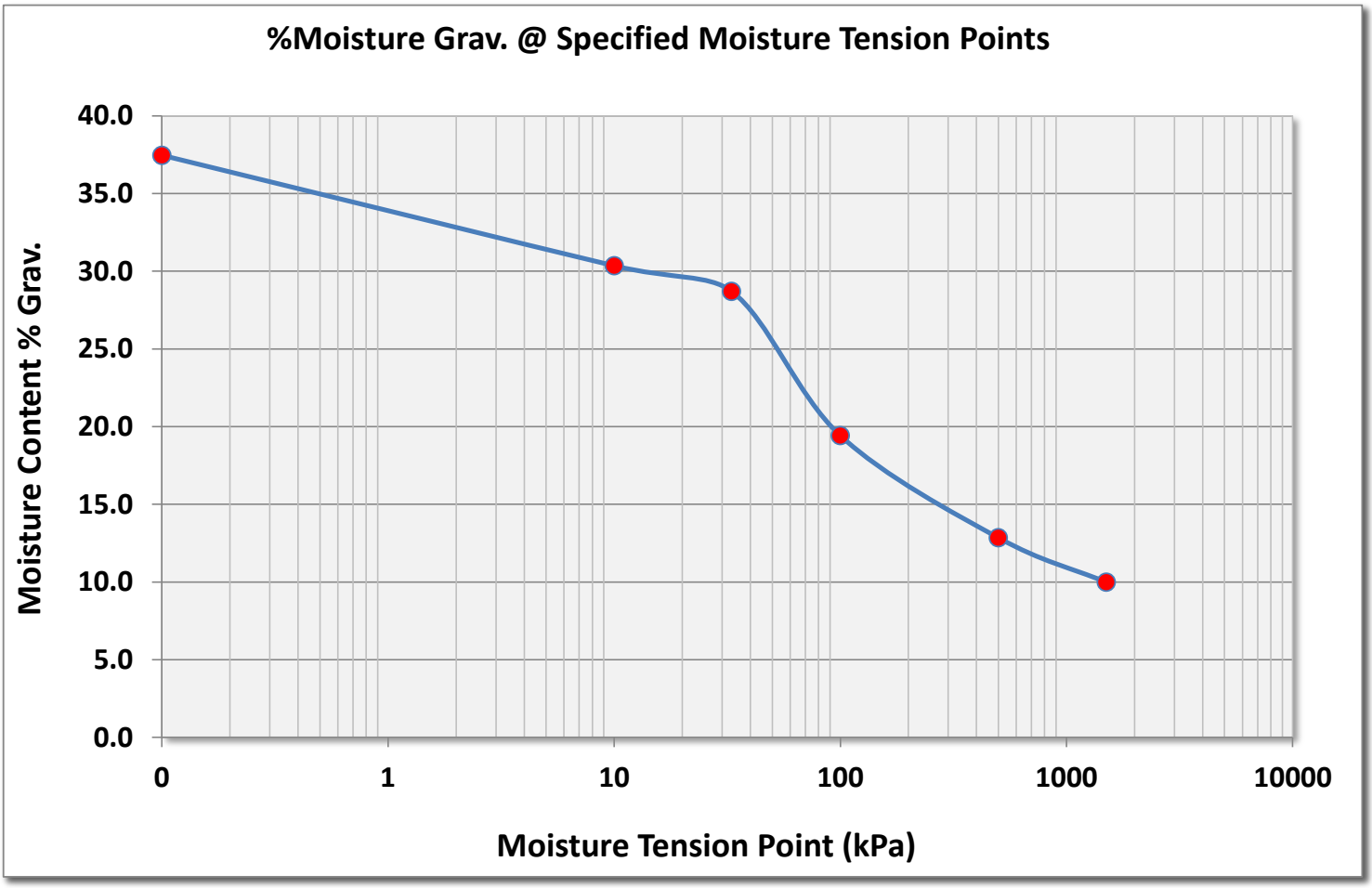
SampleID/Results	%Moisture @ Specified Moisture Tension Points										
24090394	0 kPa (0 Bar)	1 kPa (0.01 Bar)	10 kPa (0.1 Bar)	33 kPa (0.33 Bar)	50 kPa (0.5 Bar)	100 kPa (1 Bar)	300 kPa (3 Bar)	500 kPa (5 Bar)	1000 kPa (10 Bar)	1500 kPa (15 Bar)	Available Water % Grav.
%Moisture Grav.	37.5	*NM	30.4	28.7	*NM	19.4	*NM	12.8	*NM	10.0	20.4



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Test Code/Name	[449] Moisture Retention Curve - Soil		
Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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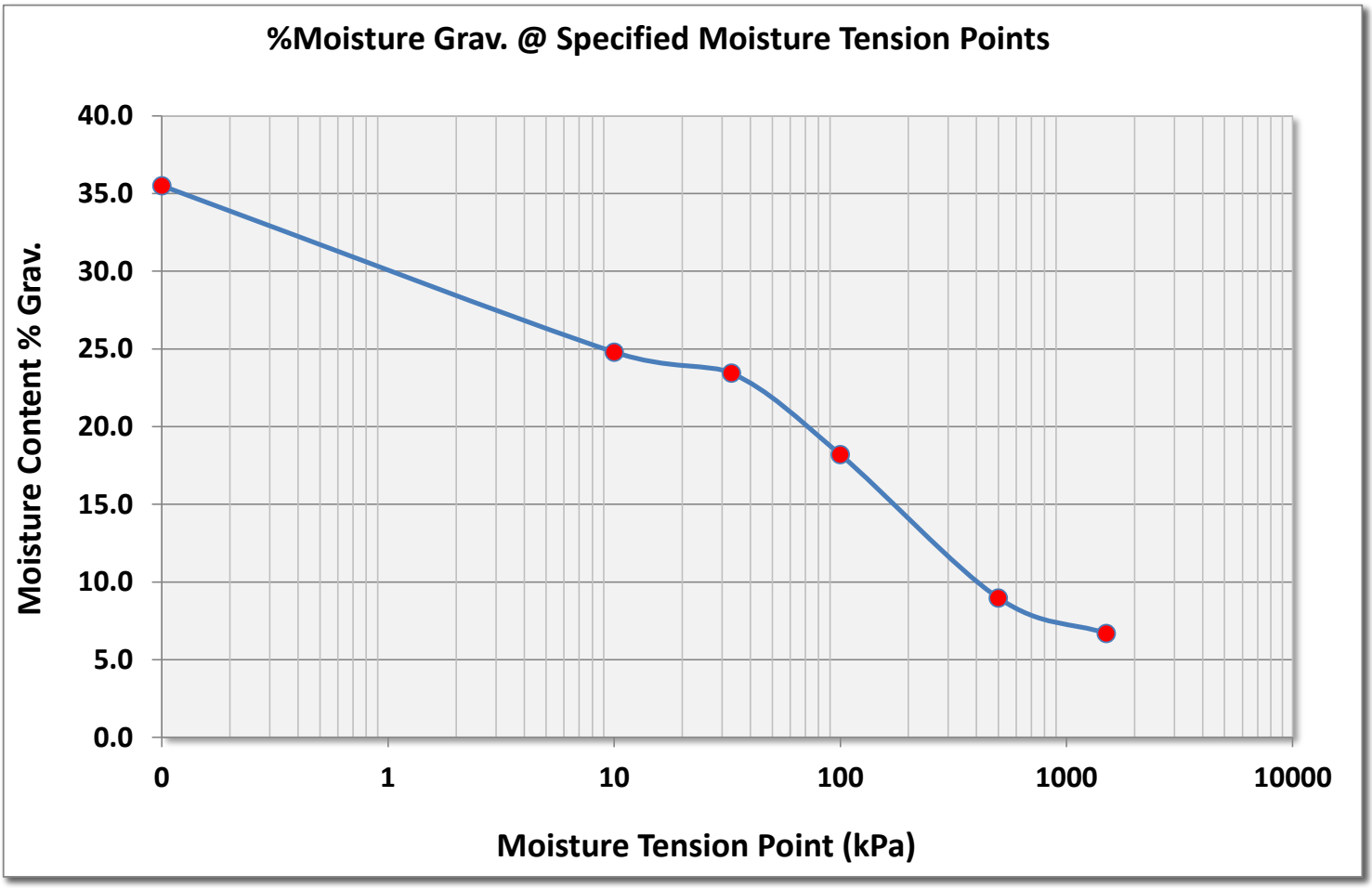
SampleID/Results	%Moisture @ Specified Moisture Tension Points										
24090395	0 kPa (0 Bar)	1 kPa (0.01 Bar)	10 kPa (0.1 Bar)	33 kPa (0.33 Bar)	50 kPa (0.5 Bar)	100 kPa (1 Bar)	300 kPa (3 Bar)	500 kPa (5 Bar)	1000 kPa (10 Bar)	1500 kPa (15 Bar)	Available Water % Grav.
%Moisture Grav.	35.5	*NM	24.8	23.4	*NM	18.2	*NM	9.0	*NM	6.7	18.1



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Test Code/Name	**[449] Moisture Retention Curve - Soil**		
Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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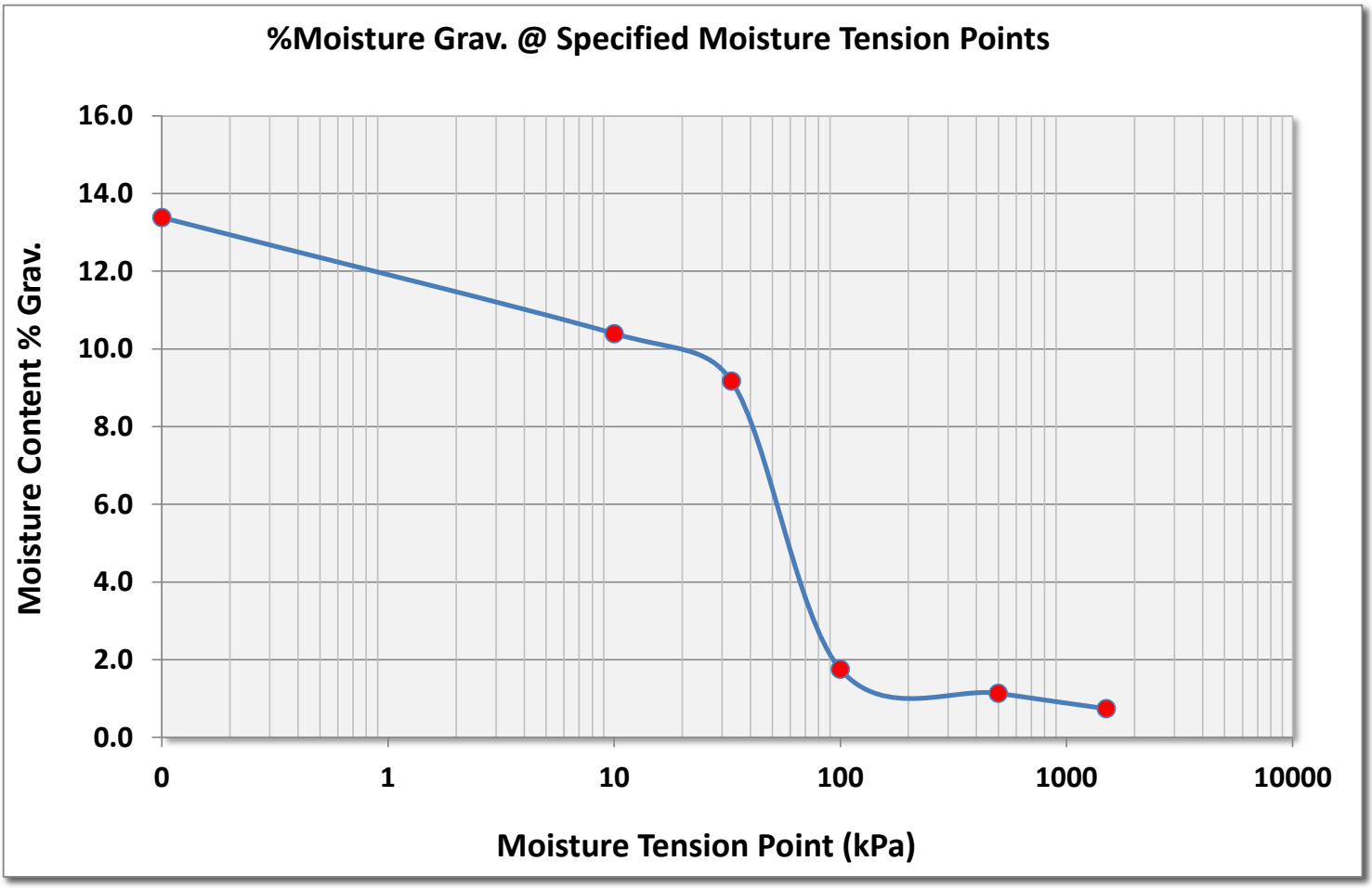
SampleID/Results	**%Moisture @ Specified Moisture Tension Points**										
24090396 [1]	**0 kPa (0 Bar)**	**1 kPa (0.01 Bar)**	**10 kPa (0.1 Bar)**	**33 kPa (0.33 Bar)**	**50 kPa (0.5 Bar)**	**100 kPa (1 Bar)**	**300 kPa (3 Bar)**	**500 kPa (5 Bar)**	**1000 kPa (10 Bar)**	**1500 kPa (15 Bar)**	**Available Water % Grav.**
%Moisture Grav.	13.4	*NM	10.4	9.2	*NM	1.8	*NM	1.1	*NM	0.7	9.7



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Test Code/Name	[449] Moisture Retention Curve - Soil		
Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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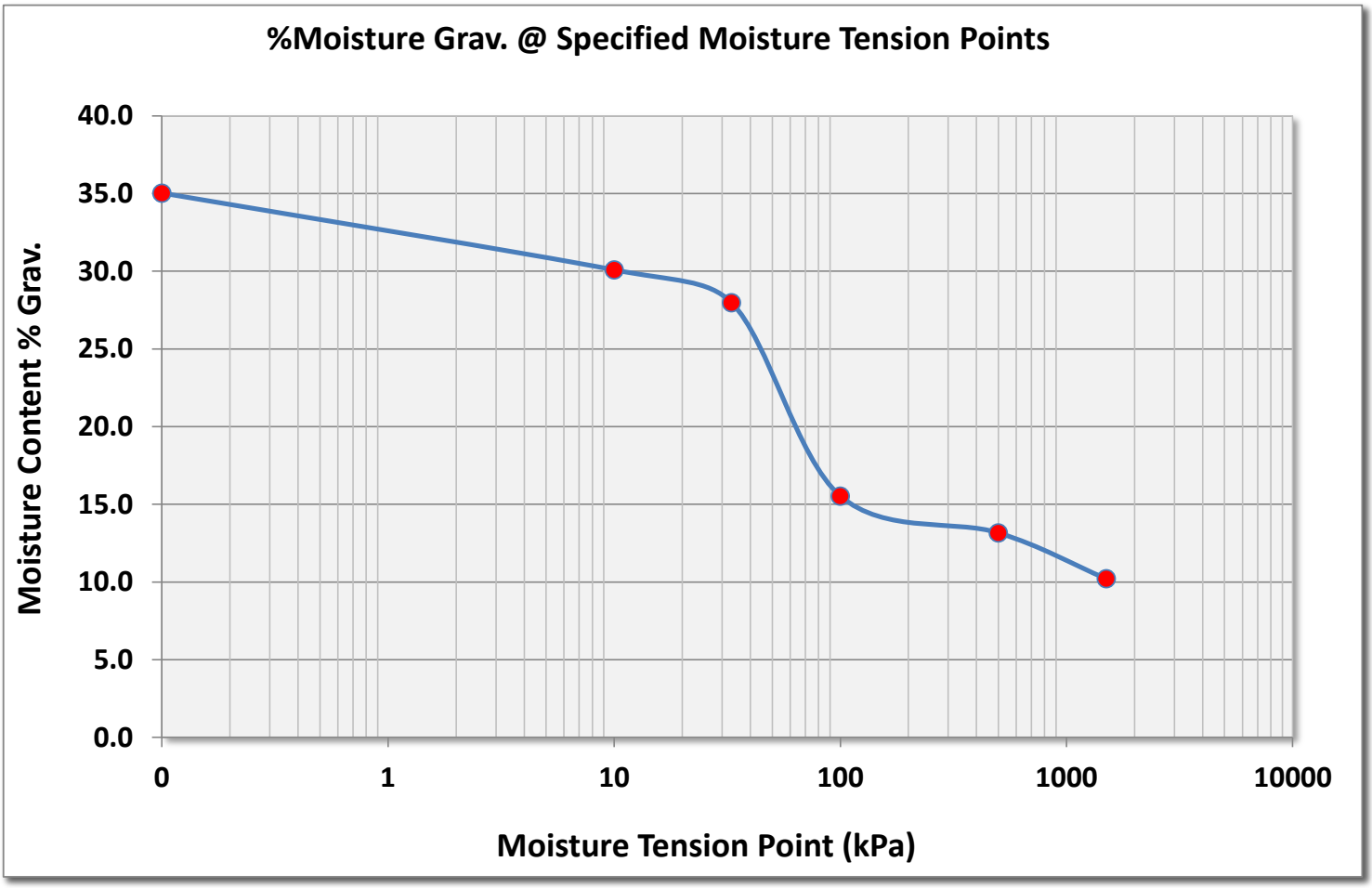
SampleID/Results	%Moisture @ Specified Moisture Tension Points										
24090397	0 kPa (0 Bar)	1 kPa (0.01 Bar)	10 kPa (0.1 Bar)	33 kPa (0.33 Bar)	50 kPa (0.5 Bar)	100 kPa (1 Bar)	300 kPa (3 Bar)	500 kPa (5 Bar)	1000 kPa (10 Bar)	1500 kPa (15 Bar)	Available Water % Grav.
%Moisture Grav.	35.0	*NM	30.1	28.0	*NM	15.5	*NM	13.2	*NM	10.2	19.9



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Test Code/Name	**[449] Moisture Retention Curve - Soil**		
Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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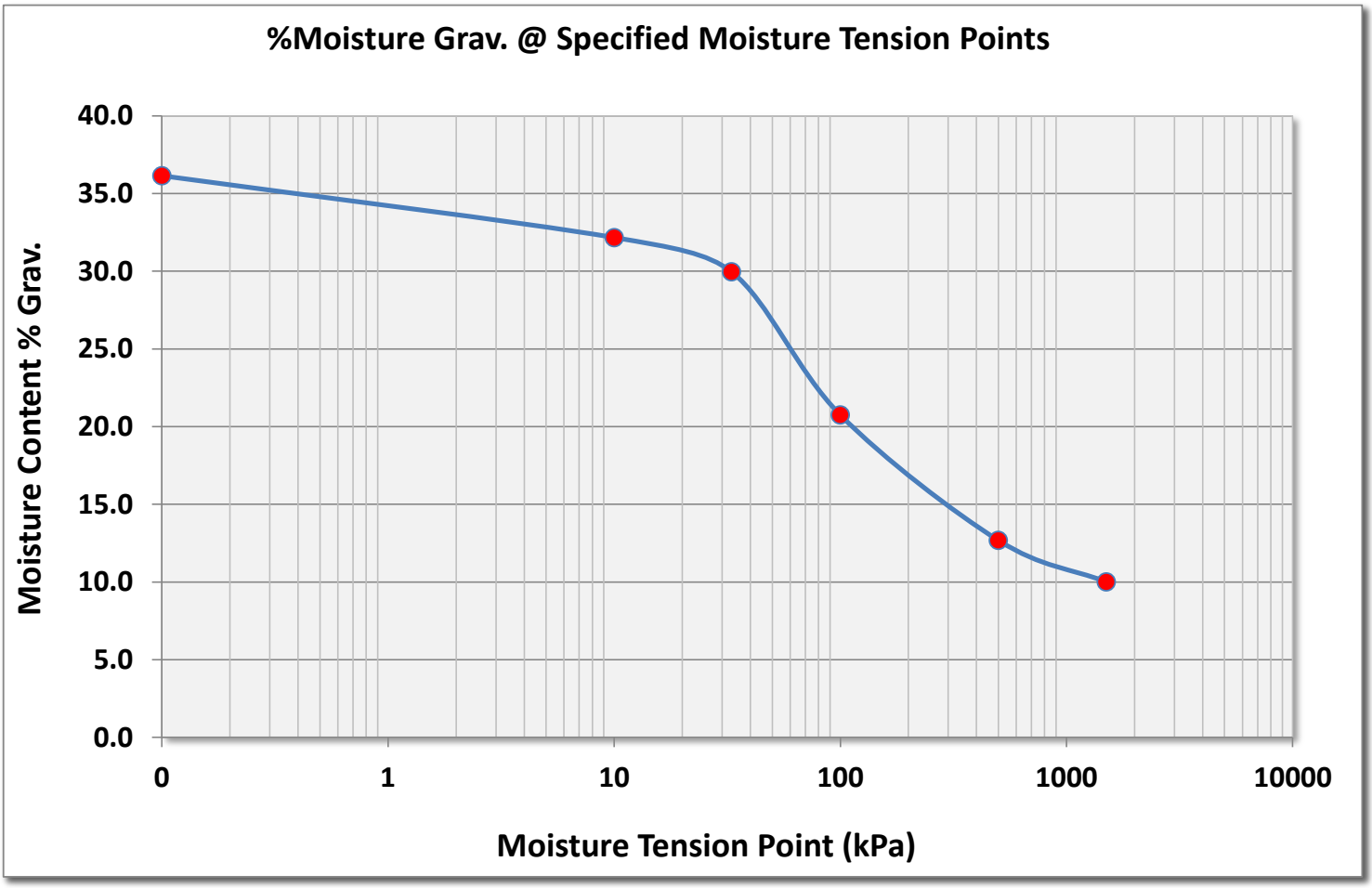
SampleID/Results	**%Moisture @ Specified Moisture Tension Points**										
24090398	**0 kPa (0 Bar)**	**1 kPa (0.01 Bar)**	**10 kPa (0.1 Bar)**	**33 kPa (0.33 Bar)**	**50 kPa (0.5 Bar)**	**100 kPa (1 Bar)**	**300 kPa (3 Bar)**	**500 kPa (5 Bar)**	**1000 kPa (10 Bar)**	**1500 kPa (15 Bar)**	**Available Water % Grav.**
%Moisture Grav.	36.1	*NM	32.2	30.0	*NM	20.7	*NM	12.7	*NM	10.0	22.2



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Test Code/Name	[449] Moisture Retention Curve - Soil		
Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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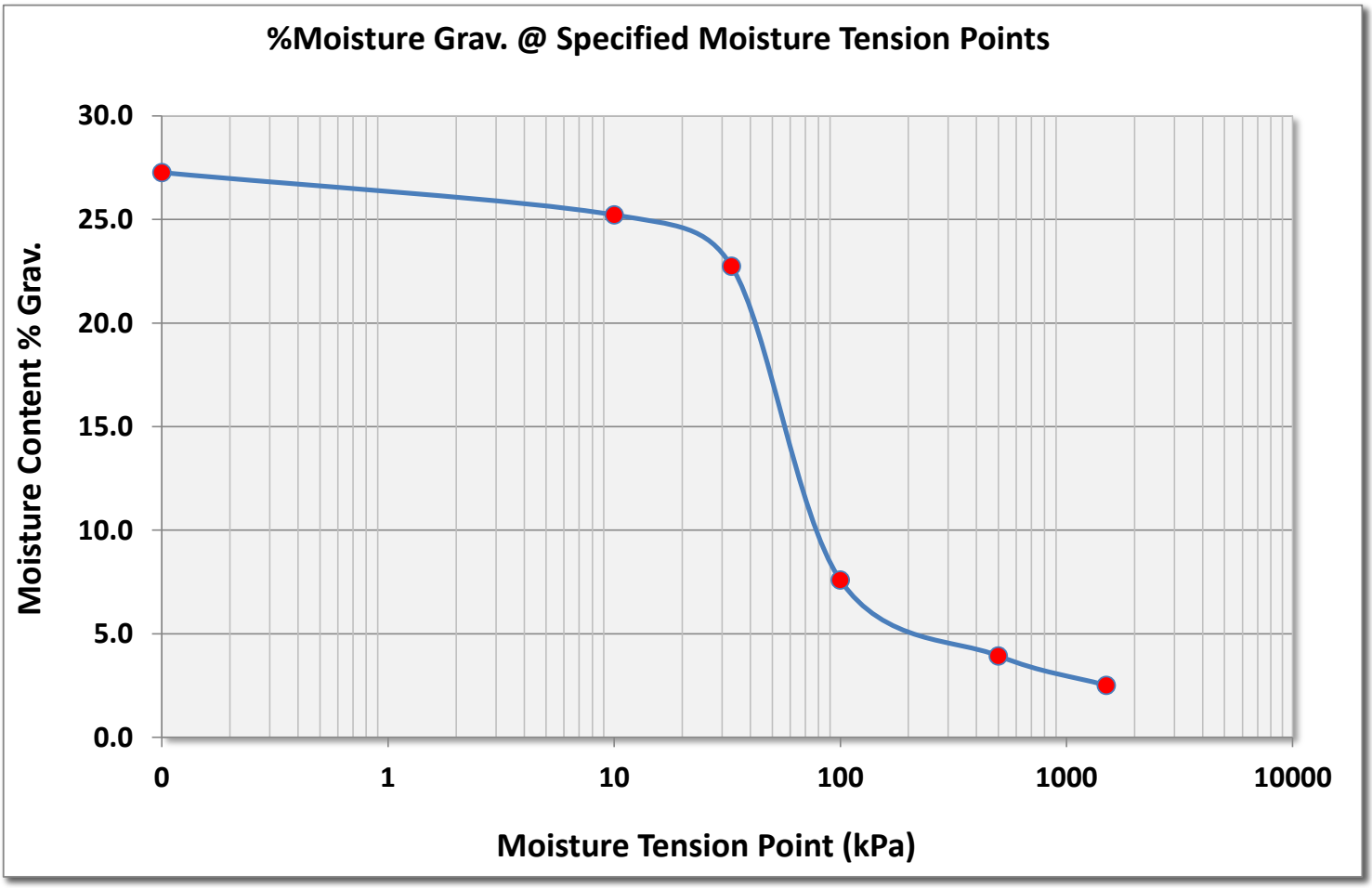
SampleID/Results	%Moisture @ Specified Moisture Tension Points										
24090399	0 kPa (0 Bar)	1 kPa (0.01 Bar)	10 kPa (0.1 Bar)	33 kPa (0.33 Bar)	50 kPa (0.5 Bar)	100 kPa (1 Bar)	300 kPa (3 Bar)	500 kPa (5 Bar)	1000 kPa (10 Bar)	1500 kPa (15 Bar)	Available Water % Grav.
%Moisture Grav.	27.3	*NM	25.2	22.7	*NM	7.6	*NM	3.9	*NM	2.5	22.7



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Test Code/Name	[449] Moisture Retention Curve - Soil		
Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
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[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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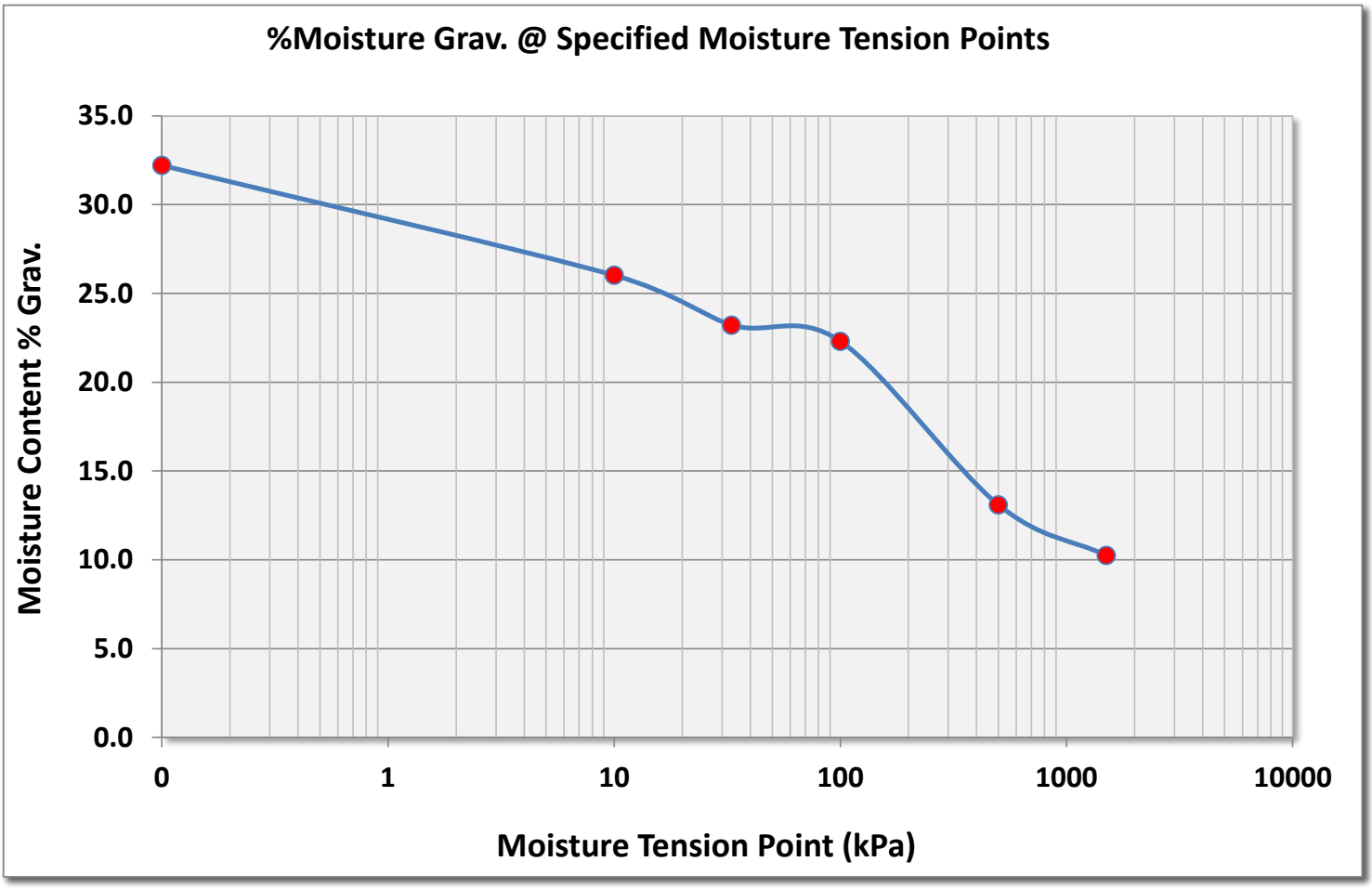
SampleID/Results	%Moisture @ Specified Moisture Tension Points										
24090400	0 kPa (0 Bar)	1 kPa (0.01 Bar)	10 kPa (0.1 Bar)	33 kPa (0.33 Bar)	50 kPa (0.5 Bar)	100 kPa (1 Bar)	300 kPa (3 Bar)	500 kPa (5 Bar)	1000 kPa (10 Bar)	1500 kPa (15 Bar)	Available Water % Grav.
%Moisture Grav.	32.2	*NM	26.0	23.2	*NM	22.3	*NM	13.1	*NM	10.3	15.8



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Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
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[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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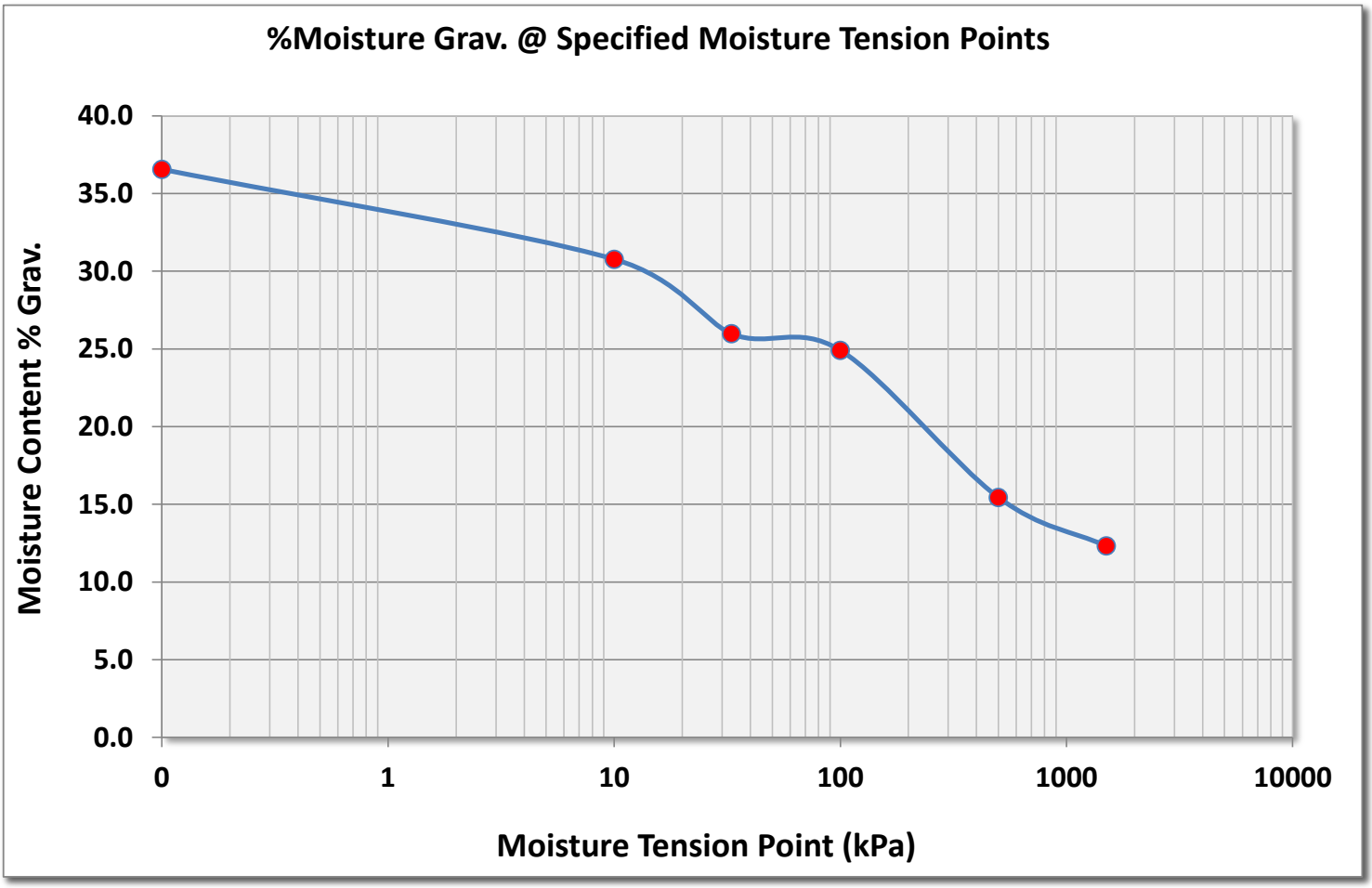
SampleID/Results	%Moisture @ Specified Moisture Tension Points										
24090401	0 kPa (0 Bar)	1 kPa (0.01 Bar)	10 kPa (0.1 Bar)	33 kPa (0.33 Bar)	50 kPa (0.5 Bar)	100 kPa (1 Bar)	300 kPa (3 Bar)	500 kPa (5 Bar)	1000 kPa (10 Bar)	1500 kPa (15 Bar)	Available Water % Grav.
%Moisture Grav.	36.6	*NM	30.8	26.0	*NM	24.9	*NM	15.4	*NM	12.3	18.5



Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

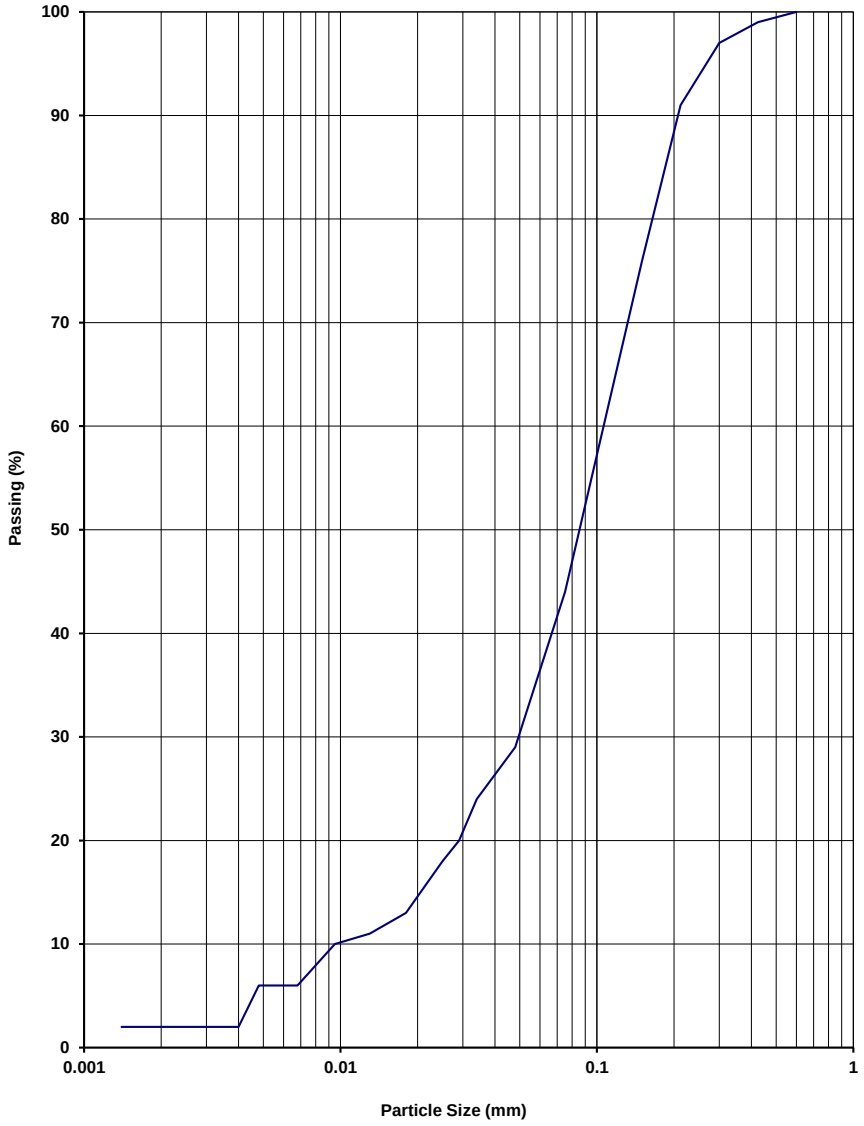
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090390-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	16/9/2024
		Report Date	8/10/2024
Project	TCK-2405		
Client ID	T1	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	
1.18	
0.600	100
0.425	99
0.300	97
0.212	91
0.150	76
0.075	44
0.048	29
0.034	24
0.029	20
0.025	18
0.018	13
0.013	11
0.0095	10
0.0068	6
0.0048	6
0.004	2
0.0034	2
0.0028	2
0.0024	2
0.0014	2



NOTES/REMARKS: -

Moisture Content 3% -2.36mm Soil Particle Density(t/m^3) 2.70

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory

Michael Hamilton

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090391-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090391
Liquid Limit Determination	AS 1289.3.1.2
Test Date	30/09/2024
Client ID	T2
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	Non-attainable
Plastic Limit (%)	Non-attainable
Plasticity Index (%)	Non-plastic
Linear Shrinkage (%)	Non-attainable
Moisture Content (%)	11.6

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred **Page 1 of 1** REP00102

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PERMEABILITY BY CONSTANT HEAD TEST REPORT

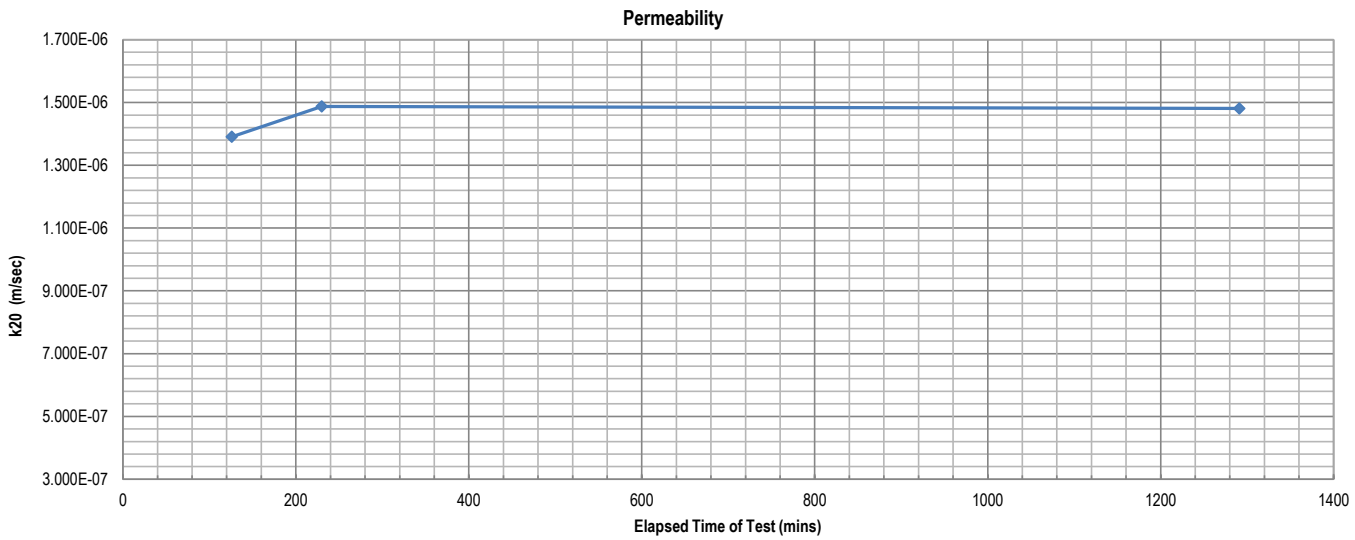
Test Method AS 1289 6.7.1, 5.1.1

Client	Mine Earth	**Report No.**	24090391-CPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	8/10/2024
		Report Date	25/10/2024
Project	TCK-2405		
Client ID	T2	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.57**	Hydraulic Gradient	**2.3**
Optimum Moisture Content (%)	**15.1**	Surcharge (kPa)	**2.8**
Placement Moisture Content (%)	**15.8**	Head Pressure Applied (kPa)	**2.65**
Moisture Ratio (%)	**104.4**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**1.72**	Percentage Material Retained/Sieve Size (mm)	**0 % / 19 mm**
Density Ratio (%)	**94.4**	Sample Height and Diameter (mm)	**116.65 / 101.45 mm**

PERMEABILITY $k_{(20)} = 1.5 \times 10^{-06}$ **(m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090391-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090391
Client ID	T2
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**4 Gypsum**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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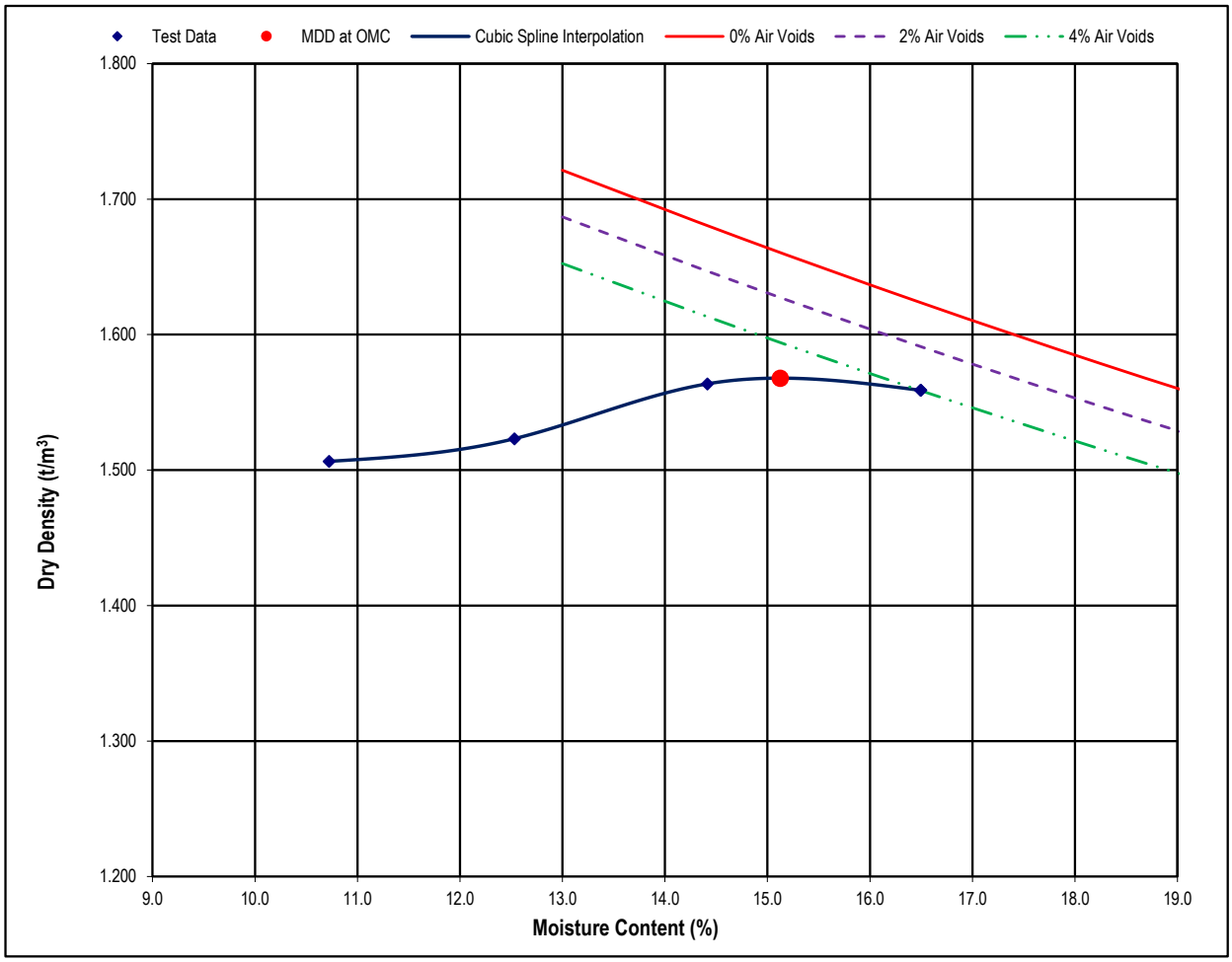
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090391-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	24/09/2024
		Report Date	1/10/2024
Project	TCK-2405		
Client ID	T2	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m³)	1.57	**Optimum Moisture Content (%)**	15.1
Moisture Content (%)	11.6	**Percentage of Oversize/Sieve Size (mm)**	0 / 19

NOTES/REMARKS:

Curing Time (hrs): 0 * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.22

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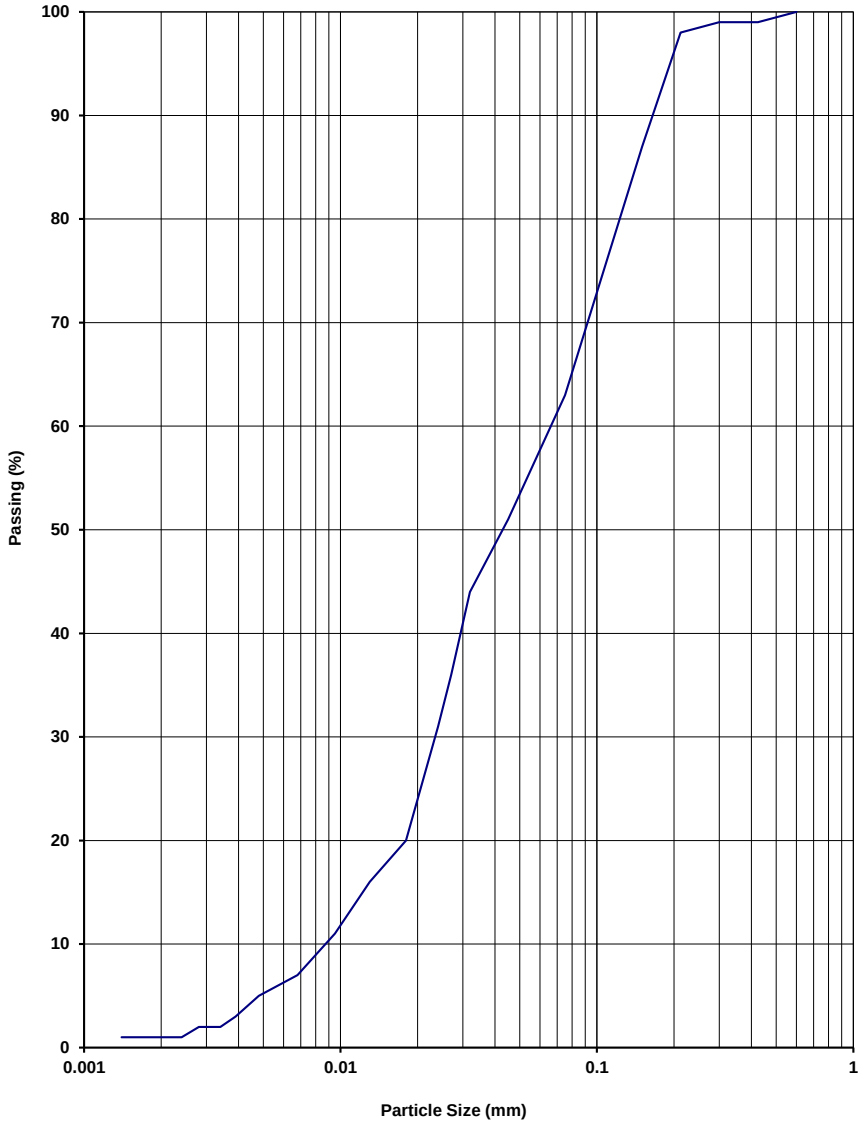
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090391-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	16/9/2024
		Report Date	8/10/2024
Project	TCK-2405		
Client ID	T2	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	
1.18	
0.600	100
0.425	99
0.300	99
0.212	98
0.150	87
0.075	63
0.045	51
0.032	44
0.027	36
0.024	31
0.018	20
0.013	16
0.0095	11
0.0068	7
0.0048	5
0.0039	3
0.0034	2
0.0028	2
0.0024	1
0.0014	1



NOTES/REMARKS: -

Moisture Content 11.6% -2.36mm Soil Particle Density(t/m^3) 2.71

Sample/s supplied by the client

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090392-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090392
Liquid Limit Determination	AS 1289.3.1.2
Test Date	3/10/2024
Client ID	TC1
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	26
Plastic Limit (%)	17
Plasticity Index (%)	9
Linear Shrinkage (%)	7.0 +
Moisture Content (%)	1.3

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred **Page 1 of 1** REP00102

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PERMEABILITY BY CONSTANT HEAD TEST REPORT

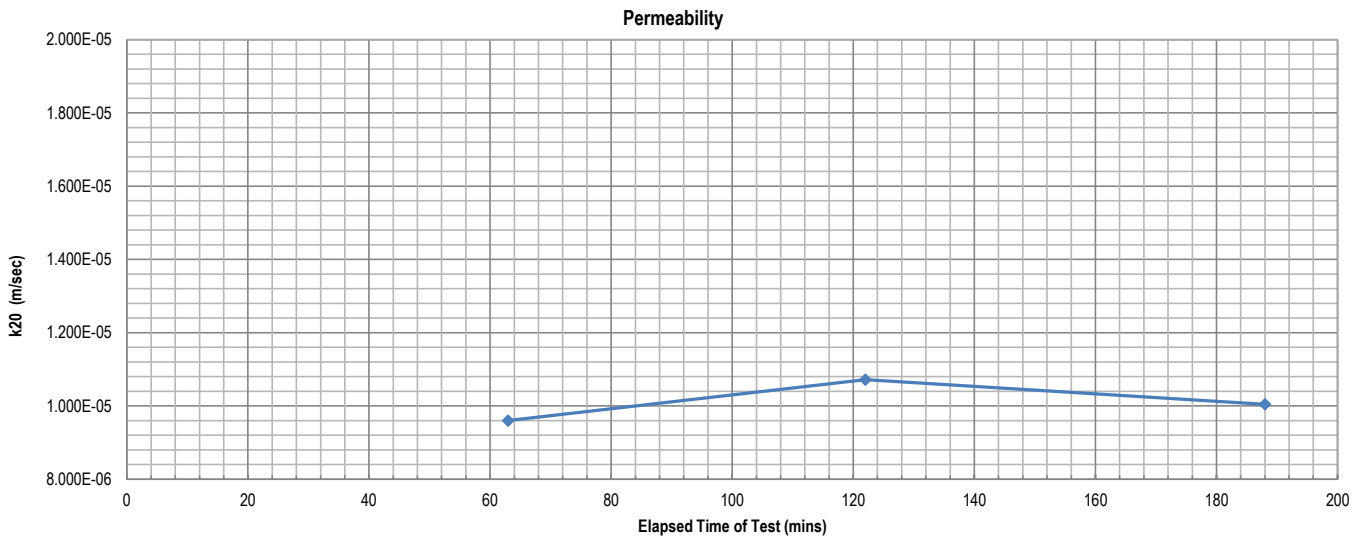
Test Method AS 1289 6.7.1, 5.1.1

Client	Mine Earth	**Report No.**	24090392-CPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	25/10/2024
		Report Date	8/10/2024
Project	TCK-2405		
Client ID	TC1	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**2.21**	Hydraulic Gradient	**2.1**
Optimum Moisture Content (%)	**8.0**	Surcharge (kPa)	**3.6**
Placement Moisture Content (%)	**8.4**	Head Pressure Applied (kPa)	**2.35**
Moisture Ratio (%)	**104.7**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**2.27**	Percentage Material Retained/Sieve Size (mm)	**23 % / 19 mm**
Density Ratio (%)	**94.7**	Sample Height and Diameter (mm)	**116.97 / 152.66 mm**

PERMEABILITY $k_{(20)} =$ **1.0×10^{-05} (m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090392-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090392
Client ID	TC1
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**5**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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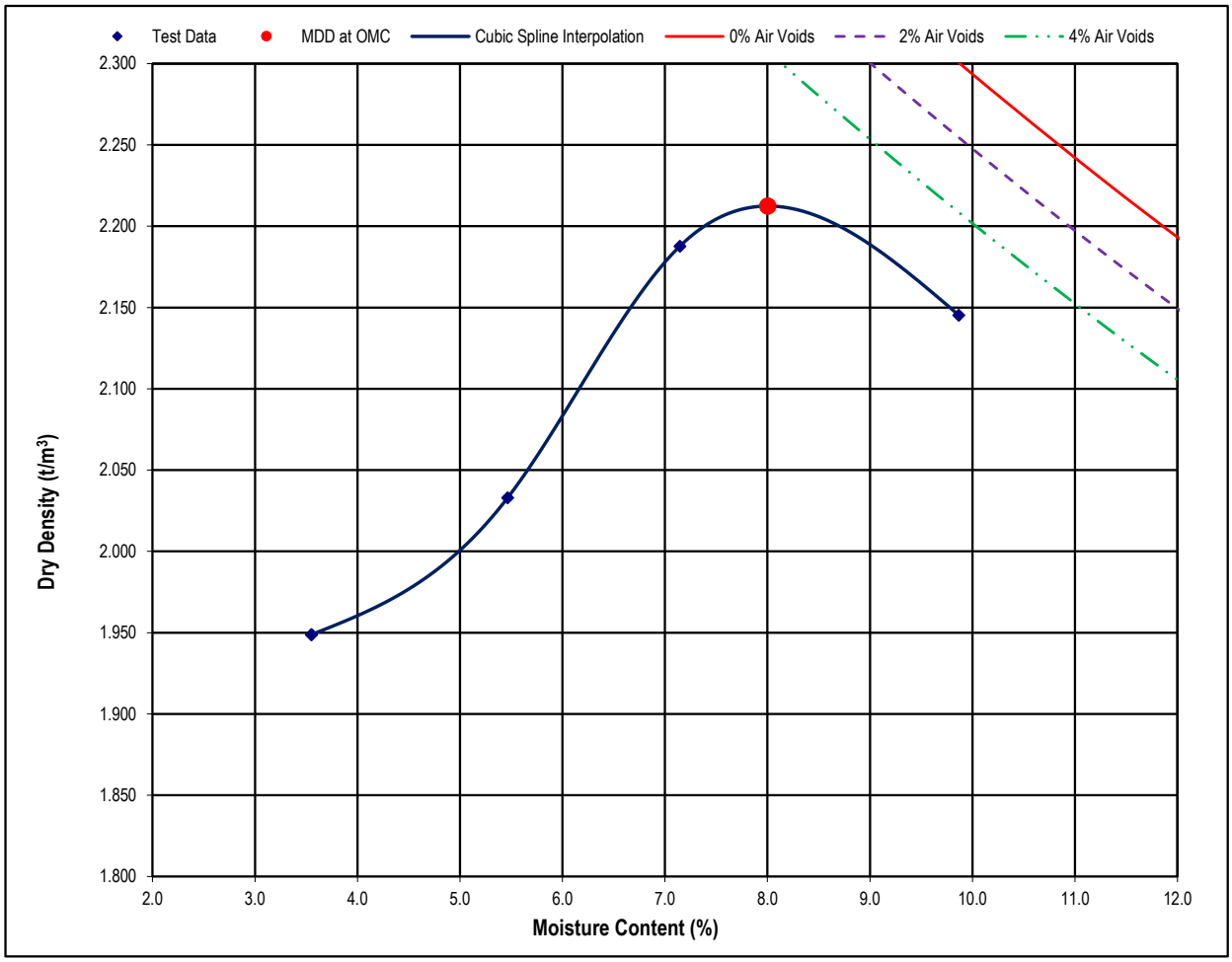
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090392-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	24/09/2024
		Report Date	1/10/2024
Project	TCK-2405		
Client ID	TC1	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m³)	2.21	**Optimum Moisture Content (%)**	8.0
Moisture Content (%)	1.3	**Percentage of Oversize/Sieve Size (mm)**	23/19

NOTES/REMARKS:

Curing Time (hrs): 24 * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.98

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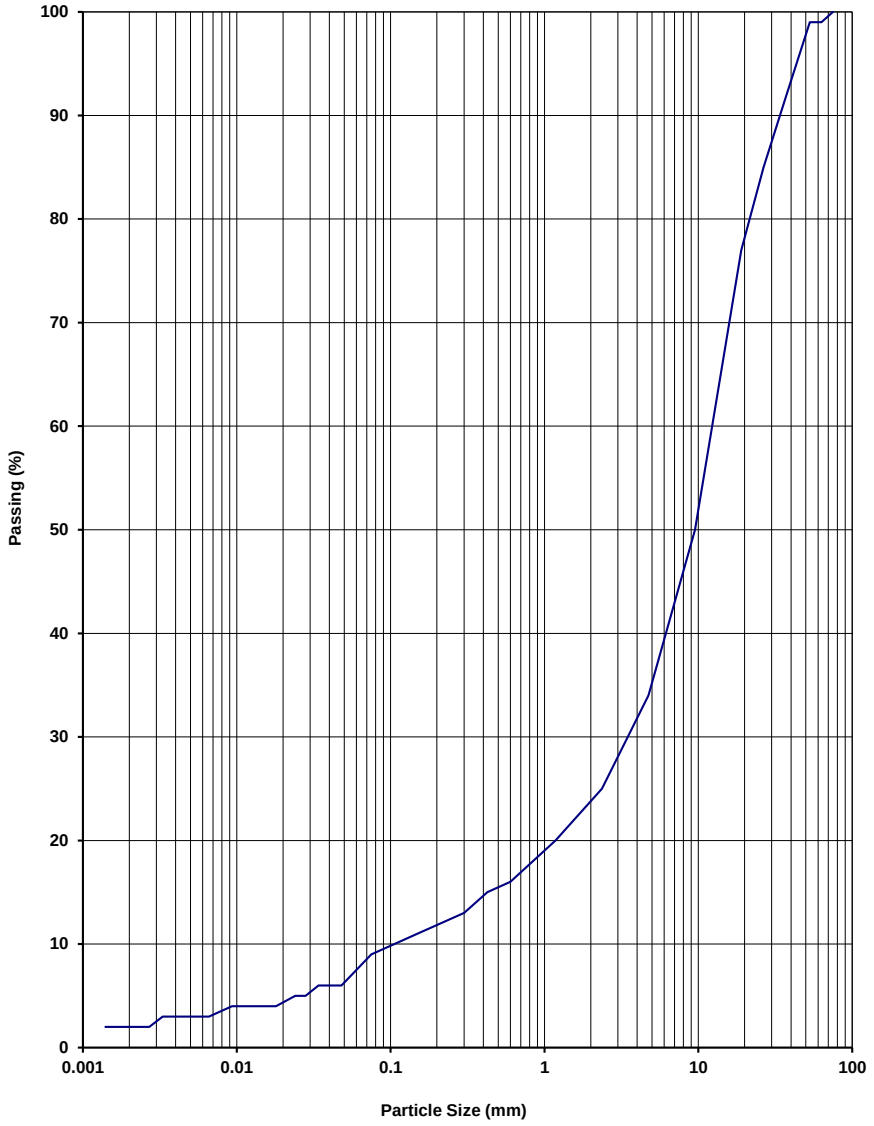
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090392-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	16/9/2024
		Report Date	8/10/2024
Project	TCK-2405		
Client ID	TC1	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	100
63.0	99
53.0	99
37.5	92
26.5	85
19.0	77
13.2	61
9.5	50
6.7	41
4.75	34
2.36	25
1.18	20
0.600	16
0.425	15
0.300	13
0.212	12
0.150	11
0.075	9
0.048	6
0.034	6
0.028	5
0.024	5
0.018	4
0.013	4
0.0093	4
0.0066	3
0.0047	3
0.0038	3
0.0033	3
0.0027	2
0.0023	2
0.0014	2



NOTES/REMARKS: -

Moisture Content 1.3% -2.36mm Soil Particle Density(t/m^3) 2.72

Sample/s supplied by the client

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090393-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090393
Liquid Limit Determination	AS 1289.3.1.2
Test Date	3/10/2024
Client ID	TC2
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	23
Plastic Limit (%)	17
Plasticity Index (%)	6
Linear Shrinkage (%)	4.0
Moisture Content (%)	1.3

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred **Page 1 of 1** REP00102

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PERMEABILITY BY CONSTANT HEAD TEST REPORT

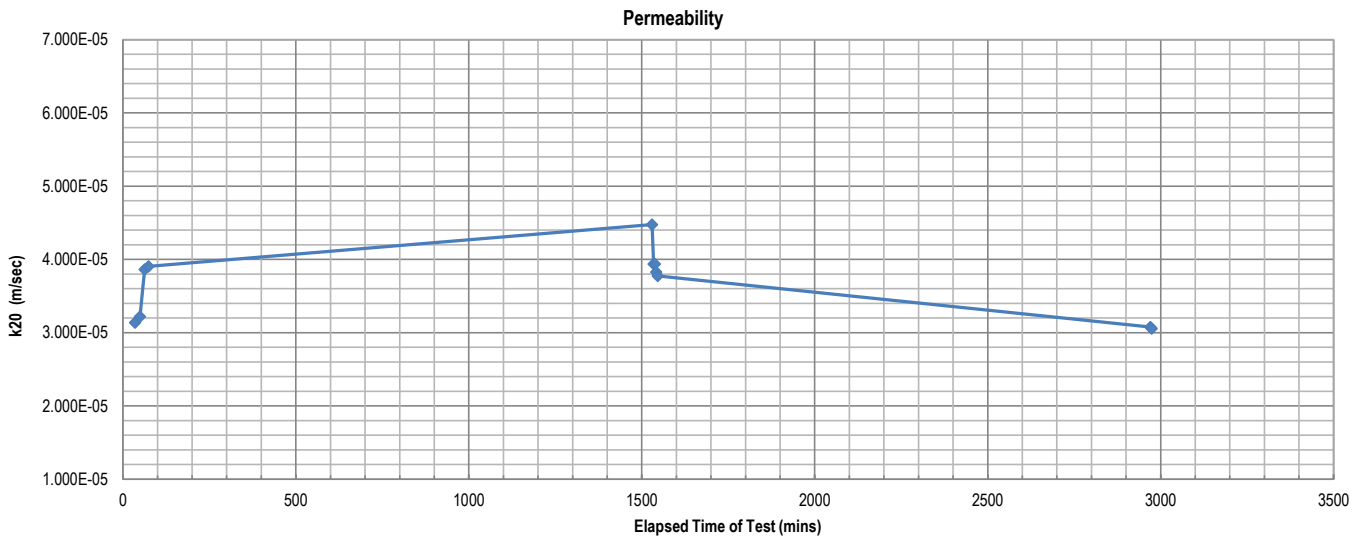
Test Method AS 1289 6.7.1, 5.1.1

Client	Mine Earth	**Report No.**	24090393-CPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	23/10/2024
		Report Date	25/10/2024
Project	TCK-2405		
Client ID	TC2	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**2.19**	Hydraulic Gradient	**4.1**
Optimum Moisture Content (%)	**8.4**	Surcharge (kPa)	**3.6**
Placement Moisture Content (%)	**7.7**	Head Pressure Applied (kPa)	**4.71**
Moisture Ratio (%)	**91.3**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**2.25**	Percentage Material Retained/Sieve Size (mm)	**19 % / 19 mm**
Density Ratio (%)	**95.6**	Sample Height and Diameter (mm)	**116 / 152.26 mm**

PERMEABILITY $k_{(20)} =$ **3.1×10^{-05} (m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing

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Tested at Trilab Brisbane Laboratory

Approved Signatory

Michael Hamilton

Michael Hamilton

NATA
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Laboratory No. 9926

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Trilab
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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090393-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090393
Client ID	TC2
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**5**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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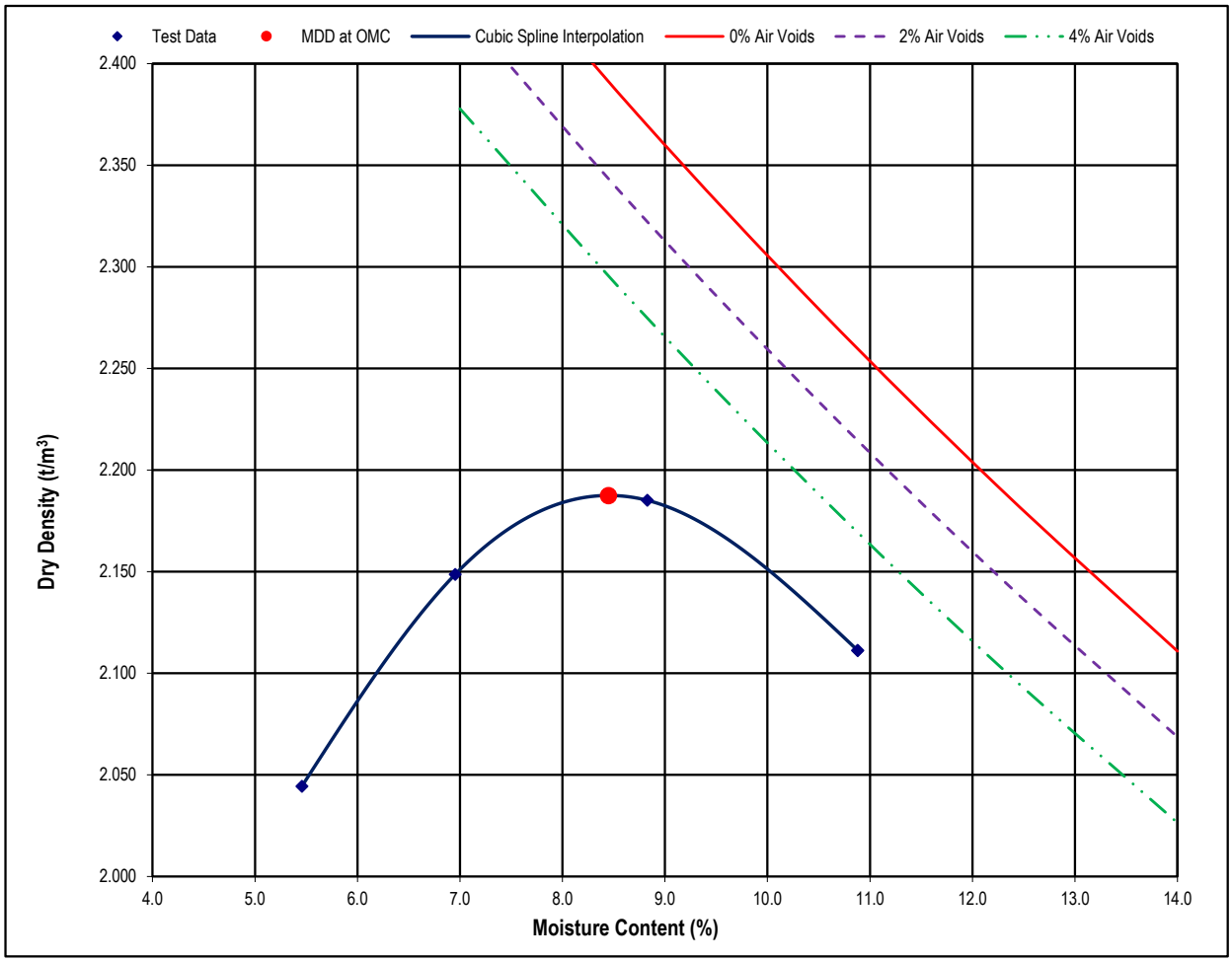
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090393-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	24/09/2024
		Report Date	1/10/2024
Project	TCK-2405		
Client ID	TC2	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m³)	2.19	**Optimum Moisture Content (%)**	8.4
Moisture Content (%)	1.3	**Percentage of Oversize/Sieve Size (mm)**	19/19

NOTES/REMARKS:

Curing Time (hrs): 24 * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 3

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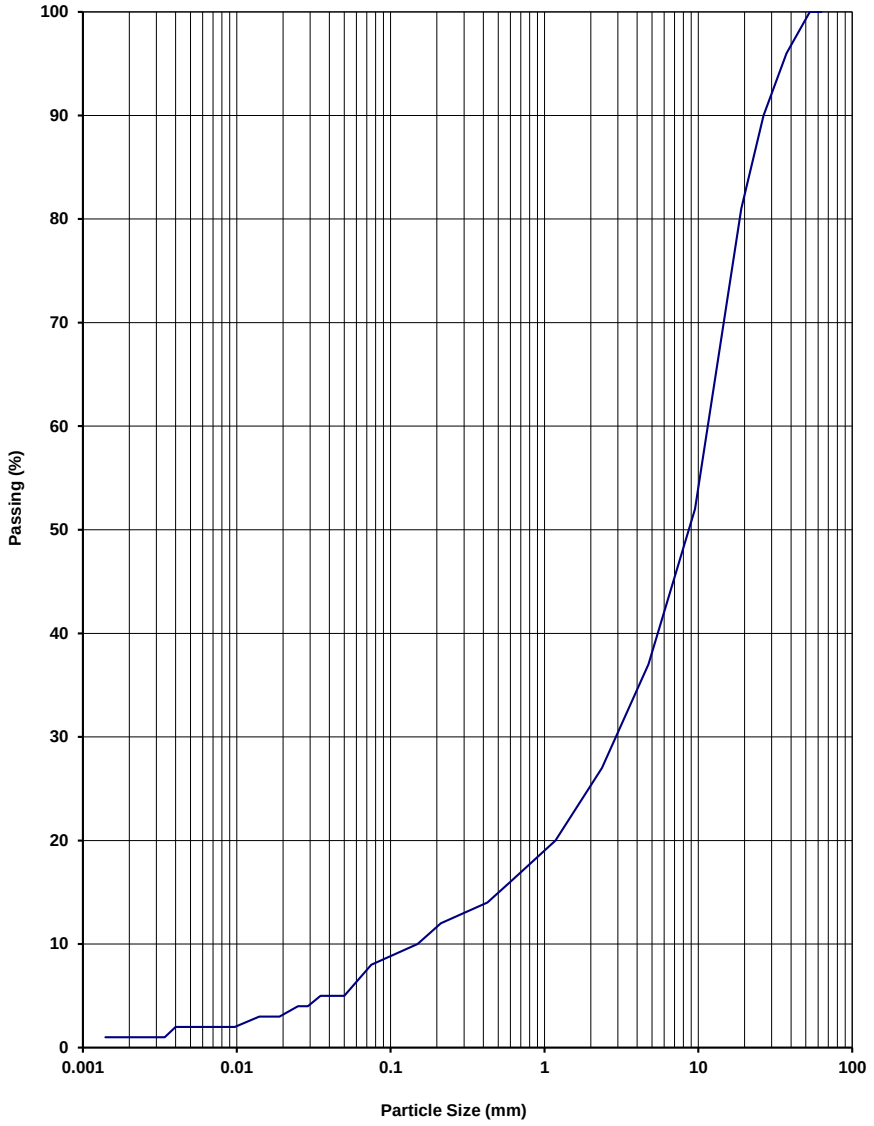
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090393-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	16/9/2024
		Report Date	8/10/2024
Project	TCK-2405		
Client ID	TC2	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	100
37.5	96
26.5	90
19.0	81
13.2	61
9.5	52
6.7	43
4.75	37
2.36	27
1.18	20
0.600	16
0.425	14
0.300	13
0.212	12
0.150	10
0.075	8
0.05	5
0.035	5
0.029	4
0.025	4
0.019	3
0.014	3
0.0097	2
0.0069	2
0.0049	2
0.004	2
0.0034	1
0.0028	1
0.0024	1
0.0014	1



NOTES/REMARKS: -

Moisture Content 1.3% -2.36mm Soil Particle Density(t/m^3) 2.72

Sample/s supplied by the client

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090394-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090394
Client ID	WR1
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**6**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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Approved Signatory

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PERMEABILITY BY FALLING HEAD TEST REPORT

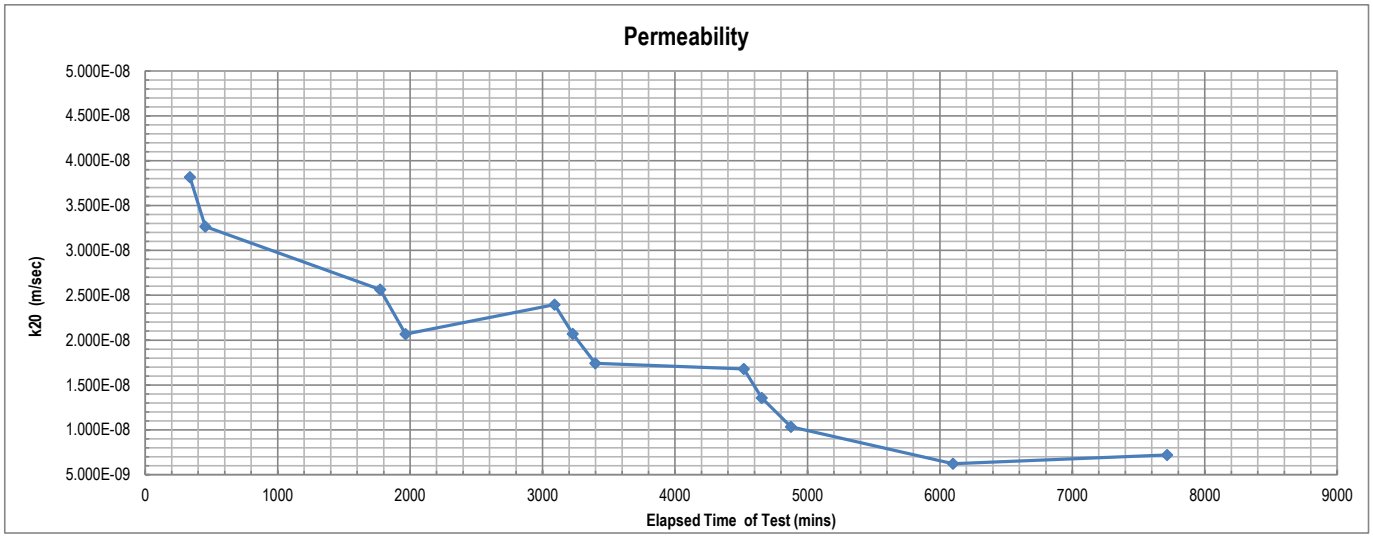
Test Method AS 1289 6.7.2, 5.1.1

Client	Mine Earth	**Report No.**	24090394-FPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	17/10/2024
		Report Date	20/11/2024
Project	TCK-2405		
Client ID	WR1	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.98**	Hydraulic Gradient	**11.2**
Optimum Moisture Content (%)	**10.7**	Surcharge (kPa)	**3.7**
Placement Moisture Content (%)	**10.8**	Head Pressure Applied (kPa)	**12.75**
Moisture Ratio (%)	**101.2**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**2.08**	Percentage Material Retained/Sieve Size (mm)	**0 % /19 mm**
Density Ratio (%)	**94.9**	Sample Height and Diameter (mm)	**116.41 / 152.4 mm**

PERMEABILITY $k_{(20)} = 7.2 \times 10^{-09}$ **(m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client The compaction data was supplied by the client. **Page: 1 of 1** REP06301

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Approved Signatory

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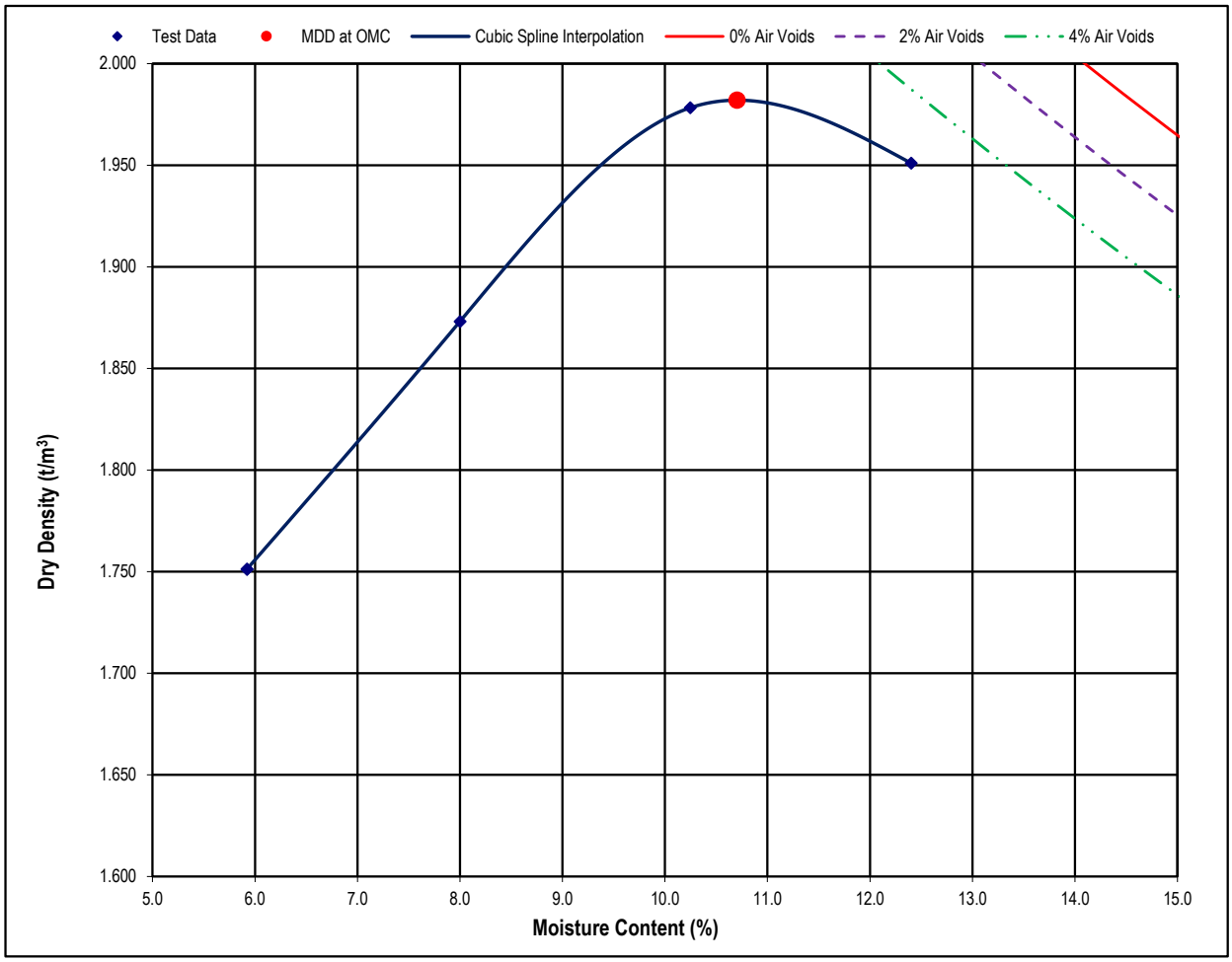
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090394-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	25/09/2024
		Report Date	1/10/2024
Project	TCK-2405		
Client ID	WR1	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m³)	1.98	**Optimum Moisture Content (%)**	10.7
Moisture Content (%)	4.6	**Percentage of Oversize/Sieve Size (mm)**	16/19

NOTES/REMARKS:

Curing Time (hrs): 24 * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.79

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Approved Signatory

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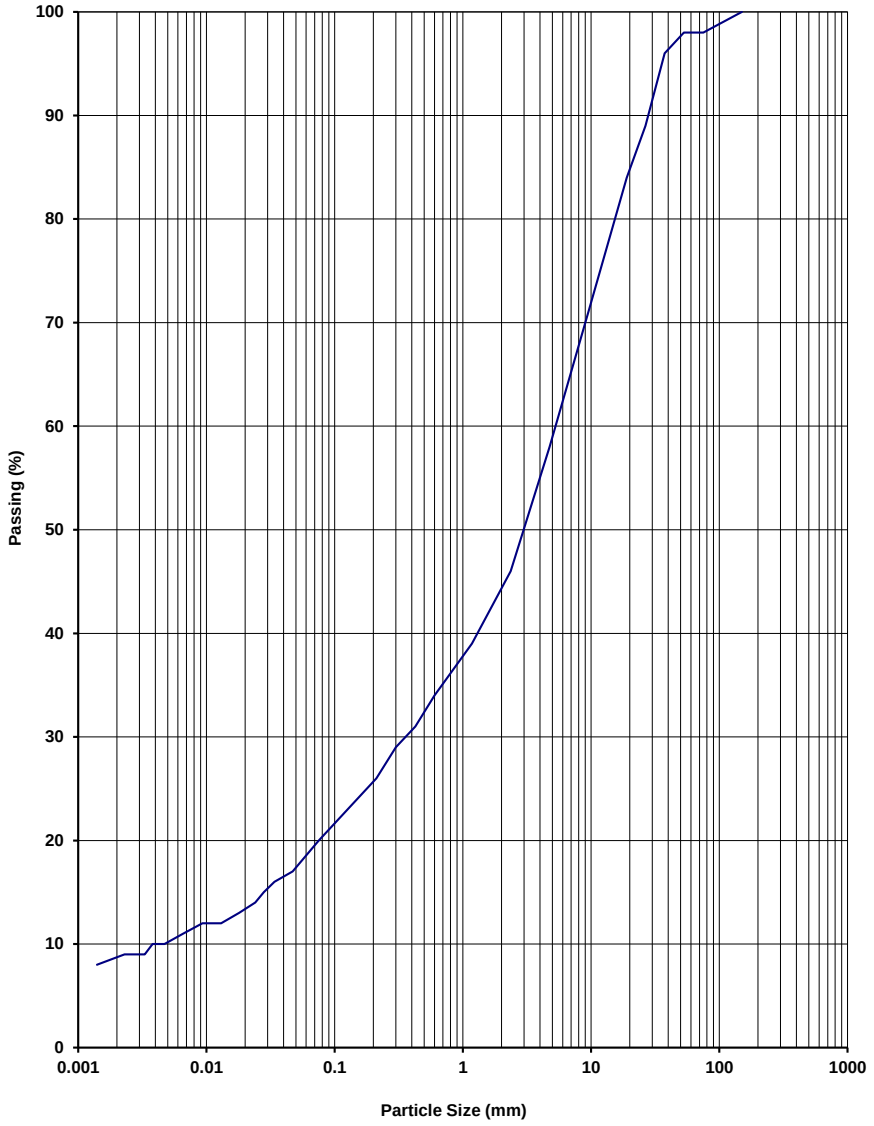
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090394-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	16/9/2024
		Report Date	8/10/2024
Project	TCK-2405		
Client ID	WR1	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	100
75.0	98
63.0	98
53.0	98
37.5	96
26.5	89
19.0	84
13.2	77
9.5	71
6.7	65
4.75	58
2.36	46
1.18	39
0.600	34
0.425	31
0.300	29
0.212	26
0.150	24
0.075	20
0.047	17
0.034	16
0.028	15
0.024	14
0.018	13
0.013	12
0.0093	12
0.0066	11
0.0047	10
0.0038	10
0.0033	9
0.0027	9
0.0023	9
0.0014	8



NOTES/REMARKS: -

Moisture Content 6% -2.36mm Soil Particle Density(t/m^3) 2.70

Sample/s supplied by the client

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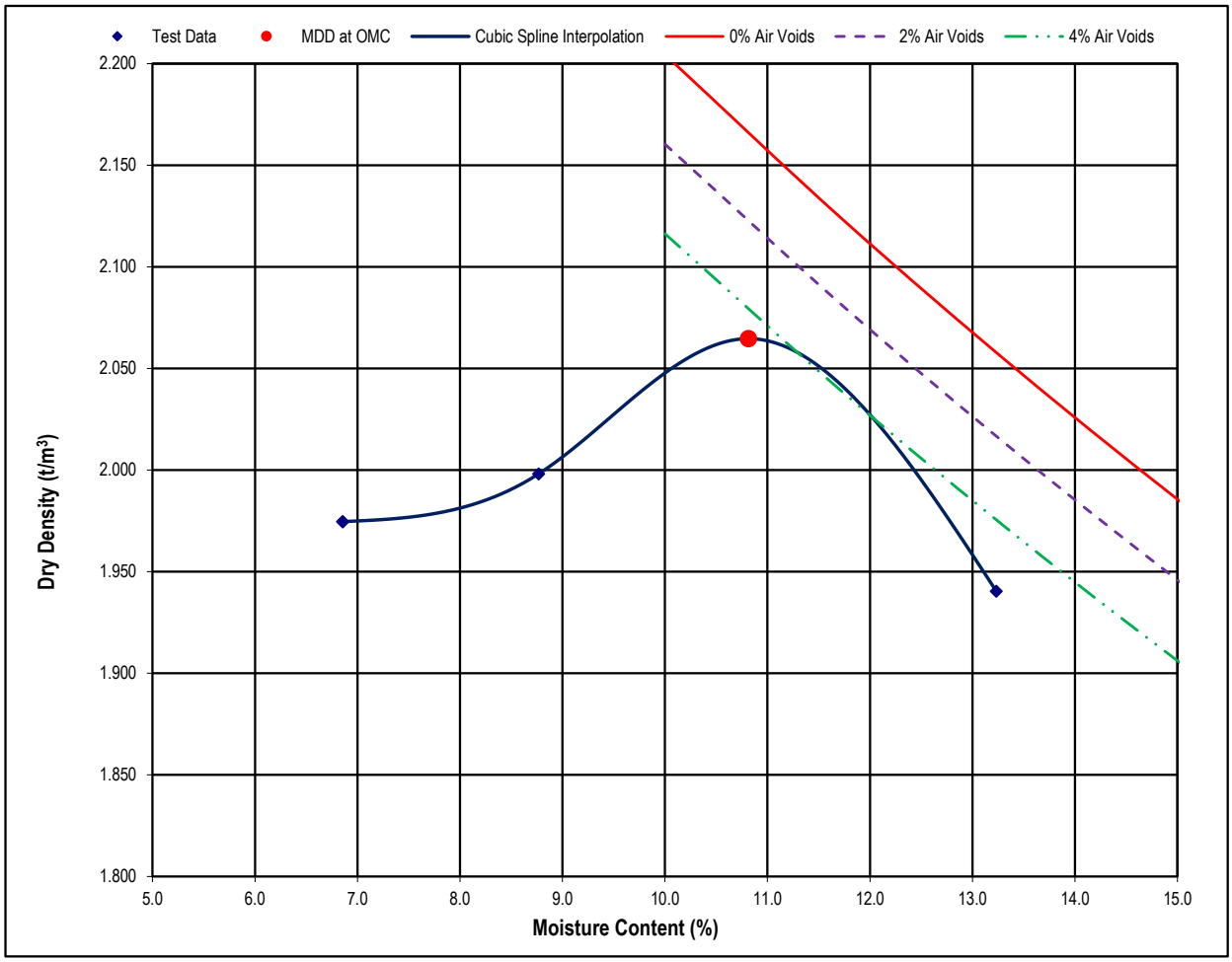
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090395-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	11/10/2024
		Report Date	18/10/2024
Project	TCK-2405		
Client ID	WR2	**Location**	Not Supplied
		Depth (m)	Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m³)	2.06	**Optimum Moisture Content (%)**	10.8
Moisture Content (%)	4.3	**Percentage of Oversize/Sieve Size (mm)**	11 / 19

NOTES/REMARKS:

Curing Time (hrs): 48 * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.83

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090395-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090395
Liquid Limit Determination	AS 1289.3.1.2
Test Date	8/10/2024
Client ID	WR2
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	34
Plastic Limit (%)	20
Plasticity Index (%)	14
Linear Shrinkage (%)	7.5
Moisture Content (%)	6.0

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090395-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090395
Client ID	WR2
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**2**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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PERMEABILITY BY FALLING HEAD TEST REPORT

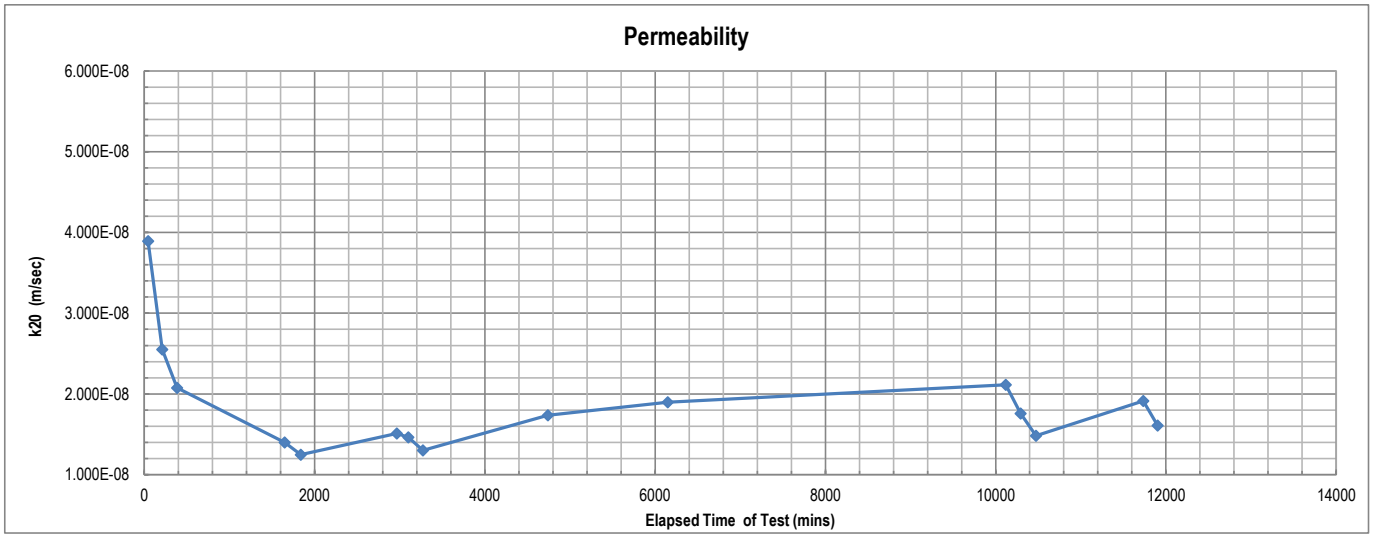
Test Method AS 1289 6.7.2, 5.1.1

Client	Mine Earth	**Report No.**	24090395-FPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	17/10/2024
		Report Date	18/11/2024
Project	TCK-2405		
Client ID	WR2	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**2.06**	Hydraulic Gradient	**11.2**
Optimum Moisture Content (%)	**10.8**	Surcharge (kPa)	**3.7**
Placement Moisture Content (%)	**11.1**	Head Pressure Applied (kPa)	**12.75**
Moisture Ratio (%)	**102.3**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**2.17**	Percentage Material Retained/Sieve Size (mm)	**0 % /19 mm**
Density Ratio (%)	**94.8**	Sample Height and Diameter (mm)	**116.5 / 152.26 mm**

PERMEABILITY $k_{(20)}$ = **1.8×10^{-08} (m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client The compaction data was supplied by the client.

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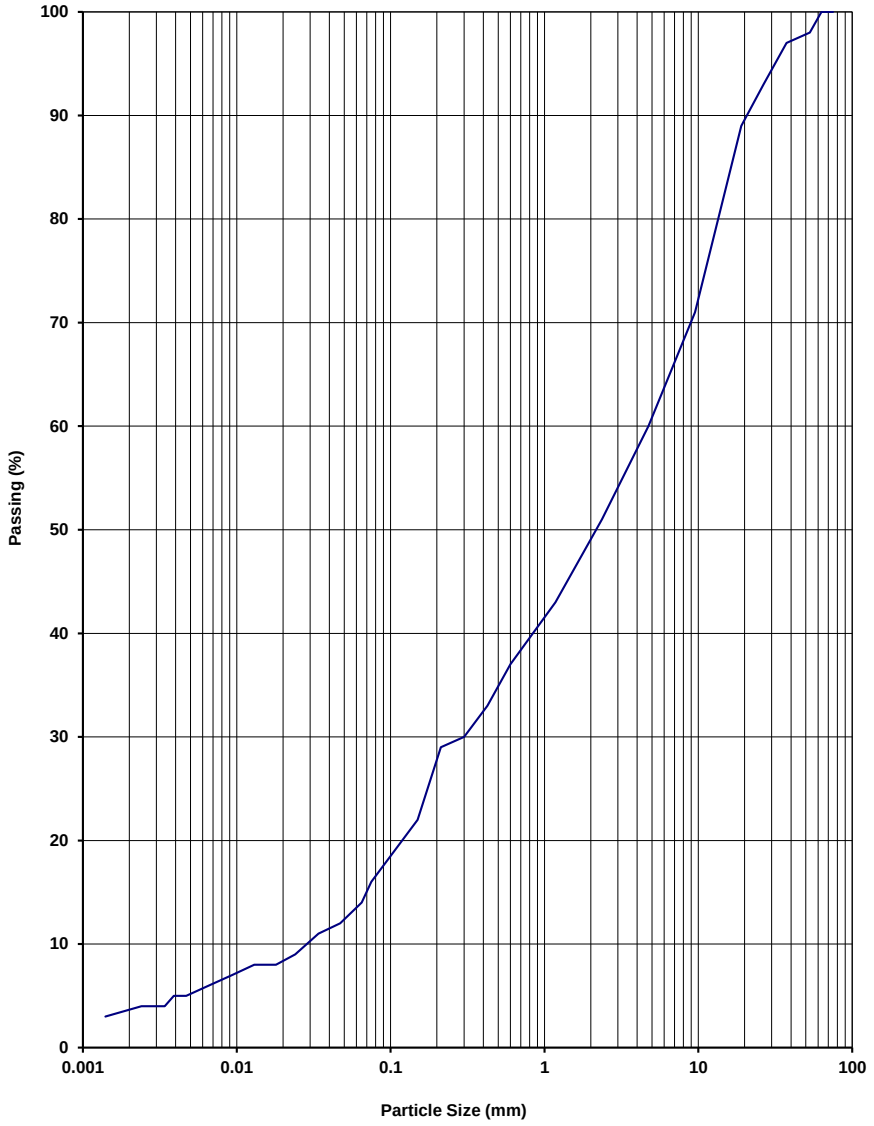
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090395-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	1/10/2024
		Report Date	21/10/2024
Project	TCK-2405		
Client ID	WR2	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	100
53.0	98
37.5	97
26.5	93
19.0	89
13.2	80
9.5	71
6.7	65
4.75	60
2.36	51
1.18	43
0.600	37
0.425	33
0.300	30
0.212	29
0.150	22
0.075	16
0.065	14
0.047	12
0.034	11
0.024	9
0.018	8
0.013	8
0.0093	7
0.0066	6
0.0047	5
0.0039	5
0.0034	4
0.0028	4
0.0024	4
0.0014	3



NOTES/REMARKS: -

Moisture Content 4.3% -2.36mm Soil Particle Density(t/m^3) 2.71

Sample/s supplied by the client

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Approved Signatory

Michael Hamilton

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090396-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090396
Liquid Limit Determination	AS 1289.3.1.2
Test Date	8/10/2024
Client ID	WR3
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	Non-attainable
Plastic Limit (%)	Non-attainable
Plasticity Index (%)	Non-plastic
Linear Shrinkage (%)	Non-attainable
Moisture Content (%)	1.4

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred **Page 1 of 1** REP00102

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PERMEABILITY BY CONSTANT HEAD TEST REPORT

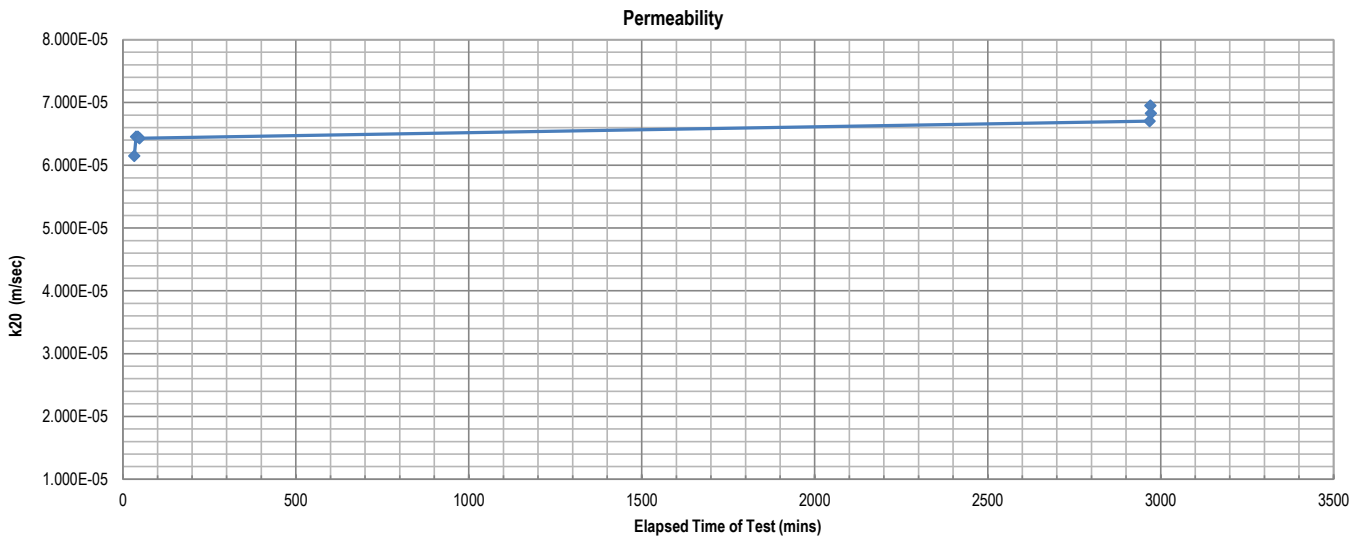
Test Method AS 1289 6.7.1, 5.1.1

Client	Mine Earth	**Report No.**	24090396-CPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	23/10/2024
		Report Date	25/10/2024
Project	TCK-2405		
Client ID	WR3	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**2.04**	Hydraulic Gradient	**3.5**
Optimum Moisture Content (%)	**7.4**	Surcharge (kPa)	**3.7**
Placement Moisture Content (%)	**7.1**	Head Pressure Applied (kPa)	**4.02**
Moisture Ratio (%)	**95.3**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**2.08**	Percentage Material Retained/Sieve Size (mm)	**0 % / 19 mm**
Density Ratio (%)	**95.3**	Sample Height and Diameter (mm)	**116.67 / 152.22 mm**

PERMEABILITY $k_{(20)} =$ **6.8×10^{-05} (m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090396-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090396
Client ID	WR3
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**5**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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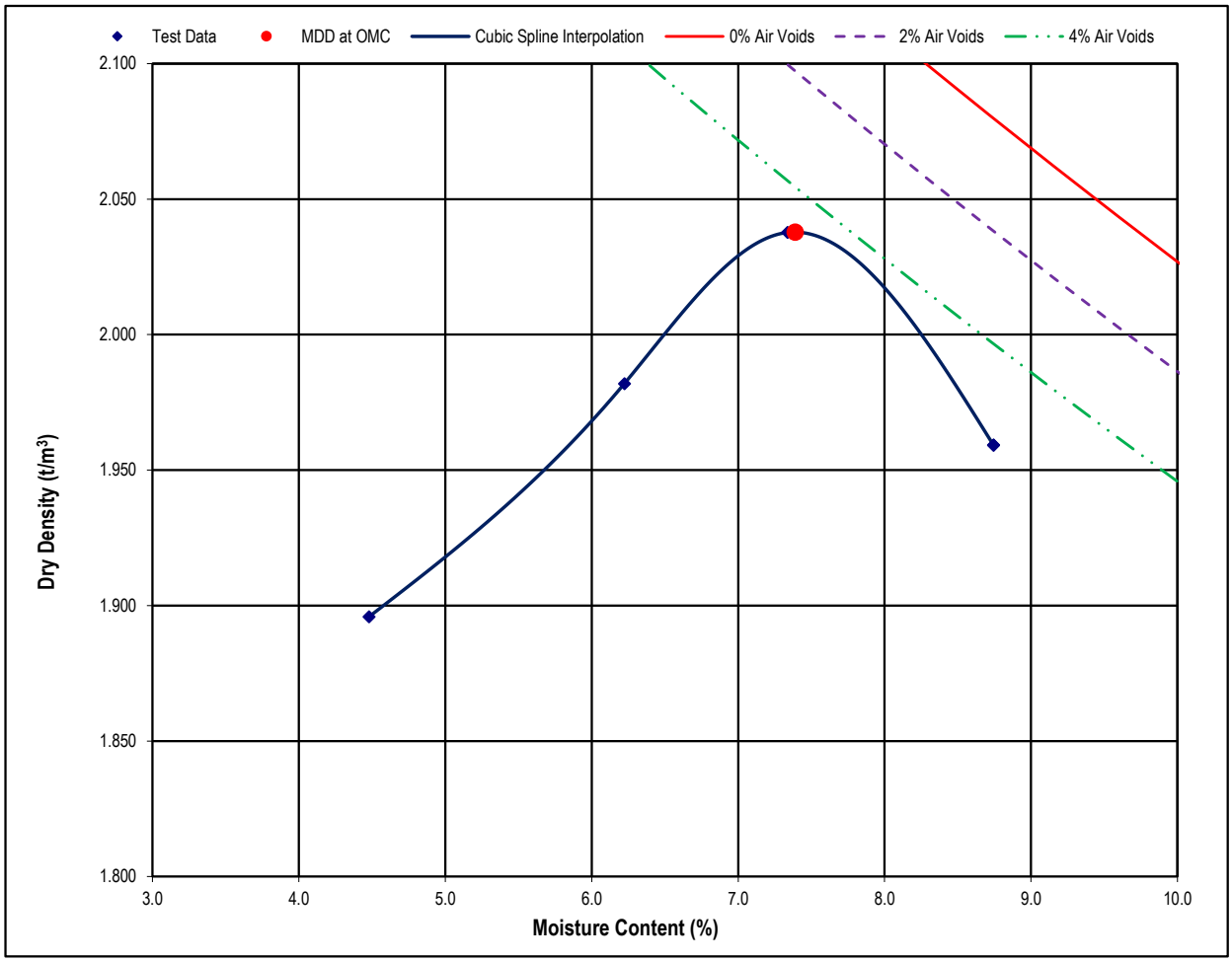
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090396-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	11/10/2024
		Report Date	18/10/2024
Project	TCK-2405		
Client ID	WR3	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m³)	2.04	**Optimum Moisture Content (%)**	7.4
Moisture Content (%)	1.4	**Percentage of Oversize/Sieve Size (mm)**	0 / 19

NOTES/REMARKS:

Curing Time (hrs): 0 * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.54

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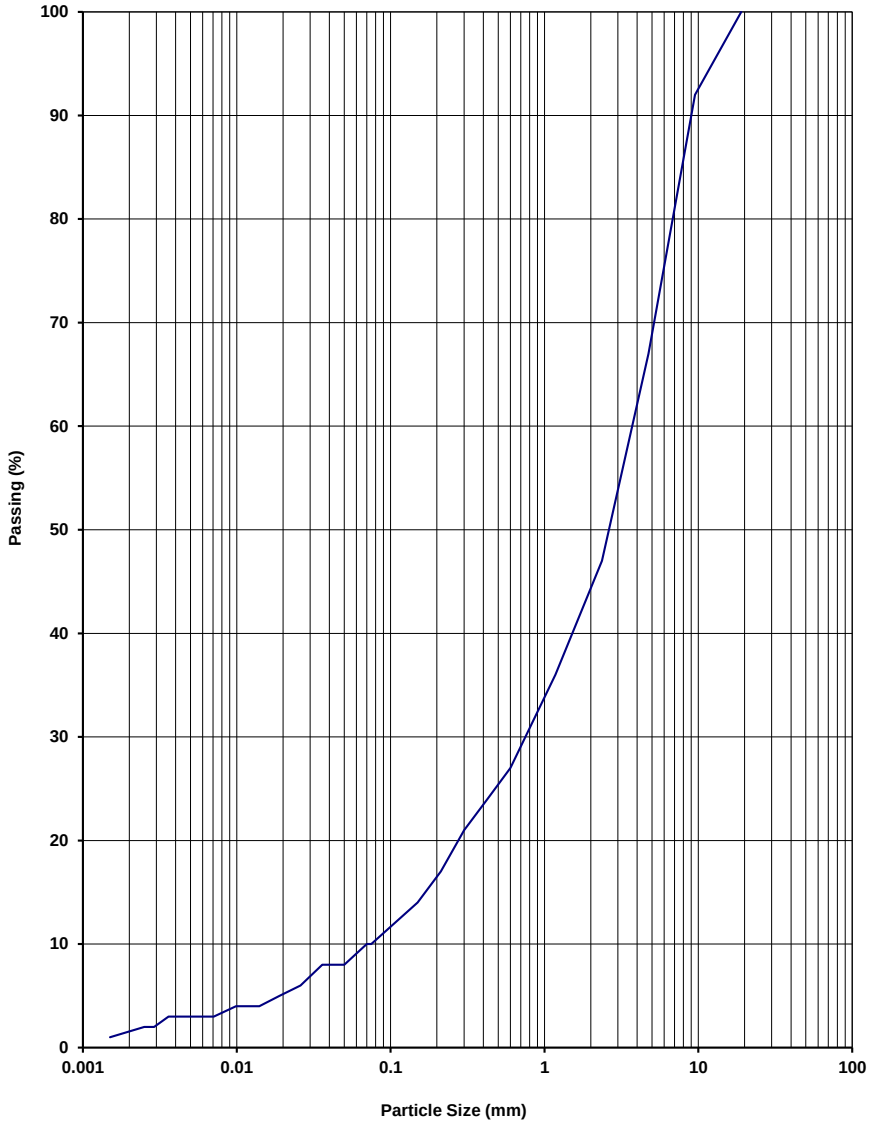
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090396-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	1/10/2024
		Report Date	21/10/2024
Project	TCK-2405		
Client ID	WR3	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	100
9.5	92
6.7	78
4.75	67
2.36	47
1.18	36
0.600	27
0.425	24
0.300	21
0.212	17
0.150	14
0.075	10
0.07	10
0.05	8
0.036	8
0.026	6
0.019	5
0.014	4
0.0099	4
0.0071	3
0.005	3
0.0041	3
0.0036	3
0.0029	2
0.0025	2
0.0015	1



NOTES/REMARKS: -

Moisture Content 1.4% -2.36mm Soil Particle Density(t/m^3) 2.67

Sample/s supplied by the client

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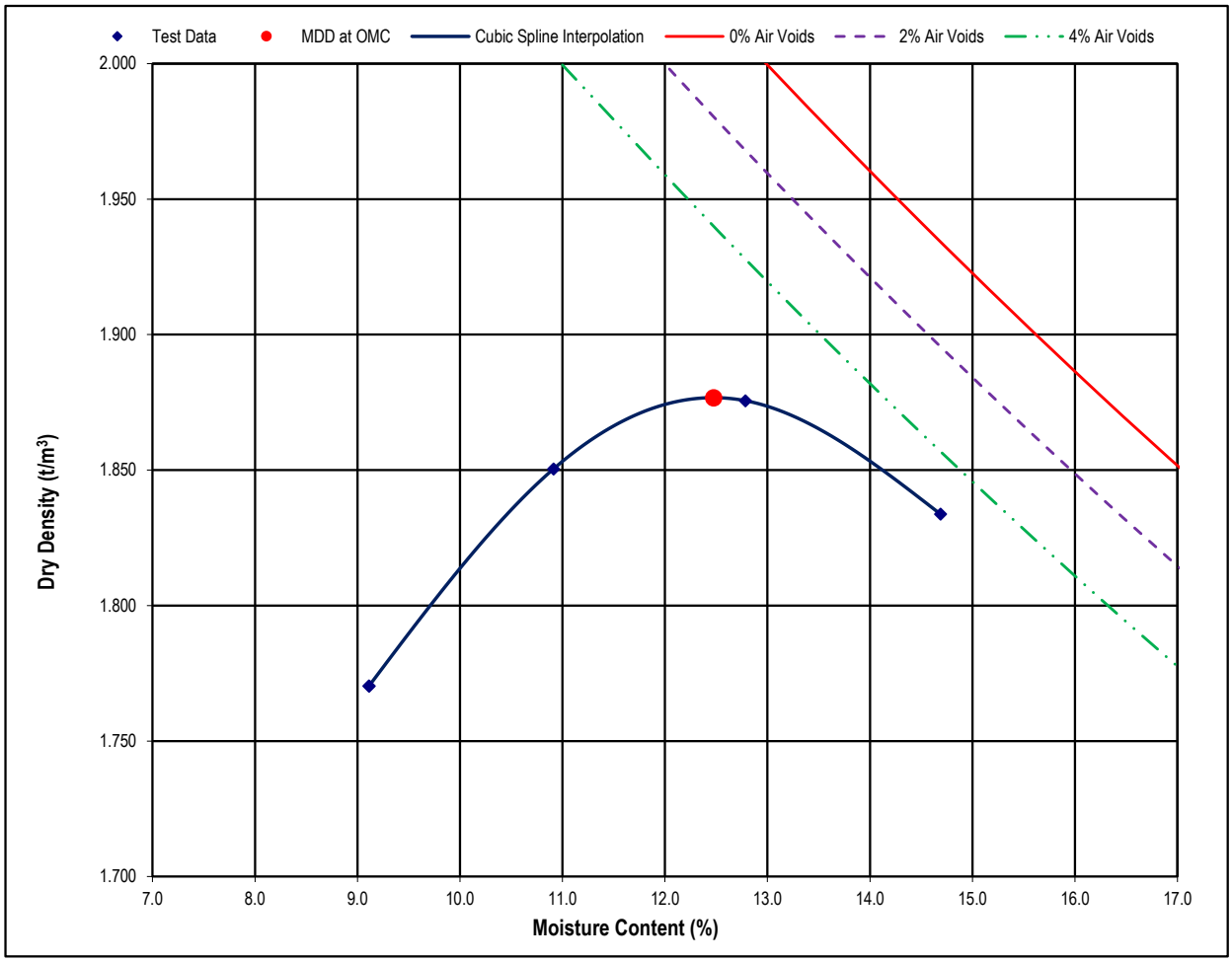
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090397-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	11/10/2024
		Report Date	18/10/2024
Project	TCK-2405		
Client ID	B1	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m³)	1.88	**Optimum Moisture Content (%)**	12.5
Moisture Content (%)	6.6	**Percentage of Oversize/Sieve Size (mm)**	4 /19

NOTES/REMARKS:

Curing Time (hrs): 48 * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.7

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090397-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090397
Liquid Limit Determination	AS 1289.3.1.2
Test Date	8/10/2024
Client ID	B1
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	36
Plastic Limit (%)	19
Plasticity Index (%)	17
Linear Shrinkage (%)	10.0
Moisture Content (%)	6.6

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred

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PERMEABILITY BY CONSTANT HEAD TEST REPORT

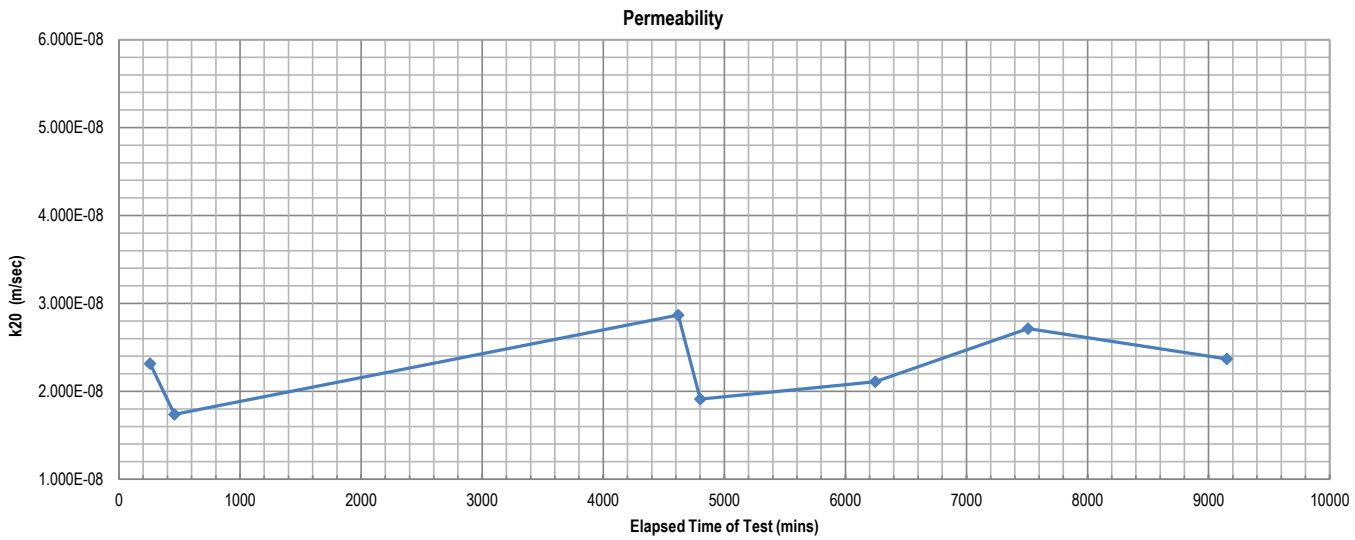
Test Method AS 1289 6.7.1, 5.1.1

Client	Mine Earth	**Report No.**	24090397-CPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	17/10/2024
		Report Date	25/10/2024
Project	TCK-2405		
Client ID	B1	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.88**	Hydraulic Gradient	**3.8**
Optimum Moisture Content (%)	**12.5**	Surcharge (kPa)	**3.6**
Placement Moisture Content (%)	**12.8**	Head Pressure Applied (kPa)	**4.32**
Moisture Ratio (%)	**102.8**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**2.01**	Percentage Material Retained/Sieve Size (mm)	**0 % / 19 mm**
Density Ratio (%)	**94.7**	Sample Height and Diameter (mm)	**116.97 / 152.66 mm**

PERMEABILITY $k_{(20)} = 2.4 \times 10^{-08}$ **(m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090397-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090397
Client ID	B1
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**6**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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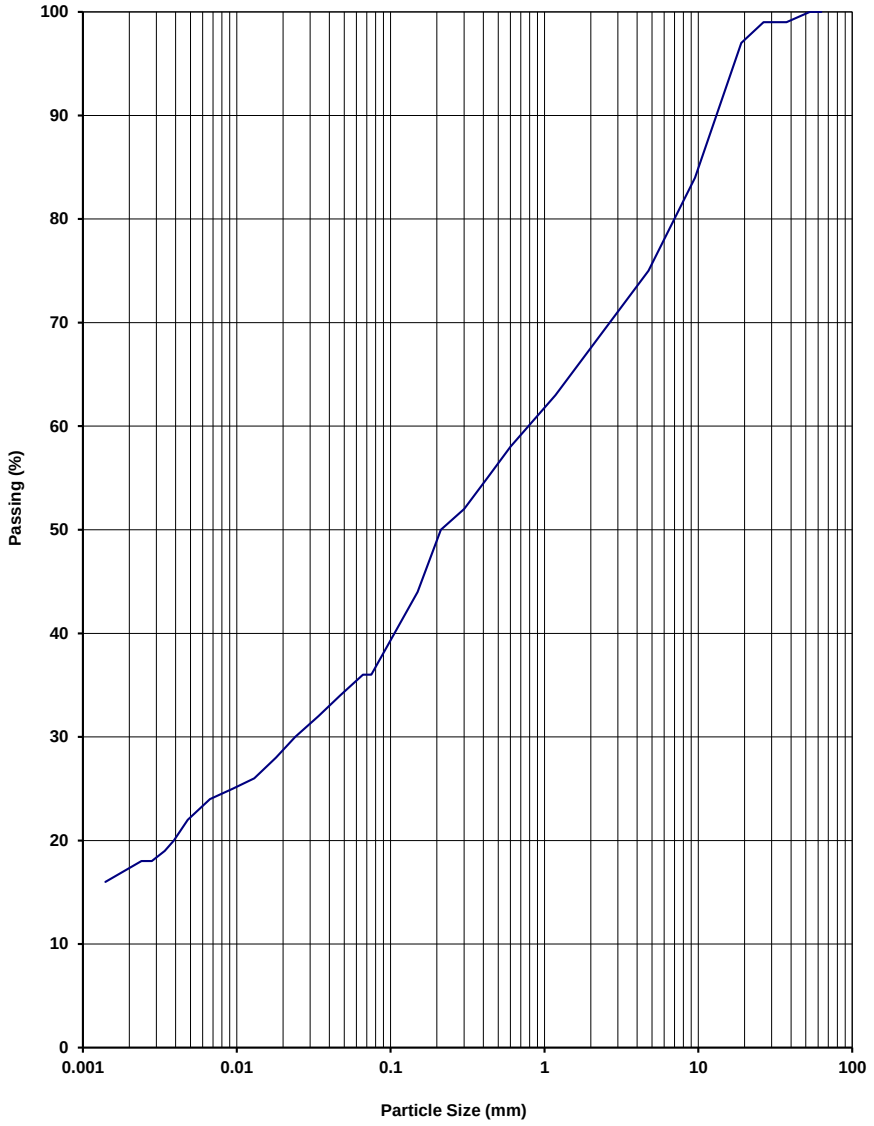
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090397-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	1/10/2024
		Report Date	21/10/2024
Project	TCK-2405		
Client ID	B1	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	100
37.5	99
26.5	99
19.0	97
13.2	89
9.5	84
6.7	80
4.75	75
2.36	69
1.18	63
0.600	58
0.425	55
0.300	52
0.212	50
0.150	44
0.075	36
0.066	36
0.047	34
0.034	32
0.024	30
0.018	28
0.013	26
0.0094	25
0.0067	24
0.0048	22
0.0039	20
0.0034	19
0.0028	18
0.0024	18
0.0014	16



NOTES/REMARKS: -

Moisture Content 6.6% -2.36mm Soil Particle Density(t/m^3) 2.62

Sample/s supplied by the client

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090398-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090398
Liquid Limit Determination	AS 1289.3.1.2
Test Date	8/10/2024
Client ID	B2
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	44
Plastic Limit (%)	21
Plasticity Index (%)	23
Linear Shrinkage (%)	18.0
Moisture Content (%)	8.8

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred **Page 1 of 1** REP00102

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090398-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090398
Client ID	B2
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**3**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

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PERMEABILITY BY FALLING HEAD TEST REPORT

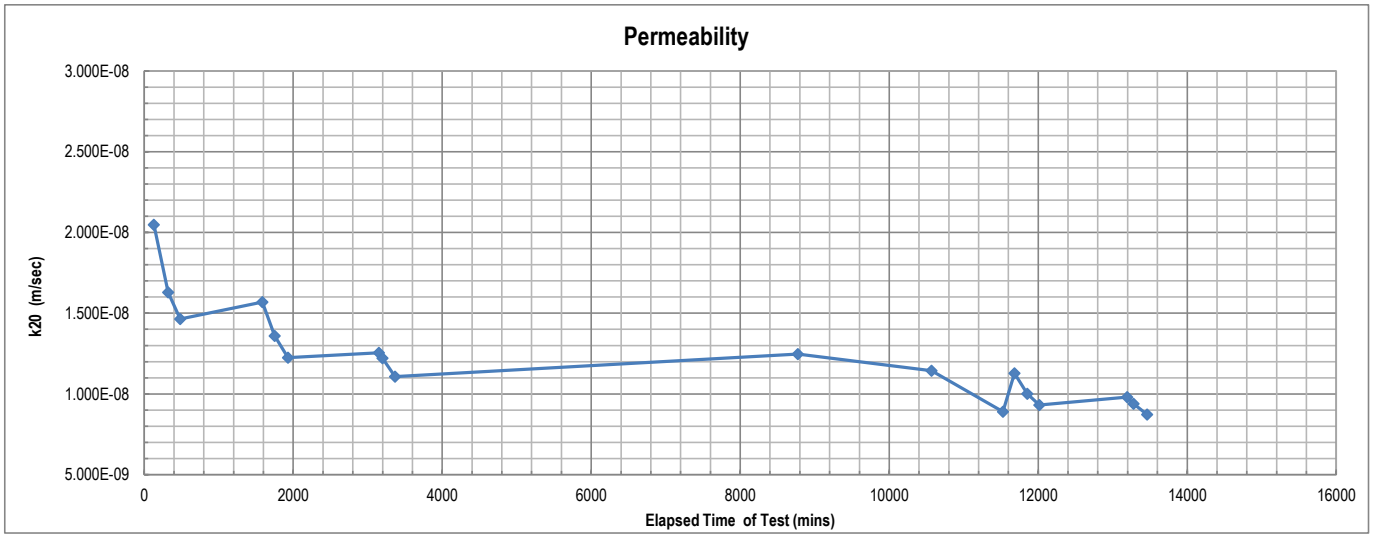
Test Method AS 1289 6.7.2, 5.1.1

Client	Mine Earth	**Report No.**	24090398-FPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	29/10/2024
		Report Date	20/11/2024
Project	TCK-2405		
Client ID	B2	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.84**	Hydraulic Gradient	**11.2**
Optimum Moisture Content (%)	**13.8**	Surcharge (kPa)	**3.7**
Placement Moisture Content (%)	**13.8**	Head Pressure Applied (kPa)	**12.75**
Moisture Ratio (%)	**99.9**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**1.99**	Percentage Material Retained/Sieve Size (mm)	**0 % /19 mm**
Density Ratio (%)	**95.0**	Sample Height and Diameter (mm)	**115.76 / 152.33 mm**

PERMEABILITY $k_{(20)} =$ **9.3×10^{-09} (m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client The compaction data was supplied by the client.

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Tested at Trilab Brisbane Laboratory

Approved Signatory

Michael Hamilton

Michael Hamilton

NATA

Laboratory No. 9926

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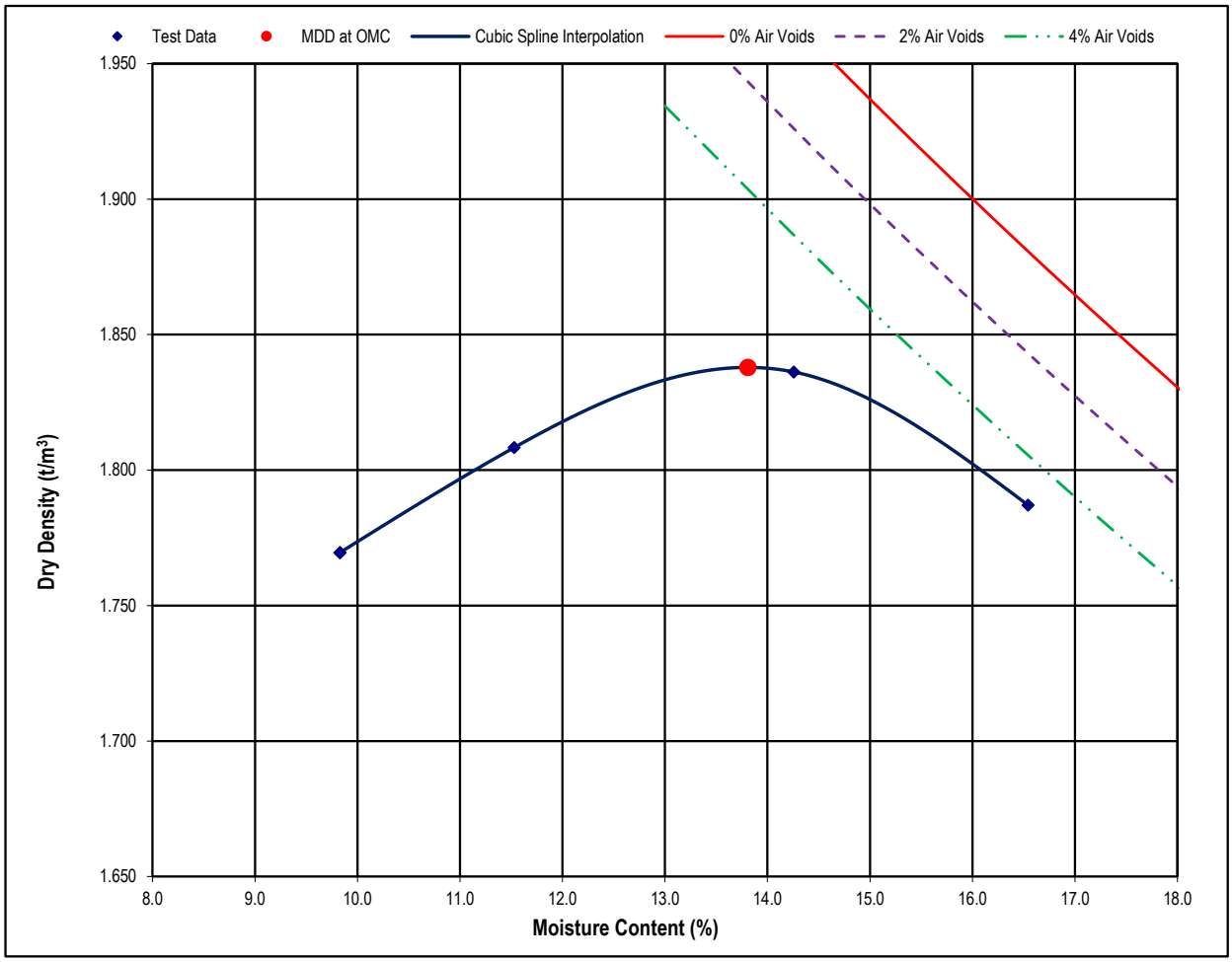
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090398-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	10/10/2024
		Report Date	18/10/2024
Project	TCK-2405		
Client ID	B2	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m³)	1.84	**Optimum Moisture Content (%)**	13.8
Moisture Content (%)	8.8	**Percentage of Oversize/Sieve Size (mm)**	7 / 19

NOTES/REMARKS:

Curing Time (hrs): * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.73

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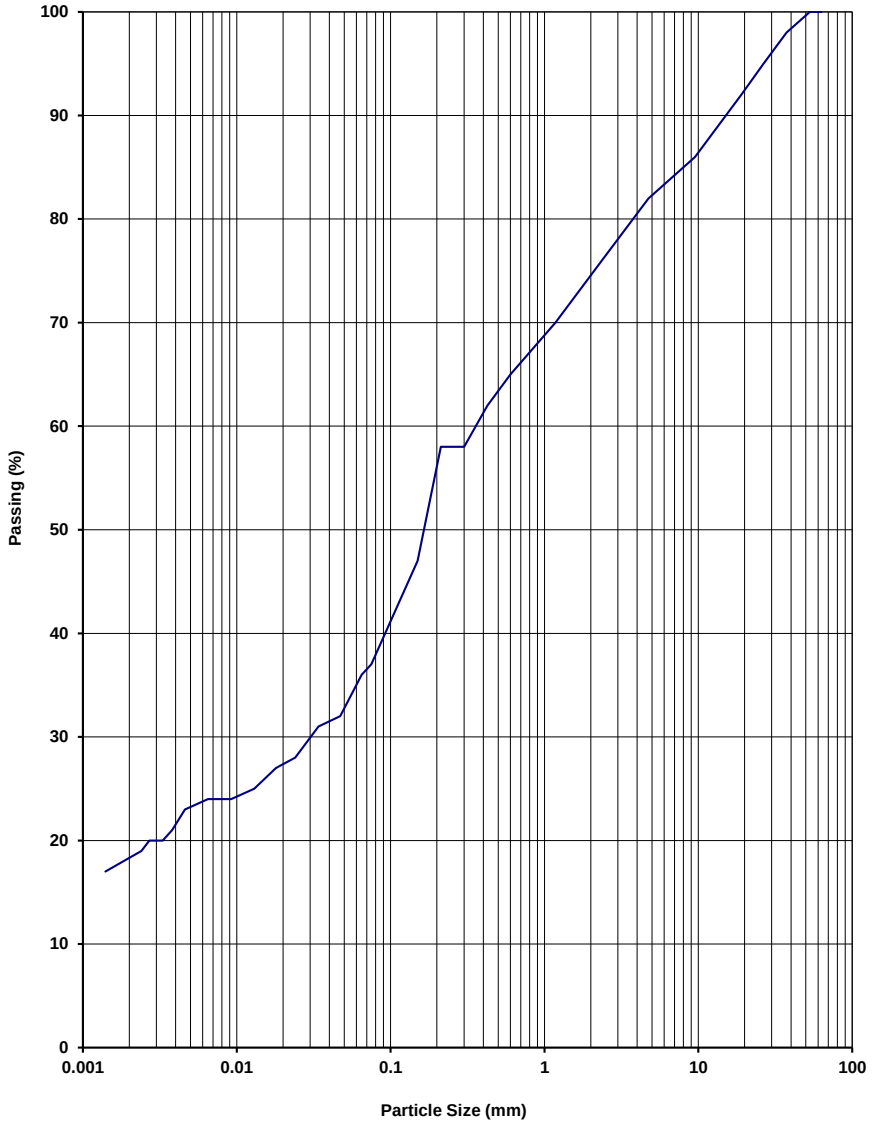
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090398-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	1/10/2024
		Report Date	21/10/2024
Project	TCK-2405		
Client ID	B2	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	100
37.5	98
26.5	95
19.0	92
13.2	88
9.5	86
6.7	84
4.75	82
2.36	76
1.18	70
0.600	65
0.425	62
0.300	58
0.212	58
0.150	47
0.075	37
0.065	36
0.047	32
0.034	31
0.024	28
0.018	27
0.013	25
0.0092	24
0.0065	24
0.0046	23
0.0038	21
0.0033	20
0.0027	20
0.0024	19
0.0014	17



NOTES/REMARKS: -

Moisture Content 8.8% -2.36mm Soil Particle Density(t/m^3) 2.70

Sample/s supplied by the client

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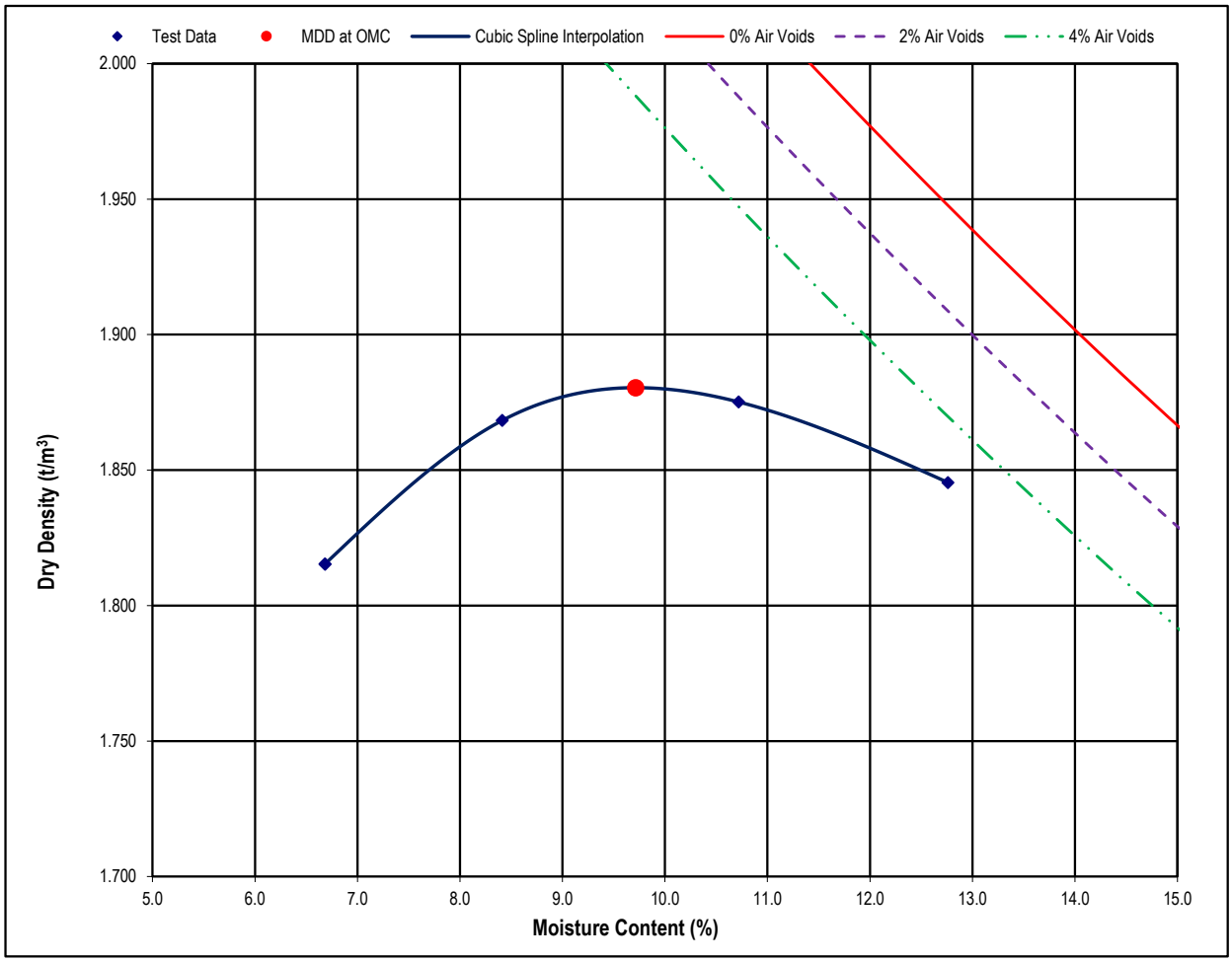
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090399-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	10/10/2024
		Report Date	18/10/2024
Project	TCK-2405		
Client ID	DC1	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m^3)	1.88	**Optimum Moisture Content (%)**	9.7
Moisture Content (%)	2.3	**Percentage of Oversize/Sieve Size (mm)**	15 / 19

NOTES/REMARKS:

Curing Time (hrs): 24 * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.59

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090399-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090399
Liquid Limit Determination	AS 1289.3.1.2
Test Date	8/10/2024
Client ID	DC1
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	Non-attainable
Plastic Limit (%)	Non-attainable
Plasticity Index (%)	Non-plastic
Linear Shrinkage (%)	Non-attainable
Moisture Content (%)	2.3

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred **Page 1 of 1** REP00102

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PERMEABILITY BY CONSTANT HEAD TEST REPORT

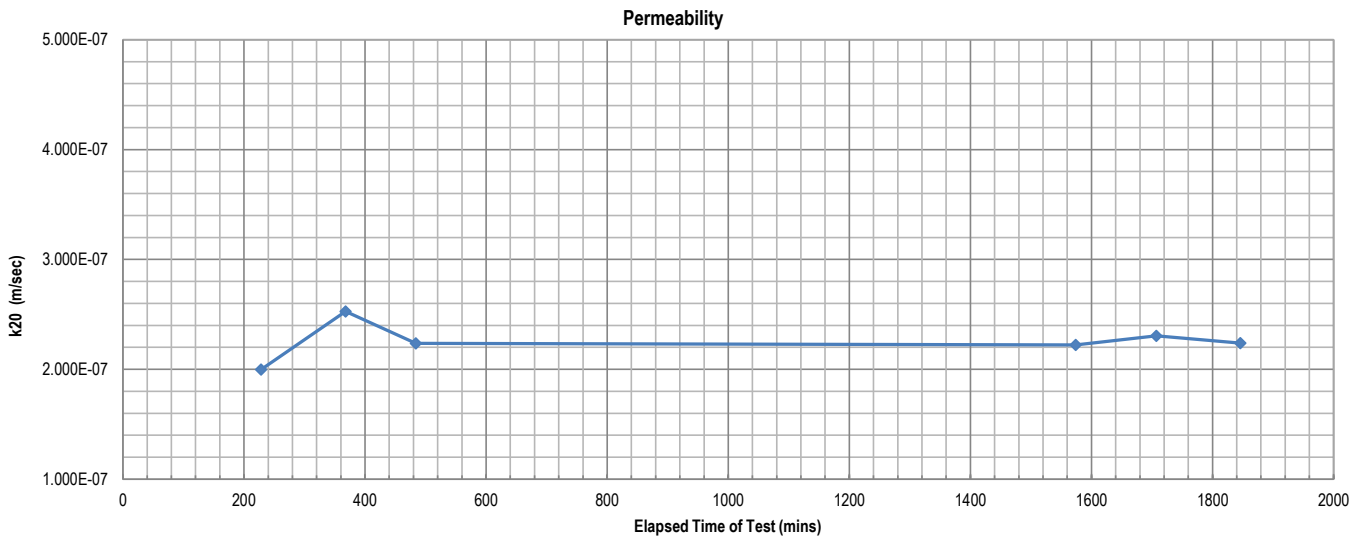
Test Method AS 1289 6.7.1, 5.1.1

Client	Mine Earth	**Report No.**	24090399-CPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	30/10/2024
		Report Date	20/11/2024
Project	TCK-2405		
Client ID	DC1	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.88**	Hydraulic Gradient	**3.6**
Optimum Moisture Content (%)	**9.7**	Surcharge (kPa)	**3.7**
Placement Moisture Content (%)	**10.0**	Head Pressure Applied (kPa)	**4.12**
Moisture Ratio (%)	**103.3**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**1.96**	Percentage Material Retained/Sieve Size (mm)	**0 % / 19 mm**
Density Ratio (%)	**94.7**	Sample Height and Diameter (mm)	**116.57 / 152.36 mm**

PERMEABILITY $k_{(20)} =$ **2.3×10^{-07} (m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client

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Approved Signatory

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090399-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090399
Client ID	DC1
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**3**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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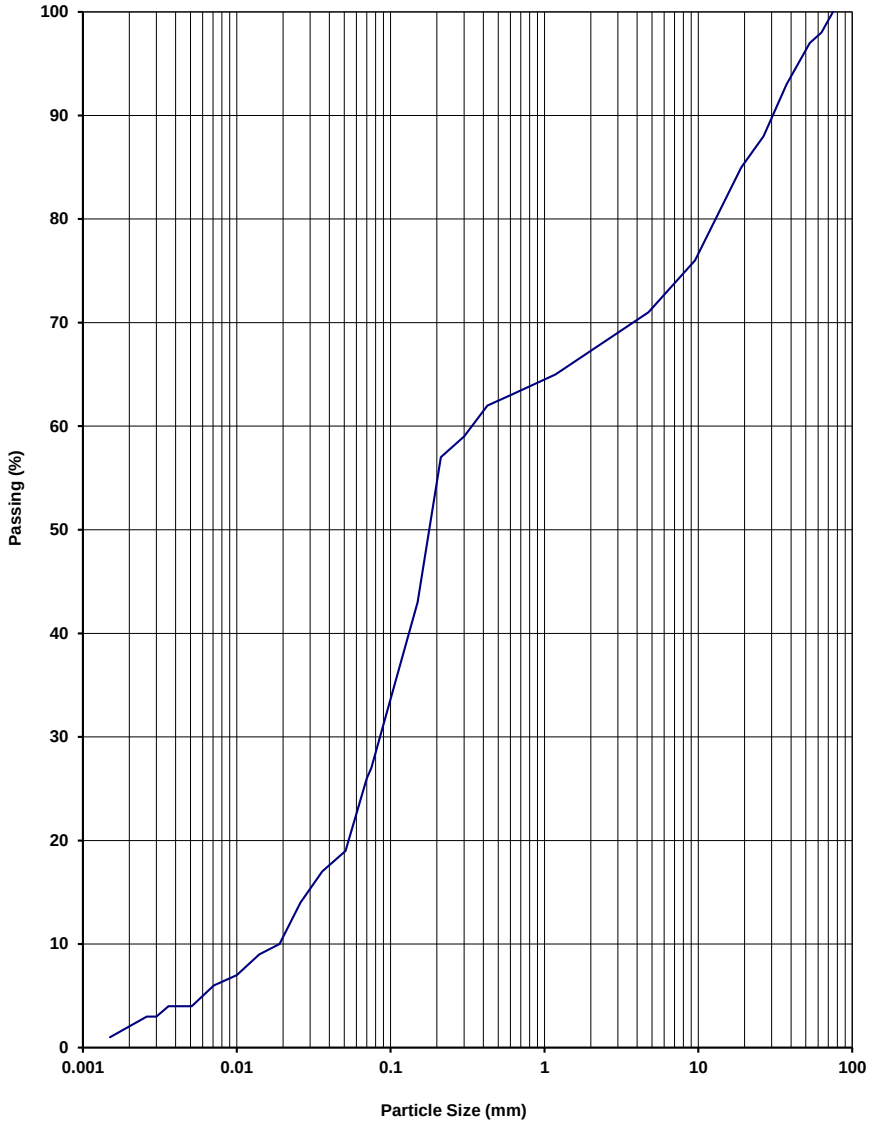
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090399-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	1/10/2024
		Report Date	22/10/2024
Project	TCK-2405		
Client ID	DC1	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	100
63.0	98
53.0	97
37.5	93
26.5	88
19.0	85
13.2	78
9.5	76
6.7	73
4.75	71
2.36	68
1.18	65
0.600	63
0.425	62
0.300	59
0.212	57
0.150	43
0.075	27
0.07	26
0.051	19
0.036	17
0.026	14
0.019	10
0.014	9
0.01	7
0.0071	6
0.0051	4
0.0041	4
0.0036	4
0.003	3
0.0026	3
0.0015	1



NOTES/REMARKS: -

Moisture Content 2.3% -2.36mm Soil Particle Density(t/m^3) 2.69

Sample/s supplied by the client

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090400-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090400
Liquid Limit Determination	AS 1289.3.1.2
Test Date	8/10/2024
Client ID	DC2
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	41
Plastic Limit (%)	21
Plasticity Index (%)	20
Linear Shrinkage (%)	11.5
Moisture Content (%)	7.0

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred **Page 1 of 1** REP00102

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090400-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090400
Client ID	DC2
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**2**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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PERMEABILITY BY FALLING HEAD TEST REPORT

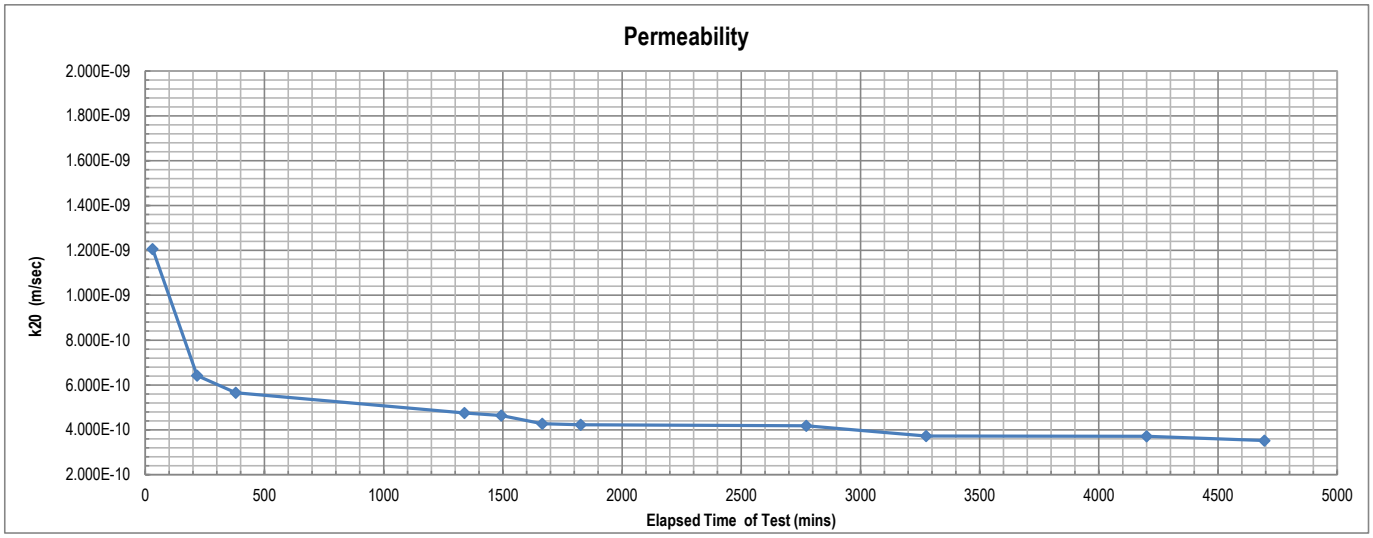
Test Method AS 1289 6.7.2, 5.1.1

Client	Mine Earth	**Report No.**	24090400-FPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	5/11/2024
		Report Date	20/11/2024
Project	TCK-2405		
Client ID	DC2	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.88**	Hydraulic Gradient	**11.2**
Optimum Moisture Content (%)	**13.5**	Surcharge (kPa)	**3.7**
Placement Moisture Content (%)	**13.1**	Head Pressure Applied (kPa)	**12.75**
Moisture Ratio (%)	**97.2**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**2.03**	Percentage Material Retained/Sieve Size (mm)	**0 % /19 mm**
Density Ratio (%)	**95.3**	Sample Height and Diameter (mm)	**116.14 / 152.51 mm**

PERMEABILITY $k_{(20)} =$ **3.6×10^{-10} (m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client The compaction data was supplied by the client.

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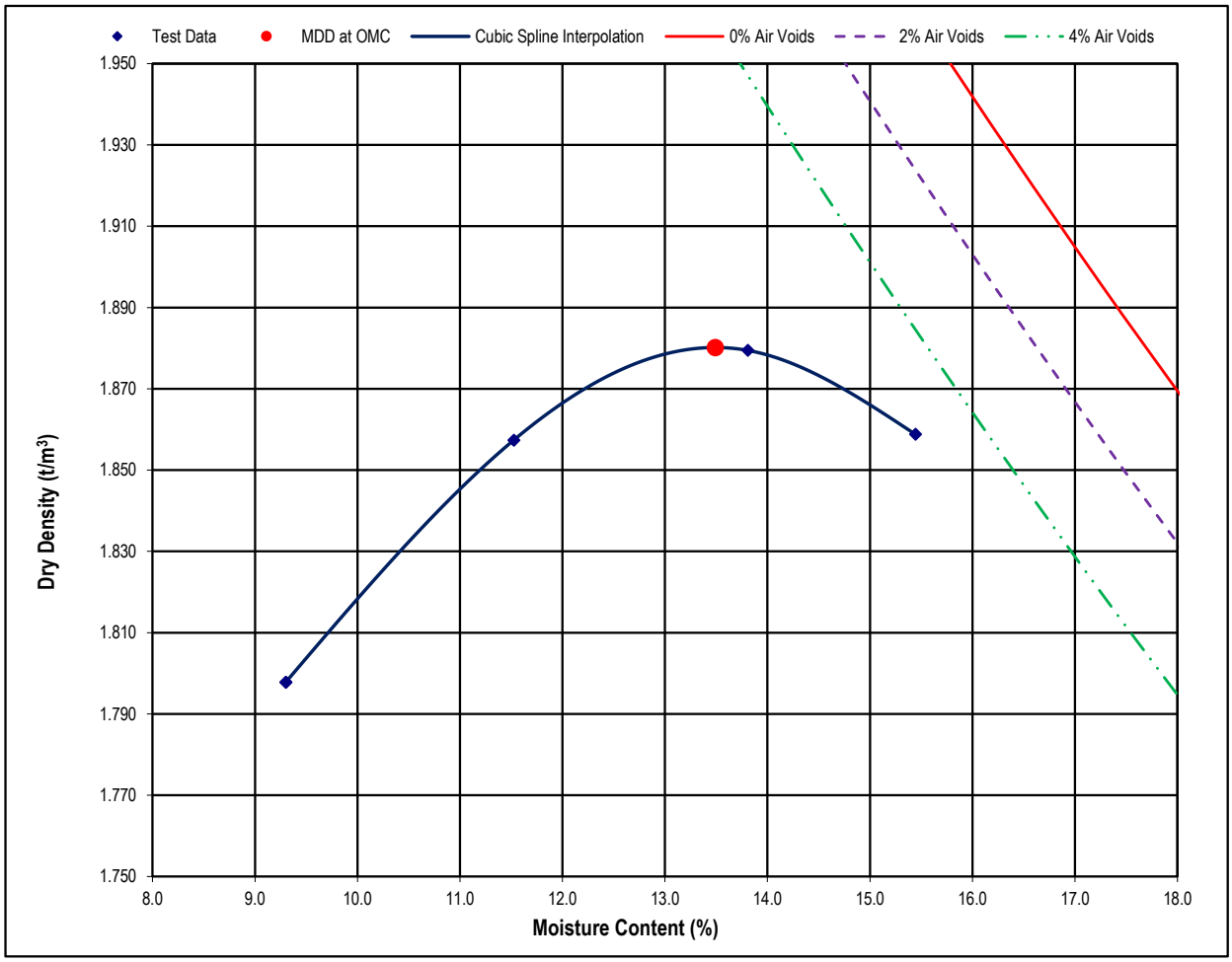
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090400-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	10/10/2024
		Report Date	18/10/2024
Project	TCK-2405		
Client ID	DC2	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m³)	1.88	**Optimum Moisture Content (%)**	13.5
Moisture Content (%)	7.0	**Percentage of Oversize/Sieve Size (mm)**	16 / 19

NOTES/REMARKS:

Curing Time (hrs): 48 * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.82

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Tested at Trilab Brisbane Laboratory

Approved Signatory

Michael Ferguson

NATA WORLD RECOGNISED ACCREDITATION

Laboratory No. 9926

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ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

Trilab
Soil Rock Calibration

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346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
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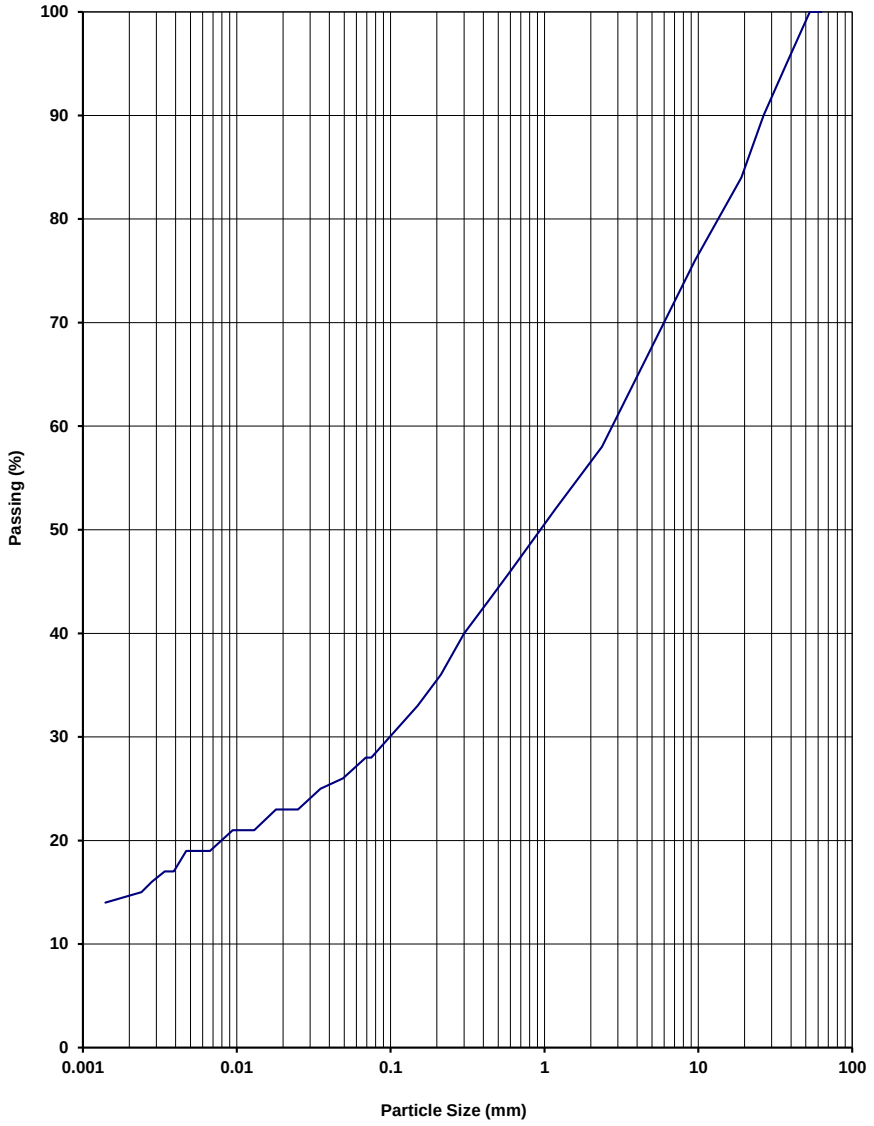
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090400-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	3/10/2024
		Report Date	22/10/2024
Project	TCK-2405		
Client ID	DC2	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	100
37.5	95
26.5	90
19.0	84
13.2	79
9.5	76
6.7	70
4.75	67
2.36	58
1.18	52
0.600	46
0.425	43
0.300	40
0.212	36
0.150	33
0.075	28
0.069	28
0.049	26
0.035	25
0.025	23
0.018	23
0.013	21
0.0094	21
0.0067	19
0.0047	19
0.0039	17
0.0034	17
0.0028	16
0.0024	15
0.0014	14



NOTES/REMARKS: -

Moisture Content 7% -2.36mm Soil Particle Density(t/m^3) 2.69

Sample/s supplied by the client

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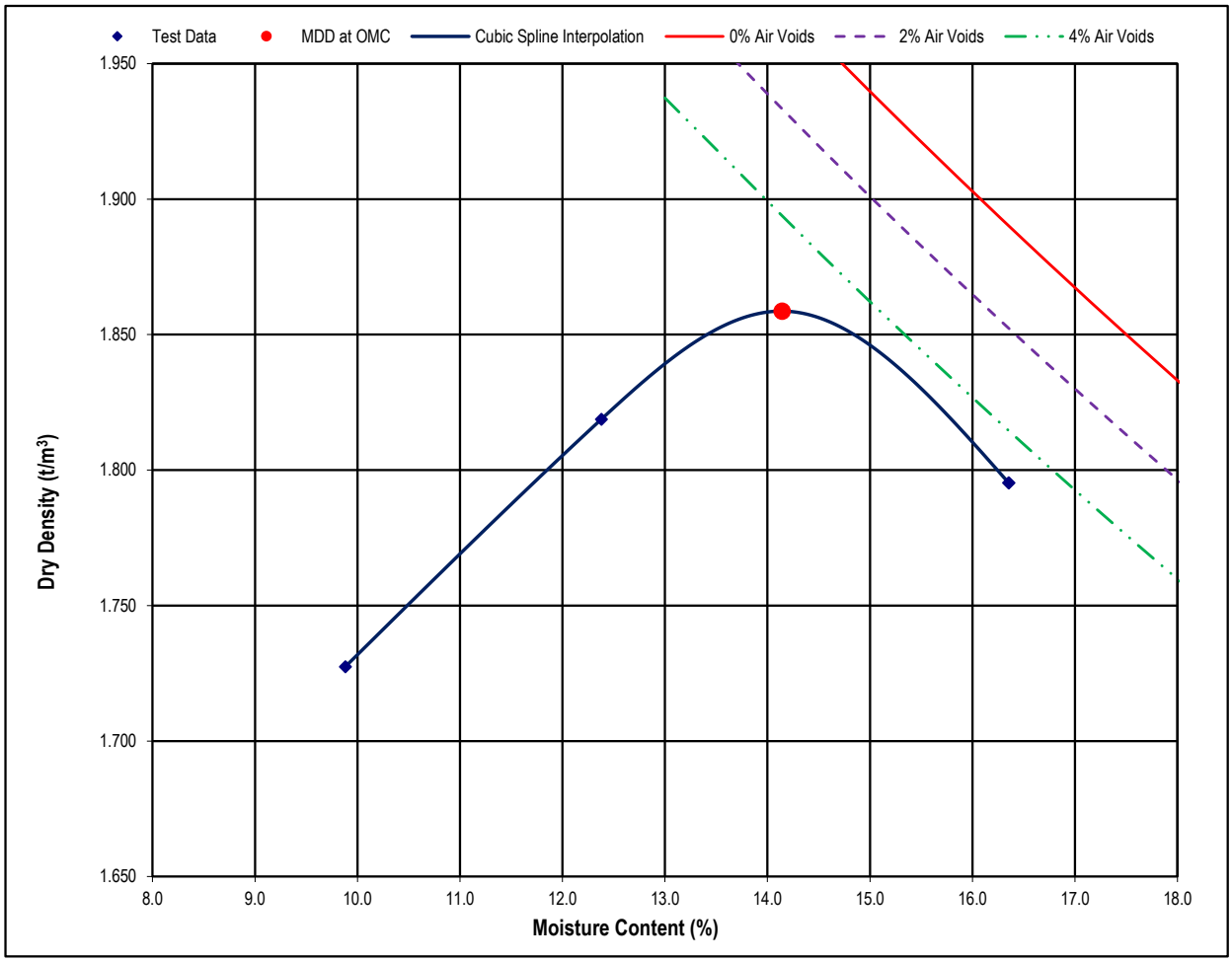
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090401-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	10/10/2024
		Report Date	18/10/2024
Project	TCK-2405		
Client ID	DE1	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m^3)	1.86	**Optimum Moisture Content (%)**	14.1
Moisture Content (%)	7.7	**Percentage of Oversize/Sieve Size (mm)**	10 / 19

NOTES/REMARKS:

Curing Time (hrs): * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.74

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Tested at Trilab Brisbane Laboratory

Approved Signatory

Michael Ferguson

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Laboratory No. 9926

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090401-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090401
Liquid Limit Determination	AS 1289.3.1.2
Test Date	8/10/2024
Client ID	DE1
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	45
Plastic Limit (%)	20
Plasticity Index (%)	25
Linear Shrinkage (%)	14.5 +
Moisture Content (%)	7.7

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred

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Approved Signatory

Michael Hamilton

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090401-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090401
Client ID	DE1
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**3**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

Accredited for compliance with ISO/IEC 17025 - Testing

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Tested at Trilab Brisbane Laboratory

Approved Signatory

Michael Hamilton

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

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PERMEABILITY BY FALLING HEAD TEST REPORT

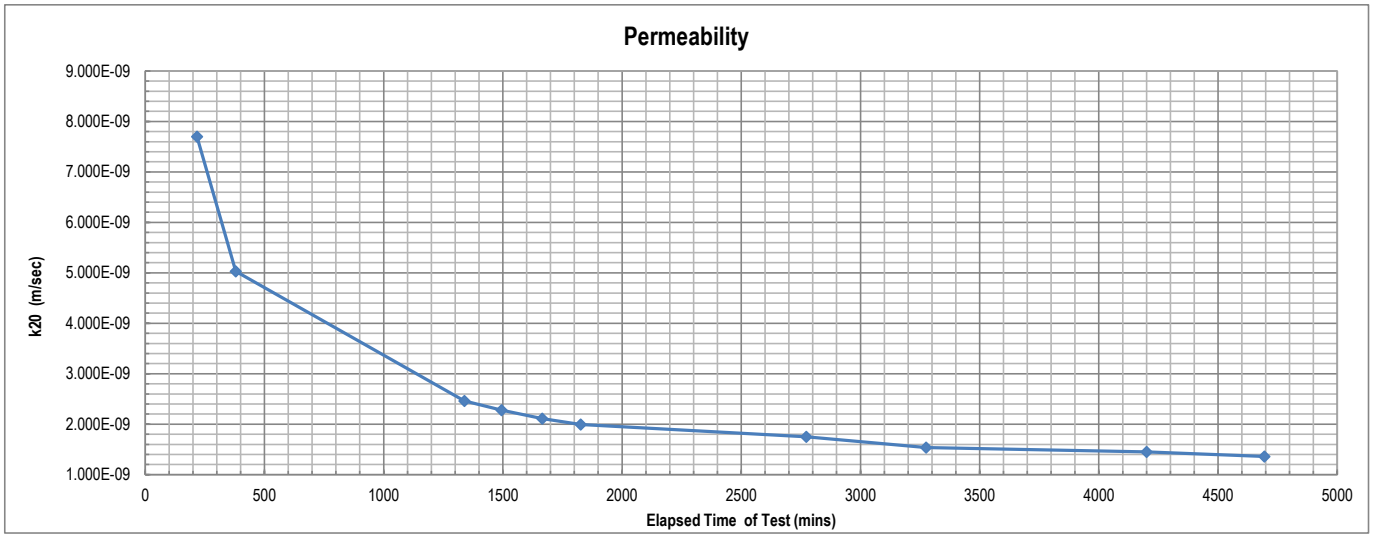
Test Method AS 1289 6.7.2, 5.1.1

Client	Mine Earth	**Report No.**	24090401-FPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	5/11/2024
		Report Date	20/11/2024
Project	TCK-2405		
Client ID	DE1	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.86**	Hydraulic Gradient	**11.2**
Optimum Moisture Content (%)	**14.1**	Surcharge (kPa)	**3.6**
Placement Moisture Content (%)	**14.0**	Head Pressure Applied (kPa)	**12.75**
Moisture Ratio (%)	**99.6**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**2.02**	Percentage Material Retained/Sieve Size (mm)	**0 % /19 mm**
Density Ratio (%)	**95.0**	Sample Height and Diameter (mm)	**116 / 152.26 mm**

PERMEABILITY $k_{(20)} = 1.4 \times 10^{-09}$ **(m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client The compaction data was supplied by the client.

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Approved Signatory

Michael Hamilton

Michael Hamilton

NATA

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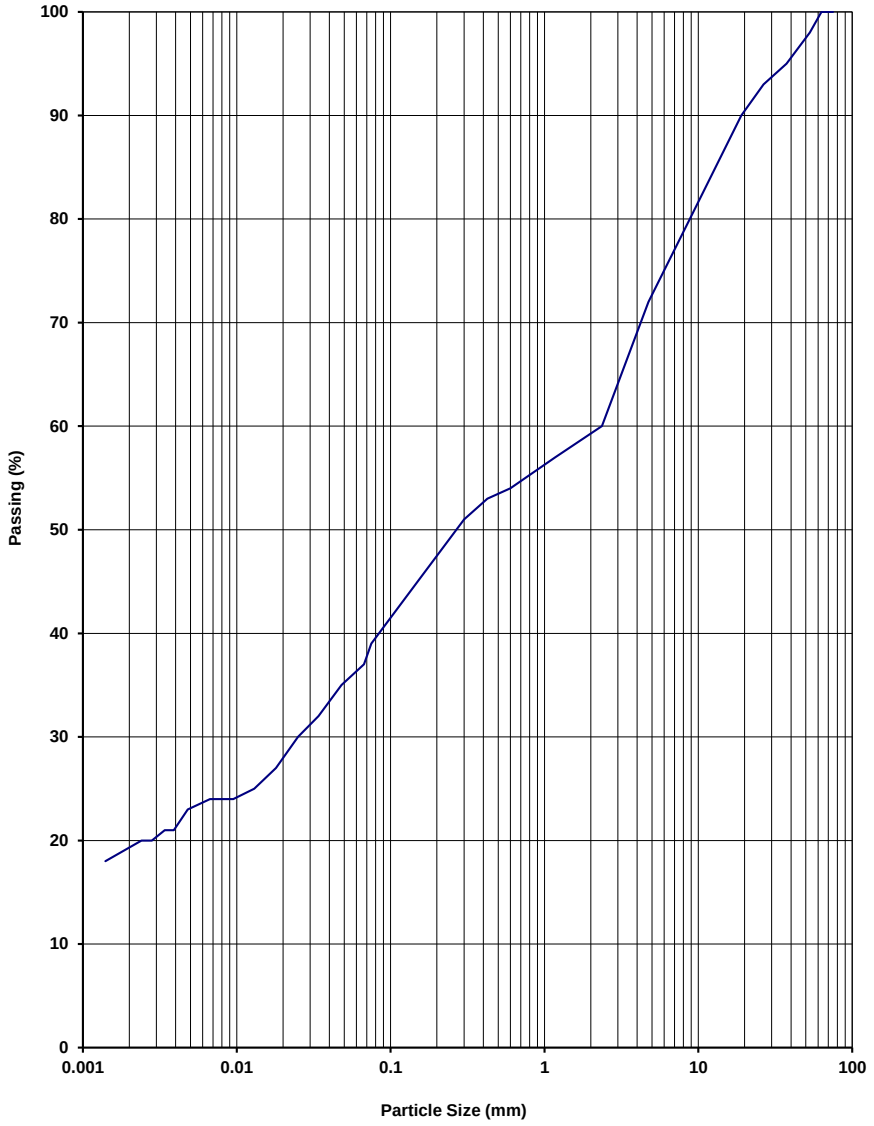
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090401-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	1/10/2024
		Report Date	22/10/2024
Project	TCK-2405		
Client ID	DE1	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	100
53.0	98
37.5	95
26.5	93
19.0	90
13.2	84
9.5	81
6.7	77
4.75	72
2.36	60
1.18	57
0.600	54
0.425	53
0.300	51
0.212	48
0.150	45
0.075	39
0.067	37
0.048	35
0.034	32
0.025	30
0.018	27
0.013	25
0.0095	24
0.0067	24
0.0048	23
0.0039	21
0.0034	21
0.0028	20
0.0024	20
0.0014	18



NOTES/REMARKS: -

Moisture Content 7.7% -2.36mm Soil Particle Density(t/m^3) 2.64

Sample/s supplied by the client

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Approved Signatory

Michael Hamilton

NATA WORLD RECOGNISED ACCREDITATION

Tested at Trilab Brisbane Laboratory

Laboratory No. 9926

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ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

CERTIFICATE OF ANALYSIS

Work Order	: **EB2428229**	Page	: 1 of 24
Client	: **The Trustee for Mine Earth Unit Trust**	Laboratory	: Environmental Division Brisbane
Contact	: Matt Braimbridge	Contact	: Customer Services EB
Address	: 1 BREAKFAST CREEK ROAD NEWSTEAD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: TCK-2405	Date Samples Received	: 07-Aug-2024 09:50
Order number	: ----	Date Analysis Commenced	: 20-Aug-2024
C-O-C number	: ----	Issue Date	: 28-Aug-2024 22:10
Sampler	: JEREMY DURBIN		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 24		
No. of samples analysed	: 24		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Inorganics, Stafford, QLD
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Soil Preparation, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Soil Preparation, Stafford, QLD
Dave Gitsham	Metals Instrument Chemist	Brisbane Inorganics, Stafford, QLD
Layla Hafner	Acid Sulphate Soils - Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Vincent Muller	Chemist - Inorganics	Brisbane Inorganics, Stafford, QLD
Vincent Muller	Chemist - Inorganics	Brisbane Soil Preparation, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED009-X (Standard Anions - Extended Method –by IC): Some samples were diluted due to matrix interference. LOR adjusted accordingly.
- EA150H: Soil particle density results fell outside the scope of AS1289.3.6.3. Results should be scrutinised accordingly.
- ALS is not NATA accredited for the analysis of Exchangeable Aluminium and Exchange Acidity in soils when performed under ALS Method ED005.
- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- As per QWI – EN55-3 Data Interpreting Procedures, Ionic balances are typically calculated using Major Anions - Chloride, Alkalinity and Sulfate; and Major Cations - Calcium, Magnesium, Potassium and Sodium. Where applicable and dependent upon sample matrix, the Ionic Balance may also include the additional contribution of Ammonia, Dissolved Metals by ICPMS and H+ to the Cations and Nitrate, SiO2 and Fluoride to the Anions.
- Ionic Balance out of acceptable limits due to analytes not quantified in this report.
- EG005T (Total Metals by ICP-AES): Sample EB2428324-003 shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- ED093C (Leachable Major Cations): Unable to report Sodium results due to it's inclusion in the extraction fluid.
- ED006 (Exchangeable Cations on Alkaline Soils): Unable to calculate Magnesium/Potassium Ratio result for some samples as required Exchangeable Magnesium and/or Potassium results are less than the limit of reporting.
- ED006 (Exchangeable Cations on Alkaline Soils): Unable to calculate Calcium/Magnesium Ratio result for some samples as required Exchangeable Calcium and/or Magnesium results are less than the limit of reporting.
- ED006 (Exchangeable Cations on Alkaline Soils): Sample DC-ALS (EB2428229-006) shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- It is recognised that EG005T (Total Metals by ICP-AES) is less than EG005C (Leachable Metals by ICP-AES) for some samples. However, the difference is within experimental variation of the methods.
- ED045G (Chloride)/ ED041G (Sulfate as SO4): Some samples were diluted due to matrix interference. LOR adjusted accordingly.
- EA058 Emerson: V. = Very, D. = Dark, L. = Light, VD. = Very Dark
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.
- ED045G: The presence of Thiocyanate, Thiosulfate and Sulfite can positively contribute to the chloride result, thereby may bias results higher than expected. Results should be scrutinised accordingly.

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)			Sample ID	T1-ALS	TC1-ALS	WR1-ALS	WR3-ALS	----
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	----
Compound	CAS Number	LOR	Unit	EB2428229-001	EB2428229-002	EB2428229-003	EB2428229-004	--------
				Result	Result	Result	Result	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**5.04**	**5.65**	**6.42**	**5.06**	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**5990**	**7490**	**7580**	**5600**	----
ED009: Anions								
Iodide	20461-54-5	1.00	mg/L	----	----	<0.500	<0.200	----
ED037P: Alkalinity by PC Titrator								
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**1440**	**2360**	**2880**	**1460**	----
Total Alkalinity as CaCO3	----	1	mg/L	**1440**	**2360**	**2880**	**1460**	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<10	<10	**4**	<10	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<10	<10	<10	**10**	----
ED093C: Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	**93**	**133**	**568**	**91**	----
Magnesium	7439-95-4	1	mg/L	**11**	**14**	**74**	**8**	----
Potassium	7440-09-7	1	mg/L	**4**	**9**	**6**	**4**	----
EG005(ED093)C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**0.7**	<0.1	<0.1	**0.4**	----
Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	----
Barium	7440-39-3	0.1	mg/L	**0.9**	**1.1**	**4.5**	**0.6**	----
Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	----
Boron	7440-42-8	0.1	mg/L	**0.2**	**0.2**	<0.1	**0.1**	----
Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	----
Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	----
Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	----
Copper	7440-50-8	0.1	mg/L	**0.2**	<0.1	<0.1	<0.1	----
Iron	7439-89-6	0.1	mg/L	**0.4**	<0.1	<0.1	**0.2**	----

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)			Sample ID	T1-ALS	TC1-ALS	WR1-ALS	WR3-ALS	----
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	----
Compound	CAS Number	LOR	Unit	EB2428229-001	EB2428229-002	EB2428229-003	EB2428229-004	--------
				Result	Result	Result	Result	----
EG005(ED093)C: Leachable Metals by ICPAES - Continued								
Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	----
Manganese	7439-96-5	0.1	mg/L	**0.5**	**2.7**	<0.1	**0.5**	----
Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	----
Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	----
Strontium	7440-24-6	0.1	mg/L	**0.1**	**0.4**	**1.1**	<0.1	----
Titanium	7440-32-6	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	----
Vanadium	7440-62-2	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	----
Zinc	7440-66-6	0.1	mg/L	**0.3**	**0.3**	**0.2**	**0.3**	----
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.2**	**0.3**	**0.4**	**0.1**	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.05**	**0.06**	<0.01	<0.01	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	**0.02**	<0.01	<0.01	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	**0.06**	<0.01	**0.02**	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	T1-ALS	TC1-ALS	WR1-ALS	WR3-ALS	B1-ALS
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-001	EB2428229-002	EB2428229-003	EB2428229-004	EB2428229-005
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	7.8	8.0	8.0	8.1	6.6
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.9	9.2	9.2	9.5	7.1
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	175	55	110	45	16
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	3.4	<1.0	6.9	1.0	2.9
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Reddish Brown (2.5YR 5/4)	Dark Reddish Gray (5YR 4/2)	Red (2.5YR 4/8)	Reddish Gray (2.5YR 6/1)	Red (2.5YR 5/6)
Texture	----	-	-	Sandy Loam	Sandy Loam	Medium Clay	Course Sand	Sandy Clay Loam
Emerson Class Number	EC/TC	-	-	3	7	3	8	3
EA150: Particle Sizing								
+75µm	----	1	%	53	79	61	90	63
+150µm	----	1	%	17	69	54	80	51
+300µm	----	1	%	1	59	44	67	41
+425µm	----	1	%	<1	53	40	60	38
+600µm	----	1	%	<1	48	35	53	36
+1180µm	----	1	%	<1	37	25	36	34
+2.36mm	----	1	%	<1	24	12	18	31
+4.75mm	----	1	%	<1	10	5	4	23
+9.5mm	----	1	%	<1	<1	<1	<1	13
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	12	9	26	2	22
Silt (2-60 µm)	----	1	%	31	11	12	6	13

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	T1-ALS	TC1-ALS	WR1-ALS	WR3-ALS	B1-ALS
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-001	EB2428229-002	EB2428229-003	EB2428229-004	EB2428229-005
				Result	Result	Result	Result	Result
EA150: Soil Classification based on Particle Size - Continued								
Sand (0.06-2.00 mm)	----	1	%	57	52	46	68	33
Gravel (>2mm)	----	1	%	<1	28	16	24	32
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.67	2.75	2.68	2.66	2.60
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	1.1	1.4	3.6	1.1	----
ø Exchangeable Magnesium	----	0.2	meq/100g	<0.2	0.5	3.4	<0.2	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	<0.2	<0.2	<0.2	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	<0.2	0.4	<0.2	----
ø Cation Exchange Capacity	----	0.2	meq/100g	1.1	1.9	7.3	1.1	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	<0.2	5.1	<0.2	----
ø Calcium/Magnesium Ratio	----	0.2	-	----	2.6	1.1	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	----	----	20.3
Exchangeable Magnesium	----	0.1	meq/100g	----	----	----	----	6.9
Exchangeable Potassium	----	0.1	meq/100g	----	----	----	----	0.8
Exchangeable Sodium	----	0.1	meq/100g	----	----	----	----	0.6
Cation Exchange Capacity	----	0.1	meq/100g	----	----	----	----	28.6
Exchangeable Sodium Percent	----	0.1	%	----	----	----	----	2.1
Calcium/Magnesium Ratio	----	0.1	-	----	----	----	----	2.9
Magnesium/Potassium Ratio	----	0.1	-	----	----	----	----	8.2
ED021: Bicarbonate Extractable Potassium (Colwell)								
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	163	446	280	138	387
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	20	<10	20	<10	<10
ED092: DTPA Extractable Metals								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	T1-ALS	TC1-ALS	WR1-ALS	WR3-ALS	B1-ALS
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-001	EB2428229-002	EB2428229-003	EB2428229-004	EB2428229-005
				Result	Result	Result	Result	Result
ED092: DTPA Extractable Metals - Continued								
ø Copper	7440-50-8	1	mg/kg	**16**	<1	<1	<1	<1
ø Iron	7439-89-6	1	mg/kg	**19**	**15**	**5**	**16**	**10**
ø Manganese	7439-96-5	1	mg/kg	**4**	**4**	<1	**3**	**3**
ø Zinc	7440-66-6	1	mg/kg	<1	<1	<1	<1	<1
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	**30**	**20**	**140**	<10	**30**
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	**17**	**12**	**11**	**3**	**17**
Cobalt	7440-48-4	2	mg/kg	**17**	**7**	**13**	<2	**7**
Copper	7440-50-8	5	mg/kg	**95**	**9**	**9**	**10**	**6**
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg	**75**	**107**	**80**	**30**	**112**
Nickel	7440-02-0	2	mg/kg	**15**	**10**	**7**	<2	**8**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**18**	**22**	**38**	<5	**41**
Zinc	7440-66-6	5	mg/kg	**11**	**10**	**5**	<5	**6**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20	<20	<20	<20	<20
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	**0.1**
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	**0.7**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	T1-ALS	TC1-ALS	WR1-ALS	WR3-ALS	B1-ALS
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-001	EB2428229-002	EB2428229-003	EB2428229-004	EB2428229-005
				Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	**0.8**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**60**	**30**	**80**	<20	**590**
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	**60**	**30**	**80**	<20	**590**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**391**	**446**	**145**	**74**	**180**
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	<5	<5	<5	**9**
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Extraction Fluid pH	----	0.1	pH Unit	**5.0**	**5.0**	**5.0**	**5.0**	**----**
Final pH	----	0.1	pH Unit	**5.1**	**5.1**	**6.4**	**5.1**	**----**
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5	<0.5	<0.5	<0.5	**1.1**
Total Organic Carbon	----	0.5	%	<0.5	<0.5	<0.5	<0.5	**0.6**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	DC-ALS	DC2-ALS	TS1-ALS	TS2-ALS	A1-1
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-006	EB2428229-007	EB2428229-008	EB2428229-009	EB2428229-010
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	8.1	8.2	7.9	7.8	7.8
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.5	9.6	8.7	8.7	8.6
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	77	374	205	98	70
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	2.2	5.6	5.1	2.6	3.4
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Reddish Brown (2.5YR 5/3)	Reddish Brown (2.5YR 5/4)	Reddish Brown (2.5YR 5/4)	Reddish Brown (2.5YR 5/4)	Yellowish Red (5YR 5/6)
Texture	----	-	-	Sandy Loam	Medium Heavy Clay	Medium Clay	Light Clay	Sandy Loam
Emerson Class Number	EC/TC	-	-	3	2	3	3	3
EA150: Particle Sizing								
+75µm	----	1	%	68	53	52	50	67
+150µm	----	1	%	36	46	36	29	52
+300µm	----	1	%	13	36	26	17	36
+425µm	----	1	%	9	32	22	13	29
+600µm	----	1	%	8	28	20	10	25
+1180µm	----	1	%	6	22	16	6	19
+2.36mm	----	1	%	4	14	11	3	11
+4.75mm	----	1	%	<1	5	5	<1	4
+9.5mm	----	1	%	<1	3	<1	<1	<1
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	9	31	28	29	19
Silt (2-60 µm)	----	1	%	22	14	18	18	12

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	DC-ALS	DC2-ALS	TS1-ALS	TS2-ALS	A1-1
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-006	EB2428229-007	EB2428229-008	EB2428229-009	EB2428229-010
				Result	Result	Result	Result	Result
EA150: Soil Classification based on Particle Size - Continued								
Sand (0.06-2.00 mm)	----	1	%	65	39	41	49	56
Gravel (>2mm)	----	1	%	4	16	13	4	13
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.68	2.64	2.65	2.67	2.64
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	1.0	3.1	4.3	5.0	10.0
ø Exchangeable Magnesium	----	0.2	meq/100g	0.9	3.7	1.8	2.6	0.5
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	0.2	0.3	0.3	<0.2
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	2.1	<0.2	<0.2	<0.2
ø Cation Exchange Capacity	----	0.2	meq/100g	1.9	9.2	6.4	7.9	10.7
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	23.2	<0.2	<0.2	<0.2
ø Calcium/Magnesium Ratio	----	0.2	-	1.2	0.8	2.4	1.9	19.9
ø Magnesium/Potassium Ratio	----	0.2	-	----	16.0	6.1	8.2	----
ED021: Bicarbonate Extractable Potassium (Colwell)								
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	221	557	528	391	377
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	70	70	20	<10
ED092: DTPA Extractable Metals								
ø Copper	7440-50-8	1	mg/kg	5	56	4	2	<1
ø Iron	7439-89-6	1	mg/kg	9	32	12	10	4
ø Manganese	7439-96-5	1	mg/kg	3	22	4	3	2
ø Zinc	7440-66-6	1	mg/kg	<1	<1	<1	<1	<1
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	20	180	30	100	120
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	DC-ALS	DC2-ALS	TS1-ALS	TS2-ALS	A1-1
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-006	EB2428229-007	EB2428229-008	EB2428229-009	EB2428229-010
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	7	9	8	26	26
Cobalt	7440-48-4	2	mg/kg	11	10	6	13	14
Copper	7440-50-8	5	mg/kg	34	79	19	34	7
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg	62	112	64	197	195
Nickel	7440-02-0	2	mg/kg	7	10	6	16	20
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	12	21	16	68	68
Zinc	7440-66-6	5	mg/kg	5	9	<5	10	11
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20	<20	<20	<20	<20
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	0.1	<0.1	0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1	4.1	3.2	1.9	0.5
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	4.2	3.2	2.0	0.5
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	40	100	590	380	190
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	40	100	590	380	190
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	348	400	332	337	4330
EK080: Bicarbonate Extractable Phosphorus (Colwell)								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	DC-ALS	DC2-ALS	TS1-ALS	TS2-ALS	A1-1
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-006	EB2428229-007	EB2428229-008	EB2428229-009	EB2428229-010
				Result	Result	Result	Result	Result
EK080: Bicarbonate Extractable Phosphorus (Colwell) - Continued								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	<5	<5	<5	<5
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5	<0.5	**0.7**	**0.7**	**0.6**
Total Organic Carbon	----	0.5	%	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A1-2	A2-1	A2-2	A2-3	A3-1
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-011	EB2428229-012	EB2428229-013	EB2428229-014	EB2428229-015
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	7.4	6.0	6.4	6.6	7.0
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.7	7.1	7.5	7.6	7.6
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	25	42	12	8	28
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	1.1	<1.0	5.8	2.6	4.5
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Pink (7.5YR 7/4)	Reddish Brown (2.5YR 4/4)	Red (2.5YR 4/6)	Red (2.5YR 5/6)	Reddish Brown (2.5YR 5/4)
Texture	----	-	-	Clayey Sand	Sandy Loam	Light Clay	Sandy Loam	Light Medium Clay
Emerson Class Number	EC/TC	-	-	5	3	3	7	3
EA150: Particle Sizing								
+75µm	----	1	%	80	67	49	79	33
+150µm	----	1	%	65	54	39	70	20
+300µm	----	1	%	52	40	28	55	11
+425µm	----	1	%	46	34	22	46	9
+600µm	----	1	%	41	30	18	34	8
+1180µm	----	1	%	31	25	12	19	6
+2.36mm	----	1	%	19	20	7	10	4
+4.75mm	----	1	%	10	6	<1	2	2
+9.5mm	----	1	%	4	<1	<1	<1	<1
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	9	19	42	14	43
Silt (2-60 µm)	----	1	%	9	12	7	7	22

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A1-2	A2-1	A2-2	A2-3	A3-1
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-011	EB2428229-012	EB2428229-013	EB2428229-014	EB2428229-015
				Result	Result	Result	Result	Result
EA150: Soil Classification based on Particle Size - Continued								
Sand (0.06-2.00 mm)	----	1	%	60	47	42	66	31
Gravel (>2mm)	----	1	%	22	22	9	13	4
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.61	2.57	2.64	2.75	2.54
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	3.3	----	4.2	1.9	6.9
ø Exchangeable Magnesium	----	0.2	meq/100g	<0.2	----	1.4	0.6	2.7
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	0.3	<0.2	0.6
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	<0.2	<0.2	<0.2
ø Cation Exchange Capacity	----	0.2	meq/100g	3.3	----	5.9	2.5	10.1
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	<0.2	<0.2	<0.2
ø Calcium/Magnesium Ratio	----	0.2	-	----	----	3.1	3.4	2.6
ø Magnesium/Potassium Ratio	----	0.2	-	----	----	4.7	----	4.5
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	11.8	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	----	4.2	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	----	0.4	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	----	0.7	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	----	17.2	----	----	----
Exchangeable Sodium Percent	----	0.1	%	----	4.0	----	----	----
Calcium/Magnesium Ratio	----	0.1	-	----	2.8	----	----	----
Magnesium/Potassium Ratio	----	0.1	-	----	10.3	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)								
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	101	424	334	<100	633
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	<10

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A1-2	A2-1	A2-2	A2-3	A3-1
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-011	EB2428229-012	EB2428229-013	EB2428229-014	EB2428229-015
				Result	Result	Result	Result	Result
ED092: DTPA Extractable Metals								
ø Copper	7440-50-8	1	mg/kg	<1	<1	<1	<1	1
ø Iron	7439-89-6	1	mg/kg	2	13	7	4	8
ø Manganese	7439-96-5	1	mg/kg	<1	7	2	<1	4
ø Zinc	7440-66-6	1	mg/kg	<1	<1	<1	<1	<1
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	10	10	20	30	80
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	<2	5	12	16	17
Cobalt	7440-48-4	2	mg/kg	<2	2	4	8	7
Copper	7440-50-8	5	mg/kg	<5	<5	<5	6	11
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg	51	54	43	63	185
Nickel	7440-02-0	2	mg/kg	<2	2	4	8	9
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	6	13	33	33	49
Zinc	7440-66-6	5	mg/kg	<5	<5	<5	<5	7
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20	<20	<20	<20	<20
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	0.3	<0.1	<0.1	0.2
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1	1.4	0.5	0.1	0.8

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A1-2	A2-1	A2-2	A2-3	A3-1
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-011	EB2428229-012	EB2428229-013	EB2428229-014	EB2428229-015
				Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	1.7	0.5	0.1	1.0
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	40	480	480	180	380
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	40	480	480	180	380
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	198	155	156	127	127
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	10	<5	<5	<5
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5	1.8	0.9	<0.5	1.1
Total Organic Carbon	----	0.5	%	<0.5	1.0	0.5	<0.5	0.6

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A3-2	A3-3	A4-1	A4-2	A4-3
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-016	EB2428229-017	EB2428229-018	EB2428229-019	EB2428229-020
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	7.8	7.8	7.7	7.4	7.4
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.7	8.7	8.5	8.3	8.4
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	78	83	83	36	84
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	9.3	5.1	3.6	8.3	7.8
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Reddish Brown (2.5YR 5/4)	Reddish Brown (2.5YR 5/4)	Reddish Brown (2.5YR 5/4)	Reddish Brown (2.5YR 5/4)	Red (2.5YR 5/6)
Texture	----	-	-	Medium Clay	Medium Clay	Light Medium Clay	Medium Clay	Light Medium Clay
Emerson Class Number	EC/TC	-	-	3	4	7	3	3
EA150: Particle Sizing								
+75µm	----	1	%	30	29	27	40	40
+150µm	----	1	%	20	18	17	27	27
+300µm	----	1	%	13	11	11	15	16
+425µm	----	1	%	11	9	9	12	12
+600µm	----	1	%	10	7	8	9	9
+1180µm	----	1	%	7	3	5	5	5
+2.36mm	----	1	%	3	2	2	2	2
+4.75mm	----	1	%	<1	<1	<1	<1	1
+9.5mm	----	1	%	<1	<1	<1	<1	<1
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	49	45	48	44	38
Silt (2-60 µm)	----	1	%	19	23	22	14	16

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A3-2	A3-3	A4-1	A4-2	A4-3
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-016	EB2428229-017	EB2428229-018	EB2428229-019	EB2428229-020
				Result	Result	Result	Result	Result
EA150: Soil Classification based on Particle Size - Continued								
Sand (0.06-2.00 mm)	----	1	%	28	30	27	39	43
Gravel (>2mm)	----	1	%	4	2	3	3	3
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.59	2.57	2.50	2.55	2.60
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	7.5	10.6	5.4	5.7	6.0
ø Exchangeable Magnesium	----	0.2	meq/100g	2.6	3.4	1.8	2.2	2.3
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	0.2	0.4	0.5	0.4
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	<0.2	<0.2	<0.2	<0.2
ø Cation Exchange Capacity	----	0.2	meq/100g	10.3	14.2	7.6	8.4	8.7
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	<0.2	<0.2	<0.2	<0.2
ø Calcium/Magnesium Ratio	----	0.2	-	2.9	3.1	3.1	2.5	2.6
ø Magnesium/Potassium Ratio	----	0.2	-	----	14.5	4.1	4.4	5.8
ED021: Bicarbonate Extractable Potassium (Colwell)								
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	250	232	927	694	555
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	20	<10	<10
ED092: DTPA Extractable Metals								
ø Copper	7440-50-8	1	mg/kg	1	1	<1	<1	<1
ø Iron	7439-89-6	1	mg/kg	7	6	5	6	5
ø Manganese	7439-96-5	1	mg/kg	1	2	3	2	2
ø Zinc	7440-66-6	1	mg/kg	<1	<1	<1	<1	<1
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	40	110	130	80	60
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A3-2	A3-3	A4-1	A4-2	A4-3
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-016	EB2428229-017	EB2428229-018	EB2428229-019	EB2428229-020
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	8	20	31	31	23
Cobalt	7440-48-4	2	mg/kg	4	8	13	8	6
Copper	7440-50-8	5	mg/kg	<5	12	20	10	6
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg	97	193	194	150	98
Nickel	7440-02-0	2	mg/kg	4	10	16	12	9
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	25	58	76	74	46
Zinc	7440-66-6	5	mg/kg	<5	7	11	6	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20	<20	<20	<20	<20
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	0.2	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	0.1	<0.1	0.3	0.2	0.1
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.1	<0.1	0.5	0.2	0.1
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	350	320	550	450	460
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	350	320	550	450	460
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	138	136	251	289	178
EK080: Bicarbonate Extractable Phosphorus (Colwell)								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A3-2	A3-3	A4-1	A4-2	A4-3
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-016	EB2428229-017	EB2428229-018	EB2428229-019	EB2428229-020
				Result	Result	Result	Result	Result
EK080: Bicarbonate Extractable Phosphorus (Colwell) - Continued								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	<5	<5	<5	<5
EP004: Organic Matter								
Organic Matter	----	0.5	%	**0.7**	**0.9**	**1.4**	**0.8**	**0.6**
Total Organic Carbon	----	0.5	%	<0.5	<0.5	**0.8**	<0.5	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A5-1	A5-2	A5-3	T2	----
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	----
Compound	CAS Number	LOR	Unit	EB2428229-021	EB2428229-022	EB2428229-023	EB2428229-024	--------
				Result	Result	Result	Result	----
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	6.5	6.4	7.9	7.9	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	7.3	7.8	9.0	8.6	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	53	15	200	219	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	3.0	7.9	10.7	10.9	----
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Reddish Brown (2.5YR 5/4)	Reddish Brown (2.5YR 4/3)	Reddish Brown (2.5YR 4/3)	Weak Red (2.5YR 5/2)	----
Texture	----	-	-	Light Clay	Medium Heavy Clay	Medium Heavy Clay	Sandy Clay Loam	----
Emerson Class Number	EC/TC	-	-	3	3	3	3	----
EA150: Particle Sizing								
+75µm	----	1	%	41	39	29	49	----
+150µm	----	1	%	28	32	22	14	----
+300µm	----	1	%	17	24	16	<1	----
+425µm	----	1	%	14	22	14	<1	----
+600µm	----	1	%	12	20	13	<1	----
+1180µm	----	1	%	8	16	10	<1	----
+2.36mm	----	1	%	4	12	6	<1	----
+4.75mm	----	1	%	1	6	3	<1	----
+9.5mm	----	1	%	<1	<1	<1	<1	----
+19.0mm	----	1	%	<1	<1	<1	<1	----
+37.5mm	----	1	%	<1	<1	<1	<1	----
+75.0mm	----	1	%	<1	<1	<1	<1	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	33	38	49	11	----
Silt (2-60 µm)	----	1	%	20	18	21	35	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A5-1	A5-2	A5-3	T2	----
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	----
Compound	CAS Number	LOR	Unit	EB2428229-021	EB2428229-022	EB2428229-023	EB2428229-024	--------
				Result	Result	Result	Result	----
EA150: Soil Classification based on Particle Size - Continued								
Sand (0.06-2.00 mm)	----	1	%	42	31	22	54	----
Gravel (>2mm)	----	1	%	5	13	8	<1	----
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.44	2.60	2.60	2.82	----
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	3.0	6.9	9.2	0.9	----
ø Exchangeable Magnesium	----	0.2	meq/100g	2.0	4.2	7.1	<0.2	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.4	0.2	<0.2	<0.2	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	0.4	2.2	<0.2	----
ø Cation Exchange Capacity	----	0.2	meq/100g	5.4	11.8	18.7	0.9	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	3.3	11.7	<0.2	----
ø Calcium/Magnesium Ratio	----	0.2	-	1.5	1.6	1.3	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	5.0	16.2	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)								
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	840	290	166	381	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	20	<10	90	<10	----
ED092: DTPA Extractable Metals								
ø Copper	7440-50-8	1	mg/kg	1	1	1	11	----
ø Iron	7439-89-6	1	mg/kg	18	20	14	16	----
ø Manganese	7439-96-5	1	mg/kg	11	10	6	4	----
ø Zinc	7440-66-6	1	mg/kg	<1	<1	<1	<1	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	----
Barium	7440-39-3	10	mg/kg	80	90	130	<10	----
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A5-1	A5-2	A5-3	T2	----
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	----
Compound	CAS Number	LOR	Unit	EB2428229-021	EB2428229-022	EB2428229-023	EB2428229-024	--------
				Result	Result	Result	Result	----
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	----
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	----
Chromium	7440-47-3	2	mg/kg	17	20	16	10	----
Cobalt	7440-48-4	2	mg/kg	9	9	9	9	----
Copper	7440-50-8	5	mg/kg	11	12	9	37	----
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	----
Manganese	7439-96-5	5	mg/kg	268	283	246	44	----
Nickel	7440-02-0	2	mg/kg	9	11	9	9	----
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	----
Vanadium	7440-62-2	5	mg/kg	49	62	53	9	----
Zinc	7440-66-6	5	mg/kg	9	8	6	7	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20	<20	<20	<20	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	0.6	<0.1	<0.1	<0.1	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	4.0	0.4	0.5	1.1	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	4.6	0.4	0.5	1.1	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	860	430	540	50	----
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	860	430	540	50	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	249	171	146	425	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A5-1	A5-2	A5-3	T2	----
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	----
Compound	CAS Number	LOR	Unit	EB2428229-021	EB2428229-022	EB2428229-023	EB2428229-024	--------
				Result	Result	Result	Result	----
EK080: Bicarbonate Extractable Phosphorus (Colwell) - Continued								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	**10**	<5	<5	<5	**----**
EP004: Organic Matter								
Organic Matter	----	0.5	%	**2.0**	**2.0**	**1.2**	<0.5	**----**
Total Organic Carbon	----	0.5	%	**1.1**	**1.1**	**0.7**	<0.5	**----**

CERTIFICATE OF ANALYSIS with GUIDELINE COMPARISON

Work Order	: **EB2428229**	Page	: 1 of 58
Client	: **The Trustee for Mine Earth Unit Trust**	Laboratory	: Environmental Division Brisbane
Contact	: Matt Braimbridge	Contact	: Customer Services EB
Address	: 1 BREAKFAST CREEK ROAD NEWSTEAD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: TCK-2405		
Order number	: ----		
C-O-C number	: ----	No. of samples received	: 24
Site	: ----	No. of samples analysed	: 24
Sampled by	: JEREMY DURBIN	Issue Date	: 28-Aug-2024 22:10
Quote number	: EP2021MINEAR0001 (EN/222)	Date Samples Received	: 07-Aug-2024 09:50

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. All pages of this report have been checked and approved for release. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to Assist with Quality Review and Sample Receipt Notification.

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position (Accreditation Category)
Beatriz Llarinas	Senior Chemist - Inorganics (Brisbane Inorganics, Stafford, QLD)
	Senior Chemist - Inorganics (Brisbane Soil Preparation, Stafford, QLD)
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist (Brisbane Acid Sulphate Soils, Stafford, QLD)
	Senior Acid Sulfate Soil Chemist (Brisbane Soil Preparation, Stafford, QLD)
Dave Gitsham	Metals Instrument Chemist (Brisbane Inorganics, Stafford, QLD)
Layla Hafner	Acid Sulphate Soils - Chemist (Brisbane Acid Sulphate Soils, Stafford, QLD)
Vincent Muller	Chemist - Inorganics (Brisbane Inorganics, Stafford, QLD)
	Chemist - Inorganics (Brisbane Soil Preparation, Stafford, QLD)

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.
Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.
Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Where a result is required to meet compliance limits, the associated uncertainty **must be** considered. Refer to the ALS Contract Terms and Conditions for details, and EnviroMail 53 for a guide on how to interpret the measurement of uncertainty (MU).

Work Order Specific Comments

- ED009-X (Standard Anions - Extended Method –by IC): Some samples were diluted due to matrix interference. LOR adjusted accordingly.
- EA150H: Soil particle density results fell outside the scope of AS1289.3.6.3. Results should be scrutinised accordingly.
- ALS is not NATA accredited for the analysis of Exchangeable Aluminium and Exchange Acidity in soils when performed under ALS Method ED005.
- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- As per QWI – EN55-3 Data Interpreting Procedures, Ionic balances are typically calculated using Major Anions - Chloride, Alkalinity and Sulfate; and Major Cations - Calcium, Magnesium, Potassium and Sodium. Where applicable and dependent upon sample matrix, the Ionic Balance may also include the additional contribution of Ammonia, Dissolved Metals by ICPMS and H+ to the Cations and Nitrate, SiO2 and Fluoride to the Anions.
- Ionic Balance out of acceptable limits due to analytes not quantified in this report.
- EG005T (Total Metals by ICP-AES): Sample EB2428324-003 shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- ED093C (Leachable Major Cations): Unable to report Sodium results due to it's inclusion in the extraction fluid.
- ED006 (Exchangeable Cations on Alkaline Soils): Unable to calculate Magnesium/Potassium Ratio result for some samples as required Exchangeable Magnesium and/or Potassium results are less than the limit of reporting.
- ED006 (Exchangeable Cations on Alkaline Soils): Unable to calculate Calcium/Magnesium Ratio result for some samples as required Exchangeable Calcium and/or Magnesium results are less than the limit of reporting.
- ED006 (Exchangeable Cations on Alkaline Soils): Sample DC-ALS (EB2428229-006) shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- It is recognised that EG005T (Total Metals by ICP-AES) is less than EG005C (Leachable Metals by ICP-AES) for some samples. However, the difference is within experimental variation of the methods.
- ED045G (Chloride)/ ED041G (Sulfate as SO4): Some samples were diluted due to matrix interference. LOR adjusted accordingly.
- EA058 Emerson: V. = Very, D. = Dark, L. = Light, VD. = Very Dark
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.
- ED045G: The presence of Thiocyanate, Thiosulfate and Sulfite can positively contribute to the chloride result, thereby may bias results higher than expected. Results should be scrutinised accordingly.

Analytical Results

Sub-Matrix: **SOIL**			*Sample ID*	**T1-ALS**		**Guideline comparison not requested for sample**		
			Laboratory sample ID	*EB2428229001*				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	*CAS Number*	*LOR*	*----*	Result	MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	**7.8**		----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**8.9**		----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**175**		----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**3.4**		----	----	----
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	**Reddish Brown (2.5YR**		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	T1-ALS	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229001			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
Texture	----	-	-	Sandy Loam	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	53	----	----	----
+150µm	----	1	%	17	----	----	----
+300µm	----	1	%	1	----	----	----
+425µm	----	1	%	<1	----	----	----
+600µm	----	1	%	<1	----	----	----
+1180µm	----	1	%	<1	----	----	----
+2.36mm	----	1	%	<1	----	----	----
+4.75mm	----	1	%	<1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	12	----	----	----
Silt (2-60 µm)	----	1	%	31	----	----	----
Sand (0.06-2.00 mm)	----	1	%	57	----	----	----
Gravel (>2mm)	----	1	%	<1	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.67	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	1.1	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	1.1	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	163	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	20	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	16	----	----	----
ø Iron	7439-89-6	1	mg/kg	19	----	----	----
ø Manganese	7439-96-5	1	mg/kg	4	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----
EG005(ED093)T: Total Metals by ICP-AES							
Arsenic	7440-38-2	5	mg/kg	<5	----	----	----
Barium	7440-39-3	10	mg/kg	30	----	----	----
Beryllium	7440-41-7	1	mg/kg	<1	----	----	----
Boron	7440-42-8	50	mg/kg	<50	----	----	----
Cadmium	7440-43-9	1	mg/kg	<1	----	----	----
Chromium	7440-47-3	2	mg/kg	17	----	----	----
Cobalt	7440-48-4	2	mg/kg	17	----	----	----
Copper	7440-50-8	5	mg/kg	95	----	----	----
Lead	7439-92-1	5	mg/kg	<5	----	----	----
Manganese	7439-96-5	5	mg/kg	75	----	----	----
Nickel	7440-02-0	2	mg/kg	15	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	T1-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229001				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**18**		----	----	----
Zinc	7440-66-6	5	mg/kg	**11**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**60**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**60**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**391**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Extraction Fluid pH	----	0.1	pH Unit	**5.0**		----	----	----
Final pH	----	0.1	pH Unit	**5.1**		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	TC1-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229002				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	**8.0**		----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**9.2**		----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**55**		----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0		----	----	----
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	**Dark Reddish Gray (5Y**		----	----	----
Texture	----	-	-	**Sandy Loam**		----	----	----
Emerson Class Number	EC/TC	-	-	**7**		----	----	----
EA150: Particle Sizing								
+75µm	----	1	%	**79**		----	----	----
+150µm	----	1	%	**69**		----	----	----
+300µm	----	1	%	**59**		----	----	----
+425µm	----	1	%	**53**		----	----	----
+600µm	----	1	%	**48**		----	----	----
+1180µm	----	1	%	**37**		----	----	----
+2.36mm	----	1	%	**24**		----	----	----
+4.75mm	----	1	%	**10**		----	----	----
+9.5mm	----	1	%	<1		----	----	----
+19.0mm	----	1	%	<1		----	----	----
+37.5mm	----	1	%	<1		----	----	----
+75.0mm	----	1	%	<1		----	----	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	**9**		----	----	----
Silt (2-60 µm)	----	1	%	**11**		----	----	----
Sand (0.06-2.00 mm)	----	1	%	**52**		----	----	----
Gravel (>2mm)	----	1	%	**28**		----	----	----
Cobbles (>6cm)	----	1	%	<1		----	----	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	**2.75**		----	----	----
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	**1.4**		----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	**0.5**		----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2		----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2		----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	**1.9**		----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2		----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	**2.6**		----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)								
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	**446**		----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10		----	----	----
ED092: DTPA Extractable Metals								
ø Copper	7440-50-8	1	mg/kg	<1		----	----	----
ø Iron	7439-89-6	1	mg/kg	**15**		----	----	----
ø Manganese	7439-96-5	1	mg/kg	**4**		----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1		----	----	----
EG005(ED093)T: Total Metals by ICP-AES								

Analytical Results

Sub-Matrix: SOIL			Sample ID	TC1-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229002				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**20**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**12**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**7**		----	----	----
Copper	7440-50-8	5	mg/kg	**9**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**107**		----	----	----
Nickel	7440-02-0	2	mg/kg	**10**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**22**		----	----	----
Zinc	7440-66-6	5	mg/kg	**10**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**30**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**30**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**446**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Extraction Fluid pH	----	0.1	pH Unit	**5.0**		----	----	----
Final pH	----	0.1	pH Unit	**5.1**		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Total Concentration: Category B

Sub-Matrix: **SOIL**

				Sample ID	WR1-ALS		Table 2: Category B : Waste Disposal contamination concentrations:		
				Laboratory sample ID	EB2428229003				
				Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	Unit		Result	MU	Low	High	Unit
ED092: DTPA Extractable Metals									
ø Copper	7440-50-8	1	mg/kg		<1		----	20000	mg/kg
ø Zinc	7440-66-6	1	mg/kg		<1		----	140000	mg/kg
EG005(ED093)T: Total Metals by ICP-AES									
Arsenic	7440-38-2	5	mg/kg		<5		----	2000	mg/kg
Barium	7440-39-3	10	mg/kg		**140**		----	25000	mg/kg
Beryllium	7440-41-7	1	mg/kg		<1		----	400	mg/kg
Boron	7440-42-8	50	mg/kg		<50		----	60000	mg/kg
Cadmium	7440-43-9	1	mg/kg		<1		----	400	mg/kg
Copper	7440-50-8	5	mg/kg		**9**		----	20000	mg/kg
Lead	7439-92-1	5	mg/kg		<5		----	6000	mg/kg
Nickel	7440-02-0	2	mg/kg		**7**		----	12000	mg/kg
Selenium	7782-49-2	5	mg/kg		<5		----	40000	mg/kg
Zinc	7440-66-6	5	mg/kg		**5**		----	140000	mg/kg
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1		----	300	mg/kg

Total Concentration: Category C

Sub-Matrix: **SOIL**

				Sample ID	WR1-ALS		Table 2: Category C : Waste Disposal contamination concentrations		
				Laboratory sample ID	EB2428229003				
				Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	Unit		Result	MU	Low	High	Unit
ED092: DTPA Extractable Metals									
ø Copper	7440-50-8	1	mg/kg		<1		----	5000	mg/kg
ø Zinc	7440-66-6	1	mg/kg		<1		----	35000	mg/kg
EG005(ED093)T: Total Metals by ICP-AES									
Arsenic	7440-38-2	5	mg/kg		<5		----	500	mg/kg
Barium	7440-39-3	10	mg/kg		**140**		----	6250	mg/kg
Beryllium	7440-41-7	1	mg/kg		<1		----	100	mg/kg
Boron	7440-42-8	50	mg/kg		<50		----	15000	mg/kg
Cadmium	7440-43-9	1	mg/kg		<1		----	100	mg/kg
Copper	7440-50-8	5	mg/kg		**9**		----	5000	mg/kg
Lead	7439-92-1	5	mg/kg		<5		----	1500	mg/kg
Nickel	7440-02-0	2	mg/kg		**7**		----	3000	mg/kg
Selenium	7782-49-2	5	mg/kg		<5		----	10000	mg/kg
Zinc	7440-66-6	5	mg/kg		**5**		----	35000	mg/kg
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1		----	75	mg/kg

Analytical Results

Total Concentration: Category D/Industrial Waste

Sub-Matrix: **SOIL**

				Sample ID	WR1-ALS		Table 2: Category D/Industrial Waste : Waste Disposal contamination concentrations		
				Laboratory sample ID	EB2428229003				
				Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	Unit		Result	MU	Low	High	Unit
ED092: DTPA Extractable Metals									
ø Copper	7440-50-8	1	mg/kg		<1		----	5000	mg/kg
ø Zinc	7440-66-6	1	mg/kg		<1		----	35000	mg/kg
EG005(ED093)T: Total Metals by ICP-AES									
Arsenic	7440-38-2	5	mg/kg		<5		----	500	mg/kg
Barium	7440-39-3	10	mg/kg		**140**		----	6250	mg/kg
Beryllium	7440-41-7	1	mg/kg		<1		----	100	mg/kg
Boron	7440-42-8	50	mg/kg		<50		----	15000	mg/kg
Cadmium	7440-43-9	1	mg/kg		<1		----	100	mg/kg
Copper	7440-50-8	5	mg/kg		**9**		----	5000	mg/kg
Lead	7439-92-1	5	mg/kg		<5		----	1500	mg/kg
Nickel	7440-02-0	2	mg/kg		**7**		----	3000	mg/kg
Selenium	7782-49-2	5	mg/kg		<5		----	10000	mg/kg
Zinc	7440-66-6	5	mg/kg		**5**		----	35000	mg/kg
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1		----	75	mg/kg

Analytical Results

Sub-Matrix: SOIL			Sample ID	WR1-ALS	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229003			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	8.0	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	9.2	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	110	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	6.9	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Red (2.5YR 4/8)	----	----	----
Texture	----	-	-	Medium Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	61	----	----	----
+150µm	----	1	%	54	----	----	----
+300µm	----	1	%	44	----	----	----
+425µm	----	1	%	40	----	----	----
+600µm	----	1	%	35	----	----	----
+1180µm	----	1	%	25	----	----	----
+2.36mm	----	1	%	12	----	----	----
+4.75mm	----	1	%	5	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	26	----	----	----
Silt (2-60 µm)	----	1	%	12	----	----	----
Sand (0.06-2.00 mm)	----	1	%	46	----	----	----
Gravel (>2mm)	----	1	%	16	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.68	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	3.6	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	3.4	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	0.4	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	7.3	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	5.1	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	1.1	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	280	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	20	----	----	----
ED092: DTPA Extractable Metals							
ø Iron	7439-89-6	1	mg/kg	5	----	----	----
ø Manganese	7439-96-5	1	mg/kg	<1	----	----	----
EG005(ED093)T: Total Metals by ICP-AES							
Chromium	7440-47-3	2	mg/kg	11	----	----	----
Cobalt	7440-48-4	2	mg/kg	13	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	WR1-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229003				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Manganese	7439-96-5	5	mg/kg	**80**		----	----	----
Vanadium	7440-62-2	5	mg/kg	**38**		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**80**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**80**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**145**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Extraction Fluid pH	----	0.1	pH Unit	**5.0**		----	----	----
Final pH	----	0.1	pH Unit	**6.4**		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Total Concentration: Category B

Sub-Matrix: SOIL			Sample ID	WR3-ALS		Table 2: Category B : Waste Disposal contamination concentrations:		
			Laboratory sample ID	EB2428229004				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	Unit	Result	MU	Low	High	Unit
ED092: DTPA Extractable Metals								
ø Copper	7440-50-8	1	mg/kg	<1		----	20000	mg/kg
ø Zinc	7440-66-6	1	mg/kg	<1		----	140000	mg/kg
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	2000	mg/kg
Barium	7440-39-3	10	mg/kg	<10		----	25000	mg/kg
Beryllium	7440-41-7	1	mg/kg	<1		----	400	mg/kg
Boron	7440-42-8	50	mg/kg	<50		----	60000	mg/kg
Cadmium	7440-43-9	1	mg/kg	<1		----	400	mg/kg
Copper	7440-50-8	5	mg/kg	**10**		----	20000	mg/kg
Lead	7439-92-1	5	mg/kg	<5		----	6000	mg/kg
Nickel	7440-02-0	2	mg/kg	<2		----	12000	mg/kg
Selenium	7782-49-2	5	mg/kg	<5		----	40000	mg/kg
Zinc	7440-66-6	5	mg/kg	<5		----	140000	mg/kg
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	300	mg/kg

Analytical Results

Total Concentration: Category C

Sub-Matrix: **SOIL**

				Sample ID		WR3-ALS		Table 2: Category C : Waste Disposal contamination concentrations		
				Laboratory sample ID		EB2428229004				
				Sampling date / time		07-Aug-2024 13:03				
Parameter	CAS Number	LOR	Unit			Result	MU	Low	High	Unit
ED092: DTPA Extractable Metals										
ø Copper	7440-50-8	1	mg/kg			<1		----	5000	mg/kg
ø Zinc	7440-66-6	1	mg/kg			<1		----	35000	mg/kg
EG005(ED093)T: Total Metals by ICP-AES										
Arsenic	7440-38-2	5	mg/kg			<5		----	500	mg/kg
Barium	7440-39-3	10	mg/kg			<10		----	6250	mg/kg
Beryllium	7440-41-7	1	mg/kg			<1		----	100	mg/kg
Boron	7440-42-8	50	mg/kg			<50		----	15000	mg/kg
Cadmium	7440-43-9	1	mg/kg			<1		----	100	mg/kg
Copper	7440-50-8	5	mg/kg			**10**		----	5000	mg/kg
Lead	7439-92-1	5	mg/kg			<5		----	1500	mg/kg
Nickel	7440-02-0	2	mg/kg			<2		----	3000	mg/kg
Selenium	7782-49-2	5	mg/kg			<5		----	10000	mg/kg
Zinc	7440-66-6	5	mg/kg			<5		----	35000	mg/kg
EG035T: Total Recoverable Mercury by FIMS										
Mercury	7439-97-6	0.1	mg/kg			<0.1		----	75	mg/kg

Total Concentration: Category D/Industrial Waste

Sub-Matrix: **SOIL**

				Sample ID		WR3-ALS		Table 2: Category D/Industrial Waste : Waste Disposal contamination concentrations		
				Laboratory sample ID		EB2428229004				
				Sampling date / time		07-Aug-2024 13:03				
Parameter	CAS Number	LOR	Unit			Result	MU	Low	High	Unit
ED092: DTPA Extractable Metals										
ø Copper	7440-50-8	1	mg/kg			<1		----	5000	mg/kg
ø Zinc	7440-66-6	1	mg/kg			<1		----	35000	mg/kg
EG005(ED093)T: Total Metals by ICP-AES										
Arsenic	7440-38-2	5	mg/kg			<5		----	500	mg/kg
Barium	7440-39-3	10	mg/kg			<10		----	6250	mg/kg
Beryllium	7440-41-7	1	mg/kg			<1		----	100	mg/kg
Boron	7440-42-8	50	mg/kg			<50		----	15000	mg/kg
Cadmium	7440-43-9	1	mg/kg			<1		----	100	mg/kg
Copper	7440-50-8	5	mg/kg			**10**		----	5000	mg/kg
Lead	7439-92-1	5	mg/kg			<5		----	1500	mg/kg
Nickel	7440-02-0	2	mg/kg			<2		----	3000	mg/kg
Selenium	7782-49-2	5	mg/kg			<5		----	10000	mg/kg
Zinc	7440-66-6	5	mg/kg			<5		----	35000	mg/kg
EG035T: Total Recoverable Mercury by FIMS										
Mercury	7439-97-6	0.1	mg/kg			<0.1		----	75	mg/kg

Analytical Results

Sub-Matrix: SOIL			Sample ID	WR3-ALS	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229004			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	8.1	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	9.5	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	45	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	1.0	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Gray (2.5YR 6/	----	----	----
Texture	----	-	-	Course Sand	----	----	----
Emerson Class Number	EC/TC	-	-	8	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	90	----	----	----
+150µm	----	1	%	80	----	----	----
+300µm	----	1	%	67	----	----	----
+425µm	----	1	%	60	----	----	----
+600µm	----	1	%	53	----	----	----
+1180µm	----	1	%	36	----	----	----
+2.36mm	----	1	%	18	----	----	----
+4.75mm	----	1	%	4	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	2	----	----	----
Silt (2-60 µm)	----	1	%	6	----	----	----
Sand (0.06-2.00 mm)	----	1	%	68	----	----	----
Gravel (>2mm)	----	1	%	24	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.66	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	1.1	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	1.1	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	138	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Iron	7439-89-6	1	mg/kg	16	----	----	----
ø Manganese	7439-96-5	1	mg/kg	3	----	----	----
EG005(ED093)T: Total Metals by ICP-AES							
Chromium	7440-47-3	2	mg/kg	3	----	----	----
Cobalt	7440-48-4	2	mg/kg	<2	----	----	----
Manganese	7439-96-5	5	mg/kg	30	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	WR3-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229004				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Vanadium	7440-62-2	5	mg/kg	<5		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	<20		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**74**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Extraction Fluid pH	----	0.1	pH Unit	**5.0**		----	----	----
Final pH	----	0.1	pH Unit	**5.1**		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	B1-ALS	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229005			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	6.6	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	7.1	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	16	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	2.9	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Red (2.5YR 5/6)	----	----	----
Texture	----	-	-	Sandy Clay Loam	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	63	----	----	----
+150µm	----	1	%	51	----	----	----
+300µm	----	1	%	41	----	----	----
+425µm	----	1	%	38	----	----	----
+600µm	----	1	%	36	----	----	----
+1180µm	----	1	%	34	----	----	----
+2.36mm	----	1	%	31	----	----	----
+4.75mm	----	1	%	23	----	----	----
+9.5mm	----	1	%	13	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	22	----	----	----
Silt (2-60 µm)	----	1	%	13	----	----	----
Sand (0.06-2.00 mm)	----	1	%	33	----	----	----
Gravel (>2mm)	----	1	%	32	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.60	----	----	----
ED007: Exchangeable Cations							
Exchangeable Calcium	----	0.1	meq/100g	20.3	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	6.9	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	0.8	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	0.6	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	28.6	----	----	----
Exchangeable Sodium Percent	----	0.1	%	2.1	----	----	----
Calcium/Magnesium Ratio	----	0.1	-	2.9	----	----	----
Magnesium/Potassium Ratio	----	0.1	-	8.2	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	387	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	<1	----	----	----
ø Iron	7439-89-6	1	mg/kg	10	----	----	----
ø Manganese	7439-96-5	1	mg/kg	3	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	B1-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229005				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**30**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**17**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**7**		----	----	----
Copper	7440-50-8	5	mg/kg	**6**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**112**		----	----	----
Nickel	7440-02-0	2	mg/kg	**8**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**41**		----	----	----
Zinc	7440-66-6	5	mg/kg	**6**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	**0.1**		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.7**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.8**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**590**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**590**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**180**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	**9**		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**1.1**		----	----	----
Total Organic Carbon	----	0.5	%	**0.6**		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	DC-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229006				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	**8.1**		----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**9.5**		----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**77**		----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**2.2**		----	----	----
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	**Reddish Brown (2.5YR**		----	----	----
Texture	----	-	-	**Sandy Loam**		----	----	----
Emerson Class Number	EC/TC	-	-	**3**		----	----	----
EA150: Particle Sizing								
+75µm	----	1	%	**68**		----	----	----
+150µm	----	1	%	**36**		----	----	----
+300µm	----	1	%	**13**		----	----	----
+425µm	----	1	%	**9**		----	----	----
+600µm	----	1	%	**8**		----	----	----
+1180µm	----	1	%	**6**		----	----	----
+2.36mm	----	1	%	**4**		----	----	----
+4.75mm	----	1	%	<1		----	----	----
+9.5mm	----	1	%	<1		----	----	----
+19.0mm	----	1	%	<1		----	----	----
+37.5mm	----	1	%	<1		----	----	----
+75.0mm	----	1	%	<1		----	----	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	**9**		----	----	----
Silt (2-60 µm)	----	1	%	**22**		----	----	----
Sand (0.06-2.00 mm)	----	1	%	**65**		----	----	----
Gravel (>2mm)	----	1	%	**4**		----	----	----
Cobbles (>6cm)	----	1	%	<1		----	----	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	**2.68**		----	----	----
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	**1.0**		----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	**0.9**		----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2		----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2		----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	**1.9**		----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2		----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	**1.2**		----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)								
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	**221**		----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10		----	----	----
ED092: DTPA Extractable Metals								
ø Copper	7440-50-8	1	mg/kg	**5**		----	----	----
ø Iron	7439-89-6	1	mg/kg	**9**		----	----	----
ø Manganese	7439-96-5	1	mg/kg	**3**		----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1		----	----	----
EG005(ED093)T: Total Metals by ICP-AES								

Analytical Results

Sub-Matrix: SOIL			Sample ID	DC-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229006				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**20**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**7**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**11**		----	----	----
Copper	7440-50-8	5	mg/kg	**34**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**62**		----	----	----
Nickel	7440-02-0	2	mg/kg	**7**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**12**		----	----	----
Zinc	7440-66-6	5	mg/kg	**5**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**40**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**40**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**348**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	DC2-ALS	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229007			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	8.2	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	9.6	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	374	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	5.6	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Medium Heavy Clay	----	----	----
Emerson Class Number	EC/TC	-	-	2	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	53	----	----	----
+150µm	----	1	%	46	----	----	----
+300µm	----	1	%	36	----	----	----
+425µm	----	1	%	32	----	----	----
+600µm	----	1	%	28	----	----	----
+1180µm	----	1	%	22	----	----	----
+2.36mm	----	1	%	14	----	----	----
+4.75mm	----	1	%	5	----	----	----
+9.5mm	----	1	%	3	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	31	----	----	----
Silt (2-60 µm)	----	1	%	14	----	----	----
Sand (0.06-2.00 mm)	----	1	%	39	----	----	----
Gravel (>2mm)	----	1	%	16	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.64	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	3.1	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	3.7	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	2.1	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	9.2	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	23.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	0.8	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	16.0	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	557	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	70	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	56	----	----	----
ø Iron	7439-89-6	1	mg/kg	32	----	----	----
ø Manganese	7439-96-5	1	mg/kg	22	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	DC2-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229007				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**180**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**9**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**10**		----	----	----
Copper	7440-50-8	5	mg/kg	**79**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**112**		----	----	----
Nickel	7440-02-0	2	mg/kg	**10**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**21**		----	----	----
Zinc	7440-66-6	5	mg/kg	**9**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	**0.1**		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**4.1**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**4.2**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**100**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**100**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**400**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	TS1-ALS	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229008			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.9	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.7	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	205	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	5.1	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Medium Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	52	----	----	----
+150µm	----	1	%	36	----	----	----
+300µm	----	1	%	26	----	----	----
+425µm	----	1	%	22	----	----	----
+600µm	----	1	%	20	----	----	----
+1180µm	----	1	%	16	----	----	----
+2.36mm	----	1	%	11	----	----	----
+4.75mm	----	1	%	5	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	28	----	----	----
Silt (2-60 µm)	----	1	%	18	----	----	----
Sand (0.06-2.00 mm)	----	1	%	41	----	----	----
Gravel (>2mm)	----	1	%	13	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.65	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	4.3	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	1.8	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.3	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	6.4	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	2.4	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	6.1	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	528	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	70	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	4	----	----	----
ø Iron	7439-89-6	1	mg/kg	12	----	----	----
ø Manganese	7439-96-5	1	mg/kg	4	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	TS1-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229008				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**30**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**8**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**6**		----	----	----
Copper	7440-50-8	5	mg/kg	**19**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**64**		----	----	----
Nickel	7440-02-0	2	mg/kg	**6**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**16**		----	----	----
Zinc	7440-66-6	5	mg/kg	<5		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**3.2**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**3.2**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**590**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**590**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**332**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**0.7**		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	TS2-ALS	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229009			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.8	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.7	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	98	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	2.6	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Light Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	50	----	----	----
+150µm	----	1	%	29	----	----	----
+300µm	----	1	%	17	----	----	----
+425µm	----	1	%	13	----	----	----
+600µm	----	1	%	10	----	----	----
+1180µm	----	1	%	6	----	----	----
+2.36mm	----	1	%	3	----	----	----
+4.75mm	----	1	%	<1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	29	----	----	----
Silt (2-60 µm)	----	1	%	18	----	----	----
Sand (0.06-2.00 mm)	----	1	%	49	----	----	----
Gravel (>2mm)	----	1	%	4	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.67	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	5.0	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	2.6	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.3	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	7.9	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	1.9	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	8.2	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	391	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	20	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	2	----	----	----
ø Iron	7439-89-6	1	mg/kg	10	----	----	----
ø Manganese	7439-96-5	1	mg/kg	3	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	TS2-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229009				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**100**		----	----	----
Beryllium	7440-41-7	1	mg/kg	**1**		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**26**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**13**		----	----	----
Copper	7440-50-8	5	mg/kg	**34**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**197**		----	----	----
Nickel	7440-02-0	2	mg/kg	**16**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**68**		----	----	----
Zinc	7440-66-6	5	mg/kg	**10**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	**0.1**		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**1.9**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**2.0**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**380**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**380**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**337**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**0.7**		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A1-1	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229010			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.8	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.6	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	70	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	3.4	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Yellowish Red (5YR 5/6	----	----	----
Texture	----	-	-	Sandy Loam	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	67	----	----	----
+150µm	----	1	%	52	----	----	----
+300µm	----	1	%	36	----	----	----
+425µm	----	1	%	29	----	----	----
+600µm	----	1	%	25	----	----	----
+1180µm	----	1	%	19	----	----	----
+2.36mm	----	1	%	11	----	----	----
+4.75mm	----	1	%	4	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	19	----	----	----
Silt (2-60 µm)	----	1	%	12	----	----	----
Sand (0.06-2.00 mm)	----	1	%	56	----	----	----
Gravel (>2mm)	----	1	%	13	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.64	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	10.0	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	0.5	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	10.7	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	19.9	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	377	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	<1	----	----	----
ø Iron	7439-89-6	1	mg/kg	4	----	----	----
ø Manganese	7439-96-5	1	mg/kg	2	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----
EG005(ED093)T: Total Metals by ICP-AES							

Analytical Results

Sub-Matrix: SOIL			Sample ID	A1-1		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229010				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**120**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**26**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**14**		----	----	----
Copper	7440-50-8	5	mg/kg	**7**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**195**		----	----	----
Nickel	7440-02-0	2	mg/kg	**20**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**68**		----	----	----
Zinc	7440-66-6	5	mg/kg	**11**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.5**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.5**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**190**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**190**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**4330**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**0.6**		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A1-2	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229011			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.4	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.7	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	25	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	1.1	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Pink (7.5YR 7/4)	----	----	----
Texture	----	-	-	Clayey Sand	----	----	----
Emerson Class Number	EC/TC	-	-	5	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	80	----	----	----
+150µm	----	1	%	65	----	----	----
+300µm	----	1	%	52	----	----	----
+425µm	----	1	%	46	----	----	----
+600µm	----	1	%	41	----	----	----
+1180µm	----	1	%	31	----	----	----
+2.36mm	----	1	%	19	----	----	----
+4.75mm	----	1	%	10	----	----	----
+9.5mm	----	1	%	4	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	9	----	----	----
Silt (2-60 µm)	----	1	%	9	----	----	----
Sand (0.06-2.00 mm)	----	1	%	60	----	----	----
Gravel (>2mm)	----	1	%	22	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.61	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	3.3	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	3.3	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	101	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	<1	----	----	----
ø Iron	7439-89-6	1	mg/kg	2	----	----	----
ø Manganese	7439-96-5	1	mg/kg	<1	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----
EG005(ED093)T: Total Metals by ICP-AES							
Arsenic	7440-38-2	5	mg/kg	<5	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A1-2		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229011				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Barium	7440-39-3	10	mg/kg	**10**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	<2		----	----	----
Cobalt	7440-48-4	2	mg/kg	<2		----	----	----
Copper	7440-50-8	5	mg/kg	<5		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**51**		----	----	----
Nickel	7440-02-0	2	mg/kg	<2		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**6**		----	----	----
Zinc	7440-66-6	5	mg/kg	<5		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**40**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**40**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**198**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A2-1	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229012			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	6.0	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	7.1	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	42	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	<1.0	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Sandy Loam	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	67	----	----	----
+150µm	----	1	%	54	----	----	----
+300µm	----	1	%	40	----	----	----
+425µm	----	1	%	34	----	----	----
+600µm	----	1	%	30	----	----	----
+1180µm	----	1	%	25	----	----	----
+2.36mm	----	1	%	20	----	----	----
+4.75mm	----	1	%	6	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	19	----	----	----
Silt (2-60 µm)	----	1	%	12	----	----	----
Sand (0.06-2.00 mm)	----	1	%	47	----	----	----
Gravel (>2mm)	----	1	%	22	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.57	----	----	----
ED007: Exchangeable Cations							
Exchangeable Calcium	----	0.1	meq/100g	11.8	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	4.2	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	0.4	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	0.7	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	17.2	----	----	----
Exchangeable Sodium Percent	----	0.1	%	4.0	----	----	----
Calcium/Magnesium Ratio	----	0.1	-	2.8	----	----	----
Magnesium/Potassium Ratio	----	0.1	-	10.3	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	424	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	<1	----	----	----
ø Iron	7439-89-6	1	mg/kg	13	----	----	----
ø Manganese	7439-96-5	1	mg/kg	7	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A2-1		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229012				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**10**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**5**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**2**		----	----	----
Copper	7440-50-8	5	mg/kg	<5		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**54**		----	----	----
Nickel	7440-02-0	2	mg/kg	**2**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**13**		----	----	----
Zinc	7440-66-6	5	mg/kg	<5		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	**0.3**		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**1.4**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**1.7**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**480**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**480**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**155**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	**10**		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**1.8**		----	----	----
Total Organic Carbon	----	0.5	%	**1.0**		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A2-2	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229013			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	6.4	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	7.5	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	12	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	5.8	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Red (2.5YR 4/6)	----	----	----
Texture	----	-	-	Light Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	49	----	----	----
+150µm	----	1	%	39	----	----	----
+300µm	----	1	%	28	----	----	----
+425µm	----	1	%	22	----	----	----
+600µm	----	1	%	18	----	----	----
+1180µm	----	1	%	12	----	----	----
+2.36mm	----	1	%	7	----	----	----
+4.75mm	----	1	%	<1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	42	----	----	----
Silt (2-60 µm)	----	1	%	7	----	----	----
Sand (0.06-2.00 mm)	----	1	%	42	----	----	----
Gravel (>2mm)	----	1	%	9	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.64	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	4.2	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	1.4	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.3	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	5.9	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	3.1	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	4.7	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	334	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	<1	----	----	----
ø Iron	7439-89-6	1	mg/kg	7	----	----	----
ø Manganese	7439-96-5	1	mg/kg	2	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A2-2		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229013				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**20**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**12**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**4**		----	----	----
Copper	7440-50-8	5	mg/kg	<5		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**43**		----	----	----
Nickel	7440-02-0	2	mg/kg	**4**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**33**		----	----	----
Zinc	7440-66-6	5	mg/kg	<5		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.5**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.5**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**480**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**480**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**156**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**0.9**		----	----	----
Total Organic Carbon	----	0.5	%	**0.5**		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A2-3	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229014			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	6.6	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	7.6	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	8	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	2.6	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Red (2.5YR 5/6)	----	----	----
Texture	----	-	-	Sandy Loam	----	----	----
Emerson Class Number	EC/TC	-	-	7	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	79	----	----	----
+150µm	----	1	%	70	----	----	----
+300µm	----	1	%	55	----	----	----
+425µm	----	1	%	46	----	----	----
+600µm	----	1	%	34	----	----	----
+1180µm	----	1	%	19	----	----	----
+2.36mm	----	1	%	10	----	----	----
+4.75mm	----	1	%	2	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	14	----	----	----
Silt (2-60 µm)	----	1	%	7	----	----	----
Sand (0.06-2.00 mm)	----	1	%	66	----	----	----
Gravel (>2mm)	----	1	%	13	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.75	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	1.9	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	0.6	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	2.5	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	3.4	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	<100	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	<1	----	----	----
ø Iron	7439-89-6	1	mg/kg	4	----	----	----
ø Manganese	7439-96-5	1	mg/kg	<1	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----
EG005(ED093)T: Total Metals by ICP-AES							

Analytical Results

Sub-Matrix: SOIL			Sample ID	A2-3		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229014				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**30**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**16**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**8**		----	----	----
Copper	7440-50-8	5	mg/kg	**6**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**63**		----	----	----
Nickel	7440-02-0	2	mg/kg	**8**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**33**		----	----	----
Zinc	7440-66-6	5	mg/kg	<5		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.1**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.1**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**180**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**180**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**127**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A3-1	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229015			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.0	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	7.6	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	28	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	4.5	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Light Medium Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	33	----	----	----
+150µm	----	1	%	20	----	----	----
+300µm	----	1	%	11	----	----	----
+425µm	----	1	%	9	----	----	----
+600µm	----	1	%	8	----	----	----
+1180µm	----	1	%	6	----	----	----
+2.36mm	----	1	%	4	----	----	----
+4.75mm	----	1	%	2	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	43	----	----	----
Silt (2-60 µm)	----	1	%	22	----	----	----
Sand (0.06-2.00 mm)	----	1	%	31	----	----	----
Gravel (>2mm)	----	1	%	4	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.54	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	6.9	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	2.7	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.6	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	10.1	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	2.6	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	4.5	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	633	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	1	----	----	----
ø Iron	7439-89-6	1	mg/kg	8	----	----	----
ø Manganese	7439-96-5	1	mg/kg	4	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A3-1		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229015				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**80**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**17**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**7**		----	----	----
Copper	7440-50-8	5	mg/kg	**11**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**185**		----	----	----
Nickel	7440-02-0	2	mg/kg	**9**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**49**		----	----	----
Zinc	7440-66-6	5	mg/kg	**7**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	**0.2**		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.8**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**1.0**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**380**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**380**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**127**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**1.1**		----	----	----
Total Organic Carbon	----	0.5	%	**0.6**		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A3-2	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229016			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.8	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.7	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	78	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	9.3	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Medium Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	30	----	----	----
+150µm	----	1	%	20	----	----	----
+300µm	----	1	%	13	----	----	----
+425µm	----	1	%	11	----	----	----
+600µm	----	1	%	10	----	----	----
+1180µm	----	1	%	7	----	----	----
+2.36mm	----	1	%	3	----	----	----
+4.75mm	----	1	%	<1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	49	----	----	----
Silt (2-60 µm)	----	1	%	19	----	----	----
Sand (0.06-2.00 mm)	----	1	%	28	----	----	----
Gravel (>2mm)	----	1	%	4	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.59	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	7.5	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	2.6	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	10.3	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	2.9	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	250	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	1	----	----	----
ø Iron	7439-89-6	1	mg/kg	7	----	----	----
ø Manganese	7439-96-5	1	mg/kg	1	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----
EG005(ED093)T: Total Metals by ICP-AES							

Analytical Results

Sub-Matrix: SOIL			Sample ID	A3-2		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229016				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**40**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**8**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**4**		----	----	----
Copper	7440-50-8	5	mg/kg	<5		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**97**		----	----	----
Nickel	7440-02-0	2	mg/kg	**4**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**25**		----	----	----
Zinc	7440-66-6	5	mg/kg	<5		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.1**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.1**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**350**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**350**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**138**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**0.7**		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A3-3	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229017			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.8	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.7	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	83	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	5.1	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Medium Clay	----	----	----
Emerson Class Number	EC/TC	-	-	4	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	29	----	----	----
+150µm	----	1	%	18	----	----	----
+300µm	----	1	%	11	----	----	----
+425µm	----	1	%	9	----	----	----
+600µm	----	1	%	7	----	----	----
+1180µm	----	1	%	3	----	----	----
+2.36mm	----	1	%	2	----	----	----
+4.75mm	----	1	%	<1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	45	----	----	----
Silt (2-60 µm)	----	1	%	23	----	----	----
Sand (0.06-2.00 mm)	----	1	%	30	----	----	----
Gravel (>2mm)	----	1	%	2	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.57	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	10.6	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	3.4	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	14.2	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	3.1	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	14.5	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	232	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	1	----	----	----
ø Iron	7439-89-6	1	mg/kg	6	----	----	----
ø Manganese	7439-96-5	1	mg/kg	2	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A3-3		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229017				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**110**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**20**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**8**		----	----	----
Copper	7440-50-8	5	mg/kg	**12**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**193**		----	----	----
Nickel	7440-02-0	2	mg/kg	**10**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**58**		----	----	----
Zinc	7440-66-6	5	mg/kg	**7**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**320**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**320**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**136**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**0.9**		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A4-1	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229018			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.7	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.5	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	83	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	3.6	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Light Medium Clay	----	----	----
Emerson Class Number	EC/TC	-	-	7	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	27	----	----	----
+150µm	----	1	%	17	----	----	----
+300µm	----	1	%	11	----	----	----
+425µm	----	1	%	9	----	----	----
+600µm	----	1	%	8	----	----	----
+1180µm	----	1	%	5	----	----	----
+2.36mm	----	1	%	2	----	----	----
+4.75mm	----	1	%	<1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	48	----	----	----
Silt (2-60 µm)	----	1	%	22	----	----	----
Sand (0.06-2.00 mm)	----	1	%	27	----	----	----
Gravel (>2mm)	----	1	%	3	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.50	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	5.4	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	1.8	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.4	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	7.6	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	3.1	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	4.1	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	927	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	20	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	<1	----	----	----
ø Iron	7439-89-6	1	mg/kg	5	----	----	----
ø Manganese	7439-96-5	1	mg/kg	3	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A4-1		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229018				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**130**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**31**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**13**		----	----	----
Copper	7440-50-8	5	mg/kg	**20**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**194**		----	----	----
Nickel	7440-02-0	2	mg/kg	**16**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**76**		----	----	----
Zinc	7440-66-6	5	mg/kg	**11**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	**0.2**		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.3**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.5**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**550**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**550**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**251**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**1.4**		----	----	----
Total Organic Carbon	----	0.5	%	**0.8**		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A4-2	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229019			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.4	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.3	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	36	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	8.3	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Medium Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	40	----	----	----
+150µm	----	1	%	27	----	----	----
+300µm	----	1	%	15	----	----	----
+425µm	----	1	%	12	----	----	----
+600µm	----	1	%	9	----	----	----
+1180µm	----	1	%	5	----	----	----
+2.36mm	----	1	%	2	----	----	----
+4.75mm	----	1	%	<1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	44	----	----	----
Silt (2-60 µm)	----	1	%	14	----	----	----
Sand (0.06-2.00 mm)	----	1	%	39	----	----	----
Gravel (>2mm)	----	1	%	3	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.55	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	5.7	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	2.2	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.5	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	8.4	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	2.5	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	4.4	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	694	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	<1	----	----	----
ø Iron	7439-89-6	1	mg/kg	6	----	----	----
ø Manganese	7439-96-5	1	mg/kg	2	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A4-2		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229019				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**80**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**31**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**8**		----	----	----
Copper	7440-50-8	5	mg/kg	**10**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**150**		----	----	----
Nickel	7440-02-0	2	mg/kg	**12**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**74**		----	----	----
Zinc	7440-66-6	5	mg/kg	**6**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.2**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.2**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**450**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**450**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**289**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**0.8**		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A4-3	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229020			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.4	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.4	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	84	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	7.8	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Red (2.5YR 5/6)	----	----	----
Texture	----	-	-	Light Medium Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	40	----	----	----
+150µm	----	1	%	27	----	----	----
+300µm	----	1	%	16	----	----	----
+425µm	----	1	%	12	----	----	----
+600µm	----	1	%	9	----	----	----
+1180µm	----	1	%	5	----	----	----
+2.36mm	----	1	%	2	----	----	----
+4.75mm	----	1	%	1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	38	----	----	----
Silt (2-60 µm)	----	1	%	16	----	----	----
Sand (0.06-2.00 mm)	----	1	%	43	----	----	----
Gravel (>2mm)	----	1	%	3	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.60	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	6.0	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	2.3	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.4	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	8.7	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	2.6	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	5.8	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	555	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	<1	----	----	----
ø Iron	7439-89-6	1	mg/kg	5	----	----	----
ø Manganese	7439-96-5	1	mg/kg	2	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A4-3		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229020				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**60**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**23**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**6**		----	----	----
Copper	7440-50-8	5	mg/kg	**6**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**98**		----	----	----
Nickel	7440-02-0	2	mg/kg	**9**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**46**		----	----	----
Zinc	7440-66-6	5	mg/kg	<5		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.1**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.1**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**460**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**460**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**178**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**0.6**		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A5-1	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229021			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	6.5	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	7.3	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	53	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	3.0	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Light Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	41	----	----	----
+150µm	----	1	%	28	----	----	----
+300µm	----	1	%	17	----	----	----
+425µm	----	1	%	14	----	----	----
+600µm	----	1	%	12	----	----	----
+1180µm	----	1	%	8	----	----	----
+2.36mm	----	1	%	4	----	----	----
+4.75mm	----	1	%	1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	33	----	----	----
Silt (2-60 µm)	----	1	%	20	----	----	----
Sand (0.06-2.00 mm)	----	1	%	42	----	----	----
Gravel (>2mm)	----	1	%	5	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.44	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	3.0	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	2.0	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.4	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	5.4	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	1.5	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	5.0	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	840	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	20	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	1	----	----	----
ø Iron	7439-89-6	1	mg/kg	18	----	----	----
ø Manganese	7439-96-5	1	mg/kg	11	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A5-1		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229021				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**80**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**17**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**9**		----	----	----
Copper	7440-50-8	5	mg/kg	**11**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**268**		----	----	----
Nickel	7440-02-0	2	mg/kg	**9**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**49**		----	----	----
Zinc	7440-66-6	5	mg/kg	**9**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	**0.6**		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**4.0**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**4.6**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**860**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**860**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**249**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	**10**		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**2.0**		----	----	----
Total Organic Carbon	----	0.5	%	**1.1**		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A5-2	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229022			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	6.4	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	7.8	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	15	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	7.9	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Medium Heavy Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	39	----	----	----
+150µm	----	1	%	32	----	----	----
+300µm	----	1	%	24	----	----	----
+425µm	----	1	%	22	----	----	----
+600µm	----	1	%	20	----	----	----
+1180µm	----	1	%	16	----	----	----
+2.36mm	----	1	%	12	----	----	----
+4.75mm	----	1	%	6	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	38	----	----	----
Silt (2-60 µm)	----	1	%	18	----	----	----
Sand (0.06-2.00 mm)	----	1	%	31	----	----	----
Gravel (>2mm)	----	1	%	13	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.60	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	6.9	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	4.2	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	0.4	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	11.8	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	3.3	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	1.6	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	16.2	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	290	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	1	----	----	----
ø Iron	7439-89-6	1	mg/kg	20	----	----	----
ø Manganese	7439-96-5	1	mg/kg	10	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A5-2		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229022				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**90**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**20**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**9**		----	----	----
Copper	7440-50-8	5	mg/kg	**12**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**283**		----	----	----
Nickel	7440-02-0	2	mg/kg	**11**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**62**		----	----	----
Zinc	7440-66-6	5	mg/kg	**8**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.4**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.4**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**430**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**430**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**171**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**2.0**		----	----	----
Total Organic Carbon	----	0.5	%	**1.1**		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A5-3	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229023			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.9	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	9.0	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	200	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	10.7	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Medium Heavy Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	29	----	----	----
+150µm	----	1	%	22	----	----	----
+300µm	----	1	%	16	----	----	----
+425µm	----	1	%	14	----	----	----
+600µm	----	1	%	13	----	----	----
+1180µm	----	1	%	10	----	----	----
+2.36mm	----	1	%	6	----	----	----
+4.75mm	----	1	%	3	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	49	----	----	----
Silt (2-60 µm)	----	1	%	21	----	----	----
Sand (0.06-2.00 mm)	----	1	%	22	----	----	----
Gravel (>2mm)	----	1	%	8	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.60	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	9.2	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	7.1	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	2.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	18.7	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	11.7	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	1.3	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	166	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	90	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	1	----	----	----
ø Iron	7439-89-6	1	mg/kg	14	----	----	----
ø Manganese	7439-96-5	1	mg/kg	6	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----
EG005(ED093)T: Total Metals by ICP-AES							

Analytical Results

Sub-Matrix: SOIL			Sample ID	A5-3		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229023				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**130**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**16**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**9**		----	----	----
Copper	7440-50-8	5	mg/kg	**9**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**246**		----	----	----
Nickel	7440-02-0	2	mg/kg	**9**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**53**		----	----	----
Zinc	7440-66-6	5	mg/kg	**6**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.5**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.5**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**540**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**540**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**146**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**1.2**		----	----	----
Total Organic Carbon	----	0.5	%	**0.7**		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	T2	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229024			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.9	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.6	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	219	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	10.9	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Weak Red (2.5YR 5/2)	----	----	----
Texture	----	-	-	Sandy Clay Loam	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	49	----	----	----
+150µm	----	1	%	14	----	----	----
+300µm	----	1	%	<1	----	----	----
+425µm	----	1	%	<1	----	----	----
+600µm	----	1	%	<1	----	----	----
+1180µm	----	1	%	<1	----	----	----
+2.36mm	----	1	%	<1	----	----	----
+4.75mm	----	1	%	<1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	11	----	----	----
Silt (2-60 µm)	----	1	%	35	----	----	----
Sand (0.06-2.00 mm)	----	1	%	54	----	----	----
Gravel (>2mm)	----	1	%	<1	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.82	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	0.9	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	0.9	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	381	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	11	----	----	----
ø Iron	7439-89-6	1	mg/kg	16	----	----	----
ø Manganese	7439-96-5	1	mg/kg	4	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----
EG005(ED093)T: Total Metals by ICP-AES							
Arsenic	7440-38-2	5	mg/kg	<5	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	T2		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229024				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Barium	7440-39-3	10	mg/kg	<10		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**10**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**9**		----	----	----
Copper	7440-50-8	5	mg/kg	**37**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**44**		----	----	----
Nickel	7440-02-0	2	mg/kg	**9**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**9**		----	----	----
Zinc	7440-66-6	5	mg/kg	**7**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**1.1**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**1.1**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**50**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**50**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**425**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: ASLP LEACHATE			Sample ID	T1-ALS	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229001			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA005P: pH by PC Titrator							
pH Value	----	0.01	pH Unit	**5.04**	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C							
Total Dissolved Solids @180°C	----	10	mg/L	**5990**	----	----	----
ED037P: Alkalinity by PC Titrator							
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**1440**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**1440**	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<10	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	1	mg/L	<10	----	----	----
ED093C: Leachable Major Cations							
Calcium	7440-70-2	1	mg/L	**93**	----	----	----
Magnesium	7439-95-4	1	mg/L	**11**	----	----	----
Potassium	7440-09-7	1	mg/L	**4**	----	----	----
EG005(ED093)C: Leachable Metals by ICPAES							
Aluminium	7429-90-5	0.1	mg/L	**0.7**	----	----	----
Arsenic	7440-38-2	0.1	mg/L	<0.1	----	----	----
Barium	7440-39-3	0.1	mg/L	**0.9**	----	----	----
Beryllium	7440-41-7	0.05	mg/L	<0.05	----	----	----
Boron	7440-42-8	0.1	mg/L	**0.2**	----	----	----
Cadmium	7440-43-9	0.05	mg/L	<0.05	----	----	----
Chromium	7440-47-3	0.1	mg/L	<0.1	----	----	----
Cobalt	7440-48-4	0.1	mg/L	<0.1	----	----	----
Copper	7440-50-8	0.1	mg/L	**0.2**	----	----	----
Iron	7439-89-6	0.1	mg/L	**0.4**	----	----	----
Lead	7439-92-1	0.1	mg/L	<0.1	----	----	----
Manganese	7439-96-5	0.1	mg/L	**0.5**	----	----	----
Nickel	7440-02-0	0.1	mg/L	<0.1	----	----	----
Selenium	7782-49-2	0.05	mg/L	<0.05	----	----	----
Strontium	7440-24-6	0.1	mg/L	**0.1**	----	----	----
Titanium	7440-32-6	0.1	mg/L	<0.1	----	----	----
Vanadium	7440-62-2	0.1	mg/L	<0.1	----	----	----
Zinc	7440-66-6	0.1	mg/L	**0.3**	----	----	----
EG035C: Leachable Mercury by FIMS							
Mercury	7439-97-6	0.0010	mg/L	<0.0010	----	----	----
EK040P: Fluoride by PC Titrator							
Fluoride	16984-48-8	0.1	mg/L	**0.2**	----	----	----
EK055G: Ammonia as N by Discrete Analyser							
Ammonia as N	7664-41-7	0.01	mg/L	**0.05**	----	----	----
EK057G: Nitrite as N by Discrete Analyser							
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser							
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser							
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	----	----	----

Analytical Results

Sub-Matrix: ASLP LEACHATE			Sample ID	TC1-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229002				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**5.65**		----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**7490**		----	----	----
ED037P: Alkalinity by PC Titrator								
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**2360**		----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**2360**		----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<10		----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<10		----	----	----
ED093C: Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	**133**		----	----	----
Magnesium	7439-95-4	1	mg/L	**14**		----	----	----
Potassium	7440-09-7	1	mg/L	**9**		----	----	----
EG005(ED093)C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	<0.1		----	----	----
Arsenic	7440-38-2	0.1	mg/L	<0.1		----	----	----
Barium	7440-39-3	0.1	mg/L	**1.1**		----	----	----
Beryllium	7440-41-7	0.05	mg/L	<0.05		----	----	----
Boron	7440-42-8	0.1	mg/L	**0.2**		----	----	----
Cadmium	7440-43-9	0.05	mg/L	<0.05		----	----	----
Chromium	7440-47-3	0.1	mg/L	<0.1		----	----	----
Cobalt	7440-48-4	0.1	mg/L	<0.1		----	----	----
Copper	7440-50-8	0.1	mg/L	<0.1		----	----	----
Iron	7439-89-6	0.1	mg/L	<0.1		----	----	----
Lead	7439-92-1	0.1	mg/L	<0.1		----	----	----
Manganese	7439-96-5	0.1	mg/L	**2.7**		----	----	----
Nickel	7440-02-0	0.1	mg/L	<0.1		----	----	----
Selenium	7782-49-2	0.05	mg/L	<0.05		----	----	----
Strontium	7440-24-6	0.1	mg/L	**0.4**		----	----	----
Titanium	7440-32-6	0.1	mg/L	<0.1		----	----	----
Vanadium	7440-62-2	0.1	mg/L	<0.1		----	----	----
Zinc	7440-66-6	0.1	mg/L	**0.3**		----	----	----
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	<0.0010		----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.3**		----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.06**		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.02**		----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	**0.06**		----	----	----

Analytical Results

Sub-Matrix: ASLP LEACHATE			Sample ID	WR1-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229003				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**6.42**		----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**7580**		----	----	----
ED009: Anions								
Iodide	20461-54-5	1.00	mg/L	<0.500		----	----	----
ED037P: Alkalinity by PC Titrator								
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**2880**		----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**2880**		----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**4**		----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<10		----	----	----
ED093C: Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	**568**		----	----	----
Magnesium	7439-95-4	1	mg/L	**74**		----	----	----
Potassium	7440-09-7	1	mg/L	**6**		----	----	----
EG005(ED093)C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	<0.1		----	----	----
Arsenic	7440-38-2	0.1	mg/L	<0.1		----	----	----
Barium	7440-39-3	0.1	mg/L	**4.5**		----	----	----
Beryllium	7440-41-7	0.05	mg/L	<0.05		----	----	----
Boron	7440-42-8	0.1	mg/L	<0.1		----	----	----
Cadmium	7440-43-9	0.05	mg/L	<0.05		----	----	----
Chromium	7440-47-3	0.1	mg/L	<0.1		----	----	----
Cobalt	7440-48-4	0.1	mg/L	<0.1		----	----	----
Copper	7440-50-8	0.1	mg/L	<0.1		----	----	----
Iron	7439-89-6	0.1	mg/L	<0.1		----	----	----
Lead	7439-92-1	0.1	mg/L	<0.1		----	----	----
Manganese	7439-96-5	0.1	mg/L	<0.1		----	----	----
Nickel	7440-02-0	0.1	mg/L	<0.1		----	----	----
Selenium	7782-49-2	0.05	mg/L	<0.05		----	----	----
Strontium	7440-24-6	0.1	mg/L	**1.1**		----	----	----
Titanium	7440-32-6	0.1	mg/L	<0.1		----	----	----
Vanadium	7440-62-2	0.1	mg/L	<0.1		----	----	----
Zinc	7440-66-6	0.1	mg/L	**0.2**		----	----	----
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	<0.0010		----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.4**		----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.01		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01		----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01		----	----	----

Analytical Results

Sub-Matrix: ASLP LEACHATE			Sample ID	WR3-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229004				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**5.06**		----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**5600**		----	----	----
ED009: Anions								
Iodide	20461-54-5	1.00	mg/L	<0.200		----	----	----
ED037P: Alkalinity by PC Titrator								
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**1460**		----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**1460**		----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<10		----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**10**		----	----	----
ED093C: Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	**91**		----	----	----
Magnesium	7439-95-4	1	mg/L	**8**		----	----	----
Potassium	7440-09-7	1	mg/L	**4**		----	----	----
EG005(ED093)C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**0.4**		----	----	----
Arsenic	7440-38-2	0.1	mg/L	<0.1		----	----	----
Barium	7440-39-3	0.1	mg/L	**0.6**		----	----	----
Beryllium	7440-41-7	0.05	mg/L	<0.05		----	----	----
Boron	7440-42-8	0.1	mg/L	**0.1**		----	----	----
Cadmium	7440-43-9	0.05	mg/L	<0.05		----	----	----
Chromium	7440-47-3	0.1	mg/L	<0.1		----	----	----
Cobalt	7440-48-4	0.1	mg/L	<0.1		----	----	----
Copper	7440-50-8	0.1	mg/L	<0.1		----	----	----
Iron	7439-89-6	0.1	mg/L	**0.2**		----	----	----
Lead	7439-92-1	0.1	mg/L	<0.1		----	----	----
Manganese	7439-96-5	0.1	mg/L	**0.5**		----	----	----
Nickel	7440-02-0	0.1	mg/L	<0.1		----	----	----
Selenium	7782-49-2	0.05	mg/L	<0.05		----	----	----
Strontium	7440-24-6	0.1	mg/L	<0.1		----	----	----
Titanium	7440-32-6	0.1	mg/L	<0.1		----	----	----
Vanadium	7440-62-2	0.1	mg/L	<0.1		----	----	----
Zinc	7440-66-6	0.1	mg/L	**0.3**		----	----	----
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	<0.0010		----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.1**		----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.01		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01		----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	**0.02**		----	----	----

Key: CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
~ = Indicates an estimated value.
ø = ALS is not NATA accredited for these tests.

QUALITY CONTROL REPORT

Work Order	: **EB2428229**	Page	: 1 of 22
Client	: **The Trustee for Mine Earth Unit Trust**	Laboratory	: Environmental Division Brisbane
Contact	: Matt Braimbridge	Contact	: Customer Services EB
Address	: 1 BREAKFAST CREEK ROAD NEWSTEAD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: TCK-2405	Date Samples Received	: 07-Aug-2024
Order number	: ----	Date Analysis Commenced	: 20-Aug-2024
C-O-C number	: ----	Issue Date	: 28-Aug-2024
Sampler	: JEREMY DURBIN		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 24		
No. of samples analysed	: 24		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Inorganics, Stafford, QLD
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Soil Preparation, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Soil Preparation, Stafford, QLD
Dave Gitsham	Metals Instrument Chemist	Brisbane Inorganics, Stafford, QLD
Layla Hafner	Acid Sulphate Soils - Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Vincent Muller	Chemist - Inorganics	Brisbane Inorganics, Stafford, QLD
Vincent Muller	Chemist - Inorganics	Brisbane Soil Preparation, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC
* = The final LOR has been raised due to dilution or other sample specific cause; adjusted LOR is shown in brackets. The duplicate ranges for Acceptable RPD% are applied to the final LOR where applicable.

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 5998897)									
EB2428229-001	T1-ALS	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	30	40	40.1	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	17	22	26.0	0% - 50%
		EG005T: Cobalt	7440-48-4	2	mg/kg	17	19	11.7	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	15	18	17.0	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	5	0.0	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	95	98	3.2	0% - 50%
		EG005T: Lead	7439-92-1	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	75	93	21.0	0% - 50%
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Vanadium	7440-62-2	5	mg/kg	18	27	36.6	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	11	14	25.0	No Limit
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.0	No Limit
EB2428229-011	A1-2	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	10	20	0.0	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	<2	<2	0.0	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	<2	<2	0.0	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	<2	<2	0.0	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.0	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 5998897) - continued									
EB2428229-011	A1-2	EG005T: Copper	7440-50-8	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	<5	7	33.6	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	51	71	33.9	0% - 50%
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Vanadium	7440-62-2	5	mg/kg	6	8	31.0	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.0	No Limit
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 5998900)									
EB2428324-003	Anonymous	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	30	40	47.2	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	7	8	0.0	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	4	5	0.0	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	8	10	23.6	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	9	8	0.0	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	16	14	14.6	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	11	21	64.9	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	245	# 438	56.5	0% - 20%
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Vanadium	7440-62-2	5	mg/kg	6	8	29.1	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	46	67	38.7	0% - 50%
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.0	No Limit
EB2428229-021	A5-1	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	80	80	0.0	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	17	17	0.0	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	9	9	0.0	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	9	10	0.0	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	11	11	0.0	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	268	274	2.1	0% - 20%
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Vanadium	7440-62-2	5	mg/kg	49	49	0.0	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	9	9	0.0	No Limit
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.0	No Limit
EK055-P: Ammonia as N (QC Lot: 5999538)									

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EK055-P: Ammonia as N (QC Lot: 5999538) - continued									
EB2428229-001	T1-ALS	EK055-P: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.0	No Limit
EB2428229-011	A1-2	EK055-P: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.0	No Limit
EK055-P: Ammonia as N (QC Lot: 5999539)									
EB2428146-001	Anonymous	EK055-P: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.0	No Limit
EA001: pH in soil using 0.01M CaCl extract (QC Lot: 5999520)									
EB2428185-001	Anonymous	EA001: pH (CaCl2)	----	0.1	pH Unit	6.7	6.8	2.1	0% - 20%
EB2428229-009	TS2-ALS	EA001: pH (CaCl2)	----	0.1	pH Unit	7.8	7.8	0.0	0% - 20%
EA001: pH in soil using 0.01M CaCl extract (QC Lot: 5999521)									
EB2428229-020	A4-3	EA001: pH (CaCl2)	----	0.1	pH Unit	7.4	7.6	2.4	0% - 20%
EA002: pH 1:5 (Soils) (QC Lot: 5998882)									
EB2428229-001	T1-ALS	EA002: pH Value	----	0.1	pH Unit	8.9	8.9	0.0	0% - 20%
EB2428229-011	A1-2	EA002: pH Value	----	0.1	pH Unit	8.7	8.7	0.0	0% - 20%
EA002: pH 1:5 (Soils) (QC Lot: 5998883)									
EB2428229-021	A5-1	EA002: pH Value	----	0.1	pH Unit	7.3	7.3	0.0	0% - 20%
EA010: Conductivity (1:5) (QC Lot: 5998881)									
EB2428229-001	T1-ALS	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	175	188	7.4	0% - 20%
EB2428229-011	A1-2	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	25	24	0.0	0% - 20%
EA010: Conductivity (1:5) (QC Lot: 5998886)									
EB2428229-021	A5-1	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	53	49	7.2	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 5998990)									
EB2422887-001	Anonymous	EA055: Moisture Content	----	0.1 (1.0)*	%	21.4	19.9	7.2	0% - 20%
EB2428229-007	DC2-ALS	EA055: Moisture Content	----	0.1 (1.0)*	%	5.6	6.0	7.1	No Limit
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 5998991)									
EB2428229-017	A3-3	EA055: Moisture Content	----	0.1 (1.0)*	%	5.1	4.8	6.1	No Limit
EB2428300-003	Anonymous	EA055: Moisture Content	----	0.1 (1.0)*	%	10.9	10.1	7.6	0% - 50%
ED006: Exchangeable Cations on Alkaline Soils (QC Lot: 6004098)									
EB2428159-009	Anonymous	ED006: Exchangeable Calcium	----	0.2	meq/100g	5.5	4.7	16.0	0% - 20%
		ED006: Exchangeable Magnesium	----	0.2	meq/100g	2.9	2.4	19.6	0% - 50%
		ED006: Exchangeable Potassium	----	0.2	meq/100g	0.6	0.4	27.7	No Limit
		ED006: Exchangeable Sodium	----	0.2	meq/100g	<0.2	<0.2	0.0	No Limit
		ED006: Cation Exchange Capacity	----	0.2	meq/100g	8.9	7.4	17.9	0% - 20%
EB2428229-006	DC-ALS	ED006: Exchangeable Calcium	----	0.2	meq/100g	1.0	1.8	52.9	No Limit
		ED006: Exchangeable Magnesium	----	0.2	meq/100g	0.9	1.5	51.9	No Limit
		ED006: Exchangeable Potassium	----	0.2	meq/100g	<0.2	<0.2	0.0	No Limit
		ED006: Exchangeable Sodium	----	0.2	meq/100g	<0.2	<0.2	0.0	No Limit
		ED006: Cation Exchange Capacity	----	0.2	meq/100g	1.9	# 3.2	52.5	0% - 50%

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
ED006: Exchangeable Cations on Alkaline Soils (QC Lot: 6004106)									
EB2428229-017	A3-3	ED006: Exchangeable Calcium	----	0.2	meq/100g	10.6	10.5	1.2	0% - 20%
		ED006: Exchangeable Magnesium	----	0.2	meq/100g	3.4	3.3	0.0	0% - 50%
		ED006: Exchangeable Potassium	----	0.2	meq/100g	0.2	0.2	0.0	No Limit
		ED006: Exchangeable Sodium	----	0.2	meq/100g	<0.2	<0.2	0.0	No Limit
		ED006: Cation Exchange Capacity	----	0.2	meq/100g	14.2	14.0	1.3	0% - 20%
ED007: Exchangeable Cations (QC Lot: 6004086)									
EB2428158-003	Anonymous	ED007: Exchangeable Calcium	----	0.1	meq/100g	1.8	1.7	9.6	0% - 50%
		ED007: Exchangeable Magnesium	----	0.1	meq/100g	0.9	0.9	0.0	No Limit
		ED007: Exchangeable Potassium	----	0.1	meq/100g	0.3	0.3	0.0	No Limit
		ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	0.0	No Limit
ED021: Bicarbonate Extractable Potassium (Colwell) (QC Lot: 6004113)									
EB2428229-001	T1-ALS	ED021: Bicarbonate Extractable K (Colwell)	----	100	mg/kg	163	170	3.9	No Limit
EB2428229-011	A1-2	ED021: Bicarbonate Extractable K (Colwell)	----	100	mg/kg	101	<100	0.0	No Limit
ED021: Bicarbonate Extractable Potassium (Colwell) (QC Lot: 6004120)									
EB2428229-023	A5-3	ED021: Bicarbonate Extractable K (Colwell)	----	100	mg/kg	166	149	11.2	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 5998880)									
EB2428229-001	T1-ALS	ED045G: Chloride	16887-00-6	10	mg/kg	20	30	0.0	No Limit
EB2428229-011	A1-2	ED045G: Chloride	16887-00-6	10	mg/kg	<10	<10	0.0	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 5998885)									
EB2428229-021	A5-1	ED045G: Chloride	16887-00-6	10	mg/kg	20	20	0.0	No Limit
ED092: DTPA Extractable Metals (QC Lot: 6004114)									
EB2428229-001	T1-ALS	ED092: Copper	7440-50-8	1	mg/kg	16	17	0.0	0% - 50%
		ED092: Iron	7439-89-6	1	mg/kg	19	20	0.0	0% - 50%
		ED092: Manganese	7439-96-5	1	mg/kg	4	4	0.0	No Limit
		ED092: Zinc	7440-66-6	1	mg/kg	<1	<1	0.0	No Limit
EB2428229-010	A1-1	ED092: Copper	7440-50-8	1	mg/kg	<1	<1	0.0	No Limit
		ED092: Iron	7439-89-6	1	mg/kg	4	4	0.0	No Limit
		ED092: Manganese	7439-96-5	1	mg/kg	2	2	0.0	No Limit
		ED092: Zinc	7440-66-6	1	mg/kg	<1	<1	0.0	No Limit
ED092: DTPA Extractable Metals (QC Lot: 6004121)									
EB2428159-007	Anonymous	ED092: Copper	7440-50-8	1	mg/kg	<1	<1	0.0	No Limit
		ED092: Iron	7439-89-6	1	mg/kg	11	10	0.0	0% - 50%
		ED092: Manganese	7439-96-5	1	mg/kg	9	10	0.0	No Limit
		ED092: Zinc	7440-66-6	1	mg/kg	<1	<1	0.0	No Limit
EB2428229-022	A5-2	ED092: Copper	7440-50-8	1	mg/kg	1	1	0.0	No Limit
		ED092: Iron	7439-89-6	1	mg/kg	20	22	11.0	0% - 20%
		ED092: Manganese	7439-96-5	1	mg/kg	10	11	14.4	0% - 50%

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
ED092: DTPA Extractable Metals (QC Lot: 6004121) - continued									
EB2428229-022	A5-2	ED092: Zinc	7440-66-6	1	mg/kg	<1	<1	0.0	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 5998898)									
EB2428229-001	T1-ALS	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EB2428229-011	A1-2	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 5998899)									
EB2428229-021	A5-1	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 5998878)									
EB2428229-001	T1-ALS	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EB2428229-011	A1-2	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 5998887)									
EB2428229-021	A5-1	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	0.6	0.8	22.1	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 5998879)									
EB2428229-001	T1-ALS	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EB2428229-011	A1-2	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 5998884)									
EB2428229-021	A5-1	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	4.6	5.4	14.7	0% - 20%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 6000533)									
EB2428229-001	T1-ALS	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	60	60	0.0	No Limit
EB2428229-011	A1-2	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	40	100	80.9	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 6000534)									
EB2428229-021	A5-1	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	860	890	3.4	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 6000532)									
EB2428229-001	T1-ALS	EK067G: Total Phosphorus as P	----	2	mg/kg	391	376	4.0	0% - 20%
EB2428229-011	A1-2	EK067G: Total Phosphorus as P	----	2	mg/kg	198	224	12.3	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 6000535)									
EB2428229-021	A5-1	EK067G: Total Phosphorus as P	----	2	mg/kg	249	241	3.2	0% - 20%
EK080: Bicarbonate Extractable Phosphorus (Colwell) (QC Lot: 6004112)									
EB2428229-001	T1-ALS	EK080: Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	<5	0.0	No Limit
EB2428229-011	A1-2	EK080: Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	<5	0.0	No Limit
EK080: Bicarbonate Extractable Phosphorus (Colwell) (QC Lot: 6004119)									
EB2428159-007	Anonymous	EK080: Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	<5	0.0	No Limit
EB2428229-023	A5-3	EK080: Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	<5	0.0	No Limit
EP004: Organic Matter (QC Lot: 5999526)									
EB2428159-007	Anonymous	EP004: Organic Matter	----	0.5	%	1.5	1.5	0.0	No Limit
		EP004: Total Organic Carbon	----	0.5	%	0.9	0.8	0.0	No Limit
EB2428229-002	TC1-ALS	EP004: Organic Matter	----	0.5	%	<0.5	<0.5	0.0	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EP004: Organic Matter (QC Lot: 5999526) - continued									
EB2428229-002	TC1-ALS	EP004: Total Organic Carbon	----	0.5	%	<0.5	<0.5	0.0	No Limit
EP004: Organic Matter (QC Lot: 5999531)									
EB2428229-013	A2-2	EP004: Organic Matter	----	0.5	%	0.9	0.9	0.0	No Limit
		EP004: Total Organic Carbon	----	0.5	%	0.5	0.5	0.0	No Limit
EB2428229-022	A5-2	EP004: Organic Matter	----	0.5	%	2.0	2.0	0.0	No Limit
		EP004: Total Organic Carbon	----	0.5	%	1.1	1.1	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
ED009: Anions (QC Lot: 6005965)									
EB2428179-001	Anonymous	ED009-X: Iodide	20461-54-5	0.01 (0.050)*	mg/L	2.03	2.13	4.8	0% - 20%
EB2428615-002	Anonymous	ED009-X: Iodide	20461-54-5	0.01 (0.500)*	mg/L	<0.500	<0.500	0.0	No Limit
EG005(ED093)C: Leachable Metals by ICPAES (QC Lot: 6007953)									
EB2428608-008	Anonymous	EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Aluminium	7429-90-5	0.1	mg/L	1.0	1.2	12.4	0% - 50%
		EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Barium	7440-39-3	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Boron	7440-42-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Iron	7439-89-6	0.1	mg/L	4.6	4.8	4.1	0% - 20%
		EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Manganese	7439-96-5	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Strontium	7440-24-6	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Titanium	7440-32-6	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Vanadium	7440-62-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Zinc	7440-66-6	0.1	mg/L	0.1	0.1	0.0	No Limit
EB2428229-003	WR1-ALS	EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Aluminium	7429-90-5	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Barium	7440-39-3	0.1	mg/L	4.5	4.4	0.0	0% - 20%
		EG005C: Boron	7440-42-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EG005(ED093)C: Leachable Metals by ICPAES (QC Lot: 6007953) - continued									
EB2428229-003	WR1-ALS	EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Iron	7439-89-6	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Manganese	7439-96-5	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Strontium	7440-24-6	0.1	mg/L	1.1	1.0	0.0	0% - 50%
		EG005C: Titanium	7440-32-6	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Vanadium	7440-62-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Zinc	7440-66-6	0.1	mg/L	0.2	0.2	0.0	No Limit
EG005(ED093)C: Leachable Metals by ICPAES (QC Lot: 6011331)									
EB2428590-007	Anonymous	EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Aluminium	7429-90-5	0.1	mg/L	0.5	0.5	0.0	No Limit
		EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Barium	7440-39-3	0.1	mg/L	3.8	3.9	0.0	0% - 20%
		EG005C: Boron	7440-42-8	0.1	mg/L	0.3	0.3	0.0	No Limit
		EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Iron	7439-89-6	0.1	mg/L	60.0	60.1	0.0	0% - 20%
		EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Manganese	7439-96-5	0.1	mg/L	1.0	1.0	0.0	No Limit
		EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Strontium	7440-24-6	0.1	mg/L	0.4	0.4	0.0	No Limit
		EG005C: Titanium	7440-32-6	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Vanadium	7440-62-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Zinc	7440-66-6	0.1	mg/L	31.2	31.1	0.0	0% - 20%
EB2428229-001	T1-ALS	EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Aluminium	7429-90-5	0.1	mg/L	0.7	0.7	0.0	No Limit
		EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Barium	7440-39-3	0.1	mg/L	0.9	0.9	0.0	No Limit
		EG005C: Boron	7440-42-8	0.1	mg/L	0.2	0.2	0.0	No Limit
		EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EG005(ED093)C: Leachable Metals by ICPAES (QC Lot: 6011331) - continued									
EB2428229-001	T1-ALS	EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Copper	7440-50-8	0.1	mg/L	0.2	0.2	0.0	No Limit
		EG005C: Iron	7439-89-6	0.1	mg/L	0.4	0.4	0.0	No Limit
		EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Manganese	7439-96-5	0.1	mg/L	0.5	0.5	0.0	No Limit
		EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Strontium	7440-24-6	0.1	mg/L	0.1	0.1	0.0	No Limit
		EG005C: Titanium	7440-32-6	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Vanadium	7440-62-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Zinc	7440-66-6	0.1	mg/L	0.3	0.3	0.0	No Limit
EA005P: pH by PC Titrator (QC Lot: 6007979)									
EB2428463-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	8.57	8.60	0.3	0% - 20%
EB2428703-026	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	7.45	7.49	0.5	0% - 20%
EA005P: pH by PC Titrator (QC Lot: 6011537)									
EB2428029-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	6.29	6.24	0.8	0% - 20%
EB2428229-002	TC1-ALS	EA005-P: pH Value	----	0.01	pH Unit	5.65	5.64	0.2	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 6010662)									
EB2428343-001	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	3110	3150	1.1	0% - 20%
EB2428456-002	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	1180	1180	0.3	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 6012013)									
EB2428229-001	T1-ALS	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	5990	5930	1.0	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 6007982)									
EB2428463-001	Anonymous	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	48	48	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	59	58	0.0	0% - 20%
EB2428703-026	Anonymous	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	532	535	0.6	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	532	535	0.6	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 6011538)									
EB2428175-001	Anonymous	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	14	16	16.3	0% - 50%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	26	28	10.3	0% - 20%
EB2428229-002	TC1-ALS	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	2360	2360	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	2360	2360	0.0	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 6007601)									
EB2428655-009	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	31	31	0.0	0% - 20%
EB2427608-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	26	26	0.0	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 6011038)									
EB2428753-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	35	35	0.0	0% - 20%

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 6011038) - continued									
EB2428229-001	T1-ALS	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1 (10)*	mg/L	<10	<10	0.0	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 6006716)									
EB2428229-003	WR1-ALS	ED045G: Chloride	16887-00-6	1 (10)*	mg/L	<10	<10	0.0	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 6011037)									
EB2428844-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	14	13	0.0	0% - 50%
ED093C: Leachable Major Cations (QC Lot: 6007954)									
EB2428229-003	WR1-ALS	ED093C: Calcium	7440-70-2	1	mg/L	568	553	2.7	0% - 20%
		ED093C: Magnesium	7439-95-4	1	mg/L	74	71	4.0	0% - 20%
		ED093C: Potassium	7440-09-7	1	mg/L	6	5	0.0	No Limit
ED093C: Leachable Major Cations (QC Lot: 6011332)									
EB2428229-001	T1-ALS	ED093C: Calcium	7440-70-2	1	mg/L	93	92	1.6	0% - 20%
		ED093C: Magnesium	7439-95-4	1	mg/L	11	10	0.0	0% - 50%
		ED093C: Potassium	7440-09-7	1	mg/L	4	4	0.0	No Limit
EG035C: Leachable Mercury by FIMS (QC Lot: 6007974)									
EB2428229-003	WR1-ALS	EG035C: Mercury	7439-97-6	0.0001 (0.0010)*	mg/L	<0.0010	<0.0010	0.0	No Limit
EG035C: Leachable Mercury by FIMS (QC Lot: 6011334)									
EB2428229-001	T1-ALS	EG035C: Mercury	7439-97-6	0.0001 (0.0010)*	mg/L	<0.0010	<0.0010	0.0	No Limit
EB2428590-007	Anonymous	EG035C: Mercury	7439-97-6	0.0001 (0.0010)*	mg/L	<0.0010	<0.0010	0.0	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 6007983)									
EB2428463-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
EB2428703-026	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	1.9	1.9	0.0	0% - 50%
EK040P: Fluoride by PC Titrator (QC Lot: 6011539)									
EB2428175-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.3	0.3	0.0	No Limit
EB2428229-002	TC1-ALS	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.3	0.3	0.0	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 6010885)									
EB2427441-005	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EB2428229-002	TC1-ALS	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.06	0.05	0.0	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 6006715)									
EB2428229-003	WR1-ALS	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EB2428484-010	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 6011039)									
EB2428753-002	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	0.09	0.09	0.0	No Limit
EB2428229-001	T1-ALS	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 6007603)									
EB2428503-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 6011036)									
EB2428844-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5998897)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	65.7 mg/kg	95.7	84.0	123
EG005T: Barium	7440-39-3	10	mg/kg	<10	78.4 mg/kg	99.6	89.0	129
EG005T: Beryllium	7440-41-7	1	mg/kg	<1	----	----	----	----
EG005T: Boron	7440-42-8	50	mg/kg	<50	----	----	----	----
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	----	----	----	----
EG005T: Chromium	7440-47-3	2	mg/kg	<2	14.9 mg/kg	105	83.0	125
EG005T: Cobalt	7440-48-4	2	mg/kg	<2	7.78 mg/kg	104	82.0	118
EG005T: Copper	7440-50-8	5	mg/kg	<5	38 mg/kg	108	86.0	122
EG005T: Lead	7439-92-1	5	mg/kg	<5	46.8 mg/kg	102	84.0	119
EG005T: Manganese	7439-96-5	5	mg/kg	<5	449 mg/kg	98.4	84.0	113
EG005T: Nickel	7440-02-0	2	mg/kg	<2	12.4 mg/kg	103	81.5	118
EG005T: Selenium	7782-49-2	5	mg/kg	<5	----	----	----	----
EG005T: Vanadium	7440-62-2	5	mg/kg	<5	40.7 mg/kg	103	88.0	127
EG005T: Zinc	7440-66-6	5	mg/kg	<5	160 mg/kg	99.7	80.0	120
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5998900)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	65.7 mg/kg	93.5	84.0	123
EG005T: Barium	7440-39-3	10	mg/kg	<10	78.4 mg/kg	102	89.0	129
EG005T: Beryllium	7440-41-7	1	mg/kg	<1	----	----	----	----
EG005T: Boron	7440-42-8	50	mg/kg	<50	----	----	----	----
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	----	----	----	----
EG005T: Chromium	7440-47-3	2	mg/kg	<2	14.9 mg/kg	105	83.0	125
EG005T: Cobalt	7440-48-4	2	mg/kg	<2	7.78 mg/kg	105	82.0	118
EG005T: Copper	7440-50-8	5	mg/kg	<5	38 mg/kg	114	86.0	122
EG005T: Lead	7439-92-1	5	mg/kg	<5	46.8 mg/kg	98.8	84.0	119
EG005T: Manganese	7439-96-5	5	mg/kg	<5	449 mg/kg	98.0	84.0	113
EG005T: Nickel	7440-02-0	2	mg/kg	<2	12.4 mg/kg	103	81.5	118
EG005T: Selenium	7782-49-2	5	mg/kg	<5	----	----	----	----
EG005T: Vanadium	7440-62-2	5	mg/kg	<5	40.7 mg/kg	105	88.0	127
EG005T: Zinc	7440-66-6	5	mg/kg	<5	160 mg/kg	99.3	80.0	120
EK055-P: Ammonia as N (QCLot: 5999538)								

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EK055-P: Ammonia as N (QCLot: 5999538) - continued								
EK055-P: Ammonia as N	7664-41-7	20	mg/kg	<20	25 mg/kg	97.7	90.0	110
EK055-P: Ammonia as N (QCLot: 5999539)								
EK055-P: Ammonia as N	7664-41-7	20	mg/kg	<20	25 mg/kg	99.3	90.0	110
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel) (QCLot: 5999043)								
EN60a-G: Final pH	----	0.1	pH Unit	5.0	----	----	----	----
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel) (QCLot: 6007074)								
EN60a-G: Final pH	----	0.1	pH Unit	5.0	----	----	----	----
EA001: pH in soil using 0.01M CaCl extract (QCLot: 5999520)								
EA001: pH (CaCl2)	----	----	pH Unit	----	4 pH Unit	101	99.0	101
				----	7 pH Unit	99.8	99.0	101
EA001: pH in soil using 0.01M CaCl extract (QCLot: 5999521)								
EA001: pH (CaCl2)	----	----	pH Unit	----	4 pH Unit	101	99.0	101
				----	7 pH Unit	99.8	99.0	101
EA002: pH 1:5 (Soils) (QCLot: 5998882)								
EA002: pH Value	----	----	pH Unit	----	4 pH Unit	101	98.0	102
				----	7 pH Unit	100	98.0	102
EA002: pH 1:5 (Soils) (QCLot: 5998883)								
EA002: pH Value	----	----	pH Unit	----	4 pH Unit	101	98.0	102
				----	7 pH Unit	100	98.0	102
EA010: Conductivity (1:5) (QCLot: 5998881)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1412 µS/cm	98.5	95.0	105
EA010: Conductivity (1:5) (QCLot: 5998886)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1412 µS/cm	97.9	95.0	105
EA152: Soil Particle Density (QCLot: 5999070)								
EA152: Soil Particle Density (Clay/Silt/Sand)	----	----	g/cm3	----	2.68 g/cm3	97.4	80.0	120
EA152: Soil Particle Density (QCLot: 5999072)								
EA152: Soil Particle Density (Clay/Silt/Sand)	----	----	g/cm3	----	2.68 g/cm3	98.1	80.0	120
ED006: Exchangeable Cations on Alkaline Soils (QCLot: 6004098)								
ED006: Exchangeable Calcium	----	0.2	meq/100g	<0.2	8.583 meq/100g	94.5	70.0	130
ED006: Exchangeable Magnesium	----	0.2	meq/100g	<0.2	5.911 meq/100g	85.2	70.0	130
ED006: Exchangeable Potassium	----	0.2	meq/100g	<0.2	1.283 meq/100g	105	70.0	130
ED006: Exchangeable Sodium	----	0.2	meq/100g	<0.2	14.195 meq/100g	94.9	70.0	130
ED006: Cation Exchange Capacity	----	0.2	meq/100g	<0.2	29.972 meq/100g	93.3	70.0	130
ED006: Exchangeable Cations on Alkaline Soils (QCLot: 6004106)								

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
ED006: Exchangeable Cations on Alkaline Soils (QCLot: 6004106) - continued								
ED006: Exchangeable Calcium	----	0.2	meq/100g	<0.2	8.583 meq/100g	78.8	70.0	130
ED006: Exchangeable Magnesium	----	0.2	meq/100g	<0.2	5.911 meq/100g	79.2	70.0	130
ED006: Exchangeable Potassium	----	0.2	meq/100g	<0.2	1.283 meq/100g	71.6	70.0	130
ED006: Exchangeable Sodium	----	0.2	meq/100g	<0.2	14.195 meq/100g	71.3	70.0	130
ED006: Cation Exchange Capacity	----	0.2	meq/100g	<0.2	29.972 meq/100g	75.0	70.0	130
ED007: Exchangeable Cations (QCLot: 6004086)								
ED007: Exchangeable Calcium	----	0.1	meq/100g	<0.1	8.9 meq/100g	102	79.0	113
ED007: Exchangeable Magnesium	----	0.1	meq/100g	<0.1	9.52 meq/100g	95.0	85.0	115
ED007: Exchangeable Potassium	----	0.1	meq/100g	<0.1	1.49 meq/100g	95.6	70.0	122
ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.1	1.3726 meq/100g	94.0	76.0	112
ED007: Cation Exchange Capacity	----	0.1	meq/100g	<0.1	21.283 meq/100g	97.7	82.0	112
ED021: Bicarbonate Extractable Potassium (Colwell) (QCLot: 6004113)								
ED021: Bicarbonate Extractable K (Colwell)	----	100	mg/kg	<100	300.66 mg/kg	70.2	70.0	130
ED021: Bicarbonate Extractable Potassium (Colwell) (QCLot: 6004120)								
ED021: Bicarbonate Extractable K (Colwell)	----	100	mg/kg	<100	300.66 mg/kg	71.8	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 5998880)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	50 mg/kg	97.2	83.0	119
				<10	5000 mg/kg	108	83.0	119
ED045G: Chloride by Discrete Analyser (QCLot: 5998885)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	50 mg/kg	96.9	83.0	119
				<10	5000 mg/kg	107	83.0	119
ED092: DTPA Extractable Metals (QCLot: 6004114)								
ED092: Copper	7440-50-8	1	mg/kg	<1	0.62 mg/kg	110	84.0	122
ED092: Iron	7439-89-6	1	mg/kg	<1	19.75 mg/kg	128	70.0	130
ED092: Manganese	7439-96-5	1	mg/kg	<1	2.87 mg/kg	126	70.0	130
ED092: Zinc	7440-66-6	1	mg/kg	<1	3.71 mg/kg	105	79.0	122
ED092: DTPA Extractable Metals (QCLot: 6004121)								
ED092: Copper	7440-50-8	1	mg/kg	<1	0.62 mg/kg	104	84.0	122
ED092: Iron	7439-89-6	1	mg/kg	<1	20 mg/kg	124	70.0	130
ED092: Manganese	7439-96-5	1	mg/kg	<1	2.87 mg/kg	127	70.0	130
ED092: Zinc	7440-66-6	1	mg/kg	<1	3.72 mg/kg	96.7	79.0	122
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5998898)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	0.0922 mg/kg	89.5	70.0	125
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5998899)								

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5998899) - continued								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	0.0922 mg/kg	93.1	70.0	125
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5998878)								
EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	2.5 mg/kg	100	83.0	111
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5998887)								
EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	2.5 mg/kg	101	83.0	111
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 5998879)								
EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	2.5 mg/kg	99.4	83.2	111
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 5998884)								
EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	2.5 mg/kg	96.2	83.2	111
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 6000533)								
EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20	306 mg/kg	111	70.0	130
				<20	2180 mg/kg	87.6	72.0	128
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 6000534)								
EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20	306 mg/kg	99.7	70.0	130
				<20	2180 mg/kg	85.8	72.0	128
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 6000532)								
EK067G: Total Phosphorus as P	----	2	mg/kg	<2	142 mg/kg	112	70.0	130
				<2	1200 mg/kg	108	79.0	121
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 6000535)								
EK067G: Total Phosphorus as P	----	2	mg/kg	<2	142 mg/kg	104	70.0	130
				<2	1200 mg/kg	100	79.0	121
EK080: Bicarbonate Extractable Phosphorus (Colwell) (QCLot: 6004112)								
EK080: Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	100 mg/kg	105	90.0	110
				<5	20.7 mg/kg	87.0	70.0	130
				<5	155 mg/kg	93.5	80.0	120
EK080: Bicarbonate Extractable Phosphorus (Colwell) (QCLot: 6004119)								
EK080: Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	100 mg/kg	94.2	90.0	110
				<5	20.7 mg/kg	86.0	70.0	130
				<5	155 mg/kg	97.6	80.0	120
EP004: Organic Matter (QCLot: 5999526)								
EP004: Organic Matter	----	0.5	%	<0.5	80 %	97.6	83.0	115
EP004: Total Organic Carbon	----	0.5	%	<0.5	46.4 %	97.6	85.0	115
EP004: Organic Matter (QCLot: 5999531)								
EP004: Organic Matter	----	0.5	%	<0.5	80 %	97.6	83.0	115

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EP004: Organic Matter (QCLot: 5999531) - continued								
EP004: Total Organic Carbon	----	0.5	%	<0.5	46.4 %	97.6	85.0	115

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
ED009: Anions (QCLot: 6005965)								
ED009-X: Iodide	20461-54-5	0.01	mg/L	<0.010	0.5 mg/L	104	80.0	113
EG005(ED093)C: Leachable Metals by ICPAES (QCLot: 6007953)								
EG005C: Aluminium	7429-90-5	0.1	mg/L	<0.1	0.5 mg/L	94.8	70.0	130
EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	0.1 mg/L	102	89.0	123
EG005C: Barium	7440-39-3	0.1	mg/L	<0.1	0.1 mg/L	91.3	90.0	120
EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	0.1 mg/L	92.3	70.0	130
EG005C: Boron	7440-42-8	0.1	mg/L	<0.1	0.5 mg/L	91.6	70.0	130
EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	0.1 mg/L	90.0	88.0	120
EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	0.1 mg/L	92.1	86.0	115
EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	0.1 mg/L	90.8	87.0	116
EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	0.1 mg/L	90.0	87.0	117
EG005C: Iron	7439-89-6	0.1	mg/L	<0.1	0.5 mg/L	93.8	70.0	130
EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	0.1 mg/L	86.7	85.0	117
EG005C: Manganese	7439-96-5	0.1	mg/L	<0.1	0.1 mg/L	90.8	83.0	117
EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	0.1 mg/L	92.7	90.0	116
EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	0.1 mg/L	94.6	70.0	130
EG005C: Strontium	7440-24-6	0.1	mg/L	<0.1	0.1 mg/L	70.0	70.0	130
EG005C: Titanium	7440-32-6	0.1	mg/L	<0.1	0.1 mg/L	90.0	70.0	130
EG005C: Vanadium	7440-62-2	0.1	mg/L	<0.1	0.1 mg/L	92.4	88.0	112
EG005C: Zinc	7440-66-6	0.1	mg/L	<0.1	0.1 mg/L	91.6	87.0	122
EG005(ED093)C: Leachable Metals by ICPAES (QCLot: 6011331)								
EG005C: Aluminium	7429-90-5	0.1	mg/L	<0.1	0.5 mg/L	101	70.0	130
EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	0.1 mg/L	104	89.0	123
EG005C: Barium	7440-39-3	0.1	mg/L	<0.1	0.1 mg/L	98.6	90.0	120
EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	0.1 mg/L	98.3	70.0	130
EG005C: Boron	7440-42-8	0.1	mg/L	<0.1	0.5 mg/L	99.0	70.0	130
EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	0.1 mg/L	96.1	88.0	120
EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	0.1 mg/L	96.9	86.0	115
EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	0.1 mg/L	97.5	87.0	116

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG005(ED093)C: Leachable Metals by ICPAES (QCLot: 6011331) - continued								
EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	0.1 mg/L	100	87.0	117
EG005C: Iron	7439-89-6	0.1	mg/L	<0.1	0.5 mg/L	99.8	70.0	130
EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	0.1 mg/L	92.4	85.0	117
EG005C: Manganese	7439-96-5	0.1	mg/L	<0.1	0.1 mg/L	95.7	83.0	117
EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	0.1 mg/L	94.7	90.0	116
EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	0.1 mg/L	92.4	70.0	130
EG005C: Strontium	7440-24-6	0.1	mg/L	<0.1	0.1 mg/L	70.8	70.0	130
EG005C: Titanium	7440-32-6	0.1	mg/L	<0.1	0.1 mg/L	99.5	70.0	130
EG005C: Vanadium	7440-62-2	0.1	mg/L	<0.1	0.1 mg/L	100	88.0	112
EG005C: Zinc	7440-66-6	0.1	mg/L	<0.1	0.1 mg/L	93.6	87.0	122
EA005P: pH by PC Titrator (QCLot: 6007979)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	100	98.0	102
				----	7 pH Unit	99.8	98.0	102
EA005P: pH by PC Titrator (QCLot: 6011537)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	99.8	98.0	102
				----	7 pH Unit	99.7	98.0	102
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 6010662)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	104	70.0	130
				<10	2000 mg/L	102	80.9	118
				<10	2320 mg/L	109	80.6	119
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 6012013)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	113	70.0	130
				<10	2000 mg/L	97.3	80.9	118
				<10	2320 mg/L	109	80.6	119
ED037P: Alkalinity by PC Titrator (QCLot: 6007982)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	50 mg/L	106	80.0	120
ED037P: Alkalinity by PC Titrator (QCLot: 6011538)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	104	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6007601)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	97.1	85.0	118
				<1	100 mg/L	97.1	85.0	118
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6011038)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	96.0	85.0	118
				<1	100 mg/L	96.1	85.0	118

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
ED045G: Chloride by Discrete Analyser (QCLot: 6006716)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	101	90.0	115
				<1	1000 mg/L	109	90.0	115
ED045G: Chloride by Discrete Analyser (QCLot: 6011037)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	98.2	90.0	115
				<1	1000 mg/L	108	90.0	115
ED093C: Leachable Major Cations (QCLot: 6007954)								
ED093C: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	110	70.0	130
ED093C: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	102	70.0	130
ED093C: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	104	70.0	130
ED093C: Leachable Major Cations (QCLot: 6011332)								
ED093C: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	103	70.0	130
ED093C: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	101	70.0	130
ED093C: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	98.4	70.0	130
EG035C: Leachable Mercury by FIMS (QCLot: 6007974)								
EG035C: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	94.6	84.0	117
EG035C: Leachable Mercury by FIMS (QCLot: 6011334)								
EG035C: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	105	84.0	117
EK040P: Fluoride by PC Titrator (QCLot: 6007983)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	10 mg/L	100	80.0	117
EK040P: Fluoride by PC Titrator (QCLot: 6011539)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	10 mg/L	92.5	80.0	117
EK055G: Ammonia as N by Discrete Analyser (QCLot: 6010885)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	96.8	83.5	114
EK057G: Nitrite as N by Discrete Analyser (QCLot: 6006715)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	100.0	90.0	110
EK057G: Nitrite as N by Discrete Analyser (QCLot: 6011039)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	101	90.0	110
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 6007603)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	103	81.7	117
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 6011036)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	106	81.7	117

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5998897)							
EB2428229-002	TC1-ALS	EG005T: Arsenic	7440-38-2	50 mg/kg	85.7	70.0	130
		EG005T: Cadmium	7440-43-9	50 mg/kg	85.3	70.0	130
		EG005T: Chromium	7440-47-3	50 mg/kg	86.6	70.0	130
		EG005T: Copper	7440-50-8	250 mg/kg	96.3	70.0	130
		EG005T: Lead	7439-92-1	250 mg/kg	84.3	70.0	130
		EG005T: Nickel	7440-02-0	50 mg/kg	87.3	70.0	130
		EG005T: Selenium	7782-49-2	50 mg/kg	85.8	70.0	130
		EG005T: Zinc	7440-66-6	250 mg/kg	82.9	70.0	130
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5998900)							
EB2428229-022	A5-2	EG005T: Arsenic	7440-38-2	50 mg/kg	77.6	70.0	130
		EG005T: Cadmium	7440-43-9	50 mg/kg	85.4	70.0	130
		EG005T: Chromium	7440-47-3	50 mg/kg	84.0	70.0	130
		EG005T: Copper	7440-50-8	250 mg/kg	93.6	70.0	130
		EG005T: Lead	7439-92-1	250 mg/kg	83.8	70.0	130
		EG005T: Nickel	7440-02-0	50 mg/kg	85.5	70.0	130
		EG005T: Selenium	7782-49-2	50 mg/kg	74.1	70.0	130
		EG005T: Zinc	7440-66-6	250 mg/kg	83.2	70.0	130
EK055-P: Ammonia as N (QCLot: 5999538)							
EB2428229-002	TC1-ALS	EK055-P: Ammonia as N	7664-41-7	100 mg/kg	87.1	70.0	130
EK055-P: Ammonia as N (QCLot: 5999539)							
EB2428146-002	Anonymous	EK055-P: Ammonia as N	7664-41-7	100 mg/kg	87.8	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5998898)							
EB2428229-002	TC1-ALS	EG035T: Mercury	7439-97-6	0.5 mg/kg	84.6	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5998899)							
EB2428229-022	A5-2	EG035T: Mercury	7439-97-6	0.5 mg/kg	79.6	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5998878)							
EB2428229-002	TC1-ALS	EK057G: Nitrite as N (Sol.)	14797-65-0	2.5 mg/kg	98.3	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5998887)							
EB2428229-022	A5-2	EK057G: Nitrite as N (Sol.)	14797-65-0	2.5 mg/kg	96.2	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 5998879)							
EB2428229-002	TC1-ALS	EK059G: Nitrite + Nitrate as N (Sol.)	----	2.5 mg/kg	82.8	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 5998884)							
EB2428229-022	A5-2	EK059G: Nitrite + Nitrate as N (Sol.)	----	2.5 mg/kg	101	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 6000533)							

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%) MS	Acceptable Limits (%) Low	High
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 6000533) - continued							
EB2428229-002	TC1-ALS	EK061G: Total Kjeldahl Nitrogen as N	----	500 mg/kg	96.8	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 6000534)							
EB2428229-022	A5-2	EK061G: Total Kjeldahl Nitrogen as N	----	500 mg/kg	89.5	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 6000532)							
EB2428229-002	TC1-ALS	EK067G: Total Phosphorus as P	----	100 mg/kg	# Not Determined	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 6000535)							
EB2428229-022	A5-2	EK067G: Total Phosphorus as P	----	100 mg/kg	98.0	70.0	130
EK080: Bicarbonate Extractable Phosphorus (Colwell) (QCLot: 6004112)							
EB2428229-002	TC1-ALS	EK080: Bicarbonate Ext. P (Colwell)	----	40 mg/kg	88.8	70.0	130
EK080: Bicarbonate Extractable Phosphorus (Colwell) (QCLot: 6004119)							
EB2428159-008	Anonymous	EK080: Bicarbonate Ext. P (Colwell)	----	40 mg/kg	96.2	70.0	130
EP004: Organic Matter (QCLot: 5999526)							
EB2428159-008	Anonymous	EP004: Organic Matter	----	1.6 %	95.6	70.0	130
		EP004: Total Organic Carbon	----	0.928 %	95.4	70.0	130
EP004: Organic Matter (QCLot: 5999531)							
EB2428229-014	A2-3	EP004: Organic Matter	----	1.84 %	82.6	70.0	130
		EP004: Total Organic Carbon	----	1.04 %	84.5	70.0	130

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%) MS	Acceptable Limits (%) Low	High
ED009: Anions (QCLot: 6005965)							
EB2428179-002	Anonymous	ED009-X: Iodide	20461-54-5	100 mg/L	108	70.0	130
EG005(ED093)C: Leachable Metals by ICPAES (QCLot: 6007953)							
EB2428229-004	WR3-ALS	EG005C: Arsenic	7440-38-2	1 mg/L	100	70.0	130
		EG005C: Barium	7440-39-3	1 mg/L	95.4	70.0	130
		EG005C: Beryllium	7440-41-7	1 mg/L	96.8	70.0	130
		EG005C: Cadmium	7440-43-9	0.25 mg/L	96.3	70.0	130
		EG005C: Chromium	7440-47-3	1 mg/L	94.9	70.0	130
		EG005C: Cobalt	7440-48-4	1 mg/L	92.6	70.0	130
		EG005C: Copper	7440-50-8	1 mg/L	97.2	70.0	130
		EG005C: Lead	7439-92-1	1 mg/L	99.1	70.0	130
		EG005C: Manganese	7439-96-5	1 mg/L	94.0	70.0	130
		EG005C: Nickel	7440-02-0	1 mg/L	94.5	70.0	130
		EG005C: Vanadium	7440-62-2	1 mg/L	96.7	70.0	130
		EG005C: Zinc	7440-66-6	1 mg/L	93.2	70.0	130

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%) MS	Acceptable Limits (%) Low	High
EG005(ED093)C: Leachable Metals by ICPAES (QCLot: 6011331)							
EB2428229-002	TC1-ALS	EG005C: Arsenic	7440-38-2	1 mg/L	105	70.0	130
		EG005C: Barium	7440-39-3	1 mg/L	103	70.0	130
		EG005C: Beryllium	7440-41-7	1 mg/L	90.2	70.0	130
		EG005C: Cadmium	7440-43-9	0.25 mg/L	88.5	70.0	130
		EG005C: Chromium	7440-47-3	1 mg/L	92.1	70.0	130
		EG005C: Cobalt	7440-48-4	1 mg/L	90.4	70.0	130
		EG005C: Copper	7440-50-8	1 mg/L	102	70.0	130
		EG005C: Lead	7439-92-1	1 mg/L	91.9	70.0	130
		EG005C: Manganese	7439-96-5	1 mg/L	94.8	70.0	130
		EG005C: Nickel	7440-02-0	1 mg/L	88.1	70.0	130
		EG005C: Vanadium	7440-62-2	1 mg/L	96.4	70.0	130
		EG005C: Zinc	7440-66-6	1 mg/L	82.7	70.0	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6007601)							
EB2427608-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	# Not Determined	70.0	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6011038)							
EB2428229-002	TC1-ALS	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	200 mg/L	128	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 6006716)							
EB2428229-004	WR3-ALS	ED045G: Chloride	16887-00-6	400 mg/L	115	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 6011037)							
EB2428229-002	TC1-ALS	ED045G: Chloride	16887-00-6	4000 mg/L	110	70.0	130
EG035C: Leachable Mercury by FIMS (QCLot: 6007974)							
EB2428229-004	WR3-ALS	EG035C: Mercury	7439-97-6	0.01 mg/L	87.0	70.0	130
EG035C: Leachable Mercury by FIMS (QCLot: 6011334)							
EB2428229-002	TC1-ALS	EG035C: Mercury	7439-97-6	0.01 mg/L	77.1	70.0	130
EK040P: Fluoride by PC Titrator (QCLot: 6007983)							
EB2428463-004	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	93.1	70.0	130
EK040P: Fluoride by PC Titrator (QCLot: 6011539)							
EB2428175-002	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	82.9	70.0	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 6010885)							
EB2428229-001	T1-ALS	EK055G: Ammonia as N	7664-41-7	0.5 mg/L	103	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 6006715)							
EB2428229-004	WR3-ALS	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	104	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 6011039)							
EB2428229-002	TC1-ALS	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	96.8	70.0	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 6007603)							
EB2428229-004	WR3-ALS	EK071G: Reactive Phosphorus as P	14265-44-2	0.5 mg/L	102	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 6011036)							
EB2428229-002	TC1-ALS	EK071G: Reactive Phosphorus as P	14265-44-2	0.5 mg/L	117	70.0	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2428229**	Page	: 1 of 24
Client	: **The Trustee for Mine Earth Unit Trust**	Laboratory	: Environmental Division Brisbane
Contact	: Matt Braimbridge	Telephone	: +61-7-3243 7222
Project	: TCK-2405	Date Samples Received	: 07-Aug-2024
Site	: ----	Issue Date	: 28-Aug-2024
Sampler	: JEREMY DURBIN	No. of samples received	: 24
Order number	: ----	No. of samples analysed	: 24

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Duplicate outliers exist - please see following pages for full details.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, where applicable to the methodology, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Duplicate (DUP) RPDs							
EG005(ED093)T: Total Metals by ICP-AES	EB2428324--003	Anonymous	**Manganese**	7439-96-5	56.5 %	0% - 20%	**RPD exceeds LOR based limits**
ED006: Exchangeable Cations on Alkaline Soils	EB2428229--006	DC-ALS	**Cation Exchange Capacity**	----	52.5 %	0% - 50%	**RPD exceeds LOR based limits**
Matrix Spike (MS) Recoveries							
EK067G: Total Phosphorus as P by Discrete Analyser	EB2428229--002	TC1-ALS	**Total Phosphorus as P**	----	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	EB2427608--002	Anonymous	**Sulfate as SO4 - Turbidimetric**	14808-79-8	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Outliers : Analysis Holding Time Compliance

Matrix: **SOIL**

Method		*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)		*Date extracted*	*Due for extraction*	***Days overdue***	*Date analysed*	*Due for analysis*	***Days overdue***
EA001: pH in soil using 0.01M CaCl extract							
Soil Glass Jar - Unpreserved							
T1-ALS,	TC1-ALS,	21-Aug-2024	14-Aug-2024	**7**	----	----	----
WR1-ALS,	WR3-ALS,						
B1-ALS,	DC-ALS,						
DC2-ALS,	TS1-ALS,						
TS2-ALS,	A1-1,						
A1-2,	A2-1,						
A2-2,	A2-3,						
A3-1,	A3-2,						
A3-3,	A4-1,						
A4-2,	A4-3,						
A5-1,	A5-2,						
A5-3,	T2						
EA002: pH 1:5 (Soils)							

Matrix: **SOIL**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EA002: pH 1:5 (Soils) - Analysis Holding Time Compliance							
Soil Glass Jar - Unpreserved							
T1-ALS,	TC1-ALS,	21-Aug-2024	14-Aug-2024	**7**	----	----	----
WR1-ALS,	WR3-ALS,						
B1-ALS,	DC-ALS,						
DC2-ALS,	TS1-ALS,						
TS2-ALS,	A1-1,						
A1-2,	A2-1,						
A2-2,	A2-3,						
A3-1,	A3-2,						
A3-3,	A4-1,						
A4-2,	A4-3,						
A5-1,	A5-2,						
A5-3,	T2						
EA010: Conductivity (1:5)							
Soil Glass Jar - Unpreserved							
T1-ALS,	TC1-ALS,	21-Aug-2024	14-Aug-2024	**7**	----	----	----
WR1-ALS,	WR3-ALS,						
B1-ALS,	DC-ALS,						
DC2-ALS,	TS1-ALS,						
TS2-ALS,	A1-1,						
A1-2,	A2-1,						
A2-2,	A2-3,						
A3-1,	A3-2,						
A3-3,	A4-1,						
A4-2,	A4-3,						
A5-1,	A5-2,						
A5-3,	T2						
EK057G: Nitrite as N by Discrete Analyser							

Matrix: **SOIL**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EK057G: Nitrite as N by Discrete Analyser - Analysis Holding Time Compliance							
Soil Glass Jar - Unpreserved							
T1-ALS,	TC1-ALS,	21-Aug-2024	14-Aug-2024	**7**	----	----	----
WR1-ALS,	WR3-ALS,						
B1-ALS,	DC-ALS,						
DC2-ALS,	TS1-ALS,						
TS2-ALS,	A1-1,						
A1-2,	A2-1,						
A2-2,	A2-3,						
A3-1,	A3-2,						
A3-3,	A4-1,						
A4-2,	A4-3,						
A5-1,	A5-2,						
A5-3,	T2						
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)							
Non-Volatile Leach: 7 day HT(e.g. Nitrite and Nitrate as N, Nitrate etc..)							
WR1-ALS,	WR3-ALS	20-Aug-2024	14-Aug-2024	**6**	----	----	----
Non-Volatile Leach: 7 day HT(e.g. Nitrite and Nitrate as N, Nitrate etc..)							
T1-ALS,	TC1-ALS	22-Aug-2024	14-Aug-2024	**8**	----	----	----

Matrix: **WATER**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural							
WR1-ALS,	WR3-ALS	----	----	----	23-Aug-2024	20-Aug-2024	**3**
Clear Plastic Bottle - Natural							
T1-ALS,	TC1-ALS	----	----	----	26-Aug-2024	22-Aug-2024	**4**

Outliers : Frequency of Quality Control Samples

Matrix: **SOIL**

Quality Control Sample Type / Analytical Methods	Method	Count: QC	Count: Regular	Rate (%): Actual	Rate (%): Expected	Quality Control Specification
Laboratory Duplicates (DUP)						
Soil Particle Density	EA152	0	24	0.00	10.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / *Container / Client Sample ID(s)*		*Sample Date*	*Extraction / Preparation*			*Analysis*		
			Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EA001: pH in soil using 0.01M CaCl extract								
Soil Glass Jar - Unpreserved (EA001)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**21-Aug-2024**	14-Aug-2024	×	**21-Aug-2024**	21-Aug-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EA002: pH 1:5 (Soils)								
Soil Glass Jar - Unpreserved (EA002)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**21-Aug-2024**	14-Aug-2024	×	**21-Aug-2024**	21-Aug-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA010: Conductivity (1:5)								
Soil Glass Jar - Unpreserved (EA010)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**21-Aug-2024**	14-Aug-2024	×	**21-Aug-2024**	18-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EA055: Moisture Content (Dried @ 105-110°C)								
Soil Glass Jar - Unpreserved (EA055)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**----**	----	----	**20-Aug-2024**	21-Aug-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EA058: Emerson Aggregate Test								
Soil Glass Jar - Unpreserved (EA058)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**----**	----	----	**21-Aug-2024**	03-Feb-2025	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA150: Particle Sizing								
Plastic Bag (EA150H)								
T1-ALS,	TC1-ALS,	07-Aug-2024	----	----	----	28-Aug-2024	03-Feb-2025	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EA150: Soil Classification based on Particle Size								
Plastic Bag (EA150H)								
T1-ALS,	TC1-ALS,	07-Aug-2024	----	----	----	28-Aug-2024	03-Feb-2025	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EA152: Soil Particle Density								
Plastic Bag (EA152)								
T1-ALS,	TC1-ALS,	07-Aug-2024	----	----	----	28-Aug-2024	03-Feb-2025	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED005: Exchange Acidity								
Soil Glass Jar - Unpreserved (ED005)								
B1-ALS,	A2-1	**07-Aug-2024**	**21-Aug-2024**	04-Sep-2024	✓	**22-Aug-2024**	04-Sep-2024	✓
Soil Glass Jar - Unpreserved (ED005)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**22-Aug-2024**	04-Sep-2024	✓	**22-Aug-2024**	04-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
DC-ALS,	DC2-ALS,							
TS1-ALS,	TS2-ALS,							
A1-1,	A1-2,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
ED006: Exchangeable Cations on Alkaline Soils								
Soil Glass Jar - Unpreserved (ED006)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**21-Aug-2024**	04-Sep-2024	✓	**23-Aug-2024**	04-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
DC-ALS,	DC2-ALS,							
TS1-ALS,	TS2-ALS,							
A1-1,	A1-2,							
A2-2,	A2-3,							
A3-1,	A3-2							
Soil Glass Jar - Unpreserved (ED006)								
A3-3,	A4-1,	**07-Aug-2024**	**21-Aug-2024**	04-Sep-2024	✓	**26-Aug-2024**	04-Sep-2024	✓
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
Soil Glass Jar - Unpreserved (ED006)								
B1-ALS,	A2-1	**07-Aug-2024**	**22-Aug-2024**	04-Sep-2024	✓	**22-Aug-2024**	04-Sep-2024	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED007: Exchangeable Cations								
Soil Glass Jar - Unpreserved (ED007)								
B1-ALS,	A2-1	**07-Aug-2024**	**21-Aug-2024**	04-Sep-2024	✓	**22-Aug-2024**	04-Sep-2024	✓
Soil Glass Jar - Unpreserved (ED007)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**22-Aug-2024**	04-Sep-2024	✓	**22-Aug-2024**	04-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
DC-ALS,	DC2-ALS,							
TS1-ALS,	TS2-ALS,							
A1-1,	A1-2,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
ED008: Exchangeable Cations								
Soil Glass Jar - Unpreserved (ED008)								
B1-ALS,	A2-1	**07-Aug-2024**	**21-Aug-2024**	04-Sep-2024	✓	**22-Aug-2024**	04-Sep-2024	✓
Soil Glass Jar - Unpreserved (ED008)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**22-Aug-2024**	04-Sep-2024	✓	**22-Aug-2024**	04-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
DC-ALS,	DC2-ALS,							
TS1-ALS,	TS2-ALS,							
A1-1,	A1-2,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED021: Bicarbonate Extractable Potassium (Colwell)							
Soil Glass Jar - Unpreserved (ED021) A5-1, A5-2, A5-3, T2	**07-Aug-2024**	**22-Aug-2024**	03-Feb-2025	✓	**23-Aug-2024**	03-Feb-2025	✓
Soil Glass Jar - Unpreserved (ED021) T1-ALS, TC1-ALS, WR1-ALS, WR3-ALS, B1-ALS, DC-ALS, DC2-ALS, TS1-ALS, TS2-ALS, A1-1, A1-2, A2-1, A2-2, A2-3, A3-1, A3-2, A3-3, A4-1, A4-2, A4-3	**07-Aug-2024**	**22-Aug-2024**	03-Feb-2025	✓	**27-Aug-2024**	03-Feb-2025	✓
ED045G: Chloride by Discrete Analyser							
Soil Glass Jar - Unpreserved (ED045G) T1-ALS, TC1-ALS, WR1-ALS, WR3-ALS, B1-ALS, DC-ALS, DC2-ALS, TS1-ALS, TS2-ALS, A1-1, A1-2, A2-1, A2-2, A2-3, A3-1, A3-2, A3-3, A4-1, A4-2, A4-3, A5-1, A5-2, A5-3, T2	**07-Aug-2024**	**21-Aug-2024**	04-Sep-2024	✓	**21-Aug-2024**	18-Sep-2024	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED092: DTPA Extractable Metals							
Soil Glass Jar - Unpreserved (ED092) A5-1, A5-2, A5-3, T2	**07-Aug-2024**	**22-Aug-2024**	03-Feb-2025	✓	**26-Aug-2024**	03-Feb-2025	✓
Soil Glass Jar - Unpreserved (ED092) T1-ALS, TC1-ALS, WR1-ALS, WR3-ALS, B1-ALS, DC-ALS, DC2-ALS, TS1-ALS, TS2-ALS, A1-1, A1-2, A2-1, A2-2, A2-3, A3-1, A3-2, A3-3, A4-1, A4-2, A4-3	**07-Aug-2024**	**23-Aug-2024**	03-Feb-2025	✓	**26-Aug-2024**	03-Feb-2025	✓
EG005(ED093)T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T) T1-ALS, TC1-ALS, WR1-ALS, WR3-ALS, B1-ALS, DC-ALS, DC2-ALS, TS1-ALS, TS2-ALS, A1-1, A1-2, A2-1, A2-2, A2-3, A3-1, A3-2, A3-3, A4-1, A4-2, A4-3, A5-1, A5-2, A5-3, T2	**07-Aug-2024**	**20-Aug-2024**	03-Feb-2025	✓	**20-Aug-2024**	03-Feb-2025	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG035T: Total Recoverable Mercury by FIMS								
Soil Glass Jar - Unpreserved (EG035T)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**20-Aug-2024**	04-Sep-2024	✓	**21-Aug-2024**	04-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EK055-P: Ammonia as N								
Soil Glass Jar - Unpreserved (EK055-P)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**----**	----	----	**20-Aug-2024**	04-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EK057G: Nitrite as N by Discrete Analyser								
Soil Glass Jar - Unpreserved (EK057G)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**21-Aug-2024**	14-Aug-2024	×	**21-Aug-2024**	23-Aug-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Soil Glass Jar - Unpreserved (EK059G)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**21-Aug-2024**	04-Sep-2024	✓	**21-Aug-2024**	23-Aug-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Soil Glass Jar - Unpreserved (EK061G)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**20-Aug-2024**	04-Sep-2024	✓	**22-Aug-2024**	17-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EK067G: Total Phosphorus as P by Discrete Analyser								
Soil Glass Jar - Unpreserved (EK067G)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**20-Aug-2024**	04-Sep-2024	✓	**22-Aug-2024**	17-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Soil Glass Jar - Unpreserved (EK080)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**22-Aug-2024**	03-Feb-2025	✓	**27-Aug-2024**	03-Feb-2025	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Non-Volatile Leach: 7 day HT(e.g. Nitrite and Nitrate as N, Nitrate etc..) (EN60a-G)								
WR1-ALS,	WR3-ALS	**07-Aug-2024**	**20-Aug-2024**	14-Aug-2024	×	**----**	----	----
Non-Volatile Leach: 7 day HT(e.g. Nitrite and Nitrate as N, Nitrate etc..) (EN60a-G)								
T1-ALS,	TC1-ALS	**07-Aug-2024**	**22-Aug-2024**	14-Aug-2024	×	**----**	----	----
EP004: Organic Matter								
Soil Glass Jar - Unpreserved (EP004)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**26-Aug-2024**	04-Sep-2024	✓	**26-Aug-2024**	04-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA005P: pH by PC Titrator								
Clear Plastic Bottle - Natural (EA005-P)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	**----**	**23-Aug-2024**	20-Aug-2024	×
Clear Plastic Bottle - Natural (EA005-P)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	**----**	**26-Aug-2024**	22-Aug-2024	×

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Clear Plastic Bottle - Natural (EA015H)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**24-Aug-2024**	27-Aug-2024	✓
Clear Plastic Bottle - Natural (EA015H)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	----	**26-Aug-2024**	29-Aug-2024	✓
ED009: Anions								
Clear Plastic Bottle - Natural (ED009-X)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**22-Aug-2024**	17-Sep-2024	✓
ED037P: Alkalinity by PC Titrator								
Clear Plastic Bottle - Natural (ED037-P)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**23-Aug-2024**	03-Sep-2024	✓
Clear Plastic Bottle - Natural (ED037-P)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	----	**26-Aug-2024**	05-Sep-2024	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Clear Plastic Bottle - Natural (ED041G)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**22-Aug-2024**	17-Sep-2024	✓
Clear Plastic Bottle - Natural (ED041G)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	----	**24-Aug-2024**	19-Sep-2024	✓
ED045G: Chloride by Discrete Analyser								
Clear Plastic Bottle - Natural (ED045G)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**22-Aug-2024**	17-Sep-2024	✓
Clear Plastic Bottle - Natural (ED045G)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	----	**24-Aug-2024**	19-Sep-2024	✓
ED093C: Leachable Major Cations								
Clear Plastic Bottle - Natural (ED093C)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**23-Aug-2024**	27-Aug-2024	✓	**24-Aug-2024**	27-Aug-2024	✓
Clear Plastic Bottle - Nitric Acid; Unfiltered (ED093C)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**26-Aug-2024**	19-Sep-2024	✓	**26-Aug-2024**	19-Sep-2024	✓
EG005(ED093)C: Leachable Metals by ICPAES								
Clear Plastic Bottle - Natural (EG005C)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**23-Aug-2024**	16-Feb-2025	✓	**23-Aug-2024**	16-Feb-2025	✓
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG005C)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**26-Aug-2024**	18-Feb-2025	✓	**26-Aug-2024**	18-Feb-2025	✓
EG035C: Leachable Mercury by FIMS								
Clear Plastic Bottle - Natural (EG035C)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**23-Aug-2024**	17-Sep-2024	✓
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035C)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	----	**26-Aug-2024**	19-Sep-2024	✓
EK040P: Fluoride by PC Titrator								
Clear Plastic Bottle - Natural (EK040P)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**23-Aug-2024**	17-Sep-2024	✓
Clear Plastic Bottle - Natural (EK040P)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	----	**26-Aug-2024**	19-Sep-2024	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK055G: Ammonia as N by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK055G)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**26-Aug-2024**	17-Sep-2024	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	----	**26-Aug-2024**	19-Sep-2024	✓
EK057G: Nitrite as N by Discrete Analyser								
Clear Plastic Bottle - Natural (EK057G)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**22-Aug-2024**	22-Aug-2024	✓
Clear Plastic Bottle - Natural (EK057G)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	----	**24-Aug-2024**	24-Aug-2024	✓
EK071G: Reactive Phosphorus as P by discrete analyser								
Clear Plastic Bottle - Natural (EK071G)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**22-Aug-2024**	22-Aug-2024	✓
Clear Plastic Bottle - Natural (EK071G)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	----	**24-Aug-2024**	24-Aug-2024	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Ammonia Using Steam Distillation and Titrimetric Finish	EK055-P	3	27	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Bicarbonate Extractable K (Colwell)	ED021	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Bicarbonate Extractable P (Colwell)	EK080	4	32	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
DTPA Extractable Metals	ED092	4	32	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations on Alkaline Soils	ED006	3	28	**10.71**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	4	32	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH (1:5)	EA002	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH in soil using a 0.01M CaCl2 extract	EA001	3	25	**12.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Soil Particle Density	EA152	0	24	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	3	29	**10.34**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	4	33	**12.12**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus By Discrete Analyser	EK067G	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Ammonia Using Steam Distillation and Titrimetric Finish	EK055-P	2	27	**7.41**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Bicarbonate Extractable K (Colwell)	ED021	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Bicarbonate Extractable P (Colwell)	EK080	6	32	**18.75**	**15.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	4	24	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
DTPA Extractable Metals	ED092	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations on Alkaline Soils	ED006	2	28	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH (1:5)	EA002	4	24	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH in soil using a 0.01M CaCl2 extract	EA001	4	25	**16.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Soil Particle Density	EA152	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Control Samples (LCS) - Continued							
TKN as N By Discrete Analyser	EK061G	4	24	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus By Discrete Analyser	EK067G	4	24	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia Using Steam Distillation and Titrimetric Finish	EK055-P	2	27	**7.41**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
ASLP for Non & Semivolatile Analytes - Glass Leaching Vessel	EN60a-G	2	4	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Bicarbonate Extractable K (Colwell)	ED021	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Bicarbonate Extractable P (Colwell)	EK080	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
DTPA Extractable Metals	ED092	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations on Alkaline Soils	ED006	2	28	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus By Discrete Analyser	EK067G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia Using Steam Distillation and Titrimetric Finish	EK055-P	2	27	**7.41**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Bicarbonate Extractable P (Colwell)	EK080	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus By Discrete Analyser	EK067G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by Auto Titrator	ED037-P	4	32	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP) - Continued							
Ammonia as N by Discrete analyser	EK055G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	4	25	**16.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Major Cations	ED093C	2	4	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	3	19	**15.79**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	4	33	**12.12**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	4	31	**12.90**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by Auto Titrator	EA005-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	2	4	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	4	29	**13.79**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	3	28	**10.71**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by Auto Titrator	ED037-P	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	4	13	**30.77**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	2	25	**8.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Major Cations	ED093C	2	4	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	2	19	**10.53**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	31	**6.45**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by Auto Titrator	EA005-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	13	**15.38**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	4	29	**13.79**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	6	28	**21.43**	**15.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	13	**15.38**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	2	25	**8.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Major Cations	ED093C	2	4	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	2	19	**10.53**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	31	**6.45**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	13	**15.38**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	28	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Matrix Spikes (MS) - Continued							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	13	**15.38**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	2	25	**8.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	2	19	**10.53**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	31	**6.45**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	13	**15.38**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH in soil using a 0.01M CaCl2 extract	EA001	SOIL	In house: Referenced to Rayment and Lyons 4B3 (mod.) or 4B4 (mod.) 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM Schedule B(3).
pH (1:5)	EA002	SOIL	In house: Referenced to Rayment and Lyons 4A1 and APHA 4500H+. pH is determined on soil samples after a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
pH by Auto Titrator	EA005-P	SOIL	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM Schedule B(3)
Electrical Conductivity (1:5)	EA010	SOIL	In house: Referenced to Rayment and Lyons 3A1 and APHA 2510. Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
Total Dissolved Solids (High Level)	EA015H	SOIL	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM Schedule B(3)
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM Schedule B(3).
Emerson Aggregate Test	EA058	SOIL	In house: Referenced to AS1289.3.8.1. Testing is performed only on soils with suitable aggregates; sands and gravels are usually unsuitable for this test. The test classifies the behaviour of soil aggregates, when immersed, on their coherence in water.
Particle Size Analysis by Hydrometer	EA150H	SOIL	Particle Size Analysis by Hydrometer according to AS1289.3.6.3
Soil Particle Density	EA152	SOIL	Soil Particle Density by AS 1289.3.5.1: Methods of testing soils for engineering purposes - Soil classification tests - Determination of the soil particle density of a soil - Standard method
Exchange Acidity by 1M Potassium Chloride	* ED005	SOIL	In house: referenced to Rayment and Lyons, method 15G1. This method is unsuitable for near neutral and alkaline soils. NATA accreditation does not cover performance of this service.
Exchangeable Cations on Alkaline Soils	* ED006	SOIL	In house: Referenced to Soil Survey Test Method C5. Soluble salts are removed from the sample prior to analysis. Cations are exchanged from the sample by contact with alcoholic ammonium chloride at pH 8.5. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil.
Exchangeable Cations	ED007	SOIL	In house: Referenced to Rayment & Lyons Method 15A1. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM Schedule B(3).
Exchangeable Cations with pre-treatment	ED008	SOIL	In house: Referenced to Rayment & Lyons Method 15A2. Soluble salts are removed from the sample prior to analysis. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM Schedule B(3).
Standard Anions -by IC (Extended Method)	ED009-X	SOIL	In house: Referenced to APHA 4110B. This method is compliant with NEPM Schedule B(3)
Bicarbonate Extractable K (Colwell)	ED021	SOIL	In house: Referenced to Rayment & Lyons Method 18A1 Potassium is extracted from the soil using 0.5M NaHCO3 at a 1:100 soil:solution ratio and determined by ICP.

Analytical Methods	Method	Matrix	Method Descriptions
Alkalinity by Auto Titrator	ED037-P	SOIL	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	SOIL	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	SOIL	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm.
DTPA Extractable Metals	* ED092	SOIL	In house: Referenced to Rayment and Lyons 12A1
Leachable Major Cations	ED093C	SOIL	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations in leachates are determined by either ICP-AES or ICP-MS techniques.
Leachable Metals by ICPAES	EG005C	SOIL	In house: referenced to APHA 3120; USEPA SW 846 - 6010: The ICPAES technique ionises leachate sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM Schedule B(3).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3)
Leachable Mercury by FIMS	EG035C	SOIL	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the TCLP solution. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl2) (Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3)
Fluoride by Auto Titrator	EK040P	SOIL	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	SOIL	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Ammonia Using Steam Distillation and Titrimetric Finish	EK055-P	SOIL	In house: Referenced to APHA 4500-NH3 B&G, H Samples are steam distilled prior to analysis and quantified using titration, FIA or Discrete Analyser.
Nitrite as N - Soluble by Discrete Analyser	EK057G	SOIL	In house: Referenced to APHA 4500-NO3- B. Nitrite in a water extract is determined by direct colourimetry by Discrete Analyser.

Analytical Methods	Method	Matrix	Method Descriptions
Nitrate as N - Soluble by Discrete Analyser	EK058G	SOIL	In house: Referenced to APHA 4500-NO3- F. Nitrate in the 1:5 soil:water extract is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results.
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	SOIL	In house: Thermo Scientific Method D08727 and NEMI (National Environmental Method Index) Method ID: 9171. This method covers the determination of total oxidised nitrogen (NOx-N) and nitrate (NO3-N) by calculation, Combined oxidised Nitrogen (NO2+NO3) in a water extract is determined by direct colourimetry by Discrete Analyser.
TKN as N By Discrete Analyser	EK061G	SOIL	In house: Referenced to APHA 4500-Norg-D Soil samples are digested using Kjeldahl digestion followed by determination by Discrete Analyser.
Total Nitrogen as N (TKN + NOx) By Discrete Analyser	EK062G	SOIL	In house: Referenced to APHA 4500 Norg/NO3- Total Nitrogen is determined as the sum of TKN and Oxidised Nitrrogen, each determined seperately as N.
Total Phosphorus By Discrete Analyser	EK067G	SOIL	In house: Referenced to APHA 4500 P-B&F This procedure involves sulfuric acid digestion and quantification using Discrete Analyser.
Reactive Phosphorus as P-By Discrete Analyser	EK071G	SOIL	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Bicarbonate Extractable P (Colwell)	EK080	SOIL	In house: Referenced to Rayment & Lyons Method 9B1 Phosphorus is extracted from the soil using 0.5M NaHCO3 at a 1:100 soil:solution ratio and determined by FIA.
Organic Matter	EP004	SOIL	In house: Referenced to AS1289.4.1.1. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
pH in soil using a 0.01M CaCl2 extract	EA001-PR	SOIL	In house: Referenced to Rayment and Lyons 4B1, 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM Schedule B(3).
Exchangeable Cations Preparation Method (Alkaline Soils)	* ED006PR	SOIL	In house: Referenced to Rayment and Lyons method 15C1.
Exchangeable Cations Preparation Method	ED007PR	SOIL	In house: Referenced to Rayment & Lyons method 15A1. A 1M NH4Cl extraction by end over end tumbling at a ratio of 1:20. There is no pretreatment for soluble salts. Extracts can be run by ICP for cations.
Bicarbonate Extractable K (Colwell)	ED021PR	SOIL	In house: Referenced to Rayment & Lyons Method 18A1 Potassium is extracted from the soil using 0.5M NaHCO3 at a 1:100 soil:solution ratio and determined by ICP.
DTPA Extraction for Cu, Zn, Mn, Fe (2 hour leach)	ED092PR	SOIL	In house: Referenced to Rayment & Lyons Method 12A1 2 hour end over end tumbler extraction with 0.005M DTPA at a ratio of 1:2. Extracts can be run by ICP for metals.
TKN/TP Digestion	EK061/EK067	SOIL	In house: Referenced to APHA 4500 Norg- D; APHA 4500 P - H. Macro Kjeldahl digestion.
Sample Preparation for Bicarbonate Extractable P (Colwell)	EK080-PR	SOIL	In house: Referenced to Rayment & Lyons Method 9B1 Phosphorus is extracted from the soil using 0.5M NaHCO3 at a 1:100 soil:solution ratio.
Digestion for Total Recoverable Metals in TCLP Leachate	EN25C	SOIL	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
ASLP for Non & Semivolatile Analytes - Glass Leaching Vessel	EN60a-G	SOIL	In house QWI-EN/60 referenced to AS4439.3 Preparation of Leachates
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM Schedule B(3).
Organic Matter	EP004-PR	SOIL	In house: Referenced to AS1289.4.1.1. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM Schedule B(3).

Certificate of Analysis

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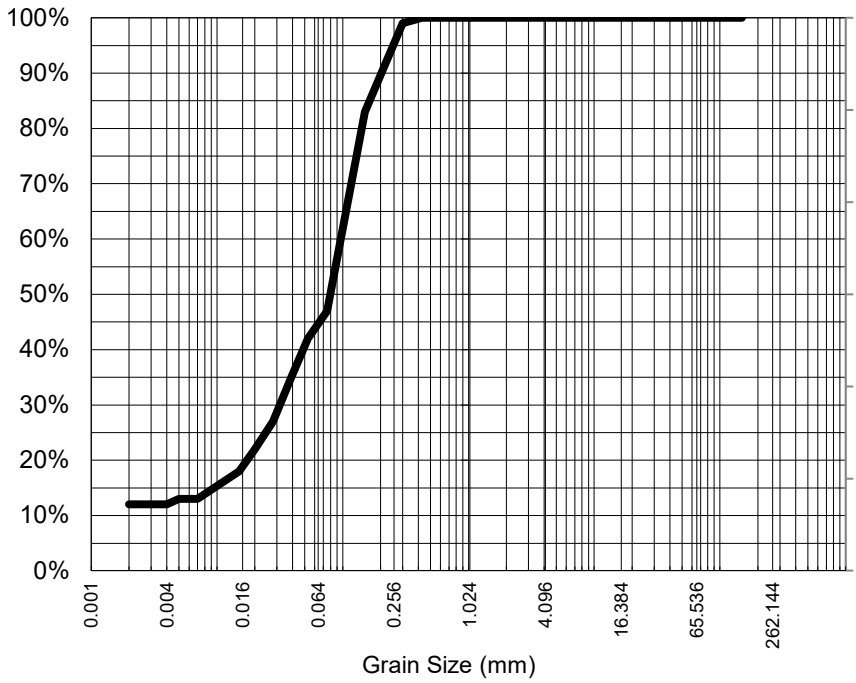
pH 07 3243 7222
samples.brisbane@alsenviro.com

ALS Environmental

Brisbane QLD

CLIENT:	Matt Braimbridge	**DATE REPORTED:**	28-Aug-2024
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-001 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	T1-ALS

Particle Size Distribution



Particle Size (mm)	% Passing
0.425	100%
0.300	99%
0.150	83%
0.075	47%
Particle Size (microns)	
53	42%
39	35%
28	27%
20	22%
15	18%
11	16%
7	13%
5	13%
2	12%

Median Particle Size (mm)*	0.081

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.67

NATA Accreditation: 825 Site: Brisbane
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NATA
WORLD RECOGNISED ACCREDITATION

Satish Trivedi
Soil Senior Chemist
Authorised Signatory

Certificate of Analysis

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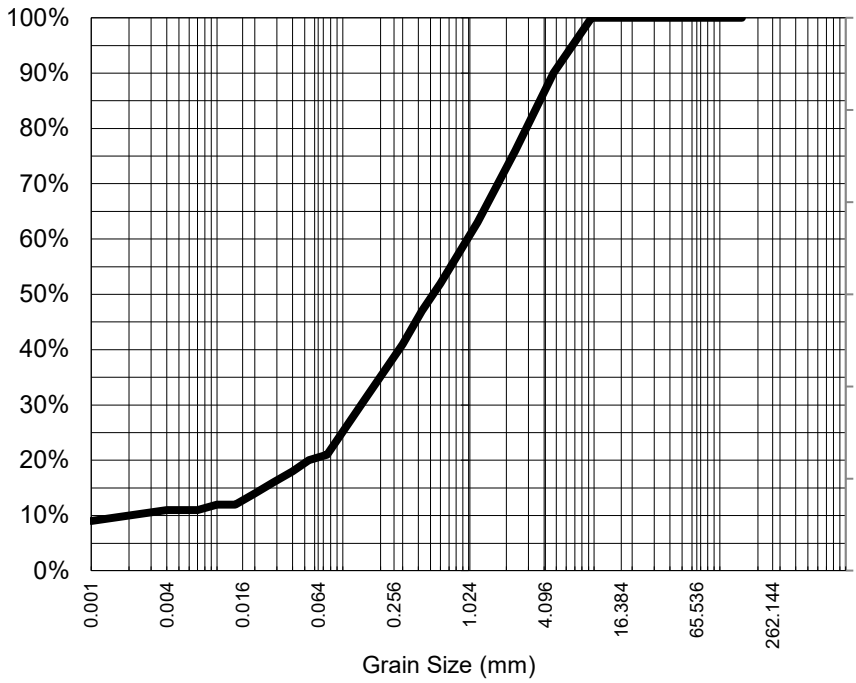
ALS Environmental

Brisbane QLD

CLIENT:	Matt Braimbridge	**DATE REPORTED:**	28-Aug-2024
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-002 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	TC1-ALS

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	90%
2.36	76%
1.18	63%
0.600	52%
0.425	47%
0.300	41%
0.150	31%
0.075	21%
Particle Size (microns)	
54	20%
40	18%
28	16%
20	14%
14	12%
10	12%
7	11%
5	11%
1	9%

Median Particle Size (mm)*	0.530

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.75

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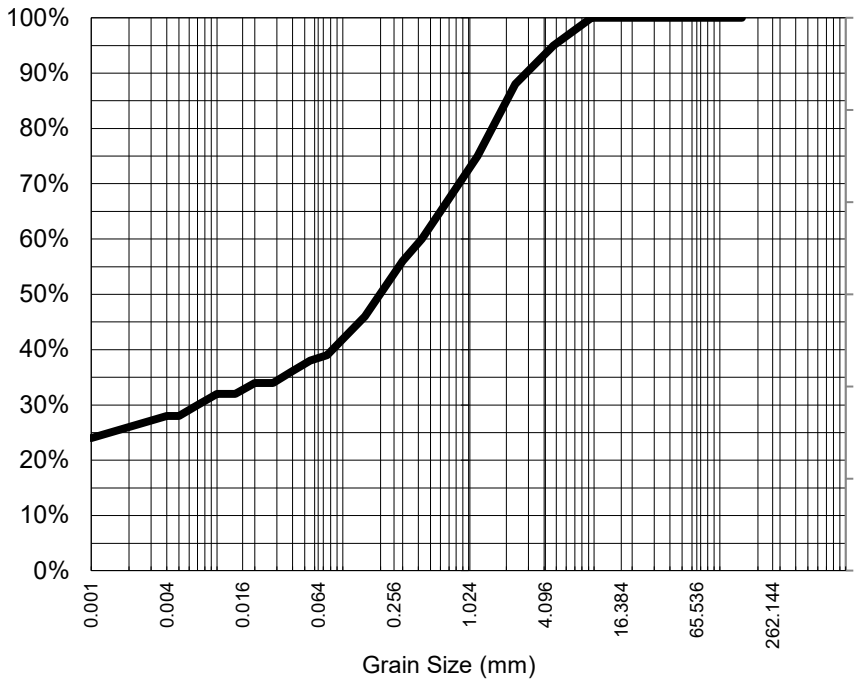
ALS Environmental

Brisbane QLD

CLIENT:	Matt Braimbridge	**DATE REPORTED:**	28-Aug-2024
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-003 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	WR1-ALS

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	95%
2.36	88%
1.18	75%
0.600	65%
0.425	60%
0.300	56%
0.150	46%
0.075	39%
Particle Size (microns)	
55	38%
39	36%
28	34%
20	34%
14	32%
10	32%
7	30%
5	28%
1	24%

Median Particle Size (mm)*	0.210

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.68

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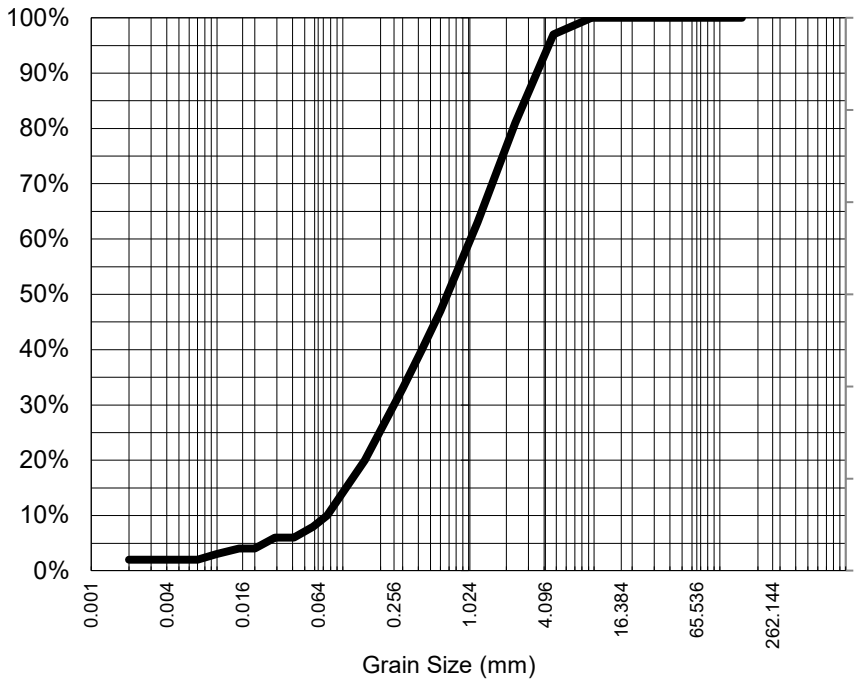
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-004 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	WR3-ALS

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	97%
2.36	81%
1.18	63%
0.600	47%
0.425	40%
0.300	33%
0.150	20%
0.075	10%
Particle Size (microns)	
58	8%
41	6%
29	6%
20	4%
15	4%
10	3%
7	2%
5	2%
2	2%

Median Particle Size (mm)*	0.709

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.66

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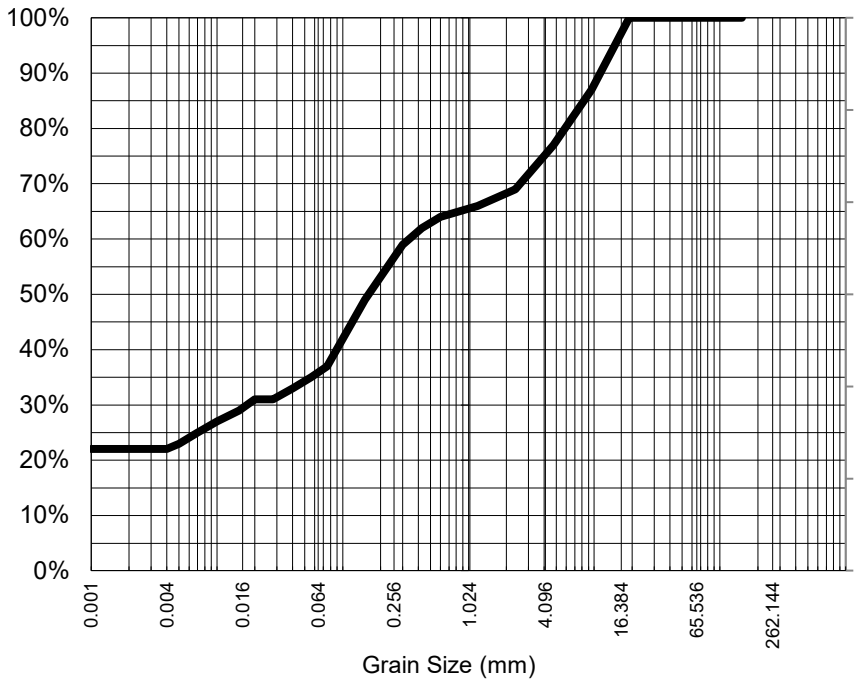
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-005 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	B1-ALS

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	87%
4.75	77%
2.36	69%
1.18	66%
0.600	64%
0.425	62%
0.300	59%
0.150	49%
0.075	37%
Particle Size (microns)	
56	35%
40	33%
28	31%
20	31%
15	29%
10	27%
7	25%
5	23%
1	22%

Median Particle Size (mm)*	0.165

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.6

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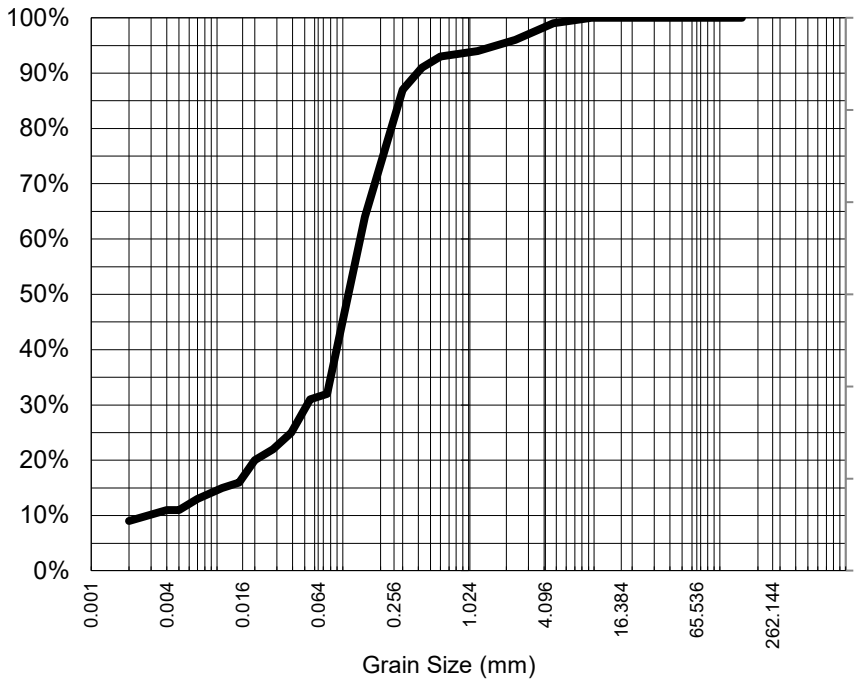
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-006 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	DC-ALS

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	99%
2.36	96%
1.18	94%
0.600	93%
0.425	91%
0.300	87%
0.150	64%
0.075	32%
Particle Size (microns)	
55	31%
39	25%
28	22%
20	20%
15	16%
11	15%
7	13%
5	11%
2	9%

Median Particle Size (mm)*	0.117

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.68

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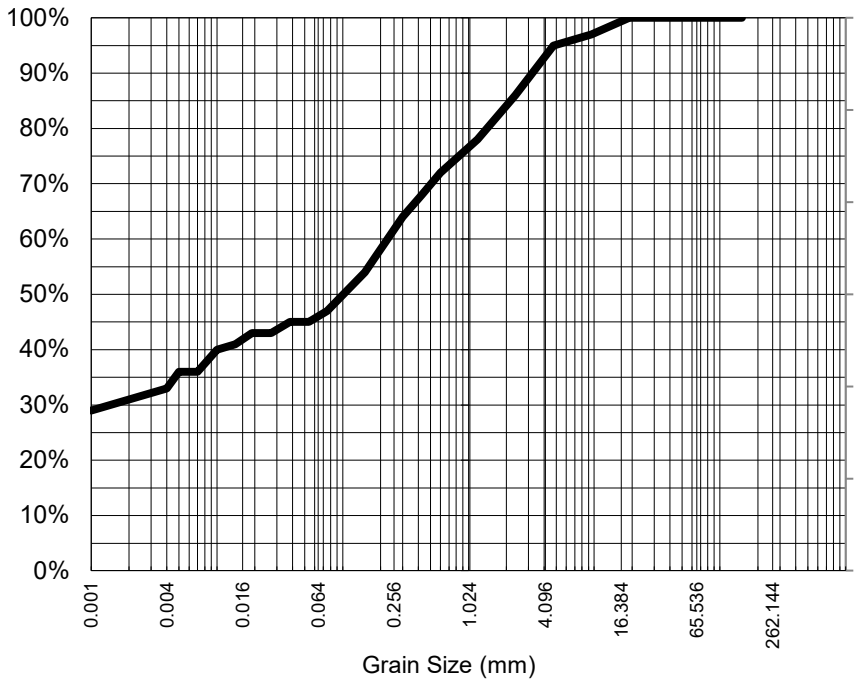
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-007 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	DC2-ALS

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	97%
4.75	95%
2.36	86%
1.18	78%
0.600	72%
0.425	68%
0.300	64%
0.150	54%
0.075	47%
Particle Size (microns)	
54	45%
38	45%
27	43%
19	43%
14	41%
10	40%
7	36%
5	36%
1	29%

Median Particle Size (mm)*	0.107

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.64

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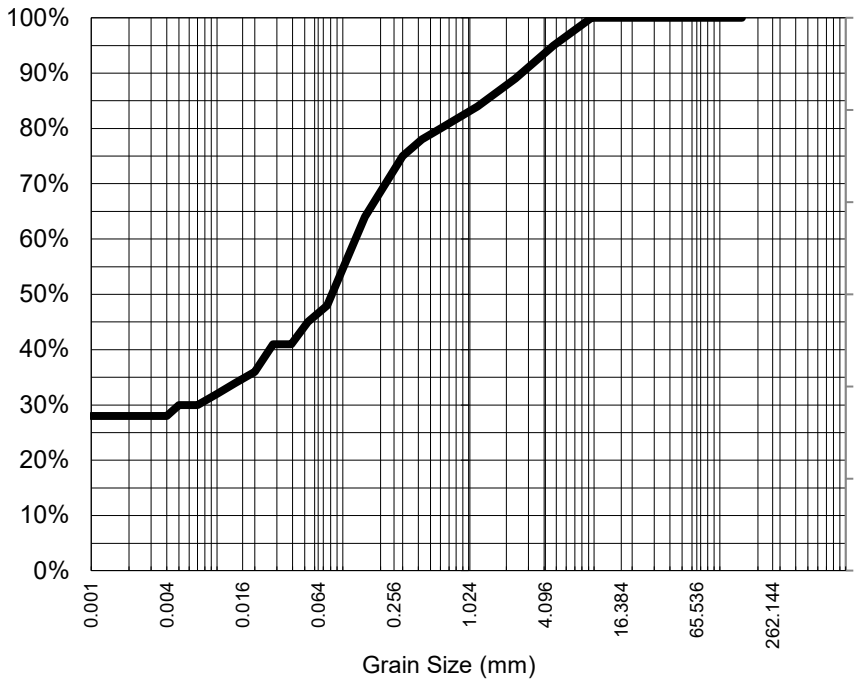
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-008 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	TS1-ALS

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	95%
2.36	89%
1.18	84%
0.600	80%
0.425	78%
0.300	75%
0.150	64%
0.075	48%
Particle Size (microns)	
53	45%
39	41%
28	41%
20	36%
14	34%
10	32%
7	30%
5	30%
1	28%

Median Particle Size (mm)*	0.084

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.65

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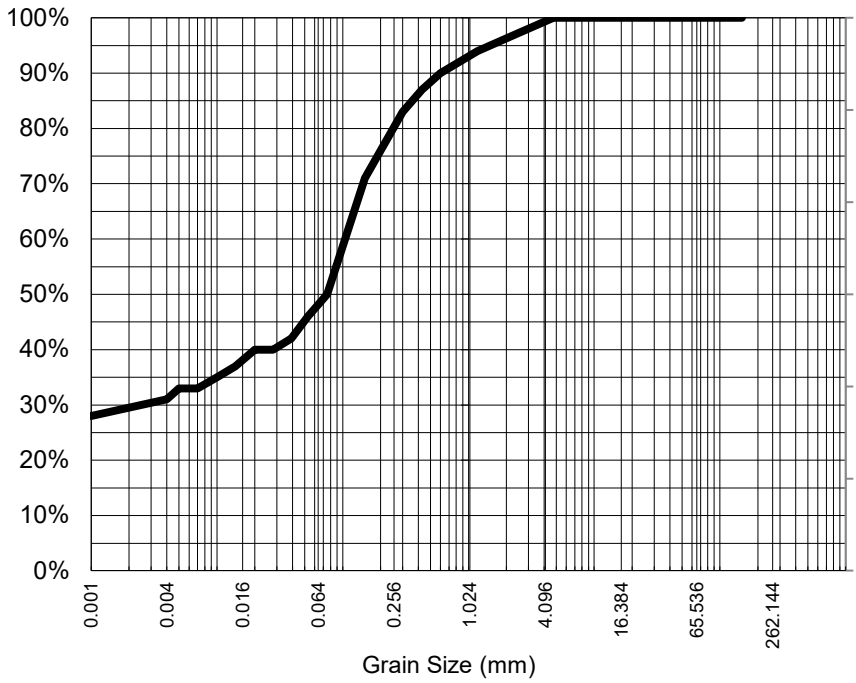
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-009 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	TS2-ALS

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	97%
1.18	94%
0.600	90%
0.425	87%
0.300	83%
0.150	71%
0.075	50%
Particle Size (microns)	
53	46%
39	42%
28	40%
20	40%
14	37%
10	35%
7	33%
5	33%
1	28%

Median Particle Size (mm)*	0.075

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.67

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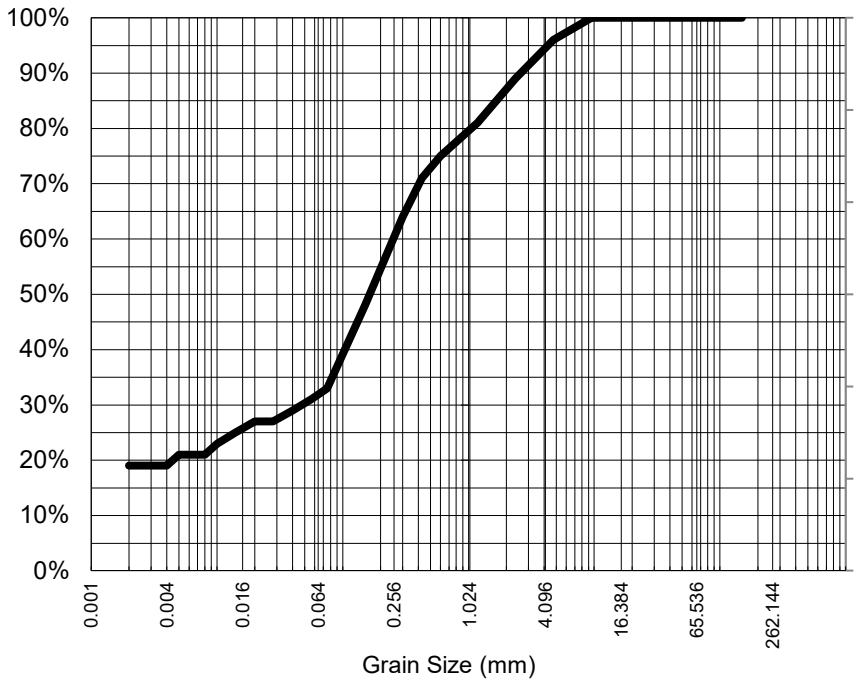
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-010 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A1-1

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	96%
2.36	89%
1.18	81%
0.600	75%
0.425	71%
0.300	64%
0.150	48%
0.075	33%
Particle Size (microns)	
56	31%
40	29%
28	27%
20	27%
14	25%
10	23%
8	21%
5	21%
2	19%

Median Particle Size (mm)*	0.169

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.64

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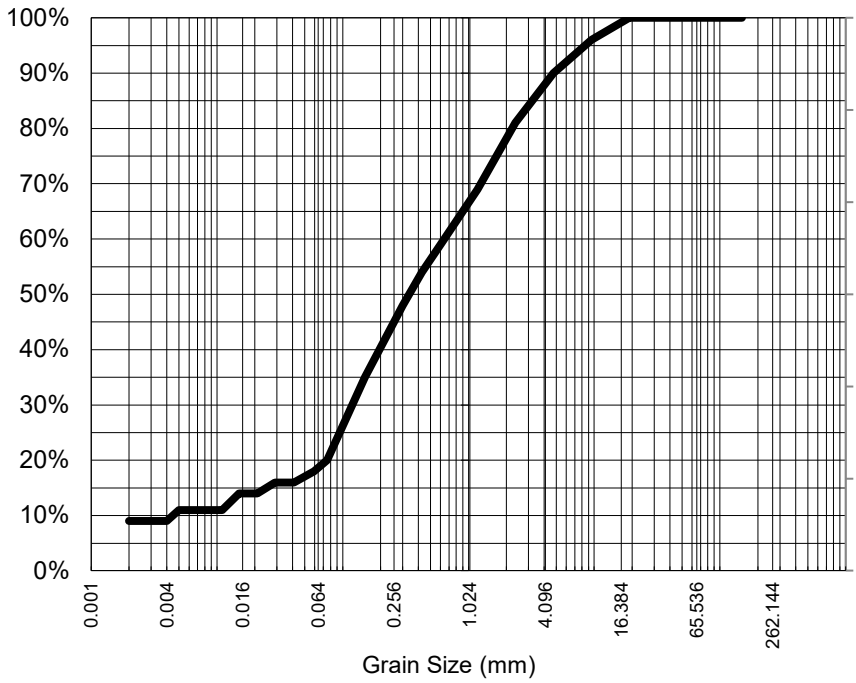
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-011 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A1-2

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	96%
4.75	90%
2.36	81%
1.18	69%
0.600	59%
0.425	54%
0.300	48%
0.150	35%
0.075	20%
Particle Size (microns)	
59	18%
41	16%
29	16%
21	14%
15	14%
11	11%
8	11%
5	11%
2	9%

Median Particle Size (mm)*	0.342

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.61

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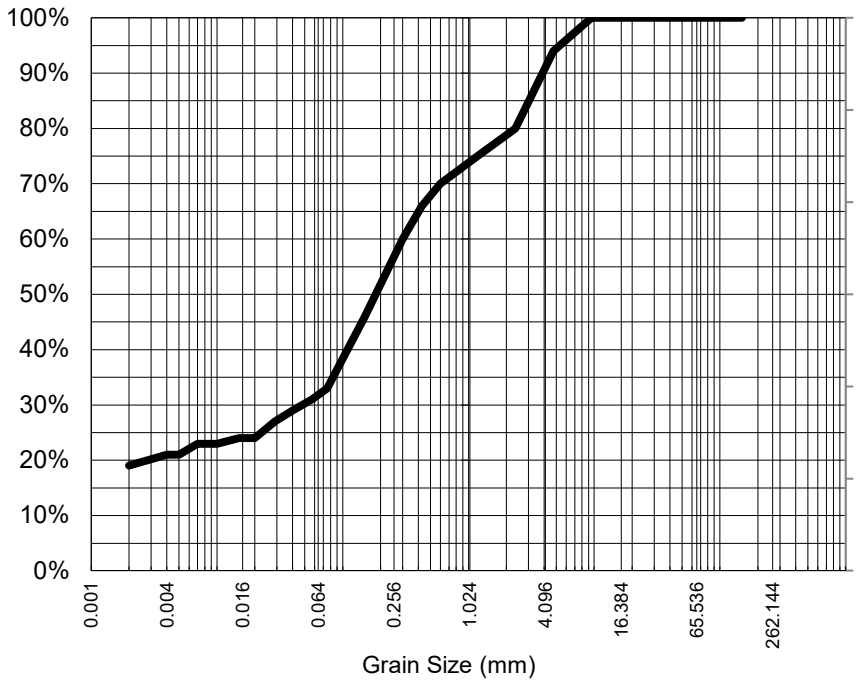
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-012 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A2-1

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	94%
2.36	80%
1.18	75%
0.600	70%
0.425	66%
0.300	60%
0.150	46%
0.075	33%
Particle Size (microns)	
57	31%
40	29%
29	27%
20	24%
15	24%
10	23%
7	23%
5	21%
2	19%

Median Particle Size (mm)*	0.193

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.57

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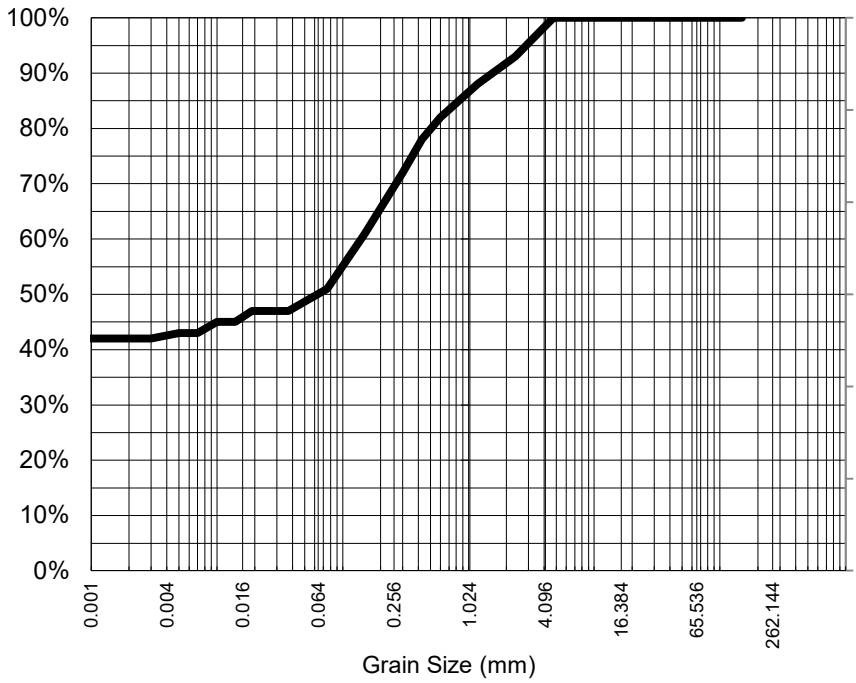
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-013 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A2-2

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	93%
1.18	88%
0.600	82%
0.425	78%
0.300	72%
0.150	61%
0.075	51%
Particle Size (microns)	
53	49%
37	47%
27	47%
19	47%
14	45%
10	45%
7	43%
5	43%
1	42%

Median Particle Size (mm)*	0.064

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.64

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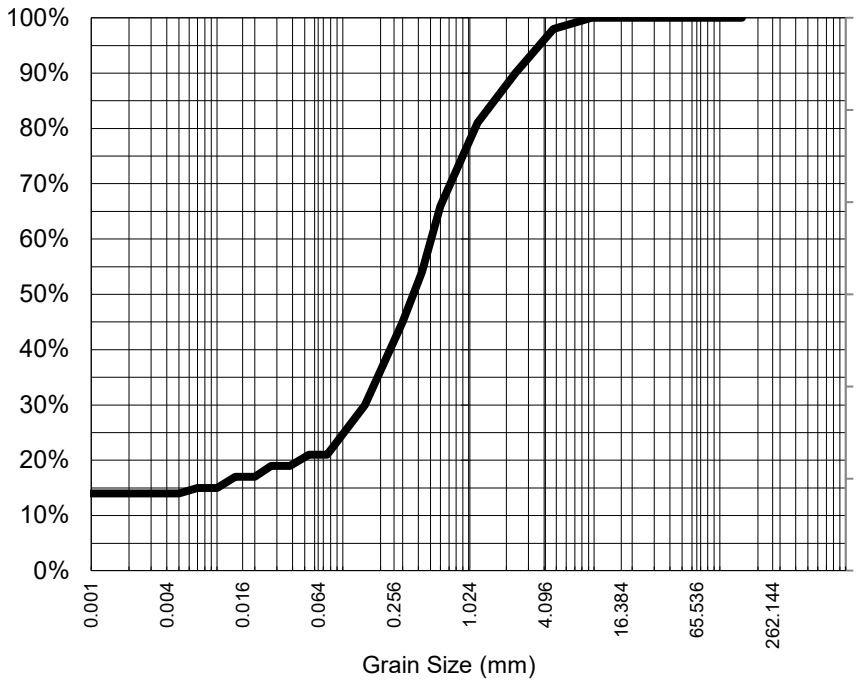
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-014 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A2-3

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	98%
2.36	90%
1.18	81%
0.600	66%
0.425	54%
0.300	45%
0.150	30%
0.075	21%
Particle Size (microns)	
54	21%
38	19%
27	19%
20	17%
14	17%
10	15%
7	15%
5	14%
1	14%

Median Particle Size (mm)*	0.369

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.75

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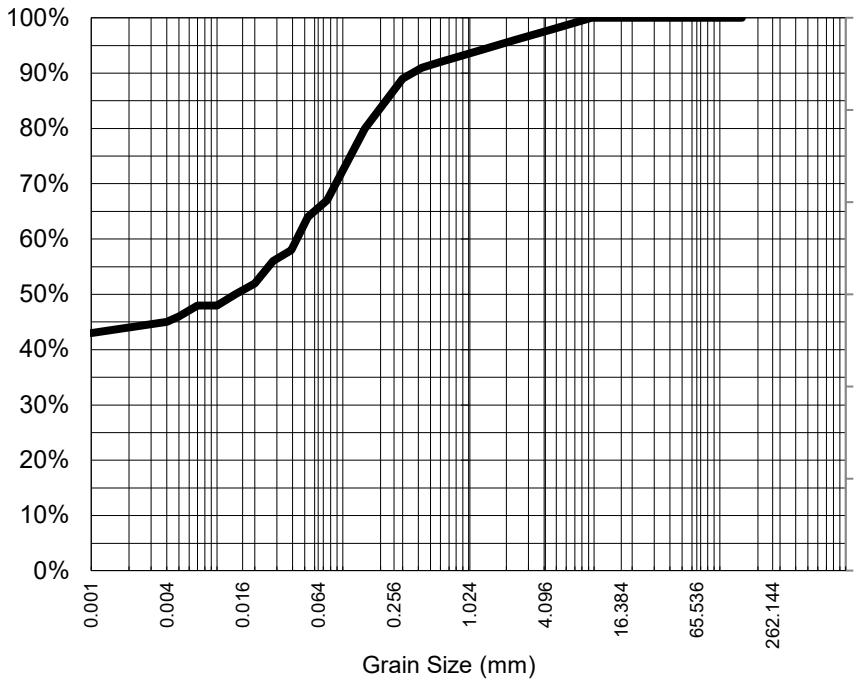
Brisbane QLD

CLIENT:	Matt Braimbridge	**DATE REPORTED:**	28-Aug-2024
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-015 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A3-1

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	98%
2.36	96%
1.18	94%
0.600	92%
0.425	91%
0.300	89%
0.150	80%
0.075	67%
Particle Size (microns)	
53	64%
39	58%
28	56%
20	52%
14	50%
10	48%
7	48%
5	46%
1	43%

Median Particle Size (mm)*	0.014

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.54

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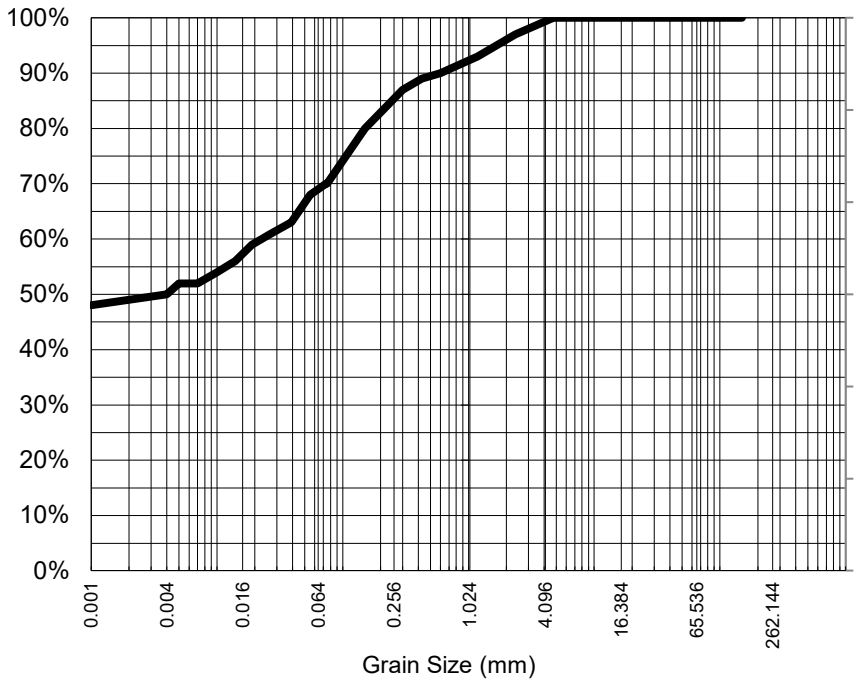
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-016 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A3-2

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	97%
1.18	93%
0.600	90%
0.425	89%
0.300	87%
0.150	80%
0.075	70%
Particle Size (microns)	
55	68%
39	63%
27	61%
19	59%
14	56%
10	54%
7	52%
5	52%
1	48%

Median Particle Size (mm)*	<0.007

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.59

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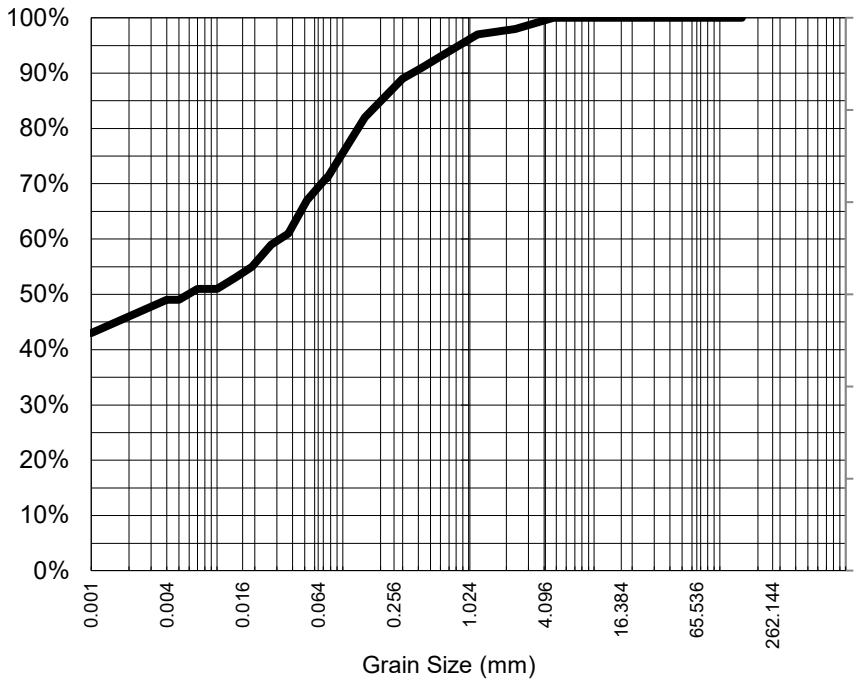
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-017 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A3-3

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	98%
1.18	97%
0.600	93%
0.425	91%
0.300	89%
0.150	82%
0.075	71%
Particle Size (microns)	
52	67%
37	61%
27	59%
19	55%
14	53%
10	51%
7	51%
5	49%
1	43%

Median Particle Size (mm)*	<0.007

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.57

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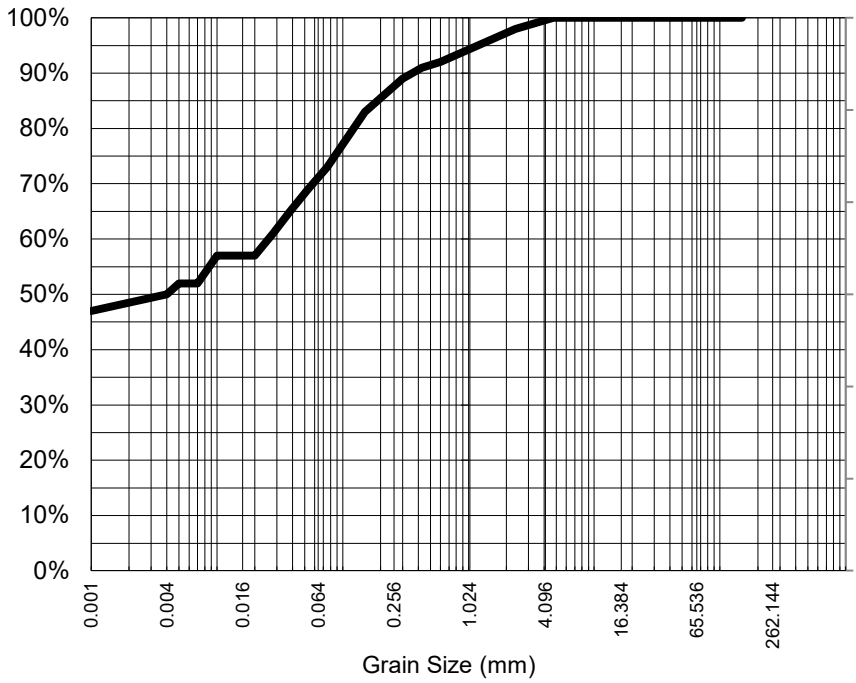
CLIENT:	Matt Braimbridge	**DATE REPORTED:**	28-Aug-2024
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-018 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A4-1

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	98%
1.18	95%
0.600	92%
0.425	91%
0.300	89%
0.150	83%
0.075	73%
Particle Size (microns)	
53	69%
38	65%
28	61%
20	57%
14	57%
10	57%
7	52%
5	52%
1	47%

Median Particle Size (mm)*	<0.007

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.5

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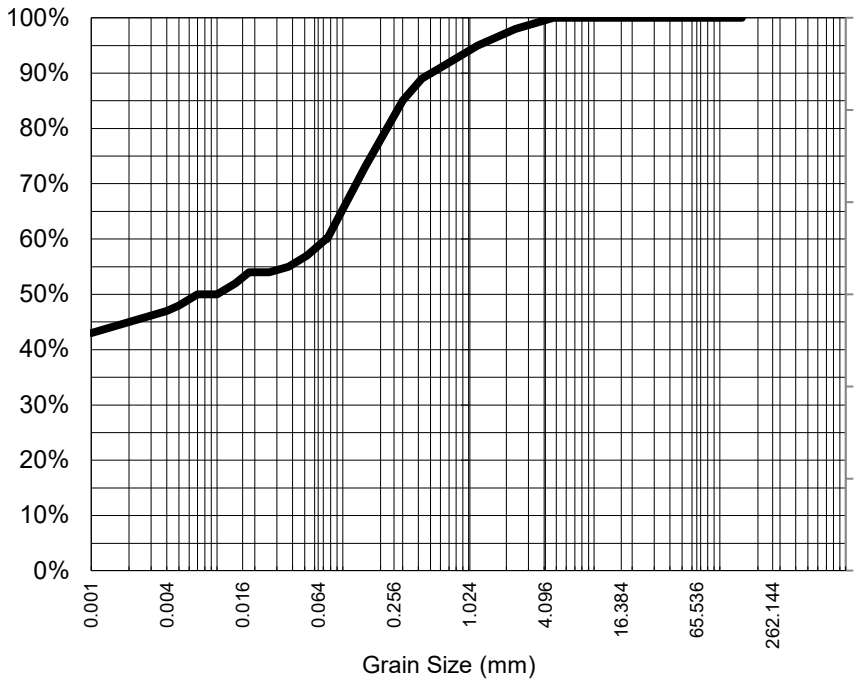
CLIENT:	Matt Braimbridge	**DATE REPORTED:**	28-Aug-2024
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-019 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A4-2

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	98%
1.18	95%
0.600	91%
0.425	89%
0.300	85%
0.150	73%
0.075	60%
Particle Size (microns)	
52	57%
37	55%
26	54%
18	54%
14	52%
10	50%
7	50%
5	48%
1	43%

Median Particle Size (mm)*	0.010

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.55

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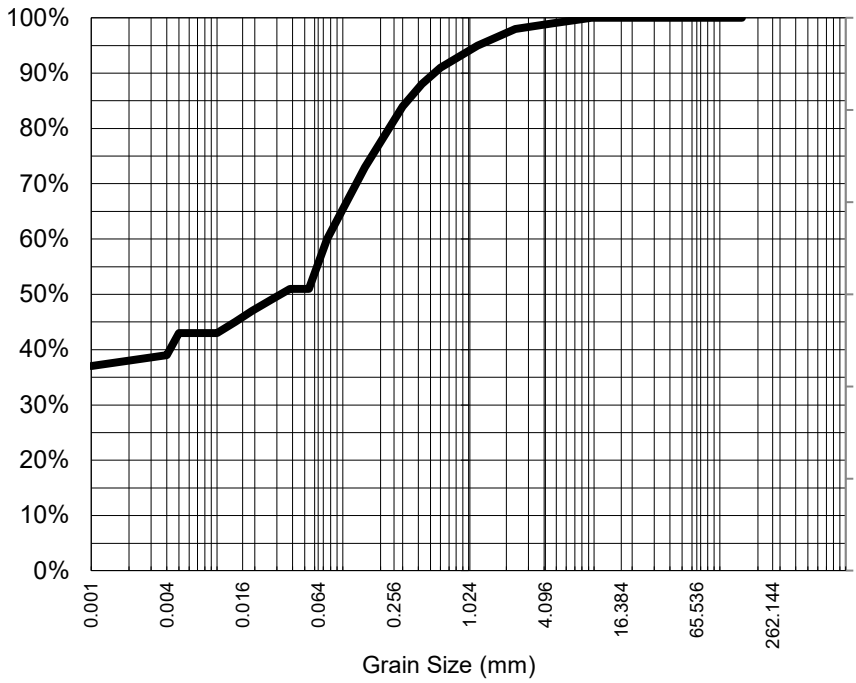
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-020 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A4-3

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	99%
2.36	98%
1.18	95%
0.600	91%
0.425	88%
0.300	84%
0.150	73%
0.075	60%
Particle Size (microns)	
54	51%
38	51%
27	49%
19	47%
14	45%
10	43%
7	43%
5	43%
1	37%

Median Particle Size (mm)*	0.033

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.6

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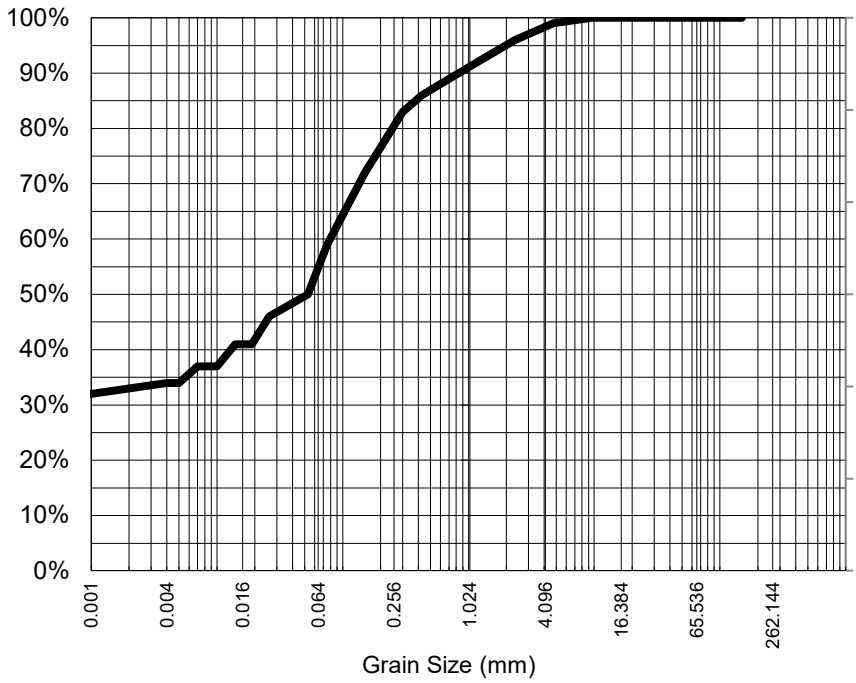
CLIENT:	Matt Braimbridge	**DATE REPORTED:**	28-Aug-2024
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-021 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A5-1

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	99%
2.36	96%
1.18	92%
0.600	88%
0.425	86%
0.300	83%
0.150	72%
0.075	59%
Particle Size (microns)	
53	50%
37	48%
26	46%
19	41%
14	41%
10	37%
7	37%
5	34%
1	32%

Median Particle Size (mm)*	0.053

Analysis Notes

Samples analysed as received.
** Soil Particle Density results fell outside the scope of AS 1289.3.6.3. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results*

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.44 (2.65)*

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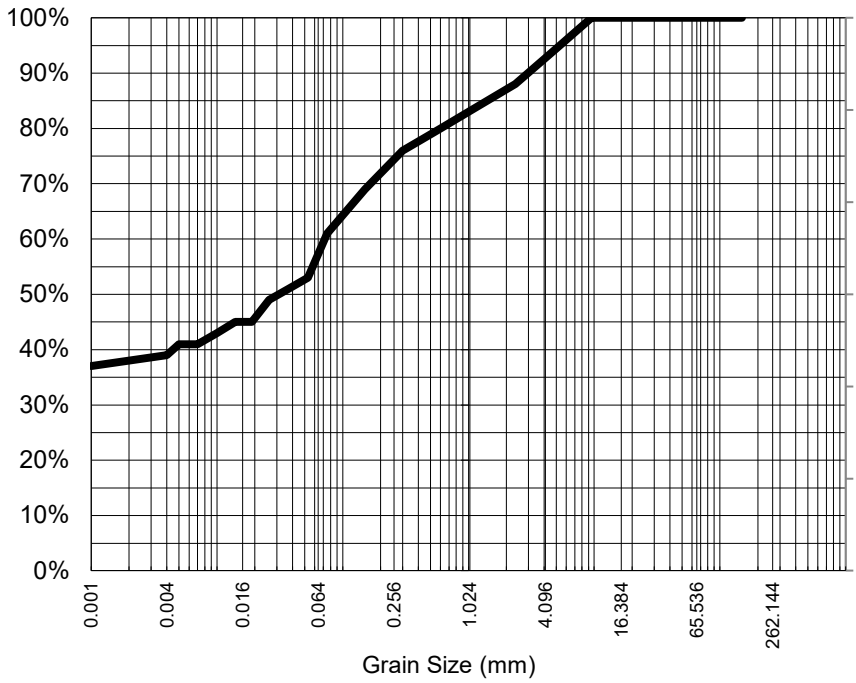
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-022 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A5-2

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	94%
2.36	88%
1.18	84%
0.600	80%
0.425	78%
0.300	76%
0.150	69%
0.075	61%
Particle Size (microns)	
53	53%
37	51%
26	49%
19	45%
14	45%
10	43%
7	41%
5	41%
1	37%

Median Particle Size (mm)*	0.032

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.6 (2.65)*

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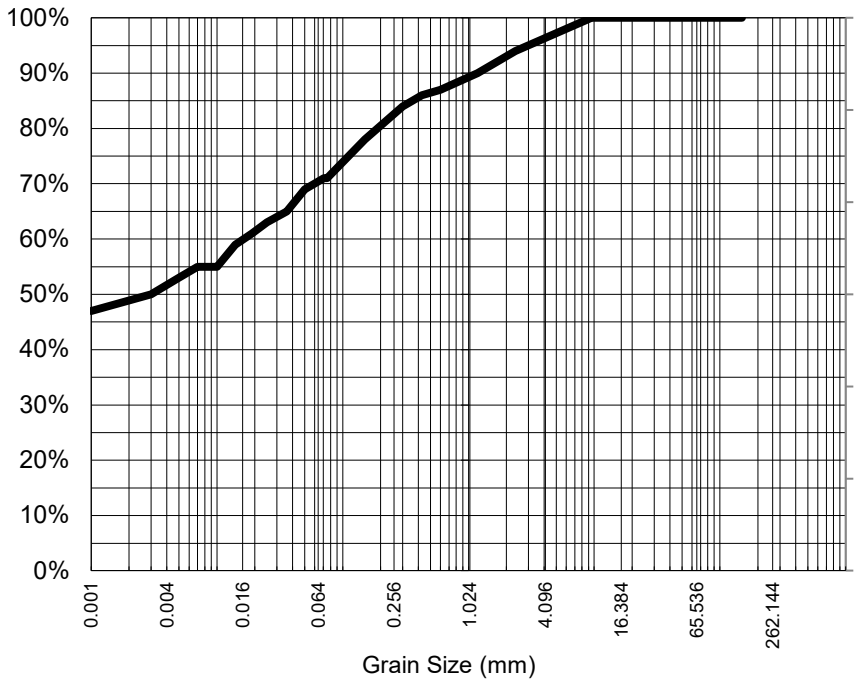
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-023 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A5-3

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	97%
2.36	94%
1.18	90%
0.600	87%
0.425	86%
0.300	84%
0.150	78%
0.075	71%
Particle Size (microns)	
50	69%
36	65%
25	63%
19	61%
14	59%
10	55%
7	55%
5	53%
1	47%

Median Particle Size (mm)*	<0.007

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.6 (2.65)*

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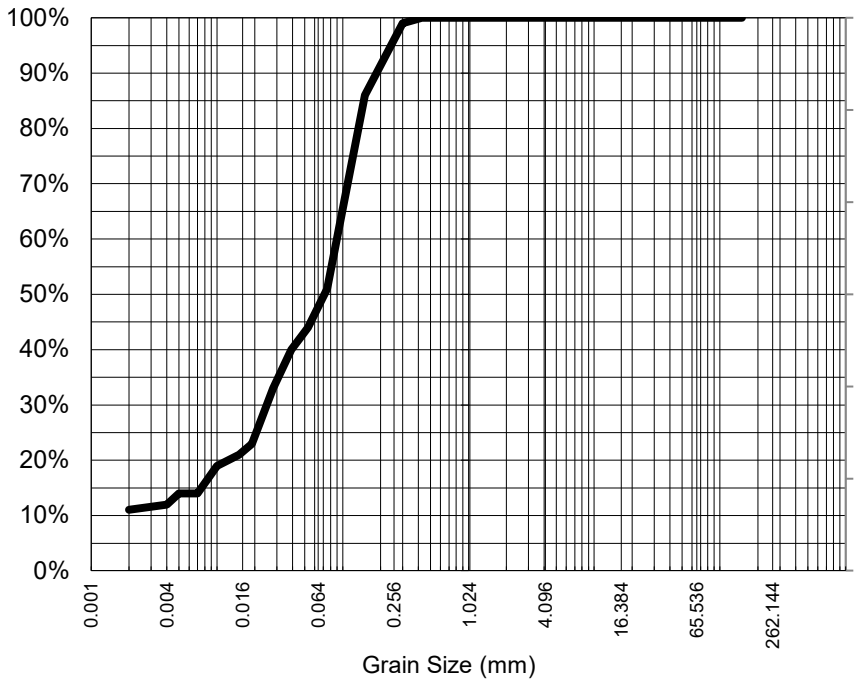
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-024 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	T2

Particle Size Distribution



Particle Size (mm)	% Passing
0.425	100%
0.300	99%
0.150	86%
0.075	51%
Particle Size (microns)	
53	44%
39	40%
28	33%
19	23%
15	21%
10	19%
7	14%
5	14%
2	11%

Median Particle Size (mm)*	0.072

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.82 (2.65)*

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APPENDIX C REGIONAL ECOSYSTEM SUMMARY

Local Regional Ecosystem summary

RE No.^	% composition	Vegetation management status	Biodiversity status	Description	Structure	Key species			Notes	Intersecting site features
						Trees	**Shrubs**	**Grasses and forbs**		
1.11.10b	85	Least concern	No concern at present	Mixed low open woodland on metamorphic plains	Low open woodland	*Eucalyptus leucophylla, Corymbia terminalis, C. aparrerinja, Atalaya hemiglauca, Grevillea striata, Hakea spp., Acacia excelsa subsp. angusta* and *A. cambagei*	*Senna* spp. and *Eremophila* spp.	Short annual grasses and forbs	Very open communities with very sparse ground cover	Pit
1.11.2a	15	Least concern	No concern at present	*E. leucophloia* low open woodland	Low open woodland	Eucalyptus leucophloia, Corymbia terminalis, C. capricornia, Terminalia aridicola and E. leucophylla	Acacia spp.	Triodia spp.	Occurs on steep hills and strike ridges	
1.5.6c	85	Least concern	No concern at present	Atalaya hemiglauca, Ventilago viminalis, Grevillea striata low open woodland on red earth plains	Low open woodland	Atalaya hemiglauca, Acacia excelsa, Acacia cambagei, Ventilago viminalis, Grevillea striata, Hakea lorea subsp. lorea, Ehretia saligna, Corymbia terminalis and C. aparrerinja	Acacia spp. and Carissa lanceolata	Aristida contorta	Mixed low open woodland. Prone to scalding	WRD
1.12.3b	15	Least concern	No concern at present	Eucalyptus leucophylla and/or Corymbia terminalis +/- C. aparrerinja low open woodland on igneous rocks	Low open woodland	Eucalyptus leucophylla, Atalaya hemiglauca, Corymbia terminalis, C. aparrerinja, Acacia cambagei, Grevillea striata, Hakea spp. and Acacia excelsa subsp. angusta	-	Short tussock grasses and *Triodia* spp	These are usually extremely open communities with very sparse ground layers	
1.5.4d	85	Least concern	No concern at present	Eucalyptus leucophylla and/or Corymbia terminalis low open woodland on red earths	Low open woodland	Eucalyptus leucophylla and Corymbia terminalis. Occasional Corymbia aparrerinja, Atalaya hemiglauca and Grevillea striata	-	Annual grasses with areas of *Triodia* spp	**Cenchrus pennisetiformis* (Cloncurry buffel grass) is present	TSF
1.11.10b	15	Least concern	No concern at present	Mixed low open woodland on metamorphic plains	Low open woodland	Eucalyptus leucophylla, Corymbia terminalis, Corymbia aparrerinja, Atalaya hemiglauca, Grevillea striata, Hakea spp., Acacia excelsa subsp. angusta and Acacia cambagei	-	Short annual grasses and forbs	-	
4.4.1d	100	Least concern	No concern at present	Astrebla pectinata +/- Aristida latifolia +/- Eulalia aurea grassland on Tertiary clays overlying limestone	Tussock Grassland	Atalaya hemiglauca, Acacia georginae, Acacia cambagei and Ventilago viminalis	-	Astrebla pectinate, Eulalia aurea, Astrebla spp., Aristida latifolia, Iseilema spp., annual grasses and forbs	-	TSF
1.5.3	100	Least concern	No concern at present	*Eucalyptus leucophloia* low open woodland to woodland on sandy and gravelly red soils	Low open woodland	Eucalyptus leucophloia and Corymbia terminalis	Acacia spp	Triodia spp		

^Note: only REs relevant to rehabilitation of THGM have been listed

APPENDIX D TICK HILL ENVIRONMENTAL SITE ASSESSMENT (EES, 2023)

Table 26a: Groundwater Field Parameters	Location	THGW001	THGW002	THGW003	THGW004	THGW005	THGW006	THGW007	THGW008	THGW009	Pit	Mine shaft	Tailings pond	No. of Samples	Average	Maximum	Minimum	5th Percentile	20th percentile	80th percentile	95th percentile	Median
	Units / Date	**20/12/2022**	**20/12/2022**	**20/12/2022**	**19/12/2022**	**20/12/2022**	**19/12/2022**				**19/12/2022**	**20/12/2022**	**20/12/2022**									
Standing water level	**m(TOC)**	26.50	30.67	16.32	16.65	15.77	18.73					51.45		7	25	51	16	16	16	30	45	19
Temperature	**°C**	33.1	31.0	31.0	31.7	31.1	31.2				25.0	27.9	28.3	9	30	33	25	26	28	31	33	31
pH	**-**	7.38	7.79	7.07	7.60	7.17	7.21				8.65	8.51	8.60	9	7.78	8.65	7.07	7.11	7.19	8.55	8.63	7.60
Electrical Conductivity	**µS/cm**	3785	582	2388	3048	2068	1997				6598	2547	9096	9	3568	9096	582	1148	2040	4910	8097	2547
Redox	**mV**	35.0	42.2	34.4	7.9	30.3	21.6				32.5	34.7	34.1	9	30	42	7.90	13	27	35	39	34
Dissolved Oxygen	**mg/L**	3.37	2.55	2.11	1.48	0.99	0.67				6.46	3.55	6.75	9	3.10	6.75	0.67	0.80	1.28	4.71	6.63	2.55
Colour	**-**	clear	clear	clear	slight grey	clear	grey - clear				clear	clear	green murky	-	-	-	-	-	-	-	-	-
Odour	**-**	none	none	none	organic	none					none	none	none	-	-	-	-	-	-	-	-	-
Volume	**L**	15	3	100	100	100	100					3		9	60	100	3.00	3.00	5.40	100	100	100
Notes	**-**				minor sheen		minor sheen initially															
Location		**THGW001**	**THGW002**	**THGW003**	**THGW004**	**THGW005**	**THGW006**	**THGW007**	**THGW008**	**THGW009**	**Pit**	**Mine shaft**										
Date		**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	12/06/2023										
Standing water level	**m(TOC)**	25.89	30.51	15.69	15.22	14.49	16.31	30.20	28.60	14.51		49.89		10	24	50	14	14	15	30	41	21
Temperature	**°C**	29.5	30.0	30.4	30.2	31.1	31.1	29.9	30.0	31.0	20.5	25.2		11	29	31	21	23	30	31	31	30
pH	**-**	7.56	7.36	7.15	7.70	7.19	7.24	7.65	7.22	7.60	8.10	8.87		11	7.60	8.87	7.15	7.17	7.22	7.70	8.49	7.56
Electrical Conductivity	**µS/cm**	2797	368	2015	2367	1762	1681	1497	5294	1114	4842	1917		11	2332	5294	368	741	1497	2797	5068	1917
Redox	**mV**	13.4	-12.8	29.0	5.3	33.3	16.1	27.6	33.7	29.6	-4.6	19.6		11	17	34	-12.80	-8.70	5.30	30	34	20
Dissolved Oxygen	**mg/L**	3.75	2.02	2.13	2.06	0.82	0.74	3.15	2.79	1.84	7.58	3.15		11	2.73	7.58	0.74	0.78	1.84	3.15	5.67	2.13
Colour	**-**	clear	clear	clear	brown	cloudy	cloudy	red-brown	brown	clear	clear	clear		11	-	-	-	-	-	-	-	-
Odour	**-**	none	none	none	swampy	none	none	none	none	none	none	minor sulfur		11	-	-	-	-	-	-	-	-
Volume	**L**	3	3	50	70	25	40	15	25	30		3		10	26	70	3.00	3.00	3.00	42	61	25
Notes	**-**		dead tree roots											1	-	-	-	-	-	-	-	-

Table 27a: Groundwater Analytical Results - Ionic Balance and Cyanide			Human Health Criteria	Ecological Criteria	Stock watering	THGW01	THGW02	THGW03	THGW04	THGW05	THGW06	THGW07	THGW08	THGW09	PIT	Mine Shaft	TSF	No. of Samples	Average	Maximum	Minimum	5th Percentile	20th percentile	80th percentile	95th percentile	Median
Analyte	Units	LOR	Drinking water	95%																						
Date						12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023										
pH Value	pH Unit	0.01	6.5 - 8.5			7.97	7.88	7.91	8.08	7.83	7.9	8.18	7.59	7.4	8.46	**8.84**		11	8.0	8.8	7.4	7.5	7.8	8.2	8.7	7.9
Total Dissolved Solids	mg/L	10	600		4000	**1780**	256	1150	1660	1050	1040	1020	3790	697	3780	1220		11	1586	3790	256	477	1020	1780	3785	1150
Bicarbonate Alkalinity as CaCO3	mg/L	1				703	181	682	1120	872	876	757	727	604	311	302		11	649	1120	181	242	311	872	998	703
Total Alkalinity as CaCO3	mg/L	1				703	181	682	1120	872	876	757	727	604	334	355		11	656	1120	181	258	355	872	998	703
Sulfate as SO4	mg/L	1	500		1000	139	20	48	89	30	22	33	474	14	488	125		11	135	488	14	17	22	139	481	48
Chloride	mg/L	1	250			**560**	16	**319**	92	96	60	75	**1260**	11	**1590**	**517**		11	418	1590	11	14	60	560	1425	96
Calcium	mg/L	1			1000	65	20	50	8	28	22	22	104	52	49	6		11	39	104	6.0	7.0	20	52	85	28
Magnesium	mg/L	1			600	145	20	97	26	67	70	41	310	86	240	80		11	107	310	20	23	41	145	275	80
Sodium	mg/L	1	180			**397**	46	**319**	**636**	**349**	**326**	**345**	**717**	96	**992**	**343**		11	415	992	46	71	319	636	855	345
Potassium	mg/L	1				7	4	4	6	5	5	6	16	5	24	12		11	8.5	24	4.0	4.0	5.0	12	20	6.0
Fluoride	mg/L	0.1	1.5		2	**2.6**	0.4	**2.5**	**5.3**	**3**	**3.8**	**3.6**	**2.4**	**1.9**	**2.4**	1.3		11	2.7	5.3	0.40	0.85	1.9	3.6	4.6	2.5
Ammonia as N	mg/L	0.01	0.5	0.9		0.14	0.66	0.09	0.23	0.12	0.1	**1.03**	0.49	0.11	0.12	0.02		11	0.28	1.0	0.02	0.06	0.10	0.49	0.85	0.12
Nitrite as N	mg/L	0.01				<0.01	<0.01	<0.01	0.03	0.11	<0.01	0.26	0.86	0.01	<0.01	<0.01		11	0.25	0.86	0.01	0.01	0.03	0.38	0.74	0.11
Nitrate as N	mg/L	0.01	11.3	2.4	90	**14.3**	0.43	3.42	**29.1**	2.15	4.15	0.86	**13.4**	0.53	0.79	<0.01		11	6.9	29	0.43	0.48	0.74	14	22	2.8
Total Phosphorus as P	mg/L	0.01				0.02	0.58	0.01	6.52	0.05	0.22	7.31	1.79	1.28	0.01	0.01		11	1.6	7.3	0.01	0.01	0.01	1.8	6.9	0.22
Reactive Phosphorus as P	mg/L	0.01				<0.01	0.41	0.01	0.08	<0.01	0.02	5.1	1.28	0.16	<0.01	<0.01		11	1.0	5.1	0.01	0.01	0.03	1.1	4.0	0.16
Ionic Balance																										
Total Anions	meq/L	0.01				32.7	4.48	23.6	26.8	20.8	19.6	17.9	59.9	12.7	61.7	24.3		11	28	62	4.5	8.6	18	33	61	24
Total Cations	meq/L	0.01				32.6	4.75	24.4	30.4	22.2	21.2	19.6	62.3	14	66	22.1		11	29	66	4.8	9.4	20	33	64	22
Ionic Balance	%	0.01				0.17	2.85	1.73	6.17	3.41	3.71	4.54	1.93	4.9	3.35	4.68		11	3.4	6.2	0.17	0.95	1.9	4.7	5.5	3.4
Free Cyanide	mg/L	0.002	0.08	0.007		0.007	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.025	<0.002	<0.002	<0.002		11	0.02	0.03	0.01	0.01	0.01	0.02	0.02	0.02
Total Cyanide	mg/L	0.002				0.204	<0.002	0.019	<0.002	0.009	<0.002	0.007	0.881	<0.002	0.003	0.025		11	0.16	0.88	0.00	0.00	0.01	0.17	0.68	0.02
Weak Acid Dissociable Cyanide	mg/L	0.002				0.003	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.022	<0.002	<0.002	<0.002		11	0.01	0.02	0.00	0.00	0.01	0.02	0.02	0.01
Date						20/12/2022	20/12/2022	20/12/2022	19/12/2022	20/12/2022	19/12/2022				19/12/2022	20/12/2022	20/12/2022									
pH Value	pH Unit	0.01	6.5 - 8.5			7.79	7.81	7.58	8.04	7.6	7.67				**8.68**	**8.87**	**8.66**	9	8.1	8.9	7.6	7.6	7.6	8.7	8.8	7.8
Total Dissolved Solids	mg/L	10	600		4000	**2090**	421	**1170**	**1720**	**1030**	**1020**				**3550**	**1290**	**5510**	9	1978	5510	421	661	1026	2674	4726	1290
Bromide	mg/L	0.02				1.96	0.24	1.11	0.61	0.44	0.33				6.15	1.61	7.95	9	2.3	8.0	0.24	0.28	0.40	3.6	7.2	1.1
Bicarbonate Alkalinity as CaCO3	mg/L	1				742	257	673	1170	897	918				319	337	237	9	617	1170	237	245	294	905	1069	673
Total Alkalinity as CaCO3	mg/L	1				742	257	673	1170	897	918				374	400	283	9	635	1170	257	267	338	905	1069	673
Sulfate as SO4	mg/L	1	500		1000	142	22	49	80	27	30				496	118	**879**	9	205	879	22	24	29	284	726	80
Chloride	mg/L	1	250			**589**	54	296	96	82	60				**1650**	**471**	**2250**	9	616	2250	54	56	73	1013	2010	296
Calcium	mg/L	1			1000	71	21	54	5	30	24				56	7	107	9	42	107	5.0	5.8	15	62	93	30
Magnesium	mg/L	1			600	152	26	89	21	65	67				230	85	276	9	112	276	21	23	49	183	258	85
Sodium	mg/L	1	180			**419**	88	**304**	**653**	**332**	**316**				**979**	**348**	**1390**	9	537	1390	88	174	311	783	1226	348
Potassium	mg/L	1				8	5	4	5	5	4				24	15	34	9	12	34	4.0	4.0	4.6	19	30	5.0
Fluoride	mg/L	0.1	1.5		2	**2.4**	0.8	**2.6**	**5.4**	**3.3**	**3.8**				**2.6**	1.4	**2**	9	2.7	5.4	0.80	1.0	1.8	3.5	4.8	2.6
Ammonia as N	mg/L	0.01	0.5	0.9		0.02	**1.27**	0.09	0.23	0.23	0.17				0.12	0.12	0.24	9	0.28	1.3	0.02	0.05	0.11	0.23	0.86	0.17
Nitrite as N	mg/L	0.01				<0.01	<0.01	<0.01	<0.01	0.03	<0.01				0.01	<0.01	<0.01	9	0.02	0.03	0.01	0.01	0.01	0.03	0.03	0.02
Nitrate as N	mg/L	0.01	11.3	2.4	90	10.1	0.77	3.4	**23.2**	2.49	3.69				0.52	0.01	<0.01	9	5.5	23	0.01	0.19	0.62	7.5	19	2.9
Reactive Phosphorus as P	mg/L	0.01				0.02	0.77	0.01	0.08	<0.01	0.02				<0.01	<0.01	0.02	9	0.15	0.77	0.01	0.01	0.02	0.08	0.60	0.02
Total Anions	meq/L	0.01				34.4	7.12	22.8	27.8	20.8	20.6				64.3	23.7	87.4	9	34	87	7.1	13	21	46	78	24
Total Cations	meq/L	0.01				34.5	7.14	23.3	30.5	21.4	20.6				64.9	22.9	89.4	9	35	89	7.1	13	21	47	80	23
Ionic Balance	%	0.01				0.12	0.19	1.14	4.74	1.46	0.24				0.45	1.86	1.11	9	1.3	4.7	0.12	0.15	0.22	1.6	3.6	1.1
Free Cyanide	mg/L	0.002	0.08	0.007		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002				<0.002	<0.002	0.023	9	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Total Cyanide	mg/L	0.002				0.446	<0.002	0.023	<0.002	0.003	<0.002				<0.002	0.033	0.028	9	0.11	0.45	0.00	0.01	0.02	0.12	0.36	0.03
Weak Acid Dissociable Cyanide	mg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002				<0.002	<0.002	0.022	9	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

Note: Exceedances of human health criteria Bold
Exceedances of ecological criteria shaded
Exceedances of stock watering criteria underline

Table 28a: Groundwater Analytical Results - Dissolved metals			Human Health Criteria	Ecological Criteria	Stock watering	THGW01	THGW02	THGW03	THGW04	THGW05	THGW06	THGW07	THGW08	THGW09	PIT	Mine Shaft	TSF	No. of Sample	Average	Maximum	Minimum	5th Percentile	20th percentile	80th percentile	95th percentile	Median
Analyte	Units	LOR	Drinking water	95% species																						
Date						**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**										
Aluminium	mg/L	0.01		0.055	5	0.02	0.02	<0.01	2.1	0.2	0.15	0.17	0.16	0.05	<0.01	<0.01		11	0.36	2.1	0.02	0.02	0.03	0.19	1.4	0.16
Antimony	mg/L	0.001	0.003	0.009		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.005**	0.004	0.002	<0.001	<0.001		11	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Arsenic	mg/L	0.001	0.01	0.024	0.5	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	0.007	0.001	0.004	0.005	<0.001		11	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00
Barium	mg/L	0.001	2	0.625		0.156	0.015	0.224	0.078	0.133	0.14	0.062	0.158	0.074	0.079	0.006		11	0.10	0.22	0.01	0.01	0.06	0.16	0.19	0.08
Cadmium	mg/L	0.0001	0.002	0.003	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0005	<0.0001	<0.0001		11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chromium	mg/L	0.001	0.05	0.01	1	<0.001	<0.001	<0.001	0.006	<0.001	<0.001	0.001	<0.001	0.002	<0.001	<0.001		11	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00
Cobalt	mg/L	0.001	0.06			**0.258**	<0.001	0.017	0.002	0.009	0.002	0.004	**1.05**	0.002	0.018	0.016		11	0.14	1.1	0.00	0.00	0.00	0.07	0.69	0.01
Copper	mg/L	0.001	2	0.0014	0.5	<0.001	0.005	0.002	0.004	<0.001	<0.001	<0.001	0.007	0.007	0.002	0.001		11	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00
Lead	mg/L	0.001	0.01	0.148	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.007	<0.001	<0.001		11	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Manganese	mg/L	0.001	0.5	1.9	10	0.002	0.014	0.007	0.034	0.032	0.009	0.03	0.17	0.014	0.003	0.022		11	0.03	0.17	0.00	0.00	0.01	0.03	0.10	0.01
Molybdenum	mg/L	0.001	0.05		0.15	0.001	<0.001	0.002	0.005	0.002	0.002	0.007	0.003	<0.001	0.033	0.001		11	0.01	0.03	0.00	0.00	0.00	0.01	0.02	0.00
Nickel	mg/L	0.001	0.02	0.125	1	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	0.001	0.005	0.003	<0.001	<0.001		11	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Selenium	mg/L	0.01	0.01	0.011	0.02	0.01	<0.01	<0.01	**0.02**	<0.01	<0.01	<0.01	0.01	<0.01	**0.04**	<0.01		11	0.02	0.04	0.01	0.01	0.01	0.03	0.04	0.02
Strontium	mg/L	0.001				0.736	0.155	0.424	0.142	0.291	0.338	0.227	1.36	0.22	0.753	0.053		11	0.43	1.4	0.05	0.10	0.16	0.74	1.1	0.29
Titanium	mg/L	0.01				<0.01	<0.01	<0.01	0.12	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		11	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Uranium	mg/L	0.001	0.017			**0.031**	0.001	**0.033**	**0.063**	**0.035**	**0.024**	**0.024**	**0.049**	0.005	**0.07**	0.015		11	0.03	0.07	0.00	0.00	0.02	0.05	0.07	0.03
Vanadium	mg/L	0.01	0.036			**0.12**	0.02	**0.07**	**0.37**	**0.08**	**0.18**	**0.12**	**0.08**	**0.04**	**0.04**	<0.01		11	0.11	0.37	0.02	0.03	0.04	0.13	0.28	0.08
Zinc	mg/L	0.005	3	0.091	20	<0.005	<0.005	<0.005	0.061	<0.005	<0.005	<0.005	0.007	<0.005	<0.005	<0.005		11	0.03	0.06	0.01	0.01	0.02	0.05	0.06	0.03
Iron	mg/L	0.05				0.06	<0.05	<0.05	1.9	0.11	0.16	0.09	0.45	<0.05	<0.05	0.85		11	0.52	1.9	0.06	0.07	0.09	0.77	1.6	0.16
Tungsten	mg/L	0.001				<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001		11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Date						**20/12/2022**	**20/12/2022**	**20/12/2022**	**19/12/2022**	**20/12/2022**	**19/12/2022**				**19/12/2022**	**20/12/2022**	**20/12/2022**									
Aluminium	mg/L	0.01		0.055	5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01	<0.01	9	<0.01	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony	mg/L	0.001	0.003	0.009		<0.001	0.001	<0.001	<0.001	<0.001	<0.001				<0.001	<0.001	<0.001	9	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	0.01	0.024	0.5	<0.001	0.001	<0.001	0.004	<0.001	<0.001				0.005	<0.001	**0.116**	9	0.03	0.12	0.00	0.00	0.00	0.05	0.10	0.00
Barium	mg/L	0.001	2	0.625		0.144	0.02	0.192	0.05	0.11	0.114				0.107	0.003	0.152	9	0.10	0.19	0.00	0.01	0.04	0.15	0.18	0.11
Cadmium	mg/L	0.0001	0.002	0.003	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001				<0.0001	<0.0001	<0.0001	9	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	0.05	0.01	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				<0.001	<0.001	<0.001	9	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	0.06			**0.603**	<0.001	0.015	<0.001	0.003	0.001				0.007	0.032	0.009	9	0.10	0.60	0.00	0.00	0.00	0.03	0.43	0.01
Copper	mg/L	0.001	2	0.0014	0.5	0.002	0.004	<0.001	<0.001	<0.001	<0.001				0.004	<0.001	0.022	9	0.01	0.02	0.00	0.00	0.00	0.01	0.02	0.00
Lead	mg/L	0.001	0.01	0.148	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				<0.001	<0.001	<0.001	9	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	0.5	1.9	10	0.002	0.005	<0.001	0.002	0.007	0.005				<0.001	0.002	0.147	9	0.02	0.15	0.00	0.00	0.00	0.01	0.11	0.01
Molybdenum	mg/L	0.001	0.05		0.15	0.002	0.001	0.002	0.006	0.002	0.002				0.034	0.002	0.059	9	0.01	0.06	0.00	0.00	0.00	0.02	0.05	0.00
Nickel	mg/L	0.001	0.02	0.125	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				<0.001	<0.001	0.002	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Selenium	mg/L	0.01	0.01	0.011	0.02	<0.01	<0.01	<0.01	**0.02**	<0.01	<0.01				**0.05**	<0.01	**0.04**	9	0.04	0.05	0.02	0.02	0.03	0.05	0.05	0.04
Strontium	mg/L	0.001				0.728	0.19	0.387	0.132	0.247	0.332				0.769	0.048	0.519	9	0.37	0.77	0.05	0.08	0.17	0.60	0.75	0.33
Titanium	mg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01	<0.01	9	<0.01	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	mg/L	0.001	0.017			**0.029**	0.006	**0.022**	**0.05**	**0.026**	**0.021**				**0.069**	**0.018**	**0.022**	9	0.03	0.07	0.01	0.01	0.02	0.04	0.06	0.02
Vanadium	mg/L	0.01	0.036			**0.08**	0.02	**0.04**	**0.34**	**0.07**	**0.14**				**0.02**	<0.01	0.01	9	0.09	0.34	0.01	0.01	0.02	0.12	0.27	0.06
Zinc	mg/L	0.005	3	0.091	20	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005				<0.005	<0.005	<0.005	9	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Iron	mg/L	0.05				0.08	<0.05	<0.05	<0.05	<0.05	<0.05				<0.05	<0.05	<0.05	9	<0.05	0.08	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Tungsten	mg/L	0.001				0.002	<0.001	<0.001	<0.001	<0.001	<0.001				0.001	<0.001	<0.001	9	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Note: Exceedances of human health criteria Bold.

Exceedances of ecological criteria shaded

Exceedances of stock watering criteria underline

Table 29a: Groundwater Analytical Results - Total metals			THGW01	THGW02	THGW03	THGW04	THGW05	THGW06	THGW07	THGW08	THGW09	PIT	Mine Shaft	TSF	No. of Sample	Average	Maximum	Minimum	5th Percentile	20th percentile	80th percentile	95th percentile	Median
Analyte	**Units**	**LOR**																					
Date			**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**										
Aluminium	mg/L	0.01	0.1	0.59	0.02	16.8	2.12	6.91	24	26.8	11.2	0.07	0.03		11	8.1	27	0.02	0.03	0.07	17	25	2.1
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.005	0.005	0.004	<0.001	<0.001		11	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.01
Arsenic	mg/L	0.001	0.001	<0.001	<0.001	0.006	0.001	0.001	0.009	0.006	0.001	0.006	<0.001		11	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00
Barium	mg/L	0.001	0.152	0.018	0.211	0.2	0.158	0.17	0.229	0.51	0.223	0.079	0.005		11	0.18	0.51	0.01	0.01	0.08	0.22	0.37	0.17
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0006	<0.0001	<0.0001	<0.0001		11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chromium	mg/L	0.001	<0.001	0.002	<0.001	0.043	0.002	0.009	0.044	0.075	0.012	<0.001	<0.001		11	0.03	0.08	0.00	0.00	0.00	0.04	0.07	0.01
Cobalt	mg/L	0.001	0.608	<0.001	0.021	0.015	0.012	0.006	0.042	1.06	0.01	0.021	0.048		11	0.18	1.1	0.01	0.01	0.01	0.16	0.86	0.02
Copper	mg/L	0.001	<0.001	0.009	<0.001	0.031	0.003	0.018	0.018	0.054	0.008	0.007	<0.001		11	0.02	0.05	0.00	0.00	0.01	0.03	0.05	0.01
Lead	mg/L	0.001	<0.001	0.002	<0.001	0.003	0.001	<0.001	0.005	0.012	0.025	0.002	<0.001		11	0.01	0.03	0.00	0.00	0.00	0.01	0.02	0.00
Manganese	mg/L	0.001	0.002	0.028	0.011	0.333	0.112	0.058	0.33	0.519	0.177	0.006	0.025		11	0.15	0.52	0.00	0.00	0.01	0.33	0.43	0.06
Molybdenum	mg/L	0.001	0.001	<0.001	0.002	0.006	<0.001	0.002	0.005	0.003	<0.001	0.035	0.002		11	0.01	0.04	0.00	0.00	0.00	0.01	0.02	0.00
Nickel	mg/L	0.001	<0.001	<0.001	<0.001	0.026	0.001	0.006	0.038	0.051	0.01	<0.001	<0.001		11	0.02	0.05	0.00	0.00	0.01	0.04	0.05	0.02
Selenium	mg/L	0.01	0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	0.04	<0.01		11	0.02	0.04	0.01	0.01	0.02	0.03	0.04	0.02
Strontium	mg/L	0.001	0.794	0.129	0.397	0.2	0.274	0.369	0.296	1.29	0.415	0.801	0.052		11	0.46	1.3	0.05	0.09	0.20	0.79	1.0	0.37
Titanium	mg/L	0.01	<0.01	0.03	<0.01	2.8	0.01	0.16	0.31	2.58	1.53	<0.01	<0.01		11	1.1	2.8	0.01	0.02	0.06	2.4	2.7	0.31
Uranium	mg/L	0.001	0.036	0.001	0.031	0.068	0.033	0.03	0.032	0.049	0.01	0.076	0.016		11	0.03	0.08	0.00	0.01	0.02	0.05	0.07	0.03
Vanadium	mg/L	0.01	0.11	0.02	0.07	0.51	0.1	0.22	0.2	0.22	0.11	0.04	<0.01		11	0.16	0.51	0.02	0.03	0.06	0.22	0.38	0.11
Zinc	mg/L	0.005	<0.005	<0.005	<0.005	0.279	0.008	0.046	0.074	0.077	0.012	0.007	<0.005		11	0.07	0.28	0.01	0.01	0.01	0.08	0.22	0.05
Iron	mg/L	0.05	0.2	1	<0.05	17.8	1.42	6.58	27.5	48.9	14.8	0.32	1.4		11	12	49	0.20	0.25	0.86	20	39	4.0
Tungsten	mg/L	0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	0.001	0.001	0.002	0.002	<0.001		11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Date			**20/12/2022**	**20/12/2022**	**20/12/2022**	**19/12/2022**	**20/12/2022**	**19/12/2022**				**19/12/2022**	**20/12/2022**	**20/12/2022**									
Aluminium	mg/L	0.01	0.06	0.05	0.02	0.96	0.02	0.22				0.03	<0.01	0.27	9	0.20	0.96	0.02	0.02	0.02	0.25	0.72	0.06
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				<0.001	<0.001	<0.001	9	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	0.002	0.002	<0.001	0.004	<0.001	0.001				0.006	<0.001	0.124	9	0.02	0.12	0.00	0.00	0.00	0.01	0.09	0.00
Barium	mg/L	0.001	0.183	0.034	0.236	0.086	0.145	0.158				0.129	0.006	0.177	9	0.13	0.24	0.01	0.02	0.07	0.18	0.21	0.15
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001				<0.0001	<0.0001	<0.0001	9	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001				<0.001	<0.001	<0.001	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cobalt	mg/L	0.001	0.721	<0.001	0.023	<0.001	0.004	0.002				0.01	0.057	0.011	9	0.12	0.72	0.00	0.00	0.01	0.05	0.52	0.01
Copper	mg/L	0.001	0.003	0.008	<0.001	0.001	<0.001	<0.001				0.007	<0.001	0.036	9	0.01	0.04	0.00	0.00	0.00	0.01	0.03	0.01
Lead	mg/L	0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001				<0.001	<0.001	<0.001	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Manganese	mg/L	0.001	0.002	0.039	0.004	0.014	0.01	0.008				0.006	0.02	0.208	9	0.03	0.21	0.00	0.00	0.01	0.03	0.14	0.01
Molybdenum	mg/L	0.001	0.001	<0.001	0.002	0.006	0.002	0.002				0.038	0.002	0.066	9	0.01	0.07	0.00	0.00	0.00	0.03	0.06	0.00
Nickel	mg/L	0.001	0.002	<0.001	<0.001	0.001	<0.001	<0.001				<0.001	<0.001	0.002	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01				0.05	<0.01	0.04	9	0.04	0.05	0.02	0.02	0.03	0.05	0.05	0.04
Strontium	mg/L	0.001	0.848	0.236	0.417	0.148	0.262	0.359				0.868	0.076	0.564	9	0.42	0.87	0.08	0.10	0.20	0.68	0.86	0.36
Titanium	mg/L	0.01	<0.01	<0.01	<0.01	0.24	<0.01	0.01				<0.01	<0.01	<0.01	9	0.13	0.24	0.01	0.02	0.06	0.19	0.23	0.13
Uranium	mg/L	0.001	0.037	0.006	0.032	0.072	0.036	0.029				0.087	0.023	0.025	9	0.04	0.09	0.01	0.01	0.02	0.05	0.08	0.03
Vanadium	mg/L	0.01	0.12	0.03	0.07	0.44	0.1	0.2				0.04	<0.01	0.02	9	0.13	0.44	0.02	0.02	0.03	0.17	0.36	0.09
Zinc	mg/L	0.005	0.007	0.006	<0.005	0.006	<0.005	<0.005				0.011	<0.005	0.016	9	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.01
Iron	mg/L	0.05	0.18	0.08	<0.05	1.09	<0.05	0.17				0.1	0.33	0.21	9	0.31	1.1	0.08	0.09	0.11	0.31	0.86	0.18
Tungsten	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				0.002	<0.001	<0.001	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 30a - Groundwater Analytical Results - Organic Compounds and PFAS			Human Health Criteria	Ecological Criteria	THGW01	THGW02	THGW03	THGW04	THGW05	THGW06	THGW07	THGW08	THGW09	PIT	Mine Shaft	No. of Sample	Average	Maximum	Minimum	5th Percentile	20th percentile	80th percentile	95th percentile	Median
Analyte	**Units**	**LOR**			**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**									
Total Recoverable Hydrocarbons - NEPM 2013																								
C6 - C10 Fraction	µg/L	20			<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	11	<20	<20	<20	<20	<20	<20	<20	<20
C6 - C10 Fraction minus BTEX (F1)	µg/L	20			<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	11	<20	<20	<20	<20	<20	<20	<20	<20
>C10 - C16 Fraction	µg/L	100			<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	----	11	<100	<100	<100	<100	<100	<100	<100	<100
>C16 - C34 Fraction	µg/L	100			<100	<100	<100	<100	<100	<100	<100	<100	140	<100	----	11	<100	<100	<100	<100	<100	<100	<100	<100
>C34 - C40 Fraction	µg/L	100			<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	----	11	<100	<100	<100	<100	<100	<100	<100	<100
>C10 - C40 Fraction (sum)	µg/L	100			<100	<100	<100	<100	<100	<100	<100	<100	140	<100	----	11	<100	<100	<100	<100	<100	<100	<100	<100
>C10 - C16 Fraction minus Naphthalene (F2)	µg/L	100			<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	----	11	<100	<100	<100	<100	<100	<100	<100	<100
EP080: BTEXN																								
Benzene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	11	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	µg/L	2			<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	11	<2	<2	<2	<2	<2	<2	<2	<2
Ethylbenzene	µg/L	2			<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	11	<2	<2	<2	<2	<2	<2	<2	<2
meta- & para-Xylene	µg/L	2			<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	11	<2	<2	<2	<2	<2	<2	<2	<2
ortho-Xylene	µg/L	2			<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	11	<2	<2	<2	<2	<2	<2	<2	<2
Total Xylenes	µg/L	2			<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	11	<2	<2	<2	<2	<2	<2	<2	<2
Sum of BTEX	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	11	<1	<1	<1	<1	<1	<1	<1	<1
Naphthalene	µg/L	5			<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	11	<5	<5	<5	<5	<5	<5	<5	<5
Perfluoroalkyl Sulfonic Acids																								
Perfluorobutane sulfonic acid (PFBS)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	11	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluoropentane sulfonic acid (PFPeS)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	11	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorohexane sulfonic acid (PFHxS)	µg/L	0.002	0.07		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.009	<0.002	11	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluoroheptane sulfonic acid (PFHpS)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	11	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorooctane sulfonic acid (PFOS)	µg/L	0.002	0.07	0.00023	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.009	0.014	11	<0.002	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorodecane sulfonic acid (PFDS)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	11	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluoroalkyl Carboxylic Acids																								
Perfluorobutanoic acid (PFBA)	µg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	11	<0.01	<0.02	<0.03	<0.04	<0.05	<0.06	<0.07	<0.08
Perfluoropentanoic acid (PFPeA)	µg/L	0.002			<0.002	0.006	<0.002	0.003	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	11	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00
Perfluorohexanoic acid (PFHxA)	µg/L	0.002			<0.002	0.002	<0.002	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Perfluoroheptanoic acid (PFHpA)	µg/L	0.002			<0.002	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Perfluorooctanoic acid (PFOA)	µg/L	0.002	0.56	19	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.013	11	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Perfluorononanoic acid (PFNA)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	11	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorodecanoic acid (PFDA)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	11	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluoroundecanoic acid (PFUnDA)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	11	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorododecanoic acid (PFDoDA)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	11	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorotridecanoic acid (PFTrDA)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	11	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorotetradecanoic acid (PFTeDA)	µg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Perfluoroalkyl Sulfonamides																								
Perfluorooctane sulfonamide (FOSA)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	11	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
N-Methyl perfluorooctane sulfonamide (MeFOSA)	µg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	µg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
N-Methyl perfluorooctane sulfonamidoethanol	µg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	µg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
N-Methyl perfluorooctane sulfonamidoacetic acid	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	11	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
N-Ethyl perfluorooctane sulfonamidoacetic acid	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	11	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
(n:2) Fluorotelomer Sulfonic Acids																								
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	µg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	µg/L	0.005			0.006	<0.005	0.006	0.04	0.01	<0.005	0.203	0.195	<0.005	<0.005	<0.005	11	0.08	0.20	0.01	0.01	0.01	0.20	0.20	0.03
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	µg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	µg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
PFAS Sums																								
Sum of PFAS	µg/L	0.002			0.006	0.01	0.006	0.045	0.01	<0.002	0.203	0.195	<0.002	<0.002	0.027	11	0.06	0.20	0.01	0.01	0.01	0.14	0.20	0.02
Sum of PFHxS and PFOS	µg/L	0.002	0.07		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.009	0.014	11	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Sum of PFAS (WA DER List)	µg/L	0.002			0.006	0.01	0.006	0.045	0.01	<0.002	0.203	0.195	<0.002	<0.002	0.027	11	0.06	0.20	0.01	0.01	0.01	0.14	0.20	0.02

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ENVIRONMENTAL SITE ASSESSMENT – TICK HILL GOLD MINE, QLD

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13 July 2023

Carnaby Resources Ltd
78 Churchill Avenue
Subiaco WA 6008

Attention: **Paul Tan**
Exploration Manager

Dear Paul

Environmental Site Assessment of Tick Hill Gold Mine, Dajarra QLD

Please find enclosed a copy of our report entitled as above. Thank you for the opportunity to undertake this work.

Should you have any queries, please do not hesitate to contact us on (07) 3852 6666.

For and on behalf of
Environmental Earth Sciences QLD

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Sam Weiss
Environmental Scientist

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722092 ESA

EXECUTIVE SUMMARY

Introduction

Environmental Earth Sciences QLD was commissioned by Carnaby Resources Ltd to undertake an Environmental Site Assessment (ESA) of Tick Hill Gold Mine, Dajarra, Queensland (the site). The site occupies mining leases ML7094, 7096 and 7097 and is located approximately 40 km south of Duchess and 140 km southeast of Mount Isa. The site covers an area of approximately 390 ha.

The investigation was required to meet the requirements of the progressive rehabilitation and closure plan (PRCP) and Environmental Evaluation (EE) for the site. The site is currently non-operational, however was previously an operational gold mine between 1990 and 1994 and tailings have been extracted for reprocessing between 2020 and 2022. The site is managed under Environmental Authority EPML00820613.

Objectives

The objectives of the ESA include the following:

- Identify potential sources of contamination and associated chemicals of potential concern (CoPC) associated with historical and recent mining activities;
- Identify potential human and ecological receptors;
- Identify potentially impacted media (soil, tailings, groundwater, surface water);
- Further develop the hydrogeological conceptual site model for the pit and surrounds; and
- Provide recommendations regarding requirements for future remediation or monitoring.

Scope

To achieve the project objectives, the following scope was undertaken:

- Desktop assessment of the site and surrounding area's environmental and physical setting, and available historical information;
- Site inspection to complement the findings of the desktop assessment and to identify any additional relevant site information;
- Groundwater investigation program, including expansion of the existing monitoring network;
- Soil investigation program targeting historical site uses and mine wastes.

Summary of findings

The findings of the investigation into groundwater, soil and tailings at Tick Hill can be summarised as follows:

- Groundwater:
    - Groundwater is naturally elevated in salts and metals which make it unsuitable for potable use without treatment.
    - Low concentrations of total cyanide (CN) are found across the site, with the highest concentrations observed at bores THGW001 and THGW008. Free CN exceeding screening criteria was observed in these two bores.
    - Nitrate and ammonia attributed to explosive residue was observed in several locations, including bore THGW004, down gradient of the waste rock dump (WRD).
    - The groundwater model indicates that the open pit acts as a groundwater sink for the site, with the exception of the area north of the WRD and potentially the western site perimeter around bore THGW003. No sensitive receptors were identified that might be impacted by groundwater quality at these locations.
    - The cyanide impact to groundwater between the tailings storage facility (TSF) and open pit is assessed as being stable, with concentrations likely to steadily decrease over time. It is not expected that cyanide impacted groundwater will adversely impact pit water quality to any significant extent and cyanide in pit water will be degraded by sunlight.
- No evidence of soil or sediment contamination was observed on site.
- Tailings material retains some cyanide as total cyanide, which is likely present as iron cyanide. This form is non-toxic. No free cyanide remains. Some elevated concentrations of copper occur within the tailings due to natural elevations of copper in the ore material. Copper concentrations are acceptable if tailings materials are managed appropriately within the TSF. No observed acid generation potential exists within tailings material.
- The waste rock dump is stable and well vegetated. However, due to age and permeability, the WRD appears to have been releasing nitrogen compounds from explosive residues into the surrounding landscape.

Conclusions

Based on the above findings the following conclusion have been made:

- The mining void currently serves as a groundwater sink, influencing groundwater flow across the site, with the exception of the area around the WRD.
- The long term scenario is that the pit will act as a groundwater sink under all plausible site conditions.

- The water quality of the pit poses no current risk of contamination to the surrounding aquifer.
- Potential for pit stratification is not currently known.
- Cyanide (free and total) at bores THGW001 and THGW008 will remain at stable concentrations for some time before decreasing.
- Free cyanide at bores THGW001 and THGW008 does not have the potential to adversely impact pit water quality or discharge to watercourses.

Recommendations

Based on the above conclusions the following recommendations have been made:

- Rectification works should be undertaken to reinstate stockpiled tailings into the eastern TSF cell and recover the TSF.
- Regular groundwater monitoring should continue, with the analysis suite extended from the current parameters to include ammonia, nitrate and phosphate. Bi-annual monitoring is recommended until at least after the TSF rectification works are completed.

This executive summary is not a standalone document and should be read in conjunction with the rest of this report.

ENVIRONMENTAL EARTH SCIENCES
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1 INTRODUCTION

Environmental Earth Sciences QLD was commissioned by Carnaby Resources Ltd to undertake an Environmental Site Assessment (ESA) of Tick Hill Gold Mine, Dajarra, Queensland (the site). A Site Locality Plan is provided in **Figure 1**. The site occupies mining leases ML7094, 7096 and 7097 and is located approximately 40 km south of Duchess and 140 km southeast of Mount Isa. The site covers an area of approximately 390 ha.

The investigation was required to meet the requirements of the progressive rehabilitation and closure plan (PRCP) and Environmental Evaluation (EE) for the site. The site is currently non-operational, however was previously an operational gold mine between 1990 and 1994 and tailings have been extracted for reprocessing between 2020 and 2022. The site is managed under Environmental Authority EPML00820613.

This report should be read in conjunction with the limitations detailed in **Section 17** of this report.

2 OBJECTIVES

The objectives of the ESA include the following:

- Identify potential sources of contamination and associated chemicals of potential concern (CoPC) associated with historical and recent mining activities;
- Identify potential human and ecological receptors;
- Identify potentially impacted media (soil, tailings, groundwater, surface water);
- Further develop the hydrogeological conceptual site model for the pit and surrounds; and
- Provide recommendations regarding requirements for future remediation or monitoring.

3 SCOPE OF WORK

To meet the stated objectives the following scope of work was undertaken:

- Desktop assessment of the site and surrounding area's environmental and physical setting;
- Desktop site history review to identify historical potentially containing land uses and activities;

- Site inspection to complement the findings of the desktop assessment and to identify any additional relevant site information;
- Groundwater investigation program, including expansion of the existing monitoring network;
- Soil investigation program targeting historical site uses and mine wastes;
- Analysis of samples by a laboratory accredited by the National Association of Testing Authorities (NATA) for the selected analytical suite;
- Quality assurance and quality control (QA/QC) sampling;
- Provision of a report detailing the findings of the ESA and recommendations for further assessment and/or remediation if required.

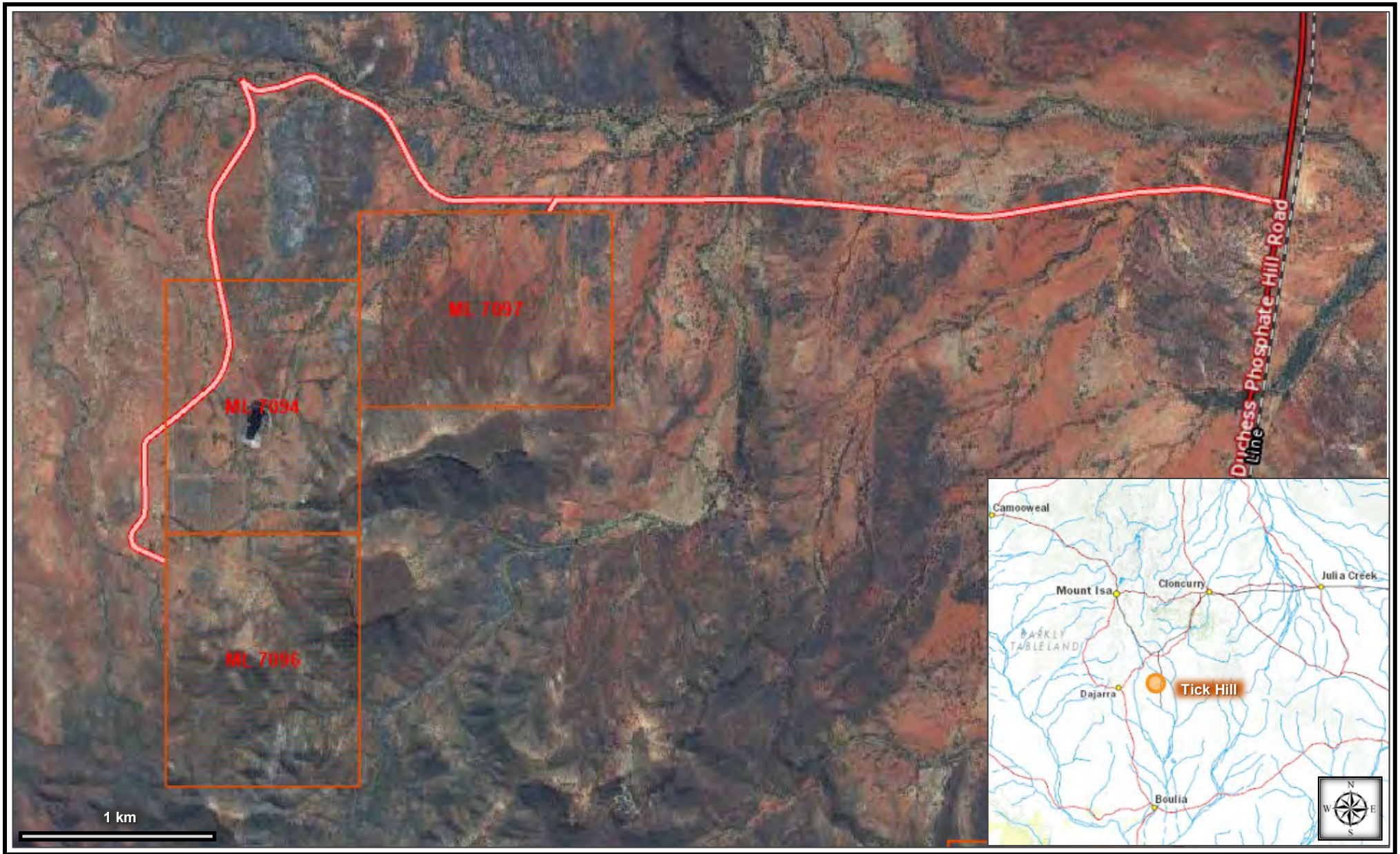
4 SITE SETTING

4.1 Site identification

Site identification details are provided in **Table 1**. A plan of the regional locality of the site, along with site lot configuration is provided in **Figure 1**. **Figure 2** presents the site layout, investigation area and surrounding land-use.

Table 1: Site Identification

Item	Details
Site Owner	Carnaby Resources Limited
Address	Tick Hill Gold Mine, Dajarra, QLD
Mine leases	ML7094, ML7096, ML7097
Lot & Plan number	Lot 13 on SP309109 (part), Lot 16 on SP309110 (part)
Area (Mining lease)	390 ha lease area + 8.5 km road access
Zoning	Rural – Extractive and Mineral Resource
Current land use	Non-operational gold mine
Proposed future land use	Rehabilitated mining land
Local Government Authority	Cloncurry Shire
Coordinates (site centre)	-21.64645 Lat, 139.92561 Long
Site Location and Layout	**Figure 1 and Figure 2**



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Base map QLD Globe (DNRM, 2023)

Title: Site Location – Tick Hill Mine Leases and Site Location

Location: Tick Hill Mine, QLD

Client: Carnaby Resources

Drawn By: A Sheldon

Date: May 2023

Figure 1

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Base map Google Earth (November 2022)

Title: Site Layout
Inset – mine layout during operations

Client: Carnaby Resources | Drawn By: A Sheldon | Date: June 2023

Location: Tick Hill Mine, QLD

Figure 2

4.2 Site description and layout

The site is located approximately 40 km south of the locality of Duchess, and approximately 140 km southeast of Mount Isa. Tick Hill is accessed via the Duchess Phosphate Hill Road which runs north-south 5 km to the east of the site.

The site is currently comprised of the former mine features including the flooded open pit, the tailings and decant dams and the waste rock dump. Site features are shown on **Figure 2.** Also present are the water supply tank, located on the hill to the east of site and the core yard, located south of the waste rock dump. Adjacent to the core yard are shipping containers for storage of maintenance equipment. Almost all other mining infrastructure from the original operations has been removed.

The former site layout is shown in **Figure 3** below. This aerial photograph shows the open pit (centre), tailings and decant dam to the right (south) and waste rock dump on the left (north). Also evident is the processing plant and mine operations are to the east of the tailings dams.

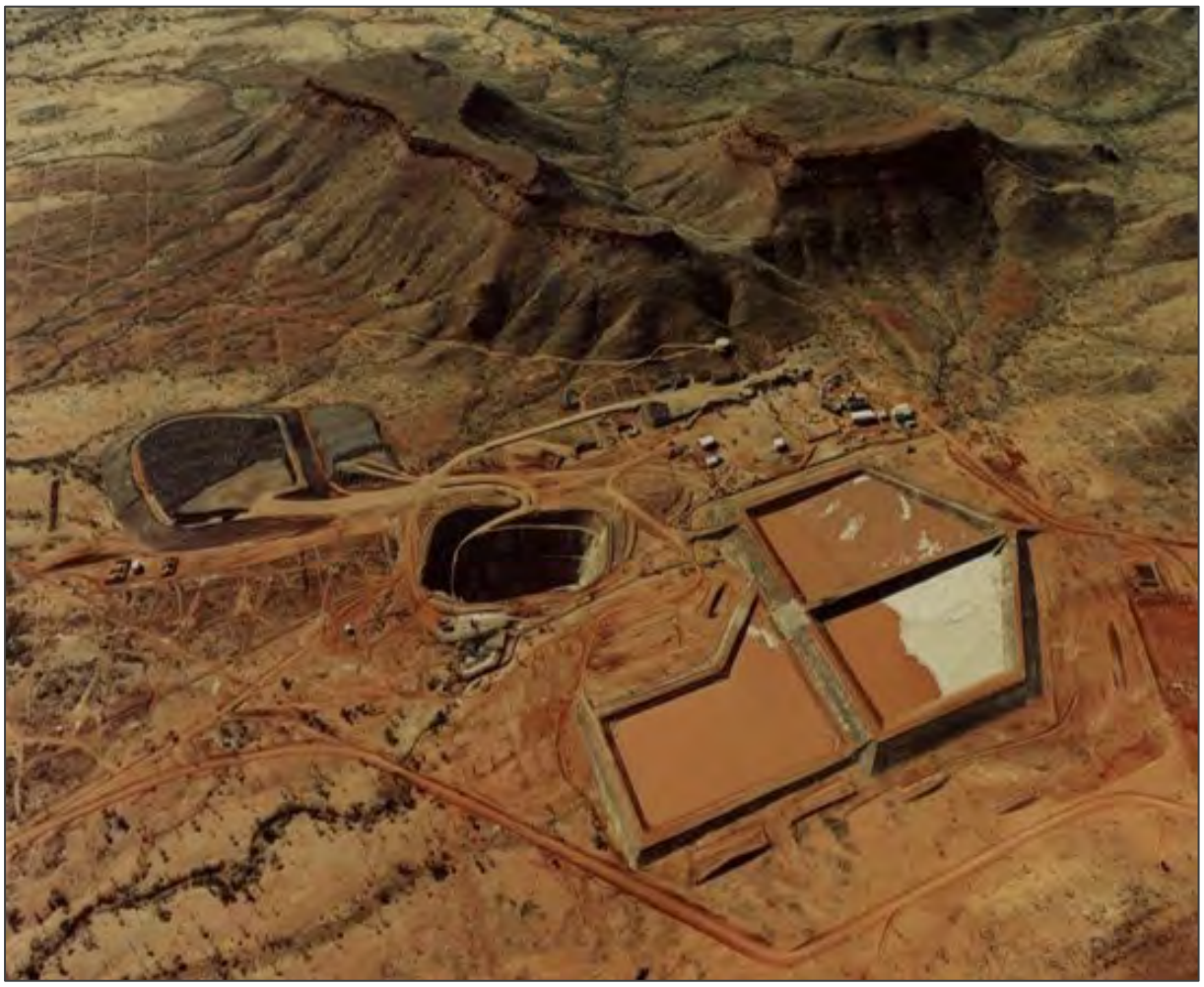


Figure 3: Aerial photograph of site during operations (from west to east)

Recent tailings re-working has included stripping and excavation of the eastern tailings cell. Cover material and some of the tailings are stockpiled on the western tailings cell. Some

tailings material has been removed from site. Equipment involved in the tailings re-working project is present on and about the tailings cells, including screening and processing plant, pumps and pipe.

For the purposes of clarity in further discussion regarding site setting or nearby activities, distances as shown on **Figure 4** are taken from the Tick Hill mine pit.

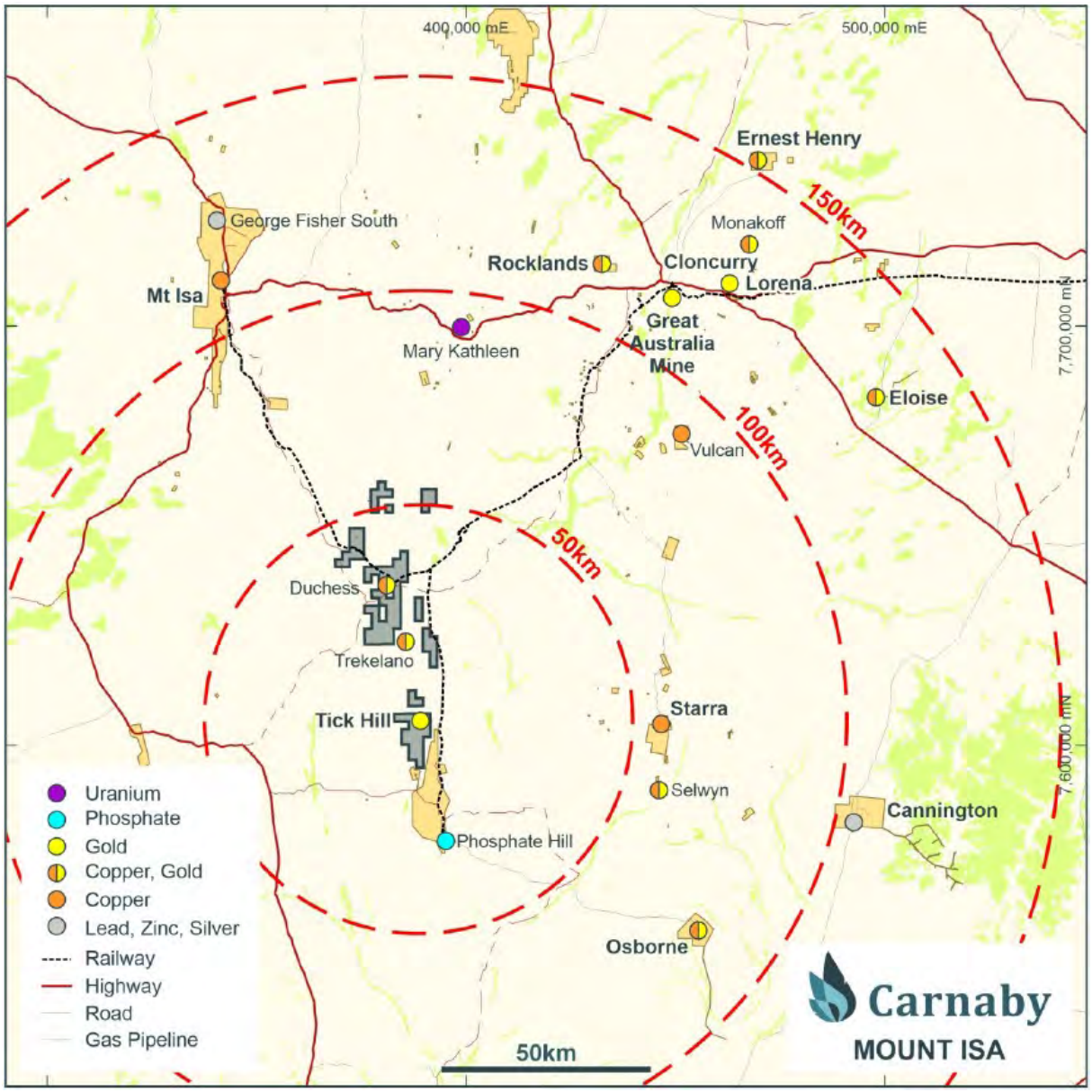


Figure 4: Mining and exploration leases within 150 km of the site

4.3 Surrounding land use

The following adjacent land uses were observed at the time of the site inspection and based on the desktop assessment:

- North: Low density grazing land. The former Trekelano Copper mine is located 19 km to the north;

- South: Low density grazing land. The Monument / Phosphate Hill mine, airstrip and village are located 12 – 26 km south of the site;
- East: Low density grazing land, Duchess Phosphate Hill Road and the Phosphate Hill branch line of the Mount Isa Railway; and
- West: Low density grazing land.

Surrounding land uses are shown on **Figure 2**. Nearby mining and exploration leases are shown on **Figure 4**.

4.4 Environmentally Relevant Activities

The site is managed under Environmental Authority (EA) EPML00820613 for the following Environmentally Relevant Activities (ERAs):

- Resource Activity, Schedule 3, 21: A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20 (ML7094, ML7096 and ML7097);
- Ancillary, Schedule 2, 31: Mineral processing 2(a) - Processing, in a year, the following quantities of mineral products, other than coke – 1,000t to 100,000t (ML7094); and
- Ancillary, Schedule 2, 60 – Waste Disposal 2: Operating a facility for disposing of, in a year, the following quantity of waste mentioned in subsection (1)(b)(a) less than 2,000 t (ML7094).

The EA is held by Carnaby Resources (holdings) Pty Ltd and is included as **Appendix A**.

5 SITE ENVIRONMENTAL SETTING

5.1 Topography and vegetation

The regional topography is described as gently rolling to hilly terrain with flat top mesas. The site's elevation within the lease areas ranges from 320 to 450 m Australian Height Datum (mAHD) although the former operational areas of the site were between 320 and 360 mAHD (**Figure 5**). The site slopes gently to the northwest and is bound by steep hills to the southeast.

Vegetation at the site consists of regrowth open woodlands, shrubs and grasses. Vegetation type are typically described as low open woodlands dominated by Eucalyptus leucophylla (Cloncurry box) or less extensively Corymbia terminalis (long-fruited bloodwood), low open woodlands and related associations, mainly lower slopes and valleys. Open plains to the west are described as Tussock grasslands dominated by Astrebla spp. (Mitchell grass) or Dichanthium spp. (bluegrass) often with Iseilema spp. on undulating downs or clay plains.

An aerial photograph from the time of site operations indicates that the site was extensively cleared, with topsoil scraped around the tailings dams. Recent site observations indicate

that site vegetation has recovered well, particularly along drainage lines and in sheltered areas, and that significant weed infestation has not occurred.

5.2 Surface water drainage and hydrology

The site is drained by several ephemeral watercourses which flow to the north and northwest. These join the larger ephemeral watercourse Petticoat Creek around 1.5 km downstream. Petticoat Creek drains the area surrounding the mine and flows east into the Burke River which flows south into the Georgina River and into Lake Eyre. Watercourses are shown on **Figure 5**.

On site water bodies include the open pit, which has partially refilled to form a permanent water body. Part of the eastern tailings cell which has been excavated for tailings reclamation also intermittently holds water.

Ephemeral watercourses at the site are potentially losing streams which contribute to groundwater recharge.

5.2.1 Surface water environmental values

Surface water quality is managed according to the Environmental Protection (Water and Wetland Biodiversity Protection) Policy 2019 (EPP[WWD] 2019). The site is located within the Lake Eyre Basin, for which water quality targets have not yet been nominated. When assessing the environmental values for the site and surrounds, site and regional conditions, observed land uses and proximity of human and environmental receptors is considered. Relevant environmental values are presented in **Table 2**. Relevant assessment guidelines have been adopted with consideration of these environmental values.

Where groundwaters interact with surface waters, groundwater quality should not compromise identified EVs and WQOs for those waters.

Table 2: Environmental Values for water

Environmental Value	Surface Water	Applicability
Aquatic Ecosystems	While all water courses at or near the site are ephemeral, surface water quality is important to maintaining these ecosystems. Due to the regional land use for grazing, ephemeral waterways would be considered slightly to moderately disturbed. No mapped riverine aquatic conservation areas occur within the vicinity of the site. The site is mapped as having low conservation significance.	Yes
Irrigation	No irrigated agriculture occurs in the vicinity of the site	No
Farm Supply use	Farm Supply within this area is primarily for stock watering. Occupied residential properties are located 17 km and 23 km from site (see drinking water below).	Yes
Stock Water	Stock will utilise available surface water.	Yes
Aquaculture	Surface water in the area is not used for aquaculture.	No
Human Consumer	Surface water in the area is not used for the production of food.	No

Environmental Value	Surface Water	Applicability
Primary Recreation	Surface water in the area is highly ephemeral; the area is very isolated from common human recreational pursuits and is not used for primary, secondary or visual recreational use.	No
Secondary Recreation		No
Visual Recreation		No
Drinking water	The nearest residences are located approximately 17 km to the SE and 23 km W, both adjoining significant waterways isolated from the Petticoat Creek system. Therefore, no drinking water is sourced in the vicinity of the site, nor would site activities impact local surface waters at these locations.	No
Industrial Use	There are numerous mining operations in the region, but none within 30 km of the site. It is therefore no considered possible that site activities would impact on surface water at other mines. Site water supply is sourced from a borefield 15 km E.	No
Cultural, Spiritual and Ceremonial Values	There are no known environmental values in relation to cultural and spiritual values of surface water in the vicinity of the site.	No

5.2.2 Flood risk

No flood risk has been identified at the site.

5.3 Soils

Soil mapping for the site includes the 1:2M Atlas of Australian Soils (Northcote et. al. 1960-1968) and the 1:1M Land Systems Survey of the Leichhardt-Gilbert Area (1964).

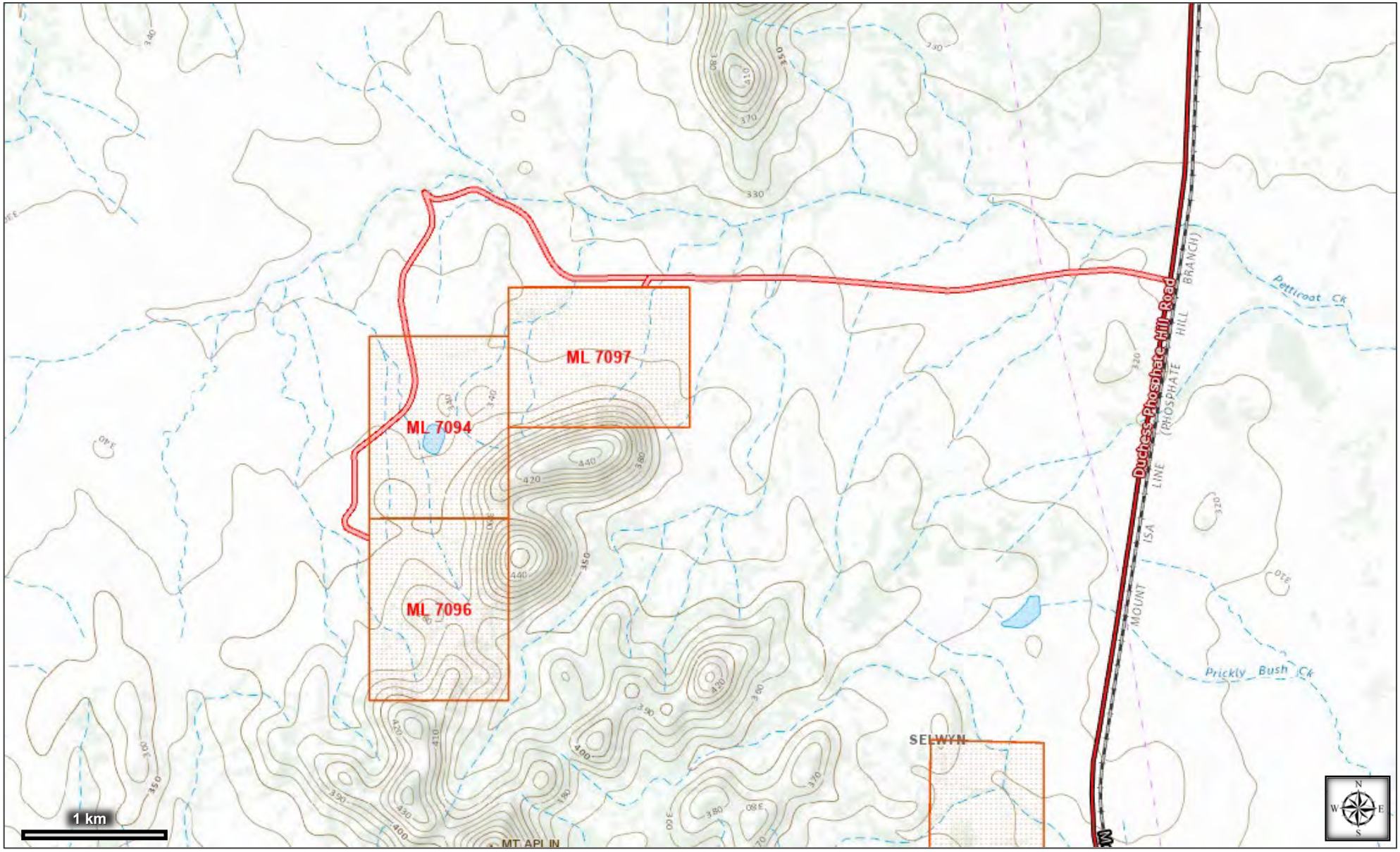
The flatter sections in the north and west of the site are mapped as the Quamby land system which is comprised of sparsely timbered undulating plains. Soils associated with this land system are described as red smooth-ped earths. These soils are gradational red earths with no A2 horizon and alkaline smooth-ped whole columnar B horizon.

The mesa hills in the southeast are the Merlin land system: stony spinifex country, gently undulating to undulating lands with occasional low mesas. Soils are earthy loams with uniform medium, porous coherent solum, and profile depth less than 0.6 m.

5.4 Regional surface geology

The surface geology (1:100,000 scale) underlying the site is classified as the Corella Formation, Paleoproterozoic aged (2500 to 1600 MYA) Calcareous siltstone, sandstone and minor limestone, passing into calc-silicate granofels, commonly scapolitic, and marble; local quartzose sandstone passing into quartzite; local breccia; minor amphibolite.

The flat top hills which rise to the southeast of the site are capped by the Mount Birnie beds, which are comprised of Neoprotozoic to early Cambrian aged massive ferruginous sandstone, cross-bedded sandstone, conglomerate, red and green shale, mudstone and dolomite; basal tillite, and middle Cambrian aged Thorntonia Limestone with laterite cap.



ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Base map QLD Globe (DNRM, 2023)
Contour interval 10 m

Title: 1:100,000 Topography and surface water bodies

Location: Tick Hill Mine, QLD

Client: Carnaby Resources | Drawn By: A Sheldon | Date: May 2023

Figure 5

5.5 Hydrogeology

5.5.1 Registered bore search

A search was undertaken of registered groundwater bores within a 5 km radius of the site using (QldGlobe May 2023). A summary is presented in **Table 3** and bore reports are provided in **Appendix B**.

5.5.2 Aquifers and aquitards

Based on bore logs from the site, groundwater is found in fractured and weathered zones within the Proterozoic metasediments and igneous rocks of the Corella formation. Comparison of water strike and standing water levels (SWLs) indicates that the regional aquifer is semi-confined to confined. Granofels typically has little to no primary porosity. Groundwater flow will therefore mainly occur through secondary porosity including fractures and weathering, and more porous interbedded layers.

Aquifer yield would be expected to be low. Occasional high flow zones may be encountered however lack of connectivity (effective porosity, specific storage or specific yield) within the aquifer means that sufficient long-term yield to supply a production bore or water supply is unlikely.

Groundwater is neutral to slightly alkaline and moderately to highly saline. Water chemistry is dominated by sodium and magnesium, and bicarbonate and chloride.

Within the landscape around Tick Hill, groundwater recharge areas are likely to be located in the ephemeral watercourses, and the limestone capped hills to the southeast.

5.5.3 Groundwater dependent ecosystems

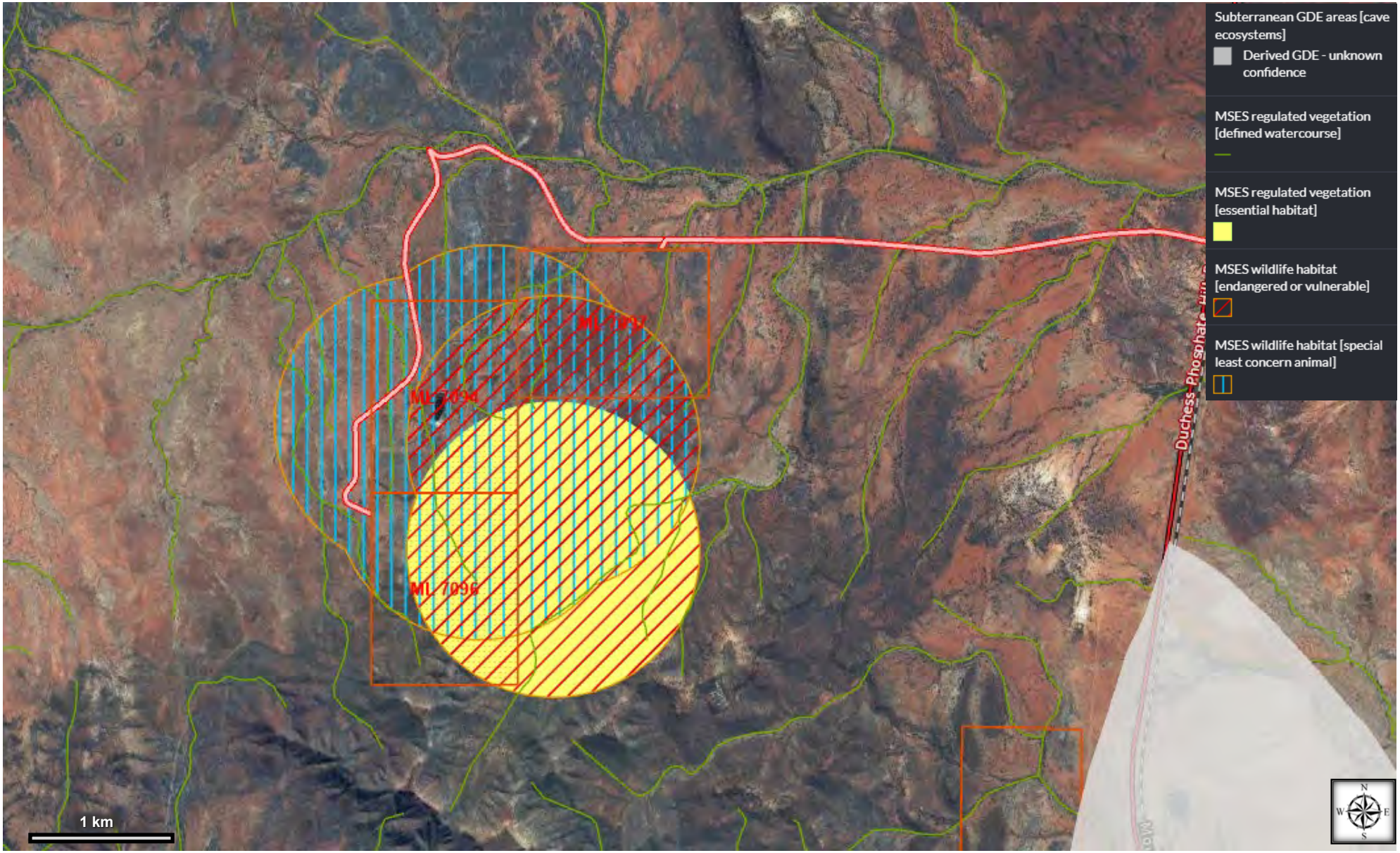
With reference to Groundwater Dependent Ecosystems (GDE) mapping (QldGlobe 2023) the site does not contain a GDE.

The closest off-site GDE is a cave ecosystem of the Devoncourt Limestone located 5 km to the southeast of the site. The GDE is described as a subterranean GDE of unknown confidence. The location of the GDE is shown on **Figure 6**.

Table 3: Registered groundwater bores

Bore ID	Direction from Site^	Distance from Site^ (km)	Installation date	Name	Depth (mbgl)	Screen (mbgl)	Water bearing zone (mbgl)	SWL (mbgl)	Aquifer lithology	Status	Use
RN5179	W	3.82	-	-	-	-	-	-	-	Abandoned & destroyed	Unknown
RN7550	E	5.55	1/1/1920	Prickley Bush Bore	68	Open from 64.9	64.9-68	30.5	Inca Formation	Abandoned & destroyed	Unknown
RN9277	W	0.66	-	-	-	-	-	-	-	Abandoned & destroyed	Unknown
RN184343	SW	0.61	11/1/2020	THGW003	40.5	28-40	30-32	18.7	Corella Formation Granite	Existing	Mine Monitoring
RN184344	S	0.95	11/1/2020	THGW005	42	29-41.5	31-32	18.7	Corella Formation Granite	Existing	Mine Monitoring
RN184345	E	0.16	11/1/2020	THGW006	30	17.5-29.5	20-30	18.5	Corella Formation Granite	Existing	Mine Monitoring
RN184353	N	4.19	11/1/2020	MBWB1	21	-	-	-	-	Abandoned & destroyed	Water supply
RN184352	NE	0.69	11/1/2020	THGW004	27.5	15-27	14.6-27	14.6	Corella Formation Granite	Existing	Mine Monitoring

Note: ^distance and direction taken from mine pit



ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Base map QLD Globe (DNRM, 2023)
Contour interval 10 m

Title: Matters of State Environmental Significance & Groundwater Dependant Ecosystems

Client: Carnaby Resources | Drawn By: A Sheldon | Date: May 2023

Location: Tick Hill Mine, QLD

Figure 6

5.6 Climate and meteorology

Regional meteorological data has been sourced from the Bureau of Meteorology (2023) (www.bom.gov.au, verified 17 May 2023); the Monument Airport weather station (037034 2000 - 2023), approximately 18 km from site. Mean maximum and minimum monthly temperatures and mean monthly rainfall recorded between 2000 and the present are presented in **Table 4**.

Evaporation is taken from climate data for Mount Isa Airport (029127, 1966 - 2023), presented in **Table 5**.

Table 4: Average monthly climate data – The Monument (2000- 2023)

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Max Temp (°C)	37.9	36.9	35.8	32.7	27.7	24.0	24.3	26.9	31.6	35.4	37.2	38.3
Min Temp (°C)	24.8	23.5	21.9	17.4	12.1	8.3	7.2	8.9	13.9	18.4	21.5	23.8
Rain (mm)	64.0	76.1	47.7	12.6	9.4	10.3	8.0	3.3	10.5	12.4	33.1	49.8

Table 5: Average monthly climate data – Mount Isa Airport (1966- 2023)

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Ave Rain (mm)	64.0	76.1	47.7	12.6	9.4	10.3	8.0	3.3	10.5	12.4	33.1	49.8
Decile 9 Rain (mm)	241.8	208.4	171.4	40.6	26.8	23.2	16.1	8.4	26.3	59.3	78.1	152.2
Evap (mm/day)	9.6	8.9	8.9	8.3	6.4	5.3	5.5	6.9	8.9	10.5	11.0	10.5
Evap (mm/month)	297.6	249.2	275.9	249	198.4	159	170.5	213.9	267	325.5	330	325.5
Deficit	-233.6	-173.1	-228.2	-236.4	-189	-148.7	-162.5	-210.6	-256.5	-313.1	-296.9	-275.7

5.7 Sensitive receptors

5.7.1 Sensitive human receptors

To identify sensitive human receptors, a review of the nearest sensitive land use, as defined in the *Planning Regulation 2017* (Queensland Government 2017), was undertaken. No sensitive land uses or receptors were identified within a 500 m radius of the site.

5.7.2 Environmentally sensitive areas

With reference to the Department of Environment and Science 'Environmentally Sensitive Areas (ESA) Map' (see **Appendix C**), the nearest identified ESA to the site is the "Stanbroke Designated Landscape Area (DLA)". This area covers the former Lot 16 on CW62 and is classified as a declared Aboriginal Site under the Relicts Act 1971.

The Stanbroke DLA covers the western area of the site within Lot 16 on SP309110. The DLA is a Category C Environmentally Sensitive Area which extends approximately 70 km east-west and 54 km north-south and surrounds the township of Dajarra.

Four areas mapped as Matters of State Environmental Significance (MSES) occur at or adjacent to the site. These include:

- Essential Habitat: Regulated vegetation map category A or B which covers the limestone hills to the southeast of the mine;
- Wildlife habitat: special least concern, one or more special least concern taxa recorded in locality, which covers the mine and surrounds;
- Wildlife habitat: endangered or vulnerable, one or more critically endangered/ endangered/ vulnerable taxa recorded in the locality which covers the mine and surrounds; and
- Regulated vegetation: defined watercourse, which includes all watercourses within the mine lease area and surrounds.

A map showing the location of MSES in the vicinity of the mine is included as **Figure 6**.

6 SITE HISTORY

The site history review includes a review of historical aerial photographs, site ownership, local and state government registers, previous reports and interviews with relevant persons. The information forthcoming from the review is described separately below.

6.1 Historical aerial photographs

A review of aerial photographs and other available imagery of the site is presented in **Table 6** and aerial photographs are provided in **Appendix E**.

Table 6: Review of aerial photographs

Year	Scale	Notes
1970	1:85,000	Black and white image. No development on site. No roads (Duchess Phosphate Hill Road not present). Small dam in creek 4 km west of future Tick Hill Site.
1981	1:25,000	Black and white image. No development on site.

Year	Scale	Notes
unknown	Aerial photo	Undated photo taken during mine operations. Colour. Image taken from low height looking east across the site. Major mine structures of the pit (centre), tailings and decant dams (front right) and waste rock dump (centre left) are present. Two flat top hills are located east of the mine. A large tank is situated at the base of the northern hill. Between the tank and the tailings dam series of buildings and structures. This image is included as **Figure 3.**
2004	1:80,000	Colour image. Major structures; pit, tailings and decant dams and waste rock dump are visible. Dams and waste rock dump appear to be capped. Tank remains on hill. Other structures have been removed. Dirt tracks into site remain. Pit flooded. Duchess Phosphate Hill Road and Phosphate Hill rail line present to the east of site.
2006	Google Earth	As above, however image clearer. Recent burn scar to vegetation north of pit and waste rock dump. Dark patch on image southwest of tank. Pit flooded.
2017	Satellite	Site as above. Poor quality image not included in appendix.
2018	Google Earth	Site as above. More vegetation growth. Dark patch near tank appears to be dense vegetation.
2020	Satellite	Poor quality image (not included in appendix). Site as above – no disturbance of tailings visible.
2021	Google Earth	Vegetation cleared from eastern tailings cell and northern part of western tailings cell. Excavation occurring in the southern part of eastern tailings cell. Some material stockpiled on the northern end of western tailings cell, however it does not appear to be tailings.
2022	Google Earth	Western tailings cell has stockpiled tailings (white) in the centre and other stockpiles in the north and western side. The eastern tailings cell has been scraped of cover to expose tailings. The southern end appears to have been excavated more deeply. The south-eastern corner is holding water.

6.2 Summary of site ownership and mining activities

A summary of lease ownership of Tick Hill and associated mining activities is presented in **Table 7**. Following the operation of the mine during the 1990s, the site has been subject to further exploration of the resource. From 2020 reprocessing of the tailings was undertaken, with some tailings processed on site and other material taken off site to Lorena Gold Mine near Cloncurry for reprocessing. Specific details related to either the original mine operation or tailings reprocessing relevant to this investigation are discussed further in the remainder of **Section 6**, and **Section 7** below.

Table 7: Mine operations at Tick Hill

Period	Owner	Activity
1991 to 1995	Carpentaria Gold Pty Ltd (MIM Holdings Ltd)	Operation of Tick Hill Gold Mine – Open cut and underground operations with processing on site.
1995 to 2004	MIM Holdings Ltd	Further exploration at Tick Hill.

Period	Owner	Activity
2004 to 2019	Diatreme Resources Ltd	Further exploration at Tick Hill.
2019 to current	Carnaby Resources Pty Ltd	Further exploration of the Tick Hill Resource. Reprocessing of tailings by Blue Cap mining, including transport of tailings to Lorena Gold Mine for extraction.

6.3 Local and state government registers relating to the site

Based on a review of DES's Enforcement Register (DES, 2023), the site has been issued with a notice to conduct or commission and environmental evaluation (EE), reference STAT1399. The EE was issued on the basis "…that an activity or proposed activity on the site is causing or is likely to cause environmental harm." The EE notice is included as **Appendix F**. A response to the EE was submitted by Carnaby Resources, which has been commented on by DES. A response to these comments has also been included in **Appendix F**.

6.4 Previous reports

The following reports and information were provided by the client for review:

- Environmental & Earth Services (1990) Assessment of cyanide decay and acid generation potential of tailings and tailings liquor, Tick Hill. Report to Kinhill Engineers Pty Ltd.
- MIM Holdings (1993) Tick Hill Gold Mine; Visit by ASARCO Directors. Summary of operations as of March 1993.
- Envirofin (2020) Tick Hill Tailings Reclamation Project. EA amendment application supporting information. Report to Carnaby Resources Ltd. 10/08/2020
- Carnaby Resources Ltd (2021) Tick Hill Mining Lease MLs 7094, 7096 & 7097. Initial Development Plan, for period 1 July 2021 to 30 June 2025.
- ATC Williams (2022) Tailings Reclamation Project – Consequence Category Assessment. Tick Hill Mine. Report to Blue Cap Mining, June 2022.
- PA Scott Consulting (2022) Tick Hill Environmental Evaluation Groundwater Geochemistry Report. ML7097, ML7094, ML7096. Environmental Authority EPML00820613. Prepared for Carnaby Resources Pty Ltd, 20 April 2022.

6.4.1 Interviews with relevant site staff

No staff were available for interviews from the original operation of the mine in the early 1990s. Information has been supplied by the current site owner regarding recent and historical site activities and is discussed in **Section 7** where relevant.

6.4.2 Assessment of cyanide degradation and acid generation potential 1990

Tailings liquor material from the site was assessed for cyanide degradation properties and acid generation potential prior to commencement of mining operations.

The cyanide decay study identified initial decay would largely occur due to volatilisation, with relatively low metal concentration not likely to significantly inhibit decay reactions as the majority of cyanide was present as free cyanide. As free cyanide is removed, cyanide decay is then limited by breakdown of metal complexes.

The maximum sulfur concentrations in the tailings material was 0.02% and therefore the material was not considered to have any potential for acid mine drainage (AMD).

6.4.3 Summary of Mine Operations 1993

A summary of mine operations is presented in the MIM Holdings Limited report (1993). At the time of this report the open pit had been mined and underground workings were under development. Schematics of the layout of the open cut and underground workings are shown in **Figures 7 and 8**.

The Tick Hill Gold Deposit was discovered in 1989 and open cut mining commence in 1991. Initially ore was transported off-site for processing. The open cut was 70 m deep and completed in 1992. While the open cut was mined, the infrastructure was under development for the underground mine. This included the vent shaft which joined each level of the underground mine, and the decline which runs off the open cut haul road, 25 m below ground surface.

A processing plant was set up on site, with ore processing involving crushing and milling followed by cyanide leach. Gold was then extracted via electrowinning and smelted in a gas furnace.

Figure 7: Schematic of open cut and planned underground workings (Tick Hill 1993)

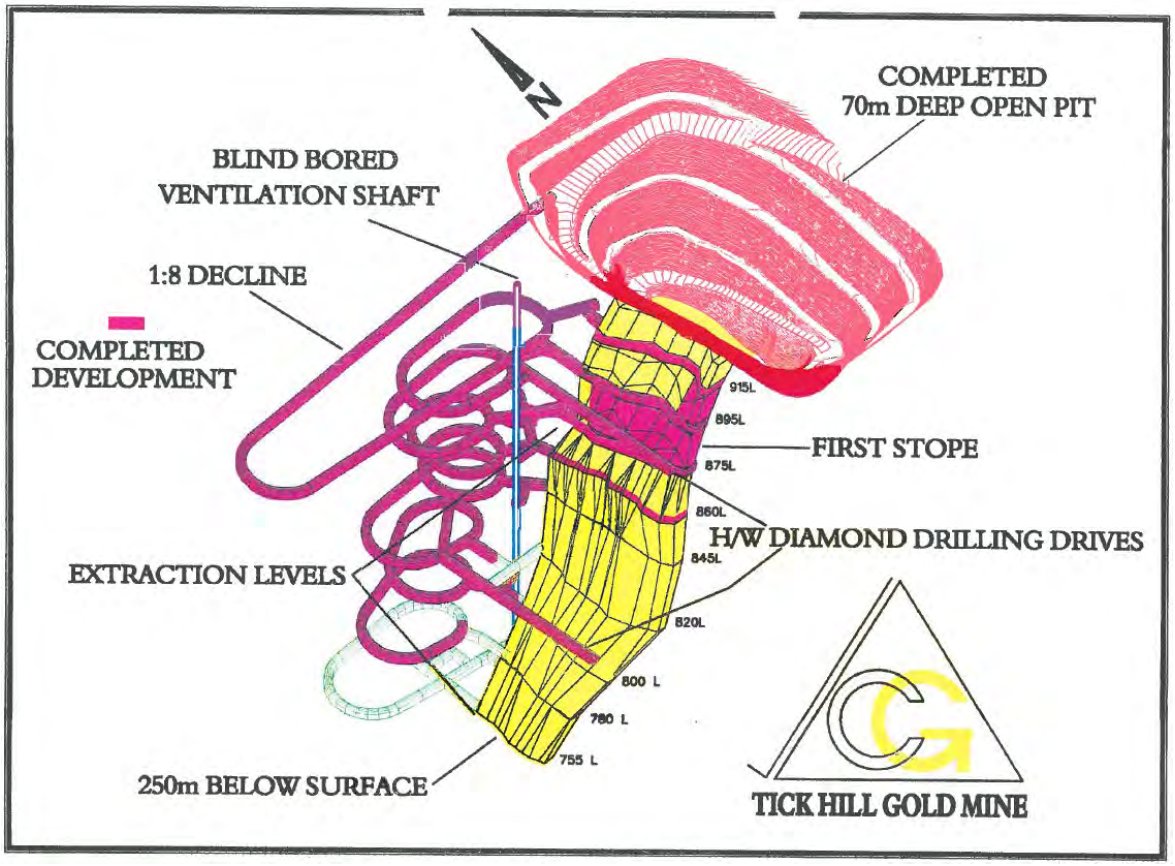
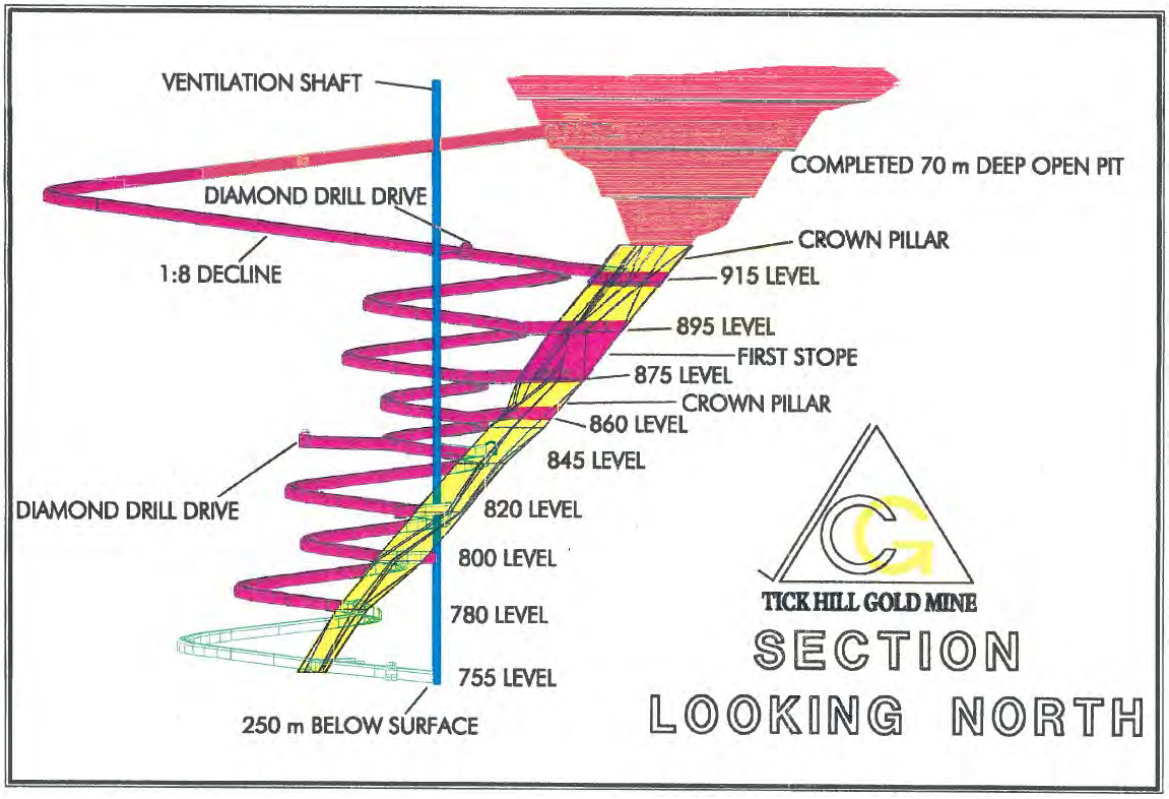


Figure 8: Cross section schematic of open cut and planned underground workings (Tick Hill 1993)



The mine aimed to operate on a total containment basis with no effluents leaving the site. The waste rock dump (WRD) was constructed in lifts of 5 m. The waste rock was assessed as containing no acid generating material or toxic properties. Topsoil from clearing the waste dump area was stockpiled for use as cover on the WRD at completion of operations.

The tailings dams were constructed of waste rock with clay sealant to comply with guidelines at the time of operations. Two tailings cells were constructed with a decant dam for return water. Planned rehabilitation of the tailings involved a waste rock cover and replacement of stockpiled topsoil.

Water for mine operations was pumped from the Pilgrims Creek borefield 15 km to the east of site.

Site staff and contractors lived at The Monument township to the south of Tick Hill.

6.4.4 Tick Hill Tailings Reclamation Project. EA amendment application supporting information 2020

In 2020 a project was developed to reclaim and reprocess tailings from Tick Hill to extract residual gold. The plan involved excavation of dry tailings for transport to a processing facility near Cloncurry. An application to amend the site EA to allow these works was prepared by Envirofin (2020).

The tailings excavation plan involved scrapping of the existing cap from the tailings and excavation of tailings for export for reprocessing. On completion, the remaining tailings were to be re-encapsulated within a smaller cell, thereby reducing the footprint of the tailings cell on site.

The EA amendment application included a summary of existing site conditions and an assessment of potential risks to environmental values, land, surface water, groundwater, air quality, noise and biodiversity at the site.

The assessment identified a potential reduction in impacts associated with cyanide in the tailings as exposure of tailings would result in further breakdown of residual cyanide. Removal of tailings volume would also reduce potential for leaching of cyanide into the surrounding environment. The report includes a discussion on the construction of the tailings dam, which will be presented further in Section 7 below.

The hydrogeological assessment of the site including description of a regolith aquifer beneath the tailings dam and surrounding valley. It is noted that subsequent bore installation near the tailings dam and elsewhere on site showed no evidence of a shallow aquifer of this type.

Characterisation of tailings material was included in the assessment, which focused on presence of cyanide, metals and oxidable sulfur. The investigation found the tailings material was alkaline and did not have the potential for acid generation. Metals concentrations were low, except for moderate concentrations of copper. Residual cyanide was present as total cyanide, with concentrations up to 583 mg/kg, with no detections of free cyanide. Cyanide concentrations increased with depth. The cyanide profile indicates that cyanide has progressively degraded within the tailings cells over the years since mine closure. The free

cyanide pool has been depleted and breakdown of metal-complexed cyanide is occurring at a faster rate closer to the cell surface.

A summary of the limited existing monitoring data for groundwater and surface water is also included in this report.

6.4.5 Tick Hill Mining Lease MLs 7094, 7096 & 7097. Initial Development Plan, for period 1 July 2021 to 30 June 2025

The Initial Development plan provides further detail on the tailings reprocessing project. Between late 2020 and early 2021, approximately 100t of tailings was transported to Lorena Gold Mine, near Cloncurry for reprocessing. Due to the cost of haulage, a gravity separation plant was installed at Tick Hill to process the tailings on site. At the time of the report the gravity plant was undergoing commissioning to optimise gold extraction.

The development plan therefore outlines the planned works on site to extract and process tailings. In addition, it was planned that residual ore in the open pit be mined and processed on site following the tailings reprocessing.

6.4.6 Tailings Reclamation Project – Consequence Category Assessment. Tick Hill Mine 2022

The consequence category assessment (CCA) outlines the proposed works associated with the on-site reprocessing of tailings and provides a risk assessment of potential impacts to human and ecological receptors. This includes assessment of potential for structural failure of loss of containment from site structures.

6.4.7 Tick Hill Environmental Evaluation Groundwater Geochemistry Report. ML7097, ML7094, ML7096. Environmental Authority EPML00820613 2022

The groundwater geochemistry report details the site hydrogeological model, and groundwater monitoring activities conducted to date. This includes assessment of potential impacts associated with cyanide, metals, acid and metalliferous drainage. The report includes available groundwater data along with geochemical characterisation of tailings and waste rock materials.

Of the installed groundwater bores, bores THGW001, THGW003 and THGW004 were described as located in fractured, mineralised host rock, while bores THGW002, THGW005 and THGW006 were in unmineralised host rock.

This assessment identified cyanide impact at bore THGW001, located downgradient of the tailings and decant dams. Concentrations have fluctuated over the period monitored. Cyanide was also detected in bores THGW003 and THGW005 and in the mine pit and mine shaft bore. The source of impact to bores THGW003 and THGW005 was not certain at the time of investigation as these bores were considered to be up and cross gradient from the tailings cell.

The report also discussed the chemistry of the pit water, noting that the pit is consistently three times more saline than the mine shaft bore, which samples water from the underground

workings. The higher salinity in the pit is due to evaporative concentration of water in the pit over time.

6.5 Previous environmental monitoring

6.5.1 Groundwater monitoring

Groundwater monitoring bores on site are summarised in **Table 8** and shown on **Figure 9**. Available borelogs are presented in **Appendix G**.

Two bores, THGW001 and THGW002, are likely to have been installed circa 2012 by Diatreme Resources (**Photo 1**). No installation details are available for these bores. These bores were sampled on six occasions between 2012 and 2017, with typical analysis including major cations and anions, total and dissolved metals and cyanide. These bores were included in the site monitoring program following the installation of four additional bores in 2020.

Four bores, THGW003 to THGW006 were installed by Carnaby Resources in 2020 (**Photo 2**). These bores have been periodically monitored since installation. Installation logs are presented in **Appendix G**. Bores THGW001 to THGW006 were sampled on nine occasions between 2020 and 2022. At this time the mine vent shaft bore was also included in the monitoring program.

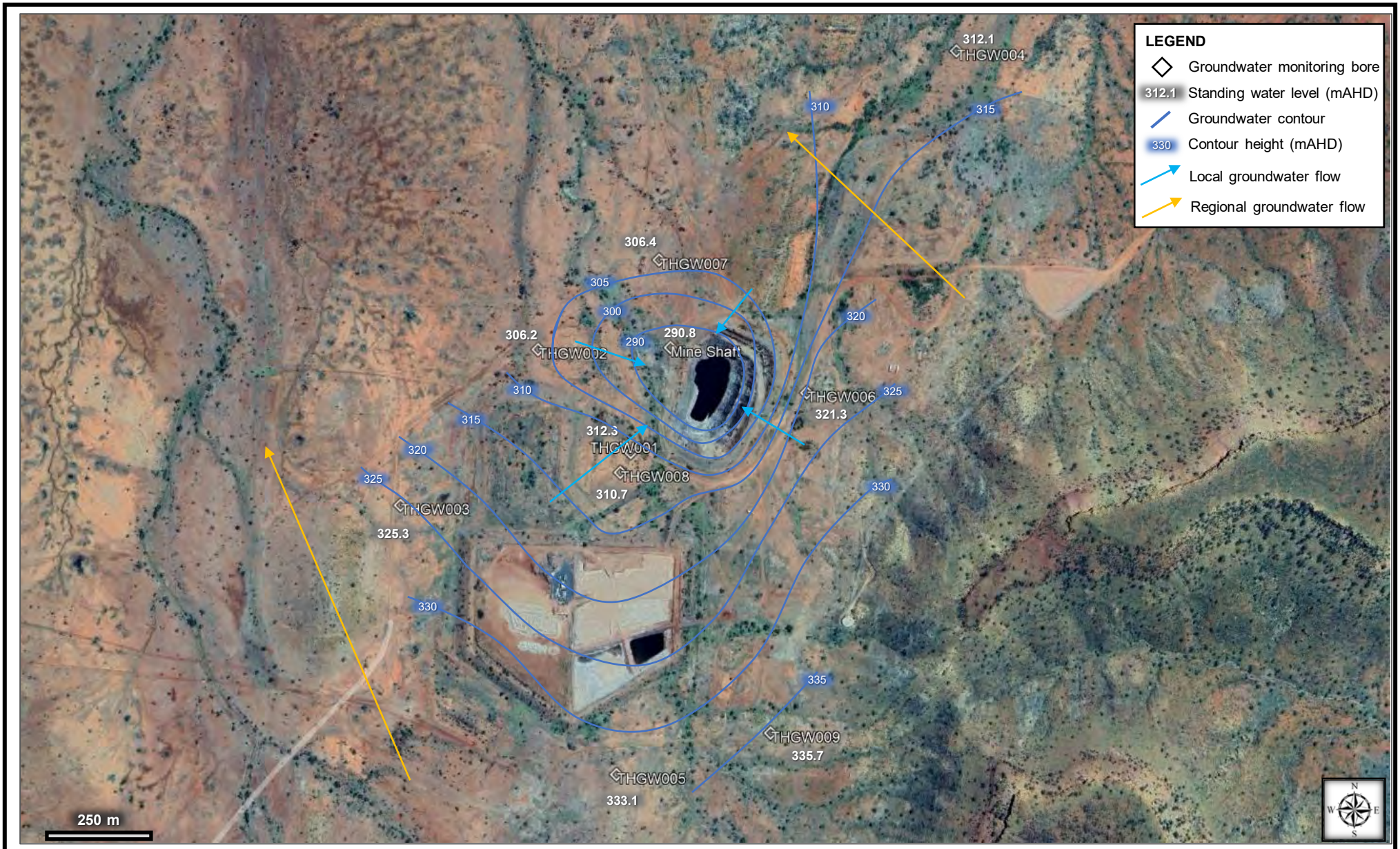
Three groundwater bores, THGW007 to THGW009 were installed in June 2023 as part of this ESA, to address data gaps and further characterise groundwater at the site. One sampling event was conducted in June 2023 for all bores on site.

The mine pit was sampled in 2012, however a collapse of the north western wall removed a section of the haul road which prevented safe access to the water. A sample was collected in 2017, however it is not known how this was collected. In 2020 a flying fox arrangement was set up to allow sampling of the pit using a bailer. The pit was sampled nine times between 2020 and 2022, with both deep and shallow water sampled in June 2020.

Sampling events completed up to February 2022 were conducted by Carnaby, or the site operator at the time. Supplied results have been presented in **Table 37** in the Tables Appendix, which collates all historical results. Relevant results have been incorporated in trend graphs prepared to assess ionic balance, cyanide and metals concentrations over time.

1. Bore THGW001. Bore THGW002 has similar surface structure.

2. Bore THGW004. Bores THGW003 – THGW006 are also installed with monuments.



ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Base map Google Earth (November 2022)

Title: Groundwater monitoring bores with groundwater contours – June 2023

Client: Carnaby Resources | Drawn By: A Sheldon | Date: June 2023

Location: Tick Hill Mine, QLD

Figure 9

Table 8: Groundwater monitoring bore locations

Bore / location	Date	Northing	Easting	Top of Casing (mAHD)	Standpipe (m)	Target
THGW001	2012?	388681.2	7605808	338.23	0.11	Tailings dams
THGW002	2012?	388509.6	7605984	336.75	0.09	Decant dam
THGW003	2020	388276.7	7605699	341.032	0.87	Tailings Dam / western boundary
THGW004	2020	389234	7606544	327.269	0.62	Waste rock dump
THGW005	2020	388678.6	7605240	347.573	0.68	Tailings dam / upgradient
THGW006	2020	388990.1	7605926	337.573	0.65	Pit
THGW007	2023	388718.066	7606151.291	336.603	0.9	Pit / downgradient
THGW008	2023	388664.101	7605772.161	339.336	0.95	Tailings dams
THGW009	2023	388949.397	7605324.585	350.176	0.92	Upgradient
Pit Water	1991	388846	7605967	294	-	Pit
Mine Shaft Bore	1991	388744.3	7605997.7	340.721	-	Underground workings

6.5.2 Surface water monitoring

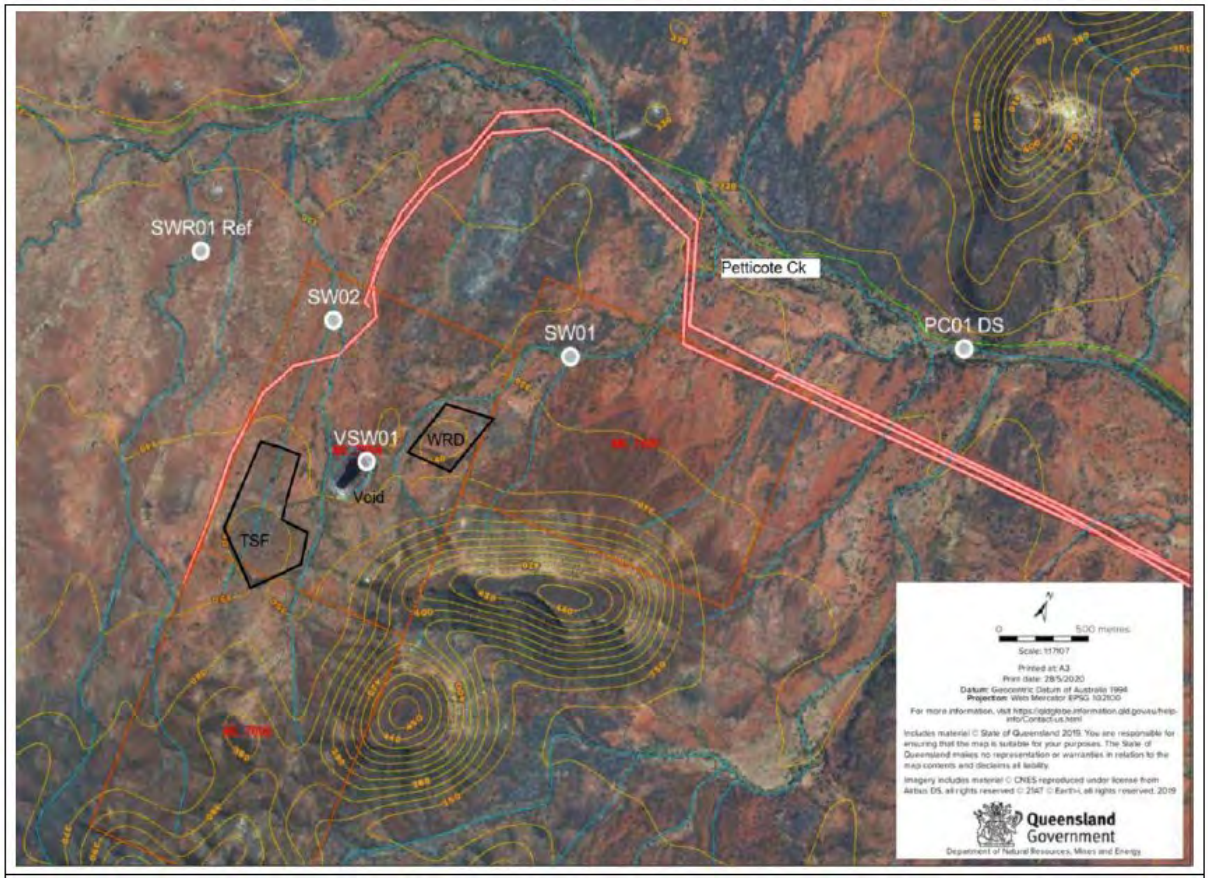
All watercourses on site are ephemeral and flow for a brief period after rainfall, consequently surface water monitoring data was only available from two sampling events, undertaken in 2015 and 2018. Surface water sample locations and their purpose are described in **Table 9** and sample locations presented on **Figure 10**.

All surface water samples were analysed for major anions and cations, nutrients, dissolved and total metals. Results are presented in **Table 38** in the Tables appendix.

Table 9: Summary of surface water monitoring locations

Location	Description	Target
THSWR01 ref	Reference site in neighbouring watercourse to the west of site. Similar conditions to on-site watercourses	Background conditions
THSW01	Ephemeral watercourse to the northeast of site, downstream of waste rock dump	Waste rock dump
THSW02	Ephemeral watercourse to the northwest of site, downstream from the tailings dam, decant dam, open pit and former processing area.	Tailings, decant and mine pit
THSWPC01 DS	Petticoat Creek, downstream of site.	Downstream of site

Figure 10: Surface water monitoring locations



7 SITE CONDITIONS

The investigation works completed between December 2022 and June 2023 included two site visits by Principal Soil Scientist and Suitably Qualified Person (SQP) Dr Anna Sheldon of Environmental Earth Sciences. These site visits occurred on 19-20 December 2022, accompanied by Carnaby Resources Geologist Neill Kite, and on 8-12 June 2023, accompanied by Environmental Earth Sciences' Environmental Scientist Sam Weiss.

The section below collates observations and photographs from these site inspections, along with relevant information from the site history.

7.1 Significant site features

The current site layout of Tick Hill is shown on **Figure 2**, with an inset showing available information on the former site layout during mine operations during the 1990s. The aerial photograph in **Figure 3** also shows the site layout during mine operations.

The mine is located at the foot of a flat topped mesa hill, on a northwest facing slope. Entry to the site is from the Duchess Phosphate Hill Road. The majority of operational structures have been removed from site, with only the major mining structures (open pit, waste rock

dump and tailings and decant dams) remaining. Some infrastructure associated with tailings reclamation works is also present on site.

7.1.1 Open pit

In the centre of the site is the open pit (**Photos 3 and 4**). The pit is elongated north-south, and 70 m deep, with water filling approximately 25 m depth. Water level varies by several meters, depending on rainfall. The former haul road into the pit collapsed in the northwest corner of the pit, preventing access to the water level. The pit rim is higher than the surrounding landscape (**Photo 5**) which means that the pit catchment is limited to the pit excavation boundary.

The area between the pit rim and bund wall drains externally, via gaps in the bund wall. These gaps are placed in locations that are not otherwise accessible so that the bund is still effective in preventing pit access (see **Photo 6**). The bund wall is surrounded by a barbed wire fence with warning signs.

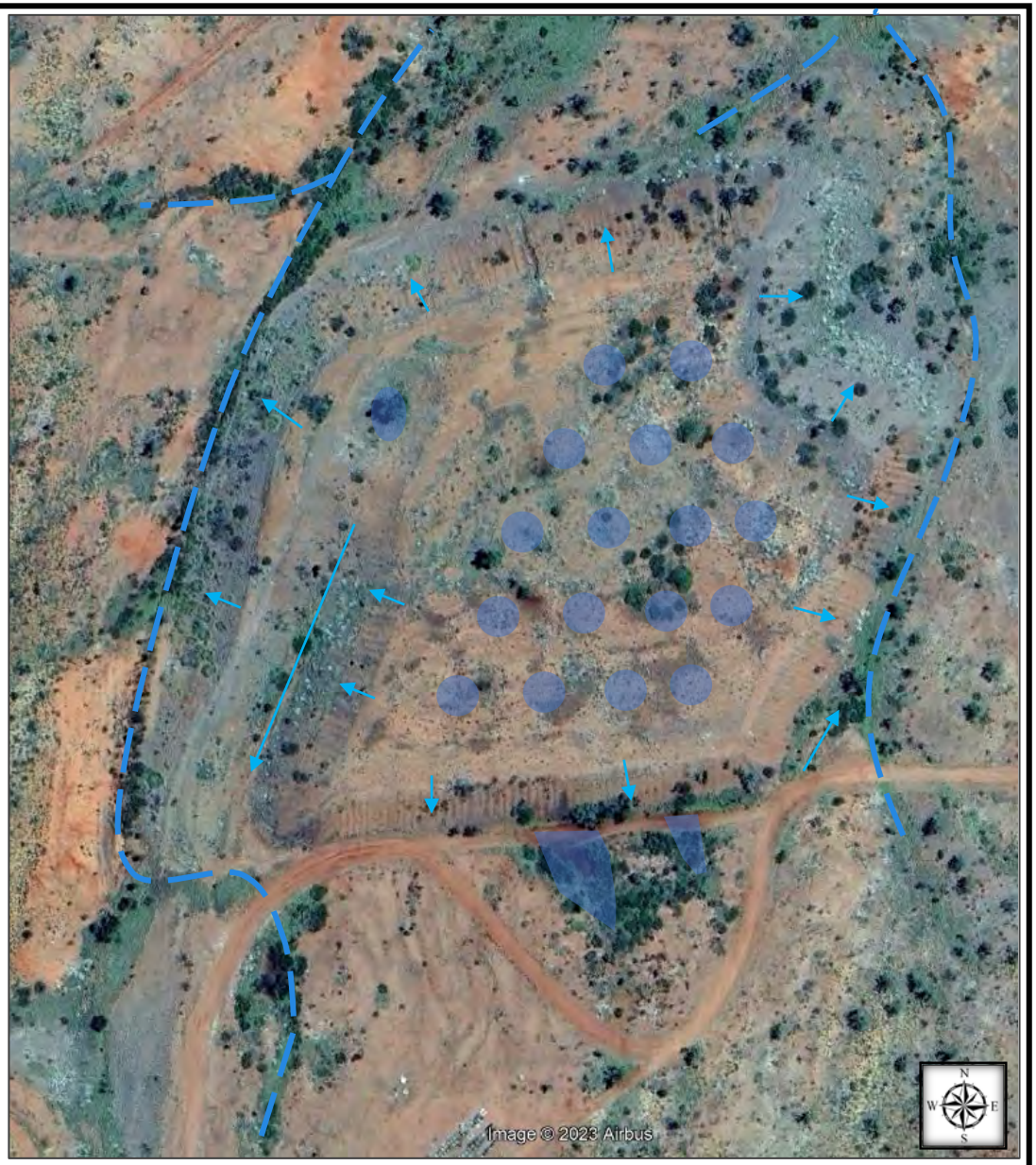
Drainage flows around the open pit are shown on **Figure 11**.

3. Mine open pit – facing south from haul road.

4. Mine open pit – facing west from pit rim. Note collapse of face in north west corner.

5. View of the open pit from the hill to the southeast. Note the raised rim relative to the surrounding landscape.

6. Gap in the bund on the southwestern side to allow drainage from the pit perimeter area.



ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Base map Google Earth (November 2022)

Title: Open pit area and waste rock dump drainage. Observations June 2023. Image November 2022.

Client: Carnaby Resources | Drawn By: A Sheldon | Date: June 2023

Location: Tick Hill Mine, QLD

Figure 11

7.1.2 Waste rock dump (WRD)

The WRD is located northeast of the pit. The WRD is diamond shaped and has a flat top (**Photo 7**). There is a small V in the northeast corner and the former access ramp acts as a drainage line towards the southwest corner.

The WRD was constructed in 5 m lifts and is capped with rock mulch and topsoil. Waste rock material at the mine was assessed as not having potential for acid or metalliferous drainage and waste rock was therefore considered inert.

Observations at the time of the December 2022 and June 2023 inspections indicate that the WRD is stable and becoming integrated into the surrounding landscape. The batters are stable and well vegetated (**Photos 8 and 9**), with one minor (stable) scour observed on the northern side. On the southern (uphill) side of the WRD an area of water ponding was observed adjacent to the WRD, where a minor drainage line meets the WRD (**Photo 10**).

No evidence of scalding or seepage was observed around the perimeter of the WRD.

The top of the WRD is generally flat and well vegetated (**Photos 11 and 12**). The surface of the WRD is slightly uneven, indicating that rainwater will pond and infiltrate. As described above, an area of ponding was also observed at the top of the ramp / drainage line on the WRD during recent site inspections. Drainage flows around the WRD are shown on **Figure 11**.

7. View of the waste rock dump from the hill to the southeast.

8. Waste rock dump batter – north side.

9. Waste rock dump batter – south side.

10. Waste rock dump batter – south side, with area of local ponding at base.

11. Top of waste rock dump showing access ramp / drainage line which flows to the left of the image.

12. Top of waste rock dump showing vegetation and slightly uneven surface.

7.1.3 Tailings Storage Facility (TSF)

The TSF consists of two cells, divided in to east and west with a total capacity of 600,000 m³. The TSF cells are built as a turkey nest dam and designed as Referable dams. The cells have a 500 mm clay liner in the base, and clay core in the walls. The cells range in depth from 6 on the up-slope side to 10 m on the down-slope site. Walls were built with a batter angle of 1:3. The cells have a flat top, and the perimeter embankments are higher than the cell surface. Excess runoff was designed to be directed to a spillway on the northern end of the eastern cell. The cover material was a waste rock mulch covered with topsoil. The cover was not designed or expected to restrict water infiltration. Clay and topsoil used for lining and cover were source from borrow pits and scrapes on site (Envirofin 2020).

At the time of the site inspections the tailings reclamation project had ceased, with the eastern cell remaining open. The entire eastern cell had been removed of cover, and the southern part of the eastern tailings cell had been substantially excavated (**Photo 13**). Stockpiles of tailings were located on the western cell, surrounded by an earth bund (**Photo 14**).

The northern part of the eastern tailings cell had the cover removed but minimal excavation of tailings. Erosion scours indicated flow of surface water to the north, towards the spillway (**Photo 15**). It was not possible to determine visually whether overflow of stormwater from the TSF had occurred. The central part of the eastern tailings cell had been partially excavated, while the southern part was split into two areas. The south-western section was excavated to the base of the tailings cell (**Photo 16**). The south-eastern section was excavated to the base of tailings and a plastic liner installed. This section of the cell was being used for water storage (**Photo 17**). Areas of disturbance and water flow on the tailings and decant dams is shown on **Figure 12**.

On the western cell cover material was stockpiled across the cell. Areas of intermittent ponding were also evident (**Photo 18**). Infrastructure associated with the tailings reclamation work remained on the western tailings cell and water storage cell. This includes a screening for processing tailings (**Photo 19**) and a gravity separation unit (**Photo 20**). Also remaining were two locked shipping containers, a tractor, pumps and generators, empty IBCs for peroxide and other rubbish. Large diameter pipe was also located on and around the tailings cells and from the water supply tank. In areas of the western cell not disturbed by the tailings reclamation project, low scrubby vegetation was well established (**Photo 21**). The TSF batter slopes were vegetated and in good condition (**Photo 22**).

13. TSF from the hill east of site, the eastern cell has been excavated for tailings reclamation.

14. Stockpiled excavated tailings with earth bund on western cell.

15. Northern section of eastern cell – cover removed from tailings, and surface erosion.

16. Southern section of eastern cell where tailings have been excavated to base of cell.

17. Southeast section of eastern cell which has been plastic lined for use as water storage.

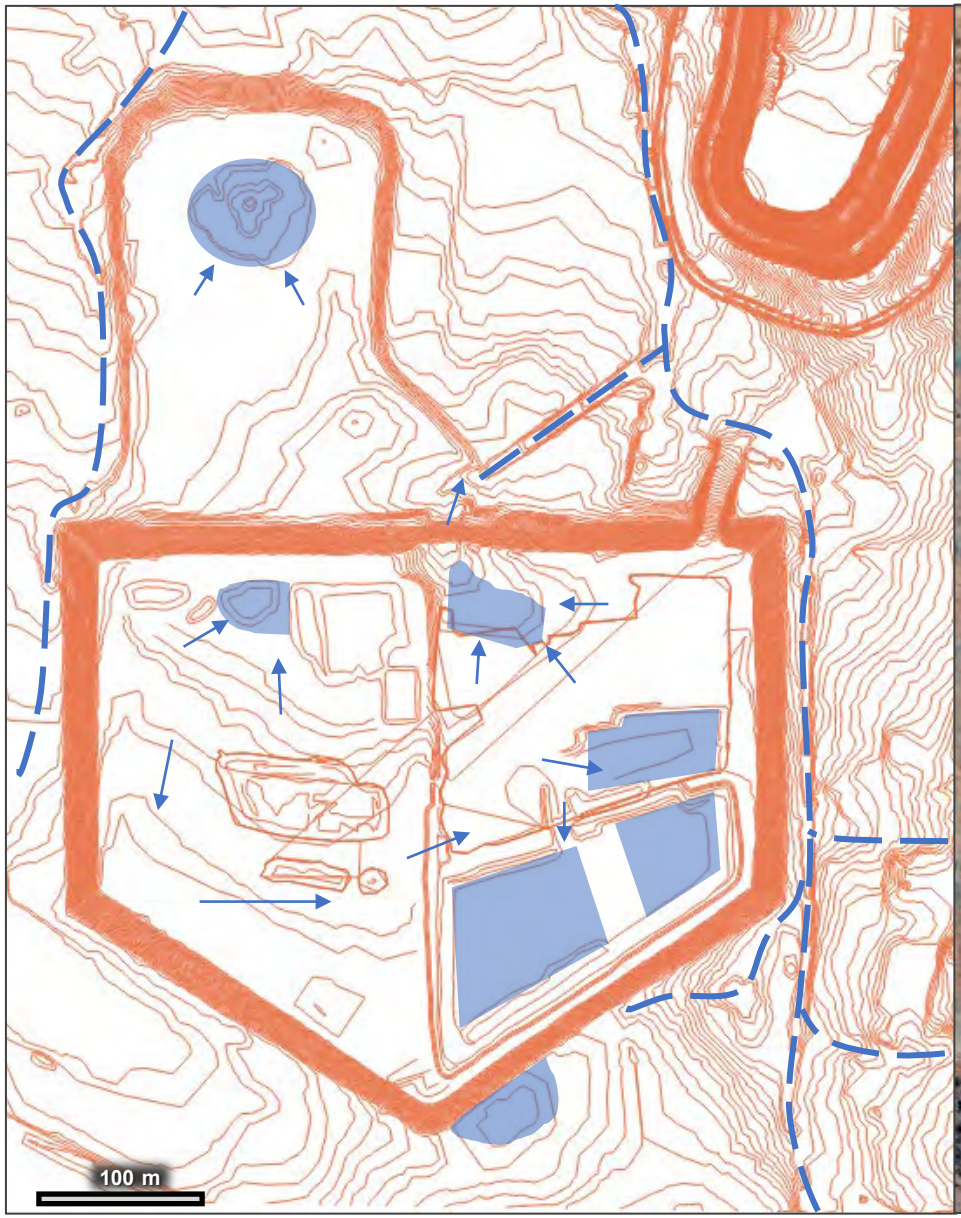
18. Stockpiled cover material and areas where water had ponded on northern end of western cell.

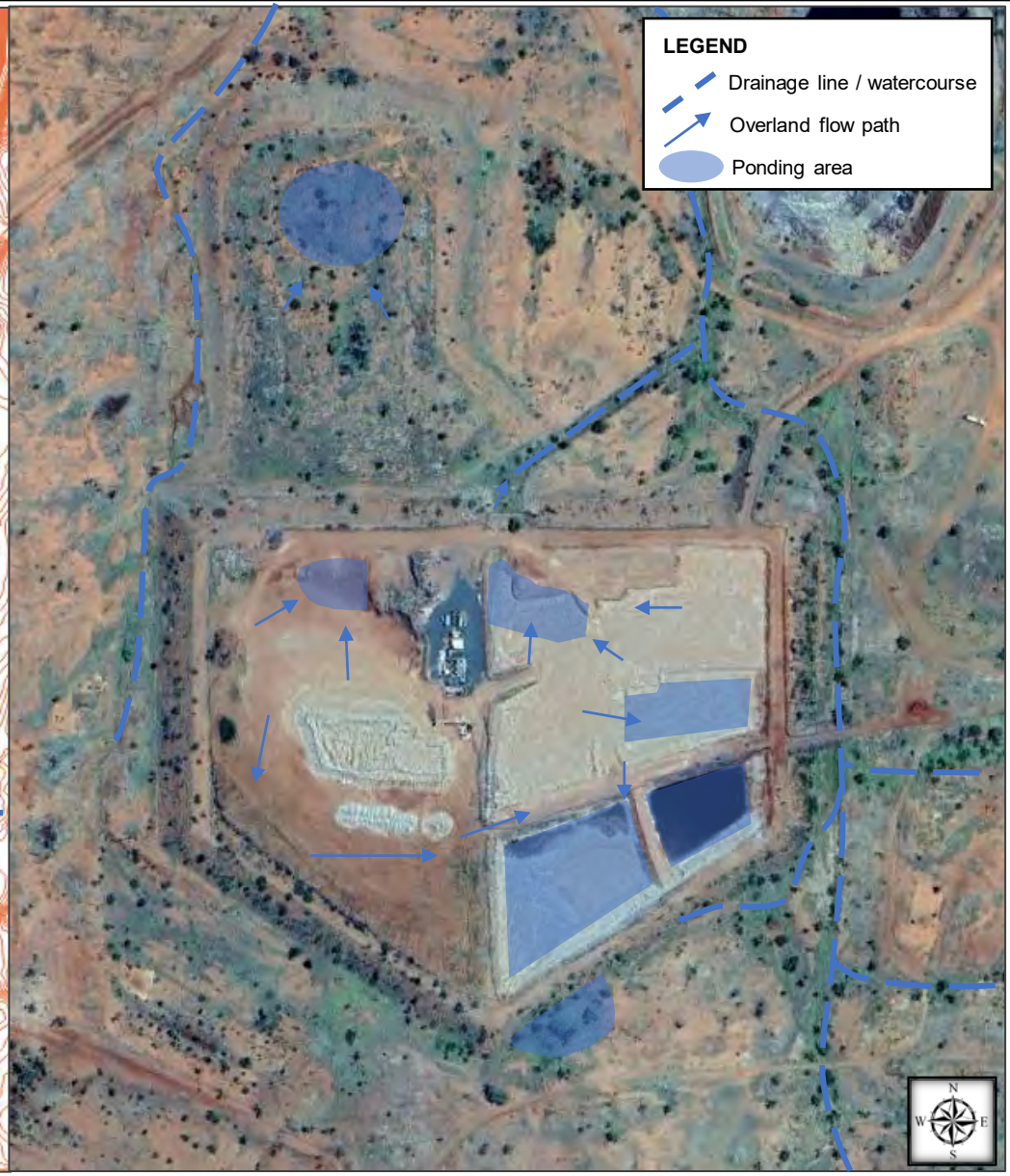
19. Screen used for processing excavated tailings.

20. Gravity separation unit used for processing of excavated tailings.

21. Vegetation on southern part of western tailings cell.

22. Vegetation on southern batter slope of western tailings cell.





ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Base map Google Earth (November 2022)

Title: Tailings and decant dam drainage. Observations June 2023. Image November 2022, contours October 2022.

Client: Carnaby Resources | Drawn By: A Sheldon | Date: June 2023

Location: Tick Hill Mine, QLD

Figure 12

7.1.4 Decant dam

The decant dam was constructed to the same specifications as the TSF, with a capacity of 93,000 m³ (Envirofin 2020). The decant dam perimeter walls were in good condition and well vegetated (**Photo 23**). The decant dam surface has been subject to areas of subsidence (**Photo 24**) and in the northern centre of the dam was an area of tunnelling indicating a preferential flow path for water to enter the decant dam. Water flows on the decant dam are shown on **Figure 12**. Vegetation on the decant dam was well established.

23. Northern wall of decant dam, looking west.

24. Top of decant dam showing uneven surface and areas of subsidence.

7.1.5 Former processing plant area and remaining infrastructure

To the east of the TSF, and up-slope, was the former processing and administration area. The general layout can be estimated based on the diagram showing the site plans (**Figure 2**) and the aerial photograph of the site taking during operations (**Figure 3**).

Uphill of the former processing plant is the site water supply tank (**Photo 25**). This tank remains in use and currently supplies stock water for the surrounding area. Water is sourced from a borefield 15 km east of site.

The slope between the tank and tailings dam has been heavily disturbed, although little direct evidence of the processing plant remains. Landforms were either modified following plant removal or have eroded over time. The area is well vegetated with grass but has notably fewer trees than the surrounding landscape.

To the south west of the tank is a causeway crossing of a gully and a remnant concrete slab (**Photo 26**). This was the only remaining infrastructure observed on the slope. The processing plant area is shown in **Photos 27, 28 and 29**. The processing plant and other site infrastructure were relocated to other mines after closure of Tick Hill.

Further to the north and south of the WRD is the core yard (**Photo 30**). Two shipping containers had been located upslope of the core yard at the time of the December site visit, however these had been removed before the June visit.

The aerial photograph from the time of mine operations indicates that the ROM was located immediately south of the WRD, however nothing remains in this area.

25. Water supply tank. Water is sourced from a borefield 15 km east. Currently used for stock watering.

26. Remnant concrete slab, southwest of the water tank.

27. Processing plant area, looking north.

28. Processing plant area, looking south.

29. Processing plant area, looking west. Tailings dam in background.

30. Core yard, located south of WRD.

7.2 Summary of site conditions

7.2.1 Site activities/ uses

The site is a former gold mine. The mine operated from 1991 to 1995. Further minerals exploration works have been undertaken at the site since mining operations ceased. A project to reclaim and reprocess tailings was undertaken between 2020 and 2022 however this has ceased with the eastern tailings cell remaining open.

7.2.2 Utility infrastructure

The only current utility infrastructure is the water pipeline that supplies the on-site water supply tank. The pipeline runs north east from the tank around the hill. This tank is currently used for suppling stock in the surrounding area.

The previous mining operation would have required electricity and gas. Gas and diesel trucked in to supply the gas furnace and onsite generators.

7.2.3 Building construction, basements and crawl spaces

All site buildings and site infrastructure associated with mining operations has been removed. One concrete slab remains. Two shipping containers remain on the western tailings cell associated with the tailings reclamation project.

Underground workings associated with mine operations were accessed via a portal in the upper haul road from the open pit. On closure the entrance portal to the underground workings was sealed.

7.2.4 Industrial processes carried out on site

During mining operations ore was processed on site. This involved crushing and milling of ore, followed by cyanide leach. Gold was reclaimed from the cyanide leach by electrowinning and smelted into gold bars. Sodium cyanide is the main reagent used in this process.

For the main part of the tailings reclamation project excavated tailings were trucked off site. Due to the cost of trucking, partial processing on site was trialled. This involved gravity separation to remove gold bearing material from the tailings. The separated material was to be taken off site for processing. No chemical extraction was involved in this process.

7.2.5 Chemical storage and transfer areas

All chemicals used in ore processing would have been trucked to site and stored on site. Details of chemical and fuel storage areas during mine operations is not known. However, it is understood the following chemicals would have been stored and used on site:

- Chemicals and reagents associated with the cyanide leach process used to extract gold included sodium cyanide, activated carbon, lime, steel ball, flocculant, antiscalant and activated carbon.
- Reagents used in the extractive section of the process (elution and gold room sections) include hydrochloric acid, caustic soda, borax, potassium nitrate, silica and soda ash (sodium carbonate).
- Explosives for mine operations; and
- Chemicals used during the tailings reprocessing works including diesel fuel and IBCs of peroxide.

7.2.6 Raw materials used

The raw material for the mining operation was the ore mined on site. Excavated tailings was the raw material for the tailings reprocessing activities.

7.2.7 Product spills, losses, incidents, accidents, fires

No information was available regarding spills, losses, incidents, accidents or fires.

7.2.8 Discharges to land and water

The mine aimed to operate as a zero-discharge site, with all mine wastes contained. No information is available regarding spills or discharges that may have occurred during mine operations.

7.2.9 Waste produced and waste storage areas, management practices and disposal areas

The main waste storage areas on site are the WRD, TSF and decant dam, as detailed above. No information is known about disposal of other wastes from site including chemical or putrescible wastes.

7.2.10 Power generation

No power is currently supplied to the site. Power supply during mine operations is not known, however the smelter was gas powered. A diesel supply would have been required for site plant and vehicles.

Recent tailings reclamation work has relied on diesel powered generators. No fuel storage was observed on site.

7.2.11 Historical earthworks and areas of fill

Major earthworks were undertaken associated with mine operations on site including excavation of the open pit and underground workings, construction of the WRD, TSF and decant dam. Around the pit bund walls have been constructed to prevent access. Earthworks were also undertaken to clear topsoil for closure works and construct roads and site access. At closure the WRD, TSF and decant dam were capped and the processing plant decommissioned.

Recent earthworks have involved scrapping capping material from the eastern TSF cell and excavation of tailings material.

7.2.12 Existing monitoring infrastructure

Existing groundwater monitoring infrastructure consisted of six groundwater bores, as described in **Section 6.5.1**. Three additional bores were installed as part of these works.

8 PRELIMINARY CONCEPTUAL SITE MODEL

A conceptual site model (CSM) of the site can be formed by considering the geophysical characteristics at play at the site, the contaminant source, potential receptors and the pathways to the receptors. The CSM, as required by the NEPC (2013), is an iterative process constantly being updated during the investigation process as more information becomes available.

Prior to constructing the exposure component of the CSM, an evaluation of geophysical factors is required. This is best achieved as follows:

1. Define the Physical Environment (**Section 5** above);
2. Define the Waste (Contaminants) and its likely origin (**Sections 6 and 7**);
3. Predict the Interaction of the Waste and the Medium to establish actual and likely modes and velocity of transport (this section); and
4. Define the Receptors that could be exposed on-site (**Section 8.1.3**), and given the outcome of the first three points, the likelihood of Exposure on the Pathways.

8.1 Preliminary receptor pathway evaluation

8.1.1 Sources

Potential sources of contamination identified within the site area include:

- Potential for soil contamination:
    - Release of fuel or chemicals associated with historical mine operations and ore processing;
    - Release of fuel or chemicals associated with recent tailings reprocessing;
    - Release of tailings from the TSF;
- Potential for groundwater contamination;
    - Release of fuel or chemicals associated with historical mine operations and ore processing;
    - Leaching of cyanide, metals or other contaminants from the TSF or WRD.

8.1.2 Pathways

The potential pathways between the sources and human receptors have been identified as:

- Dermal/ inhalation/ ingestion exposure to contaminated soil materials or groundwater for future workers and visitors to the site.

The potential pathways between the sources and environmental receptors have been identified as:

- Direct contact or uptake by flora or terrestrial fauna;
- Overland flow resulting in runoff to local soil and waterways;
- Impacted groundwater migrating towards local waterways; and
- Use of impacted groundwater for stock watering

8.1.3 Receptors

The nearest onsite and offsite human receptors of any potential land contamination are identified as:

- Owners of the neighbouring grazing property and surrounding areas;
- Future site workers involved with demolition and construction works; and
- Future site workers and visitors.

The closest environmental receptors are identified as:

- The watercourses north and west of the site draining to Petticoat Creek; and
- Off-site receptors if building wastes or contaminated soil is poorly characterised or managed.

8.2 Chemicals of Potential Concern

Chemicals of potential concern (CoPC) associated with the identified sources include:

- Cyanide (CN)– cyanide leach process and residual cyanide in tailings;
- heavy metals – metals from within processed ore and tailings, from workshops, batteries and degraded site infrastructure;
- petroleum hydrocarbons (TRH) – with fuel and oil storage;
- benzene, toluene, ethyl benzene, xylenes and naphthalene (BTEXN) – fuel storage;
- per- and poly-fluoroalkyl substances (PFAS) – fire suppression;
- polychlorinated biphenyls (PCBs) – transformer oil;
- organochlorine pesticides (OCPs)– pest control;
- acids, alkalis & other reagents – gold ore processing;
- nitrogen compounds – explosive residue; and
- nutrients in effluent and soil.

9 ADOPTED ASSESSMENT CRITERIA

Environmental Earth Sciences refers to the following guideline values for the assessment of groundwater and surface water quality at Tick Hill.

General:

- NEPC (2013), *Schedule B(1): Guideline on the Investigation Levels for Soil and Groundwater:*
    - Health investigation/screening levels for soil for the protection of Human Health (Public Open Space and Commercial / Industrial).
    - Environmental Investigation/screening levels for the protection of terrestrial ecosystems (Areas of Ecological Significance and Commercial / Industrial).
    - Groundwater Investigation Levels (GILs, Table 1C) for the protection of Aquatic Ecosystems and Drinking Water (including recreation).
- ANZG (2018*) Australian and New Zealand Guidelines for Fresh and Marine Water Quality:*
    - Ecosystems, Agricultural Water quality for irrigation and livestock.
- HEPA (2020) *PFAS National Environmental Management Plan (NEMP) – Version 2.0*. Heads of EPAs Australia and New Zealand, January 2020:
    - Human Health guidelines for drinking water and recreation.
    - Ecological screening values for freshwater; 95% and 99% species protection for slightly to moderate conservation value systems, including consideration of potential for bioaccumulation and biomagnification.
- Environmental (Water and Wetland Biodiversity) Protection Policy (2019): No environmental values and water quality objectives nominated for Lake Eyre catchment (relevant environmental values discussed in Section 5.2.1).

9.1 NEPC (2013)

Results of the site investigation were initially compared with the Tier 1 criteria from the NEPM Schedule B1. For soil human health criteria, HIL-C (public open space) criteria were applied based on the potential for visitors to access the abandoned site in the future. For tailings material, HIL-D (commercial / industrial) criteria were applied as tailings material should be encapsulated into the tailings cells and not accessible by visitors.

9.2 Ecological investigation levels (EILs) for soil

The EILs assigned by NEPC (2013) Schedule B5a - *Guideline on Ecological Risk Assessment* are adopted for this assessment. This guideline presents the methodology for deriving terrestrial EILs using both fresh and aged (i.e. >2 years old) contamination for soil with the following land use types:

- areas of ecological significance;
- urban residential/ public open space; and

- commercial/ industrial.

The methodology has been developed to protect soil processes, soil biota (flora and fauna) and terrestrial invertebrates and vertebrates. The approved land use on the site is commercial/ industrial and hence these EILs have been adopted for this assessment. A summary of information used in EIL calculations is presented in **Appendix D**. Site specific EILs were derived from soil and tailings parameters collected in June 2023.

The values presented for zinc, chromium (III), copper and lead are added contaminant limits (ACLs) based on added concentrations. The EIL is calculated from summing the ACL and the ambient background concentration (ABC) to derive the site-specific soil quality guideline (SQG) taking into account the effect caused by pH, exchangeable cations, iron and total organic carbon in soil that can affect concentration toxicity data (**Table 10**).

For soil, where direct exposure to flora and fauna is possible, screening criteria for areas of ecological significance have been derived. For tailings material, which are intended to be encapsulated within the TSF or decant dam, commercial / industrial screening criteria are derived. It is noted that EILs are typically only applicable to the upper 2 m of the soil profile, except in arid zones where 4 m applies to account for deeper potential rooting depth.

A summary of the EILs for aged contamination in soil (>2 years) for the adopted land use are presented in **Table 11**. EILs for tailings are presented in **Table 12**.

Table 10: Site Specific EIL Calculation Data

Material	CEC	Iron	Organic carbon	pH
-	meq/100g	%	%	-
Soil	16.3	2.28	<0.1	8.69
Tailings	-	1.21	<0.1	9.5

Table 11: Site Specific EILs – Soil

Analyte	Ambient background concentration (mg/kg)[1]	Added contaminant limit (mg/kg)[2]	EIL – Areas of Ecological Significance (mg/kg)
Arsenic	28.1	-	40
Chromium III	459.1	130	589
Copper	48.8	67	116
Nickel	78.6	37	116
Lead	5.6	470	476
Zinc	127.6	120	248

Notes:
1. ambient background concentrations (ABC) were calculated as per Hamon *et al*. (2004).
2. added contaminant limits were determined using Tables 1B(1-5), Schedule B1, NEPC (2013).

Table 12: Site Specific EILs – Tailings

Analyte	Ambient background concentration (mg/kg)[1]	Added contaminant limit (mg/kg)[2]	EIL – Commercial / Industrial (mg/kg)
Arsenic	14.2		160
Chromium III	119.1	310	429
Copper	21.7	140	162
Nickel	31.3	55	86
Lead	4.0	1800	1804
Zinc	45.3	360	405

Notes:
1. ambient background concentrations (ABC) were calculated as per Hamon *et al*. (2004).
2. added contaminant limits were determined using Tables 1B(1-5), Schedule B1, NEPC (2013).

Exceedances of the Tier 1 EIL for copper were observed for tailings material in the decant dam. The concentration of copper in the ASLP leachate was used to determine the bioavailability factor for copper of 0.0119, which allowed derivation of a site specific (Tier 2) copper criteria (for tailings, commercial / industrial land use) of 13,600 mg/kg. No exceedances of the site specific criteria were observed.

9.3 ANZG (2018)

This environmental monitoring program is investigating the potential for groundwater at the Tick Hill mine to be extracted or discharged to surface water (noting that no current use or discharge occurs). Therefore, groundwater and surface water analysis results have been compared with ANZG (2018) trigger values for the protection of 95% of species, with consideration of the slightly to moderately disturbed ecosystem in the area surrounding Tick Hill.

The ANZG (2018) trigger values for the protection of species in various ecosystem settings are based on conservative assumptions, so they are used as an initial basis for comparison. As the potential toxicity and bioavailability of some chemicals is dependent on the pH, organic content and hardness of the water, the ANZG (2018) trigger values also allow for correction of the trigger values based on these parameters.

Heavy metals (cadmium, chromium, lead, nickel and zinc) are potential chemicals of concern for both groundwater and surface water. The trigger values have been corrected for the average surface water hardness using the ANZG (2018) hardness dependent algorithm.

It should be noted that the ANZG (2018) trigger values are directly applicable to surface water quality but are not directly relevant to groundwater quality. In cases where groundwater concentrations exceed ANZG (2018) trigger values, further assessment is required to determine whether a given concentration of an analyte is likely to significantly or detrimentally impact on the receiving water body.

9.4 Summary of Adopted Guideline Values

Reported concentrations have therefore been compared to the following guidelines:

- Human health and ecosystems (NEPC 2013);
- Freshwater Ecosystems (ANZG 2018);
- Per- Poly Fluoroalkyl Substances (PFAS) Guideline Values for human health and freshwater ecosystems (HEPA, 2020)
- Stock water (ANZG 2018); and
- Drinking Water Quality (NHMRC/ NRMMC).

References for relevant guideline values are presented in **Table 13** below. The specific guidance values adopted for the assessment are included in the results tables in the **Tables Appendix**.

Table 13: Adopted Assessment Criteria for Groundwater and Soil

Protected beneficial use	Assessment Criteria
Human health (public access)	NEPC HIL-C public open space
Human health (site works)	NEPC HIL-D public open space
Terrestrial ecosystems (soil)	NEPC EIL – areas of ecological significance
Terrestrial ecosystems (tailings)	NEPC EIL – commercial / industrial
Maintenance of ecosystems, Freshwater	Criteria specified for protection of freshwater ecosystems (95% species protection) in ANZG (2018) and HEPA (2020).
Drinking water	Australian Drinking Water Guidelines (NHMRC / NRMMC 2011) and HEPA (2020).
Stock watering	Those specified for stock watering in ANZG (2018) / Farm supply use

9.5 PFAS Assessment Criteria

For the purposes of the monitoring program, relevant screening criteria relate to concentrations of PFAS in soil, groundwater, surface water (fresh) and biota (refer **Table 14**).

Table 14: Selected Investigation Screening Criteria (PFAS)

Criteria	PFOS[1,2]	∑ PFOS + PFHxS[1]	PFOA[1]
Soil Screening Criteria (mg/kg)			
Human Health: Public Open Space		1	10
Ecological: Indirect exposure	0.01		
Ecological: Direct exposure	1		10

Criteria	PFOS[1,2]	∑ PFOS + PFHxS[1]	PFOA[1]
Water Screening Criteria (µg/L)			
Drinking water		0.07	0.56
95% ecological species protection	0.13		220
99% ecological species protection	0.00023/ 0.0091[2]		19

Notes:
1. PFAS NEMP V2.0 (HEPA, 2020). As per the guidelines, the sum of PFOS and PFHxS includes PFOS only, PFHxS only and then the sum.
2. ANZG (2023)

10 SITE INVESTIGATION METHODOLOGY

A site investigation was undertaken to further characterise the hydrogeological and contaminated land status of the site in response to a request for further information relating to the environmental evaluation (EE) notice for the site. The scope included a background assessment of the site, data gap assessment, two rounds of groundwater monitoring, installation of three additional monitoring bores and soil and tailings assessment.

10.1 Data gap assessment

A data gap assessment was conducted to assess the extent of investigations completed to date and address these in the current investigation. A summary of the data gaps identified is presented in **Table 15** below.

Table 15: Data gap assessment

Data gap / issue	Solution
Site contamination assessment addressed remaining site features rather than potential residual hazards	Conduct a site history review to assess historical site activities to determine what contaminants might remain. Include additional CoPCs in analysis suite.
Site assessments had not considered soil contamination outside the TSF or WRD	Conduct a targeted soil assessment across the site to characterise current contamination status.
Insufficient information to support the conclusion that the open pit is a groundwater sink	Install additional monitoring bores to better characterise site hydrogeology. Improve water balance model of open pit.
Inadequate delineation of the extent of impacts associated with historical mine activities	Further delineation of site conditions and consideration of contaminant concentration trends to determine extent and stability of mine impacts.
Cyanide detected in up and cross gradient bores THGW005 and THGW003.	THGW005 may not be upgradient of former processing plant. Installation of additional bores conducted to provide background bore. Further development of hydrogeological model for site.
Inadequate detail for bore THGW001 to determine cyanide impacts to groundwater at this location	Installation of a paired bore to improved cyanide delineation below the tailings dam.

Data gap / issue	Solution
Inconsistent analysis of CoPCs between waste materials and groundwater	Extend suite of groundwater analysis to account for all CoPCs
Potential irregularities or cross contamination observed in previous monitoring data	Additional sampling with care taken to avoid cross contamination between sample locations.

10.2 Installation of three monitoring bores

Based on review of the available site data, and site observations from the December 2022 site visit, three additional groundwater monitoring bores were installed. A summary of the bore locations and justification is presented in **Table 16**. Bores were installed between 8 and 11 June 2023, using air hammer drilling. Borelogs are presented in **Appendix G**.

The soil layer comprised a red-brown gravelly clay ranged from 3 m at THGW007 on the lower slope to <0.5 m at THGW009 higher on the hill. Heavily weathered rock was encounter to 6 m at THGW009 and 3 m at THGW008. Hard rock was encountered close to the ground surface at THGW009. No evidence of shallow groundwater or weathered zones indicating ephemeral flow were encountered in any of the locations.

In all locations the water bearing lithology was extremely hard with minimal weathering. In bore THGW007, no discernible water strike was identified, however water flowed into the borehole during a pause in drilling at 33 mBGL. For bore THGW008 a water strike at 33.6 mBGL was identified as a reduction in dust produced during drilling. In bore THGW009, a water strike was encountered at 18.5 mBGL, identified as a reduction in dust, which increased to a steady flow over the next 2.5 meters.

Bores THGW008 and THGW009 were considered to have inadequate yield for airlifting and were developed using dedicated bailers. These bores were bailed on several occasions prior to sampling. Bore THGW007 was airlifted until it ran clear. Post drilling, SWLs in bores THGW007 and THGW008 were similar to the height of initial water strike, while SWLs in bore THGW009 had risen higher than the initial water strike, indicating confined conditions.

Observations during drilling indicate that groundwater occurs in fine fractures within the aquifer at depth. Bore yield is highly variable and dependent on the extent of fractures encountered. Groundwater flow paths are therefore likely to be tortuous and follow local pressure gradients along fracture lines rather than directly following the overall groundwater flow direction.

Table 16: Monitoring bore installation

Bore	Location	Justification
THGW007	Northwest of the open pit	Further delineation of groundwater impacts on the “downgradient” side of the open pit.
THGW008	Between the TSF and decant dams and the open pit.	No installation details are available for THGW001 meaning that the cyanide concentrations in this bore are difficult to interpret. A new bore provides information on the aquifer conditions at this location and allows better delineation of the cyanide impacts

Bore	Location	Justification
	Adjacent to THGW001.	
THGW009	South of the former processing plant	Background location not impacted by processing or tailings activities.

10.3 Groundwater and Pit Sampling

Groundwater and pit samples were collected from the 8 existing locations in December 2022 (8 total) and both the original 8 and 3 newly installed groundwater monitoring bores (11 total), in June 2023. These bore locations are shown in **Figure 9**.

The following water sampling methodology was employed for sampling completed by Environmental Earth Sciences. The collection of groundwater samples was undertaken in general accordance with the following publications and guidelines:

- DES (2018), *Monitoring and Sampling Manual.*
- HEPA (2020) *PFAS National Environmental Management Plan – Version 2.0.*

Prior to sampling, depth to SWL was measured an accuracy of ±0.01 m. A 12 V submersible pump and 16 mm class 12 HDPE poly tubing, or waterra with 16 mm class 12 HDPE poly tubing were used to purge and sample monitoring bores Purging involved the removal of a minimum of three bore volumes from each bore or stabilisation of aquifer parameters, whichever occurred first.

For bores THGW001, THGW002, THGW007 and THGW008 where the water levels were too deep to pump, disposable bailers were used. Monitoring bores were allowed to recharge before groundwater samples were collected and transferred to appropriately preserved and labelled sampling containers.

Field pH, temperature, redox potential (Eh), dissolved oxygen (DO) and electrical conductivity (EC) were measured using a YSI multi parameter water quality meter (WQM), which was calibrated prior to use. WQM calibration certificates are presented in **Appendix H**.

All non-dedicated sampling equipment was decontaminated prior to sampling each location, and between bores, using PFAS free decontamination solution. Water samples were collected in laboratory-supplied sampling containers appropriate for the specific analysis to be conducted. Samples collected for PFAS analysis were collected in accordance with the recommended sampling procedure as per HEPA (2020). A rinsate blank sample was collected from decontaminated sampling equipment at the completion of the sampling program.

All samples were:

- Filled from the base to remove all air;
- Stored in a chilled cooler (on ice) in the dark; and

- Delivered to the laboratory within 24 hours.

10.4 Hydraulic testing of groundwater bores

In order to assess potential infiltration and migration of groundwater at the site, along with potential impacts to receptors at points of groundwater discharge, hydraulic testing was conducted on two groundwater bores, THGW005 and THGW006.

Following sampling at each bore, a pressure transducer logger (diver) was installed into the bore and the bore pumped to extract water to be used for a slug test (falling head test). Following extraction of the required amount of water, the pump was removed and water levels were then allowed to recover, as a rising head test. Water pumped from the bore was then used to fill the bore to the top of casing, allowing a falling head test to be conducted. This process was repeated for two rounds for each bore.

Results of the hydraulic testing were used to calculate the hydraulic conductivity (K) values used in modelling and are presented in **Section 11.4** below (and **Appendix J**).

10.5 Soil investigation

The soil investigation involved sampling of soil from current or former work areas at the site, and in drainage lines subject to impact from upstream activities. Sample locations are shown **Figure 13** and detailed in **Table 17**. Samples from drainage lines were treated as soil rather than sediment as the watercourses are ephemeral and rarely inundated. Samples were collected using a hand auger.

Table 17: Soil investigation locations

Location	Type	Rationale
THS01	Sediment	Base of spillway of TSF
THS02	Sediment	Drainage line downstream of TSF and processing
THS03	Sediment	Ponded area at foot of TSF wall
THS04	Sediment	Drainage line upgradient of site
THS05	Sediment	Junction of drainage line between processing and TSF
THS06	Sediment	Junction of drainage line between processing and TSF
THS07	Sediment	Drainage line downstream of TSF and processing
THS08 – THS11	Soil	Depressions or drainage lines within the former processing plant area
THS12	Sediment	Drainage line on site boundary – downstream of TSF, processing and open pit.
THS13	Soil	Foot of decant dam
THS14	Soil	Core yard
THS15	Soil	Foot of waste rock dump wall

10.6 Tailings assessment

Tailings sample locations are shown on **Figure 14**. Samples THT01 to THT08 were collected from the eastern tailings cell using a hand auger. Samples THT09 to THT11 were collected from the western tailings cell using a push tube. Samples THTSF_DEC01 and THTSF_DEC02 were collected from the decant dam by Carnaby Resources using an excavator.

The tailings assessment aimed to characterise the nature of the tailings material in the three areas.

The following observations were made:

- Tailings material in the eastern cell and decant dam is brown and appears more oxidised than tailings material in the western cell.
- Material is finely bedded with sandy and clayey layers.
- Within the western cell more clay was observed in the northern and western locations (further from the release point).
- Tailings was saturated at depth, between 4 and 5 m.
- Rocky mulch cover on the western cell ranged from 0.7 to 1.0 m.
- Distinct topsoil cover of 0.1 m was observed in one location.

10.7 Laboratory Analysis

Samples were analysed by ALS Environmental (ALS), Eurofins and Sydney Analytical Laboratories (SAL). All laboratories are accredited with the National Association of Testing Authorities (NATA) for the methods used. Intra-laboratory duplicates (blind duplicates) and inter-laboratory duplicates (split duplicate) were analysed as part of our standard QA/ QC procedure at a rate of one blind duplicate and split duplicate per 10 samples for groundwater and one blind duplicate and split duplicate per 20 samples for soil or tailings.

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Base map Google Earth (November 2022)

Title: Soil and sediment sampling locations – June 2023

Client: Carnaby Resources | Drawn By: A Sheldon | Date: June 2023

Location: Tick Hill Mine, QLD

Figure 13

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Base map Google Earth (November 2022)

Title: Tailings and decant sampling locations – June 2023

Client: Carnaby Resources | Drawn By: A Sheldon | Date: June 2023

Location: Tick Hill Mine, QLD

Figure 14

10.7.1 Analytical Schedule

The analytical schedule was chosen based on the contaminants of concern identified and is summarised in **Table 18** below. Laboratory transcripts are provided in **Appendix I**.

Table 18: Project Analytical Schedule

Analyte	No. of Samples	No. of Intra-lab Duplicates	No. of Inter-lab Duplicates	Project Total
Groundwater				
Metals – Totals (extended suite)	20	2	2	24
Metals – Dissolved (extended suite)	20	2	2	24
Ionic Balance	20	2	2	24
Total, Free and Weak Acid Dissociable Cyanide	20	2	2	24
Total Phosphorus	11	1	1	13
PFAS	11	1	1	13
Total Recoverable Hydrocarbons	11*	1	1	13
BTEXN	11	1	1	13
Soil				
Metals (extended suite)	8	1	1	10
Total, Free and Weak Acid Dissociable Cyanide	11	1		12
Total Phosphorus	5			5
PFAS	3			3
Total Recoverable Hydrocarbons	5			5
BTEXN	5			5
pH, EC	8		1	8
Cation Exchange Capacity	3			3
Total Organic Carbon	1			1
Chromium Reducible Sulfur	3			3
Organochlorine Pesticides	4			4
PCB	4			4
Tailings & Decant				
Metals (extended suite)	24	1	1	26
Total, Free and Weak Acid Dissociable Cyanide	28	1	1	30
Total Phosphorus	3			3

Analyte	No. of Samples	No. of Intra-lab Duplicates	No. of Inter-lab Duplicates	Project Total
PFAS	2			2
pH, EC	8			8
Chromium Reducible Sulfur	23			23
ASLP Leach + metals analysis	21			21
ALSP Leach + cyanide analysis	34			34

10.7.2 Quality Assurance and Quality Control

Quality control is achieved by using NATA registered laboratories using ASTM standard methods supported by internal duplicates, the checking of high, abnormal or otherwise anomalous results against background and other chemical results for the sample concerned.

Quality assurance is achieved by confirming that field results, or anticipated results based upon comparison with field observations, are consistent with laboratory results. Also, that sampling methods are uniform and that decontamination of sampling equipment is thorough. In addition, the laboratory undertakes additional duplicate analysis as part of their internal quality assurance program on the basis of one duplicate analysis for every 10 (water) or 20 (soil) samples analysed.

Field observations are compared with laboratory results when they are not as expected. Confirmation, re-sampling and re-analysis of a sample are undertaken if the results are not consistent with field observations and/or measurements. In addition, field duplicate sample results have to be within the acceptable range of reproducibility.

A discussion of the quality of internal laboratory results and field duplicate relative percentage difference (RPD) calculations is presented below. RPD calculations are presented in **Table 35**.

The overall assessment of the data quality is as follows:

- Analysis holding time breaches were present during all monitoring rounds for pH. However, as pH is measured in the field prior to sampling in the field data quality and the ability to assess the site contamination status is not considered to have been compromised;
- RPDs were identified with four RPD exceedances for each of the groundwater QAQC sets, one for the soil sample and nine for tailings. Results indicate some heterogeneity in the tailings material, and oxidation of the split samples for groundwater. Overall correlation between primary, duplicate and split samples is good;
- Field observations and measurements were generally comparable to laboratory data;
- Internal laboratory quality data is considered acceptable;
- The use of field instruments was acceptable;

- Decontamination procedures are considered acceptable based on no detections of CoPCs in rinsate samples (**Table 36**); and
- The dataset as a whole is considered reliable.

11 RESULTS AND DISCUSSION

11.1 Groundwater results

Two rounds of groundwater monitoring were completed as part of this investigation, in December 2022 and June 2023. Results have been interpreted with consideration of historical monitoring results available. This includes data from 2012 for bores THGW001 and THGW002, and from 2020 for the remaining bores. Bores THGW007 to THGW009 were installed in June 2023 and have been sampled once.

Field parameters from the two recent monitoring rounds are presented in **Table 26** of the Tables appendix. Results for ionic balance and cyanide are presented in **Table 27**, dissolved metals in **Table 28** and Total metals in **Table 29**. Total recoverable hydrocarbons (TRH), BTEXN and PFAS results are presented in **Table 30**. All available historical results are collated in **Table 37**. One sample was also collected from the water ponded in the TSF in December 2022.

11.1.1 Field parameters

As shown in **Table 26**, groundwater at the site is neutral to slightly alkaline, with pit water and mine shaft bore slightly to moderately alkaline. Groundwater salinity ranges from low in bore THGW002 and THGW009 to moderate to high in other site bores, and the mine shaft bore. The pit is highly saline. The EC of the mine pit and mine shaft bore have fluctuated, however the pit is consistently 2.5 times the EC of the mine shaft. Redox conditions and dissolved oxygen concentrations indicate that conditions are mostly oxidising within the aquifer.

11.1.2 Water levels

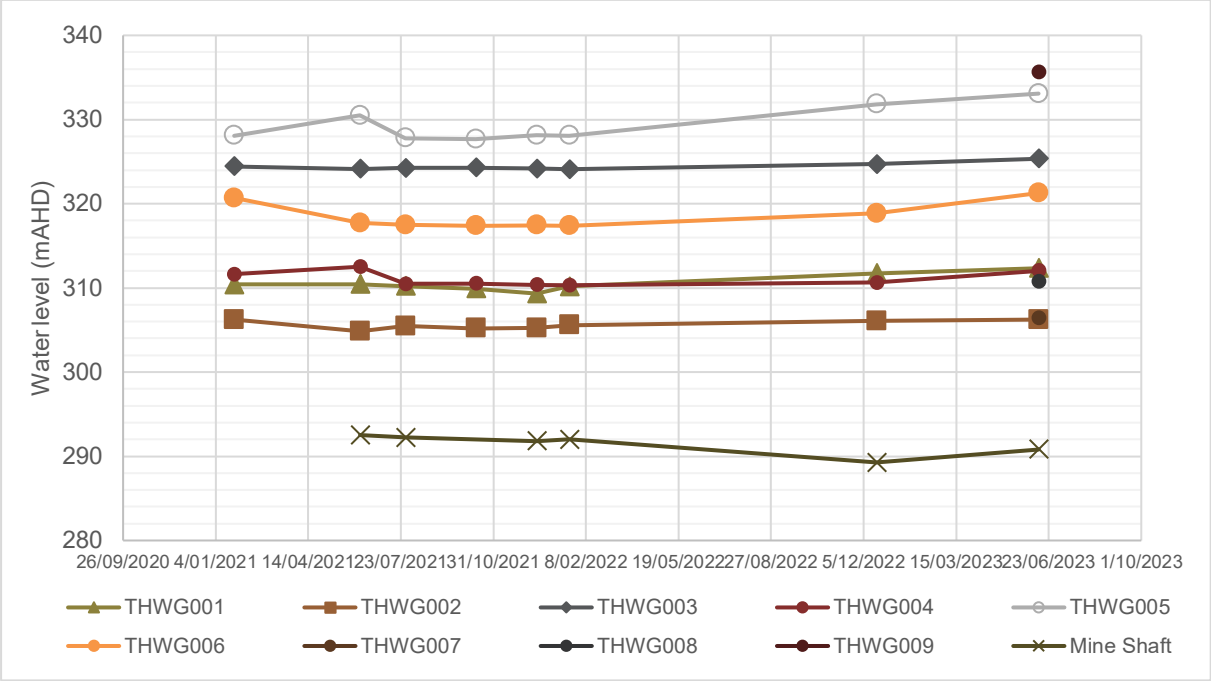
Water levels in groundwater bores and the mine shaft bore have been tracked since 2020. The mine shaft bore measures water levels within the underground workings, which are considered to be in direct connectivity with the open pit. The mine shaft bore is therefore taken as a proxy for the water level in the open pit as no direct way of measuring the pit water level is available. Water levels since 2020 are shown on **Graph 1**.

Groundwater levels have varied between 1.2 m (bore THGW003) and 5.4 m (bore THGW005) over this period. Water levels in June 2023 are higher than previously observed (since 2020), except in the pit, where water level decreased to December 2022 and subsequently increased.

Based on the SWLs measured in site bores in June 2023 and survey data provided by Carnaby Resources, groundwater contours were developed for the site. These are shown on **Figure 9** with the monitoring bore locations. The groundwater contours show the influence of the pit as a sink within the centre of the site. The hydraulic gradient from the pit

to the east (bore THGW006) is steep, while the gradient to the west is more gradual. The contours to the west show the potential influence of the underground workings in providing a preferential pathway from the aquifer to the mine pit.

Graph 1. Standing water levels – groundwater bores

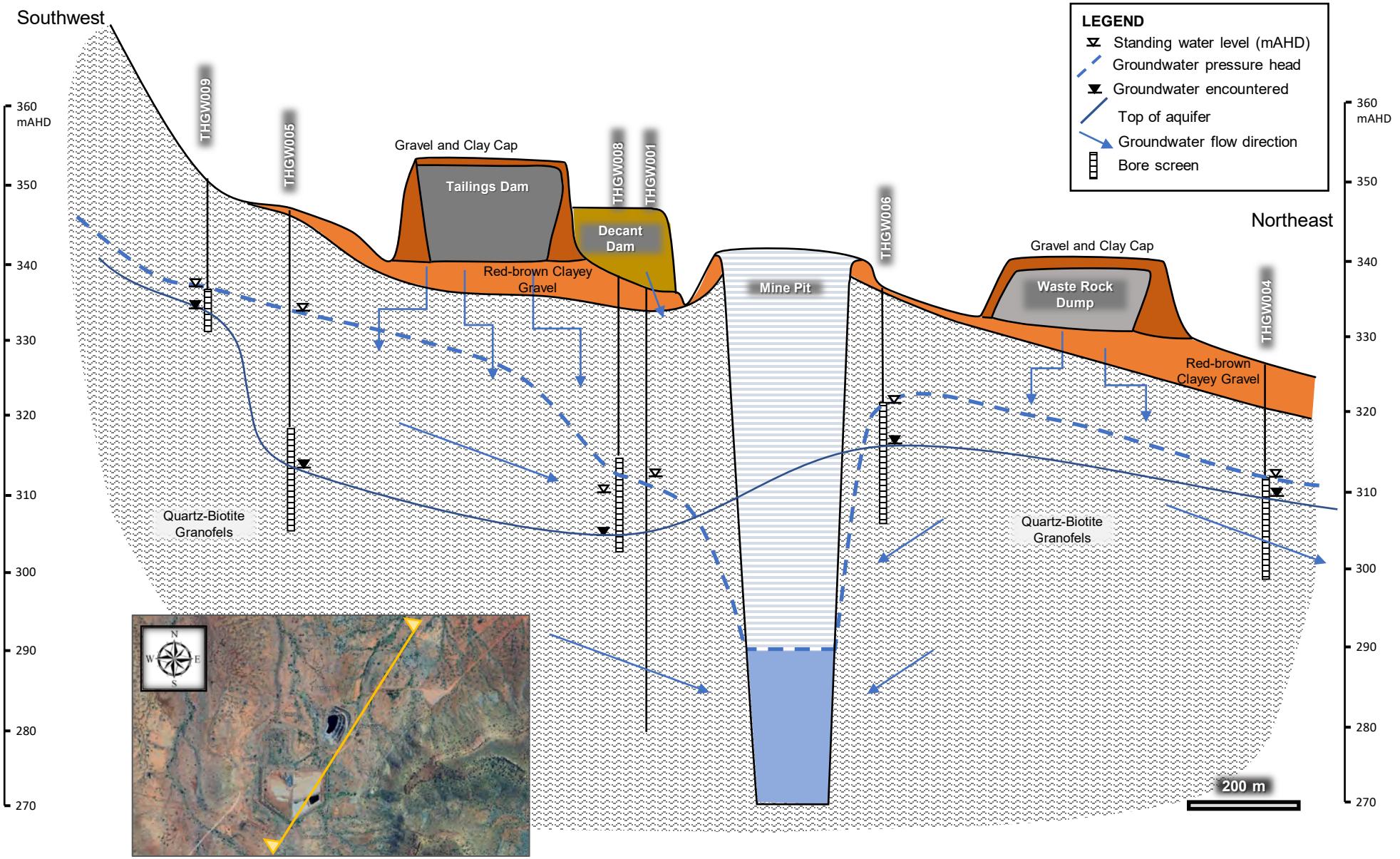


Two cross sections have been prepared to show the influence of the mine pit on groundwater at the site. These run southwest to northeast (**Figure 15**) and northwest to southeast (**Figure 16**).

11.1.3 Ionic balance

Groundwater at the site is Na(Mg):Cl/HCO_3 dominated. Water is relatively elevated in fluoride. Nitrate was detected in all locations except the mine shaft, as were low concentrations of ammonia. Phosphate was detected in varying concentrations across the site. Nitrate, ammonia and phosphate have only been included in monitoring since December 2023, so trend analysis is not possible.

Water chemistry for all bores (June 2023) is shown on the Schoeller Plot in **Graph A1** in the Graphs appendix. This graph includes chemistry for rainwater and seawater for comparison.



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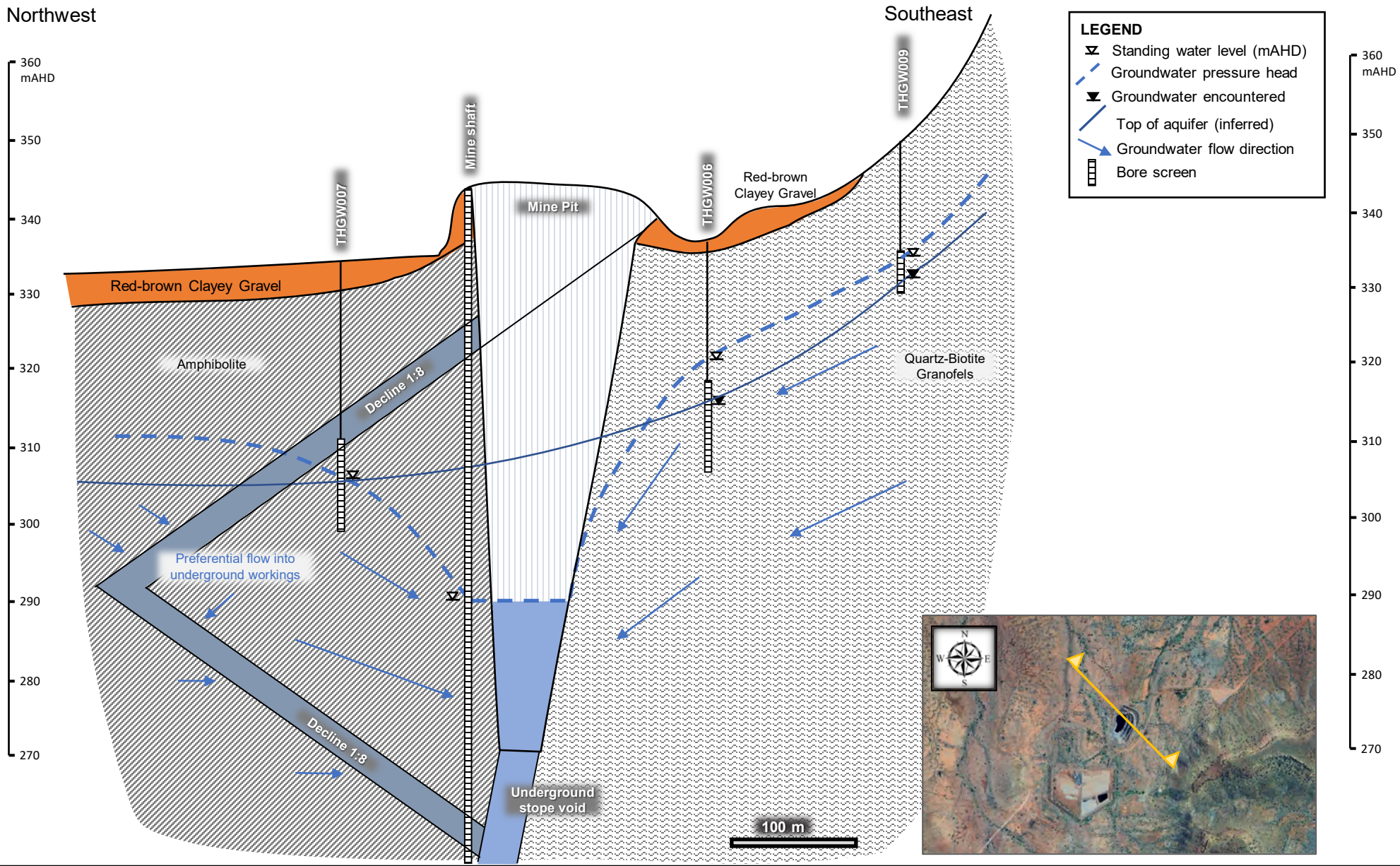
Base map Google Earth (November 2022)

Title: Conceptual Cross Section Southwest-Northeast – June 2023

Client: Carnaby Resources | Drawn By: A Sheldon | Date: June 2023 | Location: Tick Hill Mine, QLD

Figure 15



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Base map Google Earth (November 2022)

Title: Conceptual Cross Section Northwest-Southeast – June 2023

Client: Carnaby Resources | Drawn By: A Sheldon | Date: June 2023 | Location: Tick Hill Mine, QLD

Figure 16

Water chemistry over the period of monitoring has been presented for each bore, the mine shaft and pit in **Graphs A2 to A9**, with the exception of newly installed bores THGW007 to THGW009. A summary of observations is presented below:

- THGW001: Water is Na:Cl dominated. Water chemistry is consistent over time.
- THGW002: Water is Na:HCO_3 dominated. Salinity is stable until late 2021 when a sharp decrease occurred. This trend is observed for all major ions except sulfate. Sulfate concentrations were initially low (2012) but increased until 2014. Concentrations steadily decreased until a sharp decrease in 2021. Concentrations have subsequently increased and appear to have stabilised. Sulfate is utilised as an oxygen source by microbes. This fluctuation indicates that microbial activity is occurring to break down some compounds in groundwater at this location. The change in salinity from 2021 indicates that a fresher source of groundwater or surface water inflow is influencing chemistry in this location.
- THGW003: Water is Na:HCO_3 dominated. Chemistry is stable over time, with a decease in potassium the only significant trend.
- THGW004: Water is Na:HCO_3 dominated. Chemistry is stable over time, with the exception of a slight fluctuation in 2021.
- THGW005: Water is Na:HCO_3 dominated. No trends in water chemistry are observed.
- THGW006: Water is Na:HCO_3 dominated. No trends in water chemistry are observed.
- Mine shaft: Water is Na:Cl dominated. No trends in water chemistry are observed.
- Pit: Water is Na:Cl dominated. Concentrations of major ions increase steadily over time, however have remained relatively steady since 2021.

Exceedances of relevant criteria for human health, ecological species protection and stock watering are shown with the water chemistry data. A brief summary is provided below. For details of exceedances for specific analytes in specific bores, refer to the results tables.

Drinking water criteria were exceeded for pH, salinity (TDS), chloride, sodium, fluoride, ammonia and nitrate. Ecological criteria were exceeded for ammonia and nitrate while stock watering criteria were exceeded for fluoride.

Salinity and fluoride are considered to be naturally occurring. Water would require treatment to remove salinity to enable suitability for drinking. Slight exceedances of fluoride are considered acceptable for stock if other water sources are available.

Several potential sources of nitrate and ammonia are present on site. The highest nitrate concentrations are downgradient of the WRD and TSF (THGW001, THGW004 and THGW08). Ammonium nitrate is a commonly used explosive, and explosive residues in mine wastes is a likely source. Concentrations of nitrate and ammonia are similar between December 2022 and June 2023 monitoring events and no trends are currently evident. Ammonia and nitrate may also be present in an aquifer due to natural contributions from nitrogen fixing plants, where nitrogen is leached from the soil. Many arid zone plants are nitrogen fixing including wattles and gidgee, which are present across the site.

Ecological screening criteria for nitrogen in surface water relate to potential for eutrophication of waterways and toxicity of ammonia. As no surface expression of groundwater occurs at the site (other than the open pit), there is no complete pathway for ecological exposure. Concentrations of ammonia and nitrate in the open pit are below screening criteria. It is recommended that ammonia and nitrate be retained in future analysis suites for groundwater.

Due to elevated concentrations of phosphorus identified in tailings materials, total phosphorus and phosphate have been included in the groundwater analysis suite. Phosphate is considered the available form of P, while total P is mostly related to occurrence of P containing minerals. Phosphate concentrations are close to the LOR, with slightly higher concentrations in THGW002, and newly installed bores THGW007 to THGW009 which were observed to contain higher sediment load than other bores due to recent installation and development. Total P concentrations were also correlated with observed turbidity in samples.

There are no ANZG criteria for total P or phosphate and therefore no exceedances were observed.

11.1.4 Cyanide

Due to the presence of cyanide in mine tailings, cyanide has been included in the monitoring suite for groundwater since the commencement of monitoring. Cyanide in groundwater on site occurs as total cyanide. Free and weak acid dissociable (WAD) are generally not detected. The discussion therefore focuses on total cyanide.

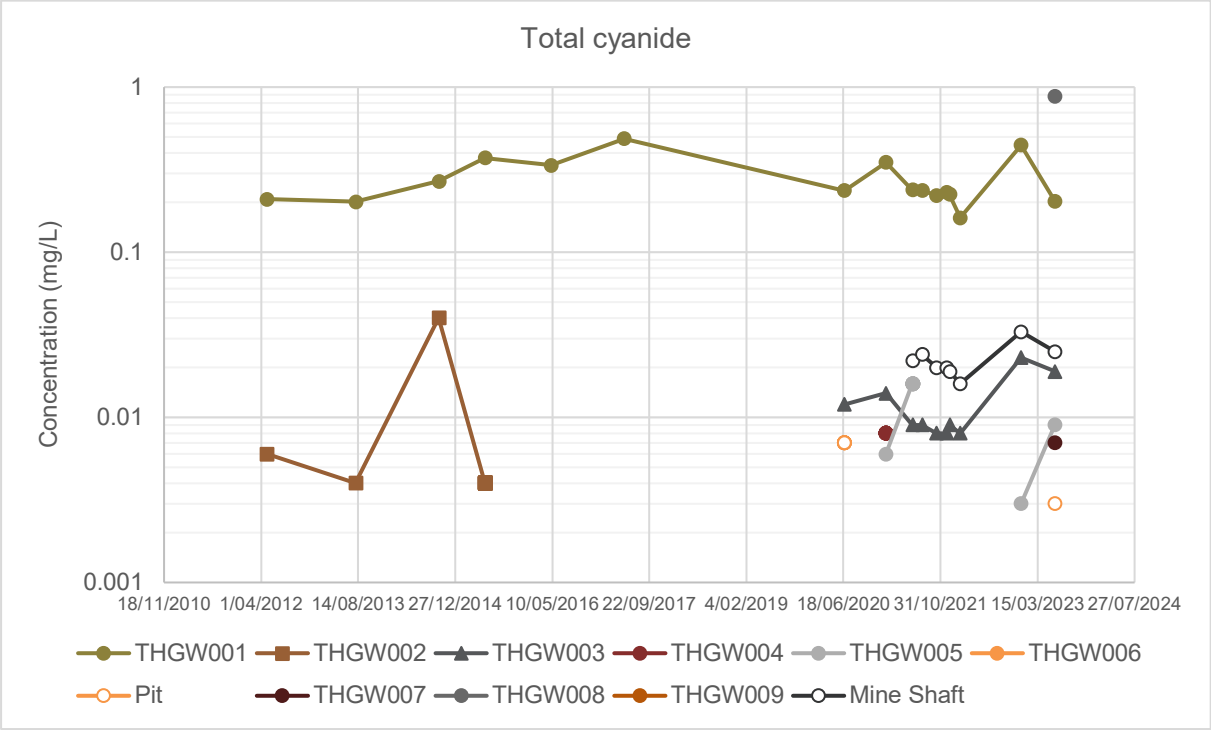
Total cyanide concentrations are presented in **Graphs 2a** (logarithmic scale)**, 2b** (linear scale) and **2c** (adjusted linear scale with bores THGW001 and THGW008 excluded) to allow ease of interpretation.

Free cyanide is shown on **Graph 3**. Exceedances of screening criteria for free cyanide have been observed at bores THGW001 and THGW008. While free cyanide is toxic, the balance of cyanide observed as total cyanide is typically iron cyanide which is non-toxic, non-reactive and moves through aquifers with minimal geochemical interaction with the aquifer matrix. Iron cyanides will also not typically degrade in alkaline conditions without light (Ghosh et. al. 1999), as occurs in the groundwater on site.

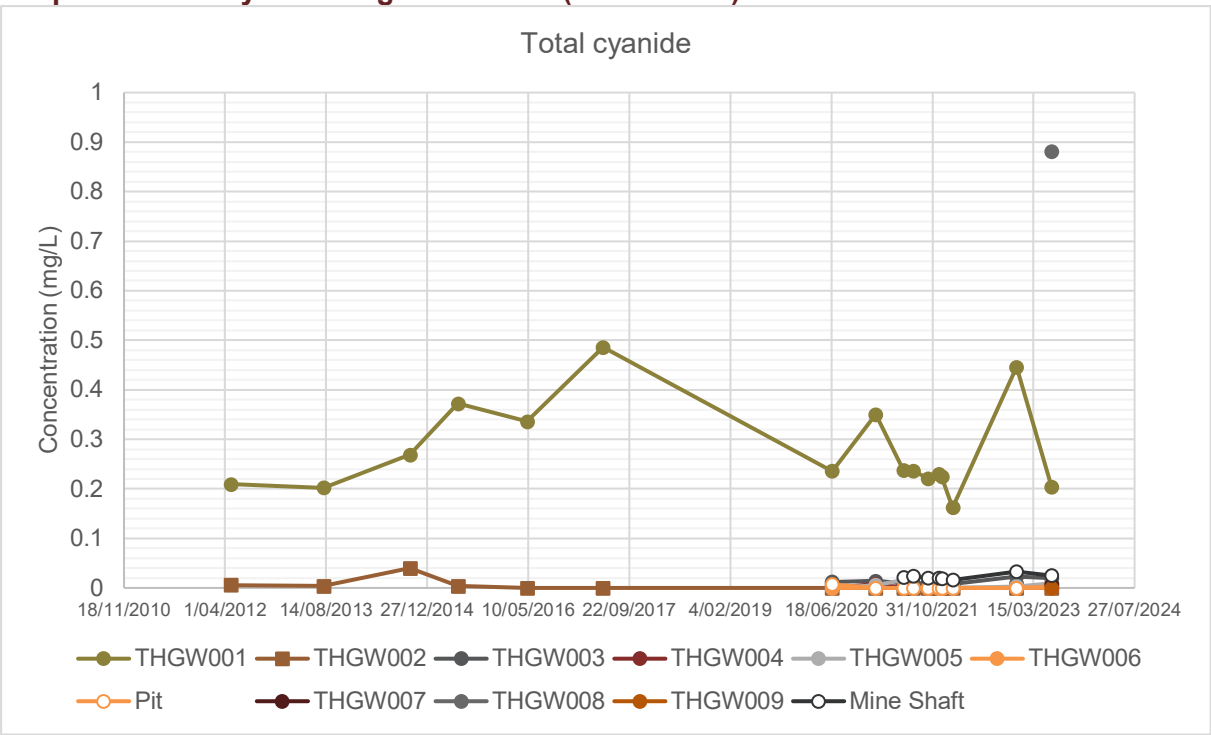
The highest concentrations of cyanide (total and free) have consistently been observed in bore THGW001. Concentrations have varied over the 11 years of monitoring, however no obvious trend is observed. As installation details of bore THGW001 are not known, characterisation of the extent of groundwater impact at bore THGW001 was difficult. Bore THGW008 was installed adjacent to bore THGW001 in the upper part of the aquifer. Bore THGW008 has higher concentrations of total and free cyanide.

The variation in concentration is consistent with vertical gradation of cyanide concentration in groundwater sourced from infiltration from the tailings dams to the south.

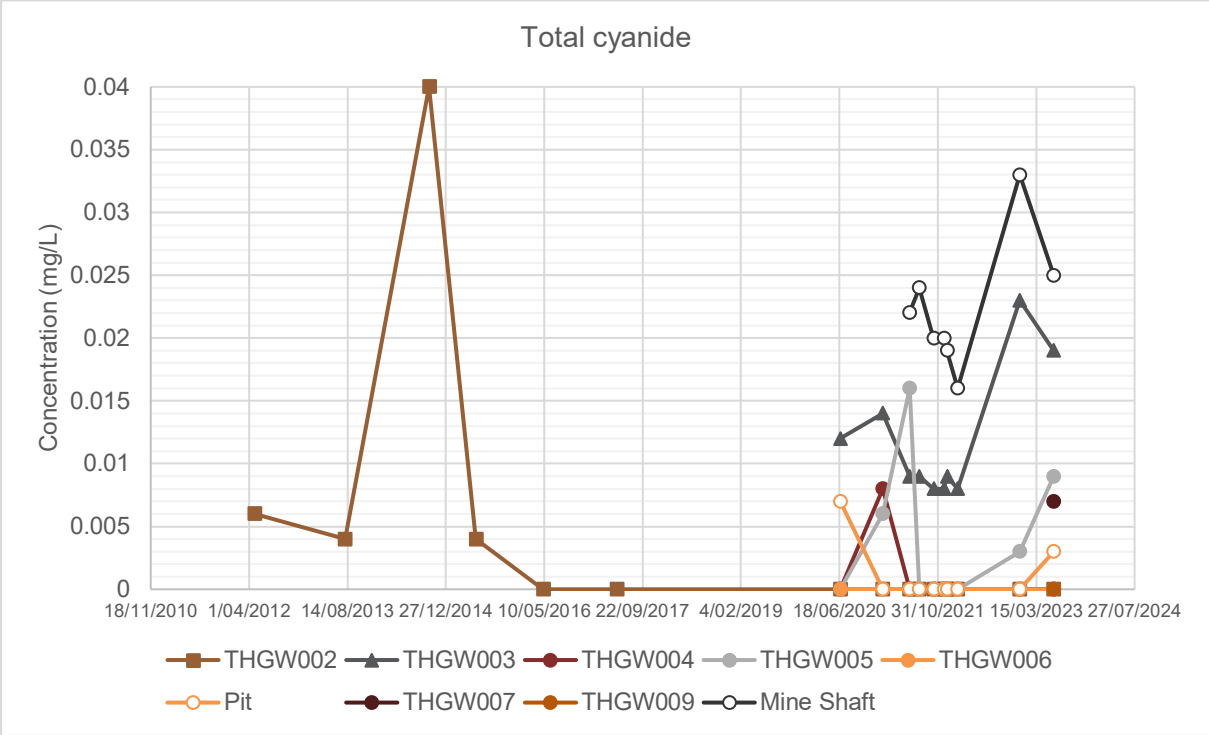
Graph 2a. Total cyanide in groundwater (logarithmic scale)



Graph 2b. Total cyanide in groundwater (linear scale)



Graph 2c. Total cyanide in groundwater (adjusted linear scale, bores THGW001 and THGW008 excluded)



Total cyanide is observed in other bores on site, but not free cyanide. Low concentrations have been observed in bore THGW003 and intermittently in bore THGW005. It is considered likely that cyanide is sourced from the tailings dam as the tailings dam acts as an infiltration zone. Due to the nature of the aquifer with water moving through irregular fractures, it is likely that low level impact to groundwater will occur radially from the TSF.

As concentrations are low and consistent, with no free cyanide detected, cyanide is not considered to have potential to impact human or ecological receptors in around the western site boundary at bore THGW003. Fluctuations in concentrations are likely to occur in response to high rainfall events resulting in increased groundwater recharge.

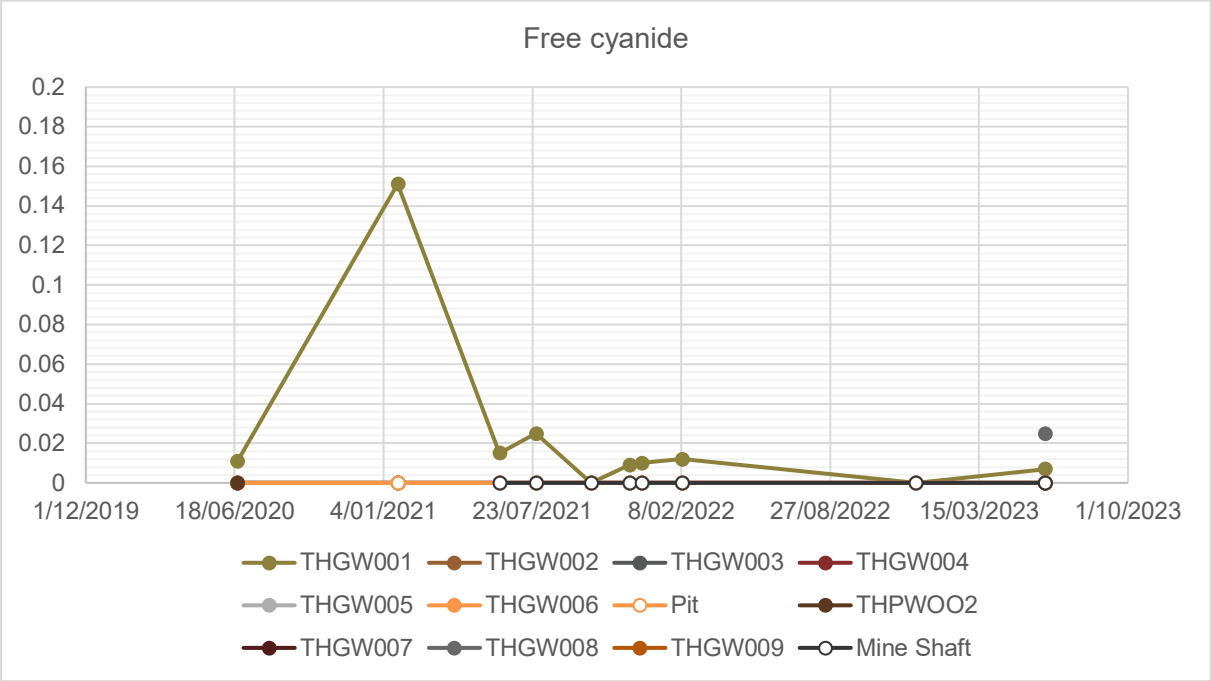
Total cyanide was previously detected at bore THGW004 in January 2021. This was considered to be due to a false positive or cross contamination. No further detections of cyanide have been made that this location, which supports the hypothesis of an anomalous result.

A low concentration of total cyanide was observed in new bore THGW007.

Other than at bores THGW001 and THGW008, the mine shaft has the highest concentrations of total cyanide. No free cyanide has been detected at this location. Concentrations of total cyanide further decrease as water migrates to the pit.

As free cyanide is only observed in locations situated between the TSF and open pit, and concentrations of total and free cyanide have been observed to vary within a consistent range, cyanide in groundwater is not considered to have the potential to cause environmental harm. While degradation of iron cyanide would occur slowly within the aquifer, any point at which cyanides are exposed to light or oxidising conditions will result in cyanide degradation.

Graph 3. Free cyanide in groundwater



11.1.5 Metals

Groundwater samples on site were analysed for an extended suite of dissolved and total metals. This includes aluminium, antimony, arsenic, barium, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, strontium, titanium, uranium, vanadium, zinc, iron and tungsten. Concentrations of total and dissolved metals are presented in **Graphs A10 to A22** in the Graphs appendix, where sufficient data were available to assess potential trends, based on sufficient sampling events and detections of metals in samples.

Exceedances of drinking water criteria were observed for dissolved cobalt, selenium, uranium and vanadium. Ecological criteria were exceeded for aluminium, copper and selenium. Arsenic also exceeded both ecological and drinking water criteria in the TSF pond.

Uranium and vanadium exceedances are consistent across the site and are considered to be associated with natural mineralisation. The site is also known to be naturally elevated in copper. Cobalt was elevated in bores THGW001 and THGW008, located downgradient of the TSF. Exceedances of selenium were observed in bore THGW004 and the mine pit. Exceedances of ecological criteria for aluminium are due to sediment contamination of the sample, as aluminium does not occur in the dissolved phase at the pH range observed on site. Detections of dissolved aluminium can also indicate sediment contamination which is the cause of other metal exceedances.

No exceedances of stock watering criteria were observed.

When reviewing trends in metal concentrations, occasional spikes are typically associated with sediment contamination and are therefore not relevant to the overall trend. The

relationship between trend concentrations and screening criteria should also be considered as relatively elevated concentrations may not exceed screening criteria.

For metals with long term trends able to be assessed:

- Arsenic: No exceedances. Slightly higher concentrations observed in the mine pit and THGW004.
- Cadmium: No exceedances. Occasional spikes in concentration but no obvious trends.
- Chromium: No exceedances. Recent spike correlates with sediment contamination.
- Cobalt: Exceedances at bores THGW001 and THGW008. Consistently elevated concentrations at THGW001, no increasing or decreasing trend.
- Copper: Exceedances at several locations however no consistent trend observed. Considered to be due to natural site conditions.
- Lead: Occasional historical exceedances at bore THGW001. No recent exceedances or trends apparent.
- Manganese: No exceedances and no trends. Variable concentrations across site.
- Molybdenum: No exceedances. Elevated concentrations at the mine pit. Consistent concentrations at each bore which correlate with pH; No increases with pH.
- Nickel: No recent exceedances. No trends.
- Selenium: Concentrations consistently exceed at the mine pit and bore THGW004. Pit concentration decreasing, no change at bore THGW004.
- Zinc: No exceedances. High variability in concentrations – no trends.

11.1.6 Organic compounds

No hydrocarbons or BTEXN compounds were detected in groundwater at the site.

PFAS was detected in groundwater at the site, with the exception of bores THGW009 (upgradient), THGW006 and the mine pit.

PFOS exceeded the 99% ecological protection criteria at the mine shaft bore but was not detected at any other location. No other exceedances were observed.

The majority of the PFAS mass is attributed to 6:2 FTS which was found in bores THGW001, THGW002, THGW004, THGW005, THGW007 and THGW008. PFAS detections are consistent with the requirement for fire suppression at the mining operation.

As PFAS with screening criteria were only detected in the mine shaft bore, the potential for off-site impact is considered negligible.

11.2 Tailings and decant dam results

Tailings and decant material results are shown in **Table 31, 32 and 34**. Tailings and decant material were assessed to determine potential residual impacts associated with these residual waste materials. Tailings materials from the TSF and decant dam were assessed against commercial / industrial criteria on the basis that these materials should be contained with the appropriate structures.

Tailings materials are:

- Alkaline to strongly alkaline;
- Salinity ranges from low to high;
- Chromium reducible sulfur (CRS) is below the threshold for acid production. This supports several previous assessments of acid generation potential which show no acid generation risk for site waste materials, as outlined in **Section 6.4**;
- Total phosphorus is high, indicating mineral P, however available phosphate concentrations are low;
- Metals:
    - All metals were below the human health criteria;
    - All metals with the exception of copper were below the EILs developed for the material.
    - Maximum concentration was 357 mg/kg.
    - ALSP leach for metals indicated a bioavailability factor of 0.0119, giving a site specific Tier 2 EIL for copper of 13600 mg/kg. No exceedances of the Tier 2 criteria were observed.
- Cyanide:
    - No free cyanide was detected in the tailings material;
    - Average total cyanide in the eastern cell was 69 mg/kg, 185 mg/kg in the western cell and 101 mg/kg in the decant dam.
    - Maximum concentration was 564 mg/kg.
    - No depth relationship was evident.
    - ASLP leach for total cyanide showed a bioavailability fraction of 0.019.

Results for tailings material in the TSF and decant dams indicates that tailings material does not have potential to cause contamination, if material is appropriately contained within the TSF and decant dam facilities.

11.3 Soil results

Soils results are presented in **Table 33 and 34**. Soil and creek sediment results were assessed to determine potential residual impacts associated with historical and recent site operations. No visible evidence of soil contamination was identified across the site, with the exception of tailings material (discussed below). A summary of soil results is presented below:

- Soil pH is slightly to moderately alkaline;
- Salinity is low;
- Chromium reducible sulfur is below the threshold for acid production;
- Total phosphorus is high, indicating mineral P, however available phosphate concentrations are low;
- Total organic carbon is low;
- Cation exchange capacity is moderately high;
- No exceedances were observed for any metals;
- No free cyanide was detected. The sediment sample collected from below the TSF spillway contained total cyanide at 5 mg/kg indicating potential overflow or runoff from the TSF and transport of tailings material. No cyanide was detected in downstream samples;
- No pesticides or PCB were detected;
- No hydrocarbons or BTEXN compounds were detected; and
- No PFAS compounds were detected.

Soil and sediment results show no evidence of contamination across the site. The total cyanide detected downstream of the TSF indicates a lack of containment of tailings material, however no exceedances of screening criteria were observed indicating that this material does not pose a contamination risk.

11.4 Groundwater migration

Results of hydraulic testing were interpreted to determine the hydraulic conductivity (K) of the site aquifer. Interpretation of slug test results included use of bore construction data provided in borelogs (Carnaby Resources 2020) and standard values for metamorphic aquifer properties. Porosity was assumed to be 0.1. Results of slug test and solute transport modelling are presented in **Appendix J**.

For each bore, the results of two of the tests is presented below, representing the range of values obtained during test interpretation. The Hvorslev and Bouwer and Rice methods provided the most consistent results for interpretation for slug test results.

Comparison of the slug test results shows a 10x difference in hydraulic conductivity between the two bores, indicating the range of variability observed on site.

Table 19: Aquifer parameters

Bore	Lithology (water bearing zone)	Thickness (m)	K (m/d)	*i* (m/m)	V_g (m/d)	KD (m²/d)
THGW005	Corella Formation	10	0.081	0.038	0.031	0.806
			0.064	0.038	0.064	0.641
THGW006	Corella Formation	10	0.898	0.236	2.12	8.98
			0.682	0.236	1.61	6.82

Note: K – hydraulic conductivity, i – hydraulic gradient, V – velocity, KD – transmissivity

11.5 Groundwater cyanide transport and sorption mechanisms

Cyanide in groundwater at the site predominantly occurs as iron cyanide, measured as total cyanide. Under alkaline conditions with no light, iron cyanides do not typically react with the aquifer matrix and do not degrade. Iron cyanide will therefore migrate at a similar speed to groundwater, with minimal retardation. Concentrations used for calibration of the groundwater model are presented in **Table 20**.

Table 20: Concentrations used in solute transport model calibration

Location	Aquifer	Total Cyanide (mg/L)
THGW001	Regional Aquifer – upper layer	0.881
THGW008	Regional Aquifer	0.206
Retardation factor (R)		1.002

Based on the velocity (V_g) and hydraulic gradient (*i*) of groundwater calculated for the water bearing zones on site, and the retardation (R) rates determined for Cyanide (**Table 20** and **Appendix J**), the potential migration rates (V_s) for total cyanide were determined. These are presented in **Table 21**. The migration pathway was calculated based on the TSF as a source, with the hydraulic gradient between bores THGW005 and THGW001/8.

The TSF is treated as an ongoing source. Width is based on the tailings and decant dams and flow towards the pit. The model considers downward migration of 10 m into a saturated zone below the TSF. The initial source concentration is based on an estimate of cyanide concentration in fresh tailings at the time of mine operations, based on tailings material used for cyanide decay trials of 350 mg/L (Environmental & Earth Services 1990).

Table 21: Groundwater and contaminant migration rates

Unit	Pathway	Water (V_g)		Total Cyanide (V_s)	
		m/d	m/yr	m/d	m/yr
Regional Aquifer	TSF to THGW001/8	0.027	9.71	0.0265	9.69

The model was calibrated based on a measured concentration of 0.8 at bore THGW008, 200 m downgradient from the TSF. The time since release has been estimated as 30 years, based on the time since tailings were deposited in the TSF. Predicted total cyanide concentrations with distance from the source and time since release (**Graphs 4 and 5**). Total cyanide concentrations observed at bore THGW008 are shown as orange diamonds on these graphs.

The model predicts that this cyanide concentration reached the receptor (bore THGW008) after 21 years and that the plume is stable. This model represents the observed site conditions relatively well, as the concentration at bore THGW001 has remained consistent over 10 years of monitoring. However, the model assumes a constant concentration at the receptor. This is not the case as cyanide in the tailings has substantially degraded over time. While the model therefore provides a good estimate of current and recent conditions, future concentrations may decrease more quickly than modelled as the source is depleted.

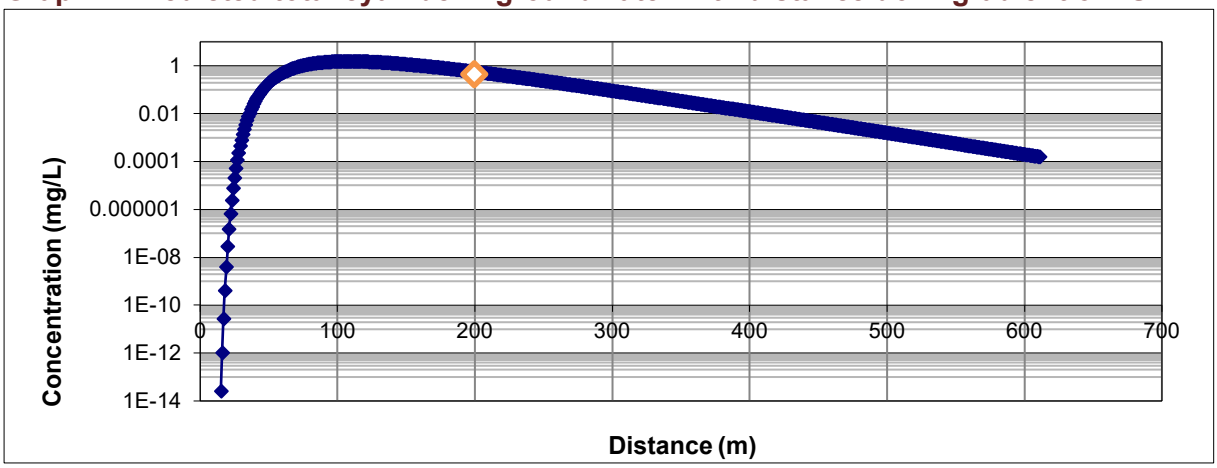
It is not expected that the cyanide impacts to groundwater would further increase pit concentrations substantially as pit inflows are sourced radially and not just from the TSF. In addition, pit water is subject to sunlight which allows breakdown of cyanide.

In summary, the groundwater model predicts that total cyanide concentrations at bores THGW001/8 are at the stable maximum of the plume migration and that depletion of the cyanide source will result in a decrease in concentrations at these bores into the future.

Cyanide in groundwater at Tick Hill is therefore limited in potential toxicity to the environment as:

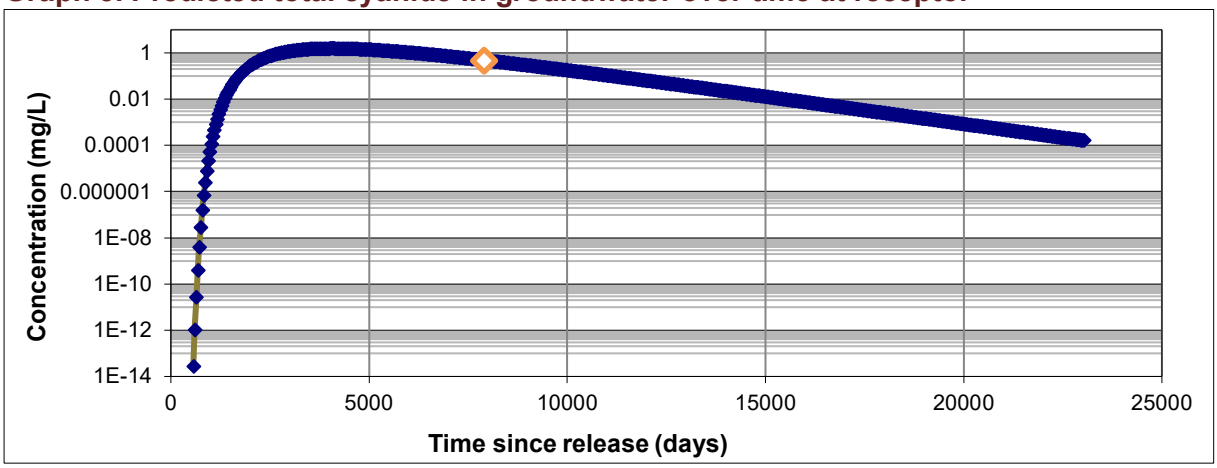
- Cyanide is almost entirely present as non-toxic, non-reactive iron cyanides, measured as total cyanide.
- Current concentrations at bores THGW001 and THGW008 represent the maximum likely concentrations over the migration of the plume.
- Bores THGW001 and THGW008 are the only locations where free cyanide exceeds criteria. These locations are well within the influence of the open pit as a sink for groundwater.
- Cyanide in the open pit is subject to breakdown in sunlight.
- Source concentrations of cyanide in the TSF are substantially depleted, with no free cyanide detected in tailings material.

Graph 4. Predicted total cyanide in groundwater with distance downgradient of TSF



Note: Orange diamond indicates concentration at bore THGW008

Graph 5. Predicted total cyanide in groundwater over time at receptor



Note: Orange diamond indicates concentration at bore THGW008

11.6 Mine void water balance

11.6.1 Current site conditions

The mine open pit acts as a groundwater sink at the site. From when mining operations in the pit ceased in the mid 1990s, the underground workings re-flooded and the water level in the pit increased to approximately 25 m from the pit base of the 70 m pit. Water levels have since fluctuated within a range of several metres. Water levels in the pit are influenced by rainfall and runoff inputs, evaporative losses and groundwater inflow. In order to estimate long term groundwater inflows, a mass balance was developed using known climatic inputs.

The mass balance calculation used the site information and data as outlined in **Table 22**.

Water inflows from rainfall and runoff were calculated under two scenarios; runoff in the catchment area after the initial 10 mm of a rainfall event, 50% runoff after 10 mm. Once the

volume of rainfall and runoff inputs and evaporative losses are calculated, the volume of groundwater discharging into the pit can be calculated. Estimated groundwater inflow volumes are presented in **Table 23.** It was initially attempted to correlate changes in pit levels to changes due to rainfall, however the rainfall inflow and groundwater flux associated with rainfall events do not synchronise. Long term average conditions were therefore assessed. The perimeter of the open pit catchment is shown on **Figure 11.**

Table 22: Mine void mass balance calculations

Parameter	Value	Notes
Mine pit surface area (pit walls and water surface) (340 mAHD)	32,000 m²	
Pit surface at 290mAHD water level	8,000 m²	Direct rainfall and evaporation
Exposed pit catchment area between 290 and 340 mAHD	24,000 m²	Runoff to pit
'Likely' runoff conditions	Runoff after 10 mm rainfall per event	Estimated likely scenario
Minimum runoff conditions	50% runoff after 10 mm rainfall event	
Rainfall data	Mean annual rainfall since 1994	The Monument - **Section 5.6**
Evaporation data	Pan evaporation	Mount Isa daily evaporation - **Section 5.6**

Using the range of estimated groundwater inflows into the pit and the standing water levels of monitoring bores at the mine, the hydraulic conductivity and transmissivity of the aquifer can be estimated (**Table 23**). The hydraulic gradient between pit water level and SWL at bore THGW001 was used to calculate inflow. Hydraulic conductivity (K) values are low compared to direct estimates based on groundwater bore measurements.

Table 23: Groundwater flux estimates

Groundwater inflow scenario	Units	High Runoff	Low runoff
Runoff Scenario		100% runoff after 10 mm	50% runoff after 10 mm
Pit area	m²	8,000	8,000
Catchment area	m²	24,000	24,000
Annual rainfall	m/yr	0.396	0.396
Annual rainfall volume to pit	m³/yr	3168	3168
Annual evaporation	m/yr	3.1	3.1
Annual evaporation volume from pit	m³/yr	24492	24492
Annual runoff from catchment	m/yr	0.257	0.257

Groundwater inflow scenario	Units	High Runoff	Low runoff
Annual runoff volume	m³/yr	6178	3089
Annual groundwater inflow	m³/yr	-15146	-18235
Daily Groundwater inflow	m³/day	-41.5	-50.0
Aquifer thickness	m	25	25
Hydraulic conductivity (K)	m/day	0.017	0.020
Transmissivity (KD)	m³/day	0.418	0.510

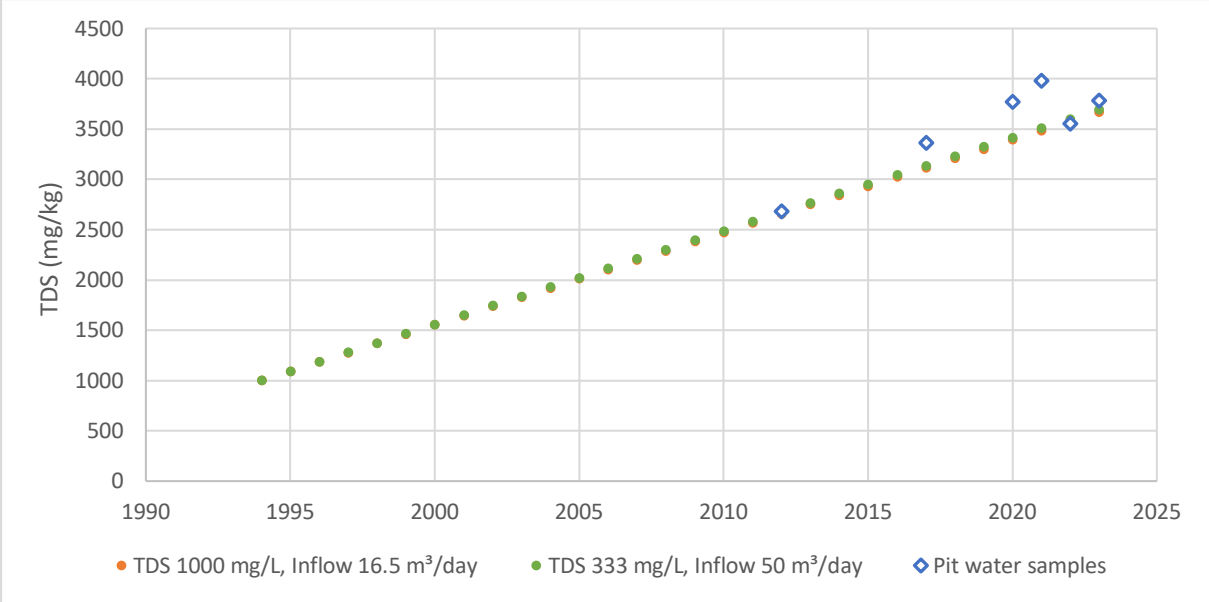
11.6.2 Salinity in the open pit

A salt balance in the open pit was estimated based on the salinity of the surrounding aquifer and observed measurements of TDS in pit water. Results are shown in **Graph 6**. Two estimates were developed, based on a starting salinity of 1000 mg/L TDS in the mid 1990s. To reach the current TDS in the pit of ~3,750 mg/L, the pit requires an addition of ~6077 kg salt per year. Rainfall salt inputs are assumed to be negligible. Two scenarios are shown on **Graph 6** to meet this requirement.

For groundwater inflows at 1000 mg/L TDS, the inflow volume would be 16 m³/day. For groundwater inflows volumes of 50 m³/day, as estimated by the pit mass balance above, the inflow TDS is 333 mg/L. This indicates that the pit is receiving lower salinity water than indicated by the shallower parts of the aquifer assessed in monitoring bores. Previous assessment of salinity with depth in the pit indicated no stratification, however sampling method details are not known.

Water quality results since 2020 indicate relatively stable salinity in the pit, however inadequate data is available to determine how this relates to long term trends. It is predicted that pit salinity will continue to increase due to evapo-concentration of pit waters.

Graph 6. Salt balance in the open pit



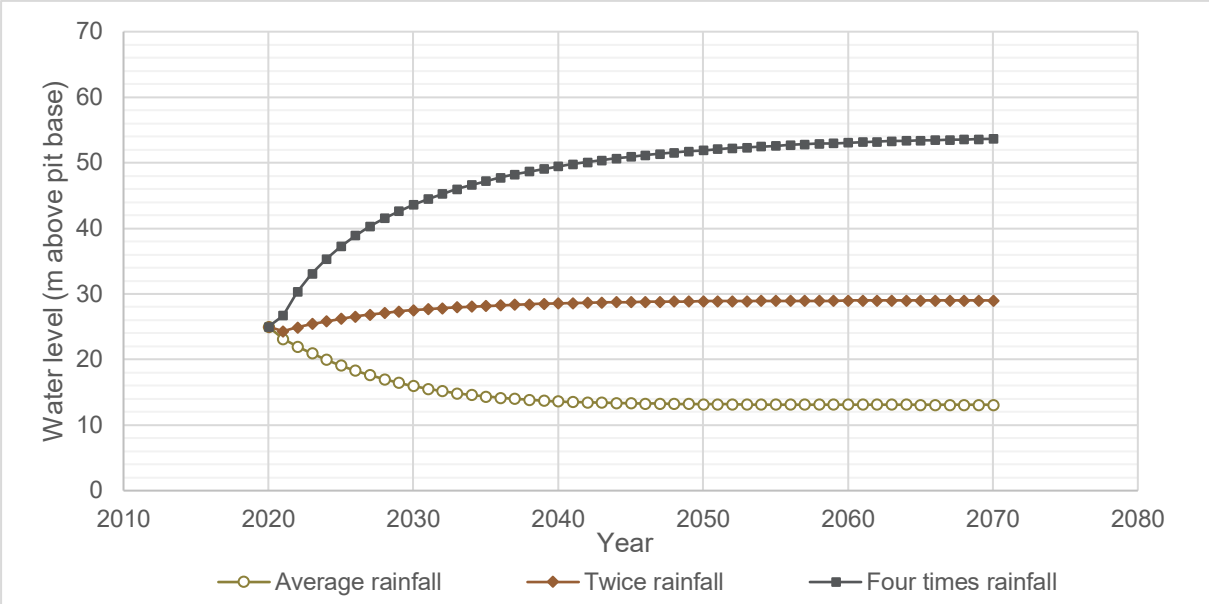
11.6.3 Future site conditions

Water level in the Tick Hill open pit has been at a stable level for many years and has acted as a groundwater sink. A mass balance calculation was conducted to examine what increased rainfall would do to the equilibrium pit level. This assessment ignored groundwater inflows on the basis that groundwater inflows steadily decrease as water level increases, due to the decreasing hydraulic gradient. Once the water level reaches the groundwater equilibrium level the pit may act as a flow through groundwater lens, at approximately 310 mAHD, or approximately 45 m above the base of pit shown in **Graph 7**.

Pit water levels over 50 years were calculated using actual annual rainfall (396 mm/year), twice annual rainfall (792 mm/year) and four times annual rainfall (1.58 mm/year), using the same catchment runoff and evaporation assumptions as in **Section 11.6.1** above. These calculations indicate that without groundwater inflow, under current rainfall conditions, the pit level would decrease to 13 m.

With double annual rainfall, pit level would stabilise at 29 m. This level is below the groundwater level in the surrounding environment and the pit would still act as a groundwater sink. With four times annual rainfall, water levels are stable at 53 m, with the pit acting as a recharge source for groundwater. Given the likelihood of these scenarios of substantially increased rainfall on a consistent basis for many years, it is evident that the pit will continue to act as a groundwater sink under all plausible site climatic conditions.

Graph 7. Water balance in the open pit under varying rainfall scenarios



12 UPDATED CONCEPTUAL SITE MODEL

A conceptual site model (CSM) of the site can be formed by considering the geophysical characteristics at play, the contaminant source, potential receptors, and the pathways to the receptors. The CSM, as required by the NEPC (2013), is an iterative process which is updated during the investigation process as more information becomes available.

12.1 Sources

Identified hazards, where relevant investigation criteria for chemicals of concern have been exceeded include:

Exposed tailings:

- Tailings material concentrations of metals and cyanide are within the relevant screening criteria for these materials, however the current nature of exposed tailings does not meet requirements for long term site management;

Groundwater:

- Groundwater exceeds drinking water criteria for salinity, sodium, chloride, ammonia, nitrate and fluoride;
- Groundwater exceeds ecological criteria for nitrate and ammonia;
- Metals exceed health and ecological screening criteria; and
- Free cyanide exceeds health and ecological criteria at bores THGW001 and THGW008.

With the exception of cyanide and nitrogen compounds, exceedances are considered to be naturally occurring and related to the natural lithology of the aquifer.

12.2 Pathways

Pathways of transport of contamination from site sources to the mine void or groundwater include:

- Seepage and groundwater migration from WRD and TSF to aquifer;
- Groundwater inflows to pit.

12.3 Receptors

The following has been identified in relation to receptors in the vicinity of site:

- The pit water is not intended to be used for stock watering or other purpose. Wildlife may consume water directly from the mine pit.
- No GDEs or groundwater discharge zones have been identified in the vicinity of site.
- For groundwater migrating from the cyanide impacted bores to the open pit, dilution and degradation of cyanide reduces concentration to below screening criteria.
- Groundwater is therefore accessed via direct pumping only.
- Groundwater impacts associated with mine activities are either subject to the direct inflow influence of the pit, or stable within the vicinity of the mine environment.

12.4 Findings of CSM refinement

The Source – Pathway – Receptor model therefore determines that there is no risk posed to sensitive receptors due to the groundwater contamination identified on site.

Exposed tailings material does not meet conditions for long term site management and requires containment.

13 QUALITATIVE RISK ASSESSMENT

This section presents an assessment of the potential physical and chemical impacts of the project, including consideration of the potential impacts to beneficial users of the groundwater.

13.1 Assessment Methodology

Potential impacts to groundwater and the surrounding environment as a result of the project have been assessed in the context of the local hydrogeological setting, i.e., the CSM, and the relevant legislation and guidelines.

The CSM was based on:

- a desktop study of existing information relating to the project site and catchment hydrogeology;
- assessment of aquifer physical properties based on site observations, and
- assessment of aquifer chemical properties at existing individual locations.

13.2 Likelihood and Consequence Matrix

A summary of the primary potential impacts of the different components of the project, based on the above discussion, has been provided in **Table 24**. The individual impacts are considered separately in terms of their likelihood and consequence; scores are attributed to both likelihood and consequence on a scale from 1 to 5 in each case. The risk is, in turn, scored as the sum of the likelihood and consequence scores.

Table 24: Risk matrix

		Likelihood				
Consequence		Very unlikely (5)	Unlikely (4)	Possible (3)	Likely (2)	Very Likely (1)
	Negligible (5)	10	9	8	7	6
	Minor (4)	9	8	7	6	5
	Moderate (3)	8	7	6	5	4
	Major (2)	7	6	5	4	3
	Critical (1)	6	5	4	3	2

Note(s):

1. Likelihood scale has five categories with scores from 5 to 1, i.e., Very Unlikely (5), Unlikely (4), Possible (3), Likely (2), Very Likely (1)
2. Consequence scale has five categories with scores from 5 to 1, i.e., Negligible (5), Minor (4), Moderate (3), Major (2), Critical (1)
3. Overall risk value = Consequence value + Likelihood value; consequence and likelihood are considered separately
4. Red denotes Extreme Risk (scores of 2-3), Orange denotes High Risk (scores of 4-5), Yellow denotes Moderate risk (scores of 6-7), Green denotes low risk (8-10)

13.3 Summary of Impacts

The risk matrix is illustrated in **Table 25** and confirms that whilst potential direct impact to the local aquifer and surface water streams is a “moderate risk”, these can be mitigated in the future as part of site management and rehabilitation.

14 SUMMARY OF FINDINGS

The findings of the investigation into groundwater, soil and tailings at Tick Hill can be summarised as follows:

- Groundwater is naturally elevated in salts and metals which make it unsuitable for potable use without treatment. Low concentrations of total cyanide are found across the site, with the highest concentrations observed at bores THGW001 and THGW008. Free cyanide exceeding screening criteria was observed in these two bores. Nitrate and ammonia attributed to explosive residue was observed in several locations, including bore THGW004, down gradient of the WRD.

- The groundwater model indicates that the open pit acts as a groundwater sink for the site, with the exception of the area north of the WRD and potentially the western site perimeter around bore THGW003. No sensitive receptors were identified that might be impacted by groundwater quality at these locations.

Table 25: Qualitative Impact Assessment

Component	Potential Impact to Receptor	Likelihood of Impact	Consequence of Impact	Level of Risk	Proposed Mitigation Measure	Observations
Contaminated groundwater reaching off site receptors	Impacts to human or ecological receptors	Unlikely (4)	Minor (4)	Low (8)	Continued monitoring of onsite groundwater.	No current known nearby receptors however groundwater may be extracted for beneficial uses, such as stock watering.
Mine pit water impact to groundwater	Contamination of groundwater	Very unlikely (5)	Minor (4)	Low (9)	Prevent contamination impacts to mine pit	Risk based on current pit water chemistry and water balance
Direct contamination of groundwater from site infrastructure or spills	Contamination of groundwater	Possible (3)	Moderate (3)	Moderate (6)	Adequate environmental controls for any future works	Future site works required to remediate TSF
Contaminated runoff from site infrastructure reaching pit	Contamination of groundwater via inflow from pit	Very Unlikely (5)	Minor (4)	Low (9)	Pit perimeter is higher than landscape. Accidental inflows unlikely	Considers subsequent impact of contamination to groundwater
Direct overflow of contaminated water from pit flowing into nearby waterways	Contamination of surface water bodies	Very unlikely (5)	Minor (4)	Low (9)	Pit contains sufficient available volume to contain extreme rainfall events	Unlikely based on pit water balance model
Direct overflow of contaminated water from TSF flowing into nearby waterways	Contamination of surface water bodies	Possible (5)	Minor (4)	Moderate (7)	Reinstate tailings into TSF and re-cover tailings.	Stream sediment indicates overflow from TSF

- The cyanide impact to groundwater between the TSF and open pit is assessed as being stable, with concentrations likely to steadily decrease over time. It is not expected that cyanide impacted groundwater will adversely impact pit water quality to any significant extent and cyanide in pit water will be degraded by sunlight.
- No evidence of soil or sediment contamination was observed on site.
- Tailings material retains some cyanide as total cyanide, which is likely present as iron cyanide. This form is non toxic. No free cyanide remains. Some elevated concentrations of copper occur within the tailings due to natural elevations of copper in the ore material. Copper concentrations are acceptable if tailings materials are managed appropriately within the TSF. No identified acid generation potential exists within tailings material.
- The waste rock dump is stable and well vegetated. The WRD appears to have been releasing nitrogen compounds from explosive residues into the surrounding landscape, however due to the age and permeability of the WRD.

15 CONCLUSIONS

Based on the above findings the following conclusion have been made:

- The mining void currently serves as a groundwater sink, influencing groundwater flow across the site, with the exception of the area around the WRD.
- The long-term scenario is that the pit will act as a groundwater sink under all plausible site conditions.
- The water quality of the pit poses no current risk of contamination to the surrounding aquifer.
- Potential for pit stratification is not currently known.
- Cyanide (free and total) at bores THGW001 and THGW008 will remain at stable concentrations for some time before decreasing.
- Free cyanide at bores THGW001 and THGW008 does not have the potential to adversely impact pit water quality or discharge to watercourses.

16 RECOMMENDATIONS

Based on the above conclusions the following recommendations have been made:

- Rectification works should be undertaken to reinstate stockpiled tailings into the eastern TSF cell and recover the TSF.

- Regular groundwater monitoring should continue, with the analysis suite extended from the current parameters to include ammonia, nitrate and phosphate. Bi-annual monitoring is recommended until at least after the TSF rectification works are completed.

17 LIMITATIONS

This report has been prepared by Environmental Earth Sciences QLD ACN 109 442 284 in response to and subject to the following limitations:

1. The specific instructions received from Carnaby Resources;
2. The specific scope of works set out in PO722108 issued by Environmental Earth Sciences for and on behalf of Carnaby Resources Ltd, is included in Section 3 (Scope of Work) of this report;
3. May not be relied upon by any third party not named in this report for any purpose except with the prior written consent of Environmental Earth Sciences QLD (which consent may or may not be given at the discretion of Environmental Earth Sciences QLD);
4. This report comprises the formal report, documentation sections, tables, figures and appendices as referred to in the index to this report and must not be released to any third party or copied in part without all the material included in this report for any reason;
5. The report only relates to the site referred to in the scope of works being located at the Tick Hill Gold Mine, Dajarra, QLD ("the site");
6. The report relates to the site as at the date of the report as conditions may change thereafter due to natural processes and/or site activities;
7. No warranty or guarantee is made in regard to any other use than as specified in the scope of works and only applies to the depth tested and reported in this report;
8. Fill, soil, groundwater and rock to the depth tested on the site may be fit for the use specified in this report. Unless it is expressly stated in this report, the fill, soil and/or rock may not be suitable for classification as clean fill if deposited off site;
9. This report is not a geotechnical or planning report suitable for planning or zoning purposes; and
10. Our General Limitations set out at the back of the body of this report.

18 REFERENCES

ATC Williams (2022) Tick Hill Mine; Tailings Reclamation Project – Consequence Category Assessment. Report to Blue Cap Mining Pty Ltd. Report 120100.01-R02 Rev 1. June 2022.

Australian and New Zealand Environment Governments (ANZG) (2018). *Australian and New Zealand guidelines for fresh and marine water quality*. August 2018.

ANZG (2023). *Toxicant default guideline values for aquatic ecosystem protection. Perfluoro-octane sulfonate (PFOS) in freshwater*. Technical Brief, May 2023.

Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia (ARMCANZ) (2000). *Australian and New Zealand guidelines for fresh and marine water quality.*

Australian Standards (2005). *AS4482.1 – 2005. Guide to the sampling and investigation of potentially contaminated soil, Part 1, non-volatile and semi-volatile compounds*. – now withdrawn.

Australian Soil Resources Information System (ASRIS) (2013). *Online soils mapping, acid sulfate soils*.

Bureau of Meteorology (BOM) (2023). *Atlas of groundwater dependent ecosystems*. Australian Government.

Bureau of Meteorology (BOM) (2023). *Climate data and weather observations.* Mount Isa: Station ID 029127, Duchess: Station ID 037019, The Monument: Station ID 037034.

Carnaby Resources (2021a) Tick Hill: Mining Leases MLs7094, 7096 & 7097 Initial Development Plan 1 July 2021 to 30 June 2025.

Carnaby Resources (2021b) Water extraction reporting to Associated Water (AWT) by mining tenure holders. Mineral Resources Act 1989 s334ZP and the Mineral Resources Regulation 2013 (MRR) s31A-31C.

Cloncurry Shire Council (2017) Cloncurry Shire Planning Scheme 2016. Version 2. 4 July 2017.

Department of Environment and Science (DES) (2023) *Queensland auditor handbook for contaminated land. Module 6: Content requirements for contaminated land investigation documents, certifications and audit reports*. ESR/2018/4224 Version 2.03 18 May 2023.

DES (2023). *Environmental authority locations interactive map*. Accessed May 2023.

Department of Natural Resources (1997) Salinity Management Handbook. Queensland Government, Coorparoo.

Domenico P A (1987). *An analytical model for multidimensional transport of a decaying contaminant species*. Journal of Hydrogeology 91: 49-58.

Drever J I (1997). *The Geochemistry of Natural Waters: Surface and Groundwater Environments.*

Environmental & Earth Services (1990) Assessment of cyanide decay and acid generation potential of tailings and tailings liquor, Tick Hill. Report to Kinhill Engineers Pty Ltd.

Envirofin (2020) Tick Hill Tailings Reclamation Project. EA Amendment Application Supporting Information. Report to Carnaby Resources Ltd. CR0002v2 10 August 2020

Ghosh, R. S., Dzombak, D. A., Luthy, R. G. and Nakles, D. V. (1999) *Subsurface Fate and Transport of Cyanide Species at a Manufactured-Gas Plant Site*. Water Environment Research , Sep. - Oct., 1999, Vol. 71, No. 6 (Sep. - Oct., 1999), pp. 1205-1216. Wiley.

Hamon, R. E, McLaughlin, M. J, Gilkes, R. J, Rate, A. W, Zarcina, B, Robertson, A, Cozens, G, Radford, N, & Bettenay, L (2004). *Geochemical indices allow estimation of heavy metal background concentrations in soils.* Global Biogeochemical Cycles, vol. 18, GB1014.

Hem, J D (1985). *Study and interpretation of chemical characteristics of natural water*. United States Geological Survey (USGS) Water-Supply Paper 2254, Third Edition.

Hvorslev, M J (1951). *Time lag and soil permeability in ground-water observations*. U.S. Army Corps of Engineers, Waterways Experiment Station, Bulletin No. 36.

MIM Holdings (1993) Tick Hill Gold Mine; Visit by ASARCO Directors. Summary of operations report, March 1993.

National Environment Protection Council (NEPC) (2013). *National Environment Protection (Assessment of Site Contamination) Amendment Measure*, Adelaide, SA.

National Health and Medical Research Council (NHMRC)/ Natural Resource Management Ministerial Council (NRMMC) (2011). *Australian drinking water guidelines.* National Water Quality Management Strategy.

National Uniform Drillers Licensing Committee (NUDLC) (2020). *Minimum Construction the Requirements for Water Bores in Australia*. 4th Edition, Brisbane.

NHMRC & NRMMC (2008). *Guidelines for managing risks in recreational water.* Australian Government, February 2008.

Northcote, K. H. with Beckmann, G. G., Bettenay, E., Churchward, H. M., Van Dijk, D. C., Dimmock, G. M., Hubble, G. D., Isbell, R. F., McArthur, W. M., Murtha, G. G., Nicolls, K. D., Paton, T. R., Thompson, C. H., Webb, A. A. and Wright, M. J. (1960-1968). Atlas of Australian Soils, Sheets 1 to 10. With explanatory data (CSIRO Aust. and Melbourne University Press: Melbourne).

PA Scott Consulting (2022) Tick Hill Environmental Evaluation Groundwater Geochemistry Report. ML7097, ML7094, ML7096. Environmental Authority EPML00820613. Prepared for Carnaby Resources Pty Ltd, 20 April 2022.

Queensland Globe (2023) https://qldglobe.information.qld.gov.au/, accessed May 2023.

Queensland Government (1994), Environmental Protection (EP) Act (Amended June 2023)

Queensland Government (2019) Environmental Protection Regulation 2019

Queensland Government (2019) Environment Protection Policy (Water and Wetland Biodiversity) Policy.

Queensland Government (2023), Environmental Protection and Other Legislation Amendment Act.

R. A. Perry, J. R. Sleeman, C. R. Twidale, C. E. Prichard, R. 0. Slatyer, M. Lazarides, and F. H. Collins (1964) Land Systems survey of the Leichardt-Gilbert area, North West Queensland - ZEG2. General report on Lands of the Leichhardt-Gilbert Area, Queensland 1953-1954 Land Research Series No. 11. CSIRO Melbourne 1964.

19 GLOSSARY OF TERMS

The following descriptions are of terms used in the text of this report.

Alluvial. Describes material deposited by, or in transit in, flowing water.

Anaerobic. Reducing or without oxygen.

Aquifer. A rock or sediment in a formation, group of formations, or part of a formation which is saturated and sufficiently permeable to transmit economic quantities of water to bores and springs.

Aquifer, confined. An aquifer that is overlain by a confining bed with significantly lower hydraulic conductivity than the aquifer.

Aquifer, perched. A region in the unsaturated zone where the soil is locally saturated because it overlies soil or rock of low permeability.

Background. The natural level of a property.

Baseline. An initial value of a measure.

Biodegradation. A biochemical process of microbial oxidation of complex organic compounds, to simpler chemical products. Micro-organisms derive the energy and cell carbon for growth from oxidation of organic compounds.

Bore. A hydraulic structure that facilitates the monitoring of groundwater level, collection of groundwater samples, or the extraction (or injection) of groundwater. Also known as a well, monitoring bore or piezometer, although piezometers are typically of small diameter and only used for measuring the groundwater elevation or potentiometric surface.

Borehole. An uncased well drill hole.

Cation Exchange Capacity (CEC). The maximum positive charge required to balance the negative charge on colloids (clays and other charged particles). The units are milli-equivalents per 100 grams of material or centimoles of charge per kilogram of exchanger.

Clay. A soil material composed of particles finer than 0.002 mm. When used as a soil texture group such soils contain at least 35% clay.

Colluvial. Unconsolidated soil and rock material moved down-slope by gravity.

Confined Aquifer. An aquifer that is confined between two low-permeability aquitards. The groundwater in these aquifers is usually under hydraulic pressure, i.e. its hydraulic head is above the top of the aquifer.

Confining layer. A layer with low vertical hydraulic conductivity that is stratigraphically adjacent to one or more aquifers. A confining layer is an aquitard. It may lie above or below the aquifer.

Contaminant. Generally, any chemical species introduced into the soil or water. More particularly relates to those species that render soil or water unfit for beneficial use.

Contamination. Is considered to have occurred when the concentration of a specific element or compound is established as being greater than the normally expected (or actually quantified) background concentration.

Diffusion. A process by which species in solution move, driven by concentration gradients (from high to low).

Dilution. The mixing of a small volume of contaminated leachate with a large volume of uncontaminated water. The concentration of contaminants is reduced by the volume of the lower concentrated water. However the physical process of dilution often causes chemical disequilibria resulting in the destruction of ligand bonds, the alteration of solubility products and the alteration of water pH. This usually causes precipitation by different chemical means of various species.

Discrete sample. Samples collected from different locations and depths that will not be composited but analysed individually.

Dispersion. A process by which species in solution mix with a second solution, thus reducing in concentration. In particular, relates to the reduction in concentration resulting from the movement of flowing groundwater.

Dissolved Oxygen (DO). Oxygen in the gaseous phase dissolved in water. Measured either as a concentration in mg/L or as a percentage of the theoretical saturation point, which is inversely related to temperature. At 19, 20 and 21 degrees Celsius, the oxygen concentrations in mg/L corresponding to 100% saturation are 9.4, 9.2 and 9.0 respectively.

Electrical Conductivity (EC). The EC of water is a measure of its ability to conduct an electric current. This property is related to the ionic content of the sample, which is in turn a function of the total dissolved (ionisable) solids (TDS) concentration. An estimate of TDS in fresh water can be obtained by multiplying EC by 0.65.

Flow path. The direction in which groundwater is moving.

Fluvial. A material deposited by, or in transit, in streams or watercourses.

Fracture. A break in the geological formation, e.g. a shear or a fault.

Gradient. The rate of inclination of a slope. The degree of deviation from the horizontal; also refers to pressure.

Groundwater. The water held in the pores in the ground below the water table.

Groundwater Elevation. The elevation of the groundwater surface measured relative to a specified datum such as the Australian Height Datum (mAHD) or an arbitrary survey datum onsite, or "reduced level" (mRL).

Head space. The air space at the top of a soil or water sample.

Heavy Metals. All metallic elements whose atomic mass exceeds that of calcium (20). Typical analysis for heavy metals includes cadmium (Cd), chromium (Cr), copper (Cu), nickel (Ni), lead (Pb), zinc (Zn), and the metalloid arsenic (As).

Heterogeneous. A condition of having different characteristics in proximate locations. Non-uniform. (Opposite of homogeneous).

Hydraulic Conductivity (K). A coefficient describing the rate at which water can move through a permeable medium. It has units of length per time. The units for hydraulic conductivity are typically $m^3/day/m^2$ or m/day.

Hydraulic Gradient (i). The rate of change in total head per unit of distance of flow in a given direction – the direction is that which yields a maximum rate of decrease in head. Hydraulic Gradient is unit less.

Hydraulic Head (h). The sum of the elevation head and the pressure head at a point in an aquifer. This is typically reported as an elevation above a fixed datum, such as sea level.

Infiltration. The passage of water, under the influence of gravity, from the land surface into the subsurface.

Ionic Exchange. Adsorption occurs when a particle with a charge imbalance, neutralises this charge by the attraction (and subsequent adherence of) ions of opposite charge from solution. There are two types of such a charge: pH dependent; and pH independent or crystalline charge. Metal hydroxides and oxy-hydroxides represent examples of the former type, whilst clay minerals are representative of the latter and are normally associated with cation exchange.

Ions. An ion is a charged element or compound as a result of an excess or deficit of electrons. Positively charged ions are called cations, whilst negatively charged ions are called anions. Cations are written with superscript $^+$, whilst anions use $^-$ as the superscript. The major aqueous ions are those that dominate total dissolved solids (TDS). These ions include: Cl^-, SO_4^{2-}, HCO_3^-, Na^+, Ca^{2+}, Mg^{2+}, K^+, NH_4^+, NO_3^-, NO_2^-, F^-, PO_4^{3-} and the heavy metals.

Perched Groundwater. Unconfined groundwater separated from an underlying main body of groundwater by an unsaturated zone. Perched groundwater typically occurs in discontinuous, often ephemeral, lenses, with unsaturated conditions both above and below.

Permeability (k). Property of porous medium relating to its ability to transmit or conduct liquid (usually water) under the influence of a driving force. Where water is the fluid, this is effectively the hydraulic conductivity. A function of the connectivity of pore spaces.

Piezometric or Potentiometric Surface. A surface that represents the level to which water will rise in cased bores. The water table is the potentiometric surface in an unconfined aquifer.

pH. A logarithmic index for the concentration of hydrogen ions in an aqueous solution, which is used as a measure of acidity.

Porosity (n). The ratio of the volume of void spaces in a rock or sediment to the total volume of the rock or sediment. Typically given as a percentage.

Porosity, effective (ne). The volume of the void spaces through which water or other fluids can travel in a rock or sediment divided by the total volume of the rock or sediment.

Precipitation (chemical). There are two types of precipitation, pH dependent precipitation and solubility controlled precipitation. As the pH is raised beyond a threshold level the precipitation of metal cations such as oxy-hydroxides and hydroxides occur. As the pH is raised further precipitation continues until there are very few metal cations remaining in solution. This reaction is entirely reversible. Solubility controlled precipitation occurs between two ions when, at a given temperature and pressure, the concentration of one of the ions exceeds a certain level.

Purge (bores). The pumping out of monitoring bore water to remove drilling debris or impurities; also conducted to bring fresh groundwater into the casing for sample collection. The later ensures that a more representative sample of an aquifer is taken.

QA/QC. Quality Assurance / Quality Control.

Recharge Area. Location of the replenishment of an aquifer by a natural process such as addition of water at the ground surface, or by an artificial system such as addition through a well

Recovery. The rate at which a water level in a bore rises after pumping ceases.

Saturated Zone. A zone in which the rock or soil pores are filled (saturated) with water.

Standing Water Level (SWL). The depth to the groundwater surface in a well or bore measured below a specific reference point – usually recorded as metres below the top of the well casing or below the ground surface.

Stratigraphy. A vertical sequence of geological units.

Total Dissolved Salts (TDS). The total dissolved salts comprise dissociated compounds and undissociated compounds, but not suspended material, colloids or dissolved gases.

Toxicity. The inherent potential or capacity of a material to cause adverse effects in a living organism.

Unsaturated Zone. The zone between the land surface and the water table, in which the rock or soil pores contain both air and water (water in the unsaturated zone is present at less than atmospheric pressure). It includes the root zone, intermediate zone and capillary fringe. Saturated bodies such as perched groundwater may exist in the unsaturated zone. Also referred to as the Vadose Zone.

Volatile. Having a low boiling or subliming pressure (a high vapour pressure).

Water table. Interface between the saturated zone and unsaturated zones. The surface in an aquifer at which pore water pressure is equal to atmospheric pressure.

Well. See **Bore** (monitoring bore).

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Scope of services
The work presented in this report is Environmental Earth Sciences response to the specific scope of works requested by, planned with and approved by the client. It cannot be relied on by any other third party for any purpose except with our prior written consent. Client may distribute this report to other parties and in doing so warrants that the report is suitable for the purpose it was intended for. However, any party wishing to rely on this report should contact us to determine the suitability of this report for their specific purpose.

Data should not be separated from the report
A report is provided inclusive of all documentation sections, limitations, tables, figures and appendices and should not be provided or copied in part without all supporting documentation for any reason, because misinterpretation may occur.

Subsurface conditions change
Understanding an environmental study will reduce exposure to the risk of the presence of contaminated soil and or groundwater. However, contaminants may be present in areas that were not investigated, or may migrate to other areas. Analysis cannot cover every type of contaminant that could possibly be present. When combined with field observations, field measurements and professional judgement, this approach increases the probability of identifying contaminated soil and or groundwater. Under no circumstances can it be considered that these findings represent the actual condition of the site at all points.

Environmental studies identify actual sub-surface conditions only at those points where samples are taken, when they are taken. Actual conditions between sampling locations differ from those inferred because no professional, no matter how qualified, and no sub-surface exploration program, no matter how comprehensive, can reveal what is hidden below the ground surface. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from that predicted. Nothing can be done to prevent the unanticipated. However, steps can be taken to help minimize the impact. For this reason, site owners should retain our services.

Problems with interpretation by others
Advice and interpretation is provided on the basis that subsequent work will be undertaken by Environmental Earth Sciences QLD. This will identify variances, maintain consistency in how data is interpreted, conduct additional tests that may be necessary and recommend solutions to problems encountered on site. Other parties may misinterpret our work and we cannot be responsible for how the information in this report is used. If further data is collected or comes to light we reserve the right to alter their conclusions.

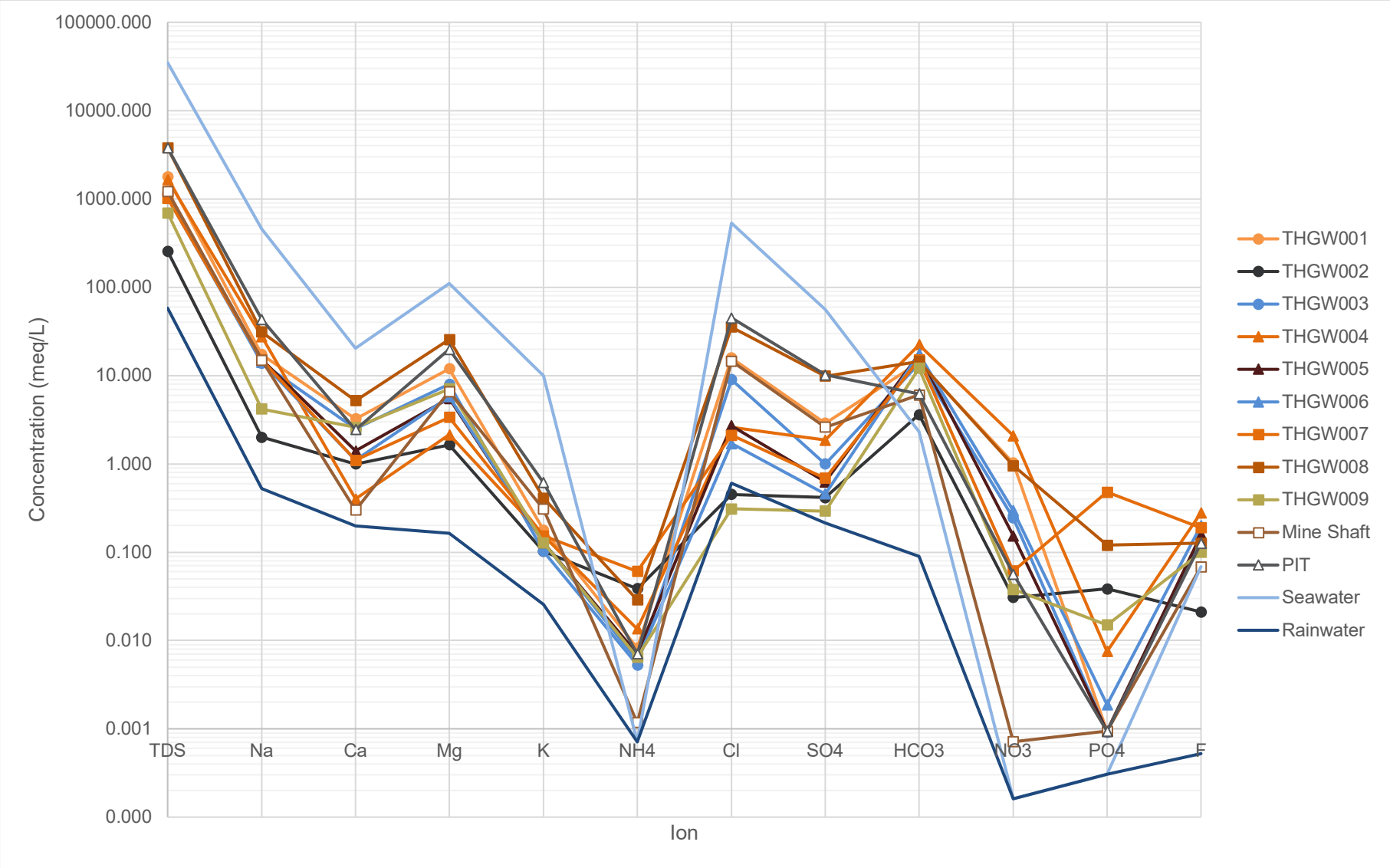
Obtain regulatory approval
The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party. When approval from a statutory authority is required for a project, that approval should be directly sought by the client.

Limit of liability
This study has been carried out to a particular scope of works at a specified site and should not be used for any other purpose. This report is provided on the condition that Environmental Earth Sciences QLD disclaims all liability to any person or entity other than the client in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by any such person in reliance, whether in whole or in part, on the contents of this report. Furthermore, Environmental Earth Sciences QLD disclaims all liability in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by the client, or any such person in reliance, whether in whole or any part of the contents of this report of all matters not stated in the brief outlined in Environmental Earth Sciences QLD's proposal number and according to Environmental Earth Sciences general terms and conditions and special terms and conditions for contaminated sites.

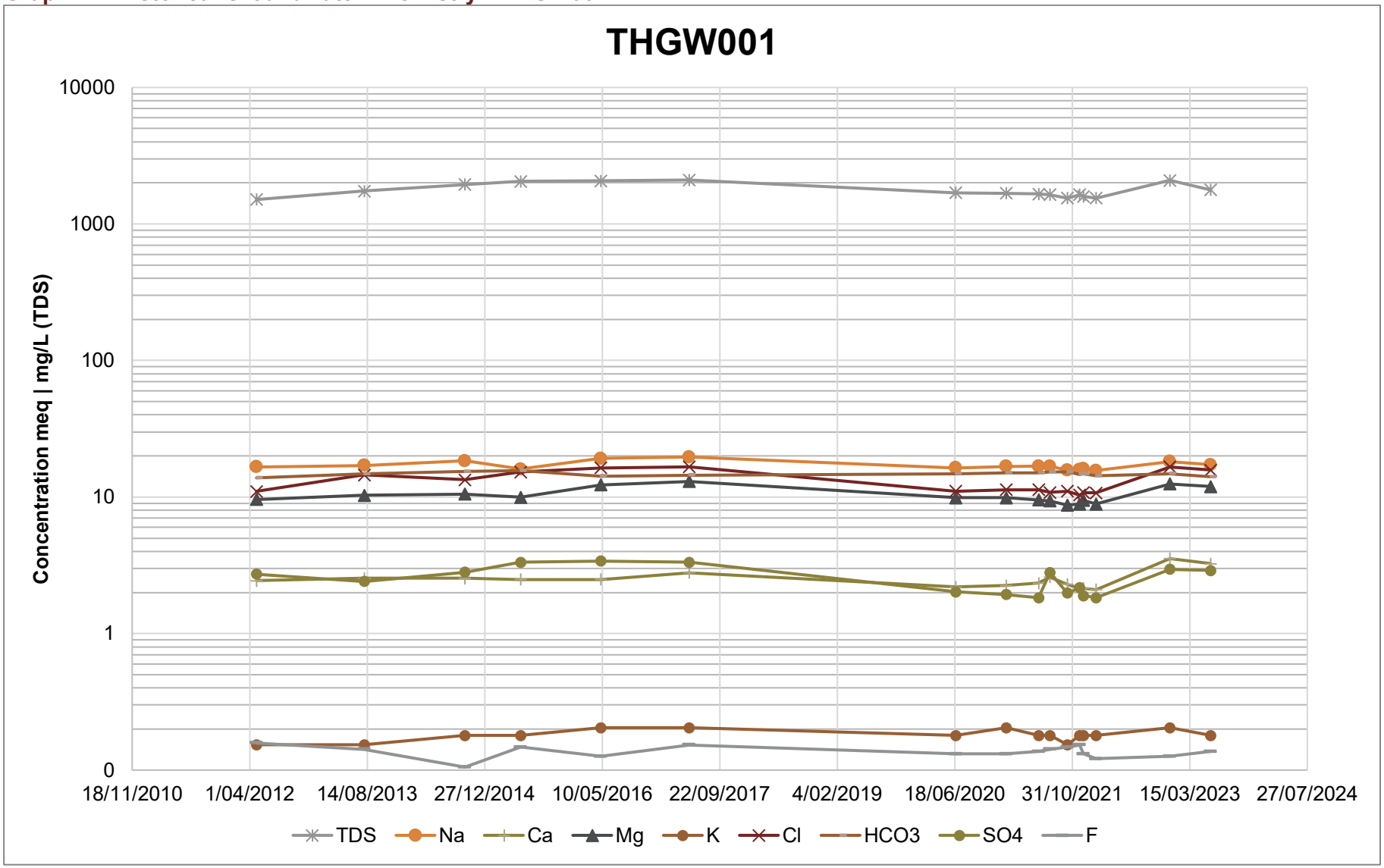
To the maximum extent permitted by law, we exclude all liability of whatever nature, whether in contract, tort or otherwise, for the acts, omissions or default, whether negligent or otherwise for any loss or damage whatsoever that may arise in any way in connection with the supply of services. Under circumstances where liability cannot be excluded, such liability is limited to the value of the purchased service.

GRAPHS

Graph A1. Schoeller Plot of Groundwater Chemistry – June 2023



Graph A2. Historical Groundwater Chemistry – THGW001



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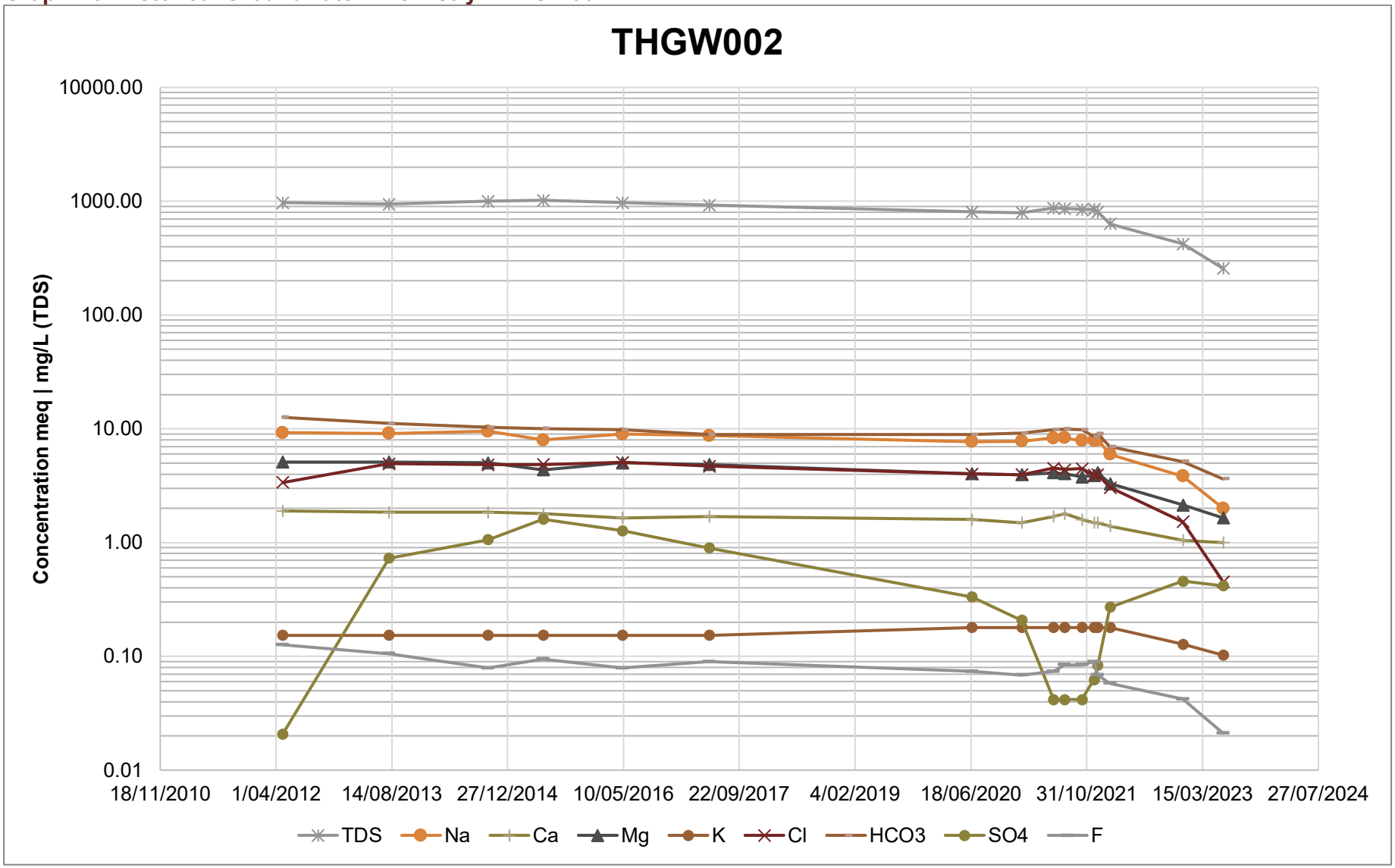
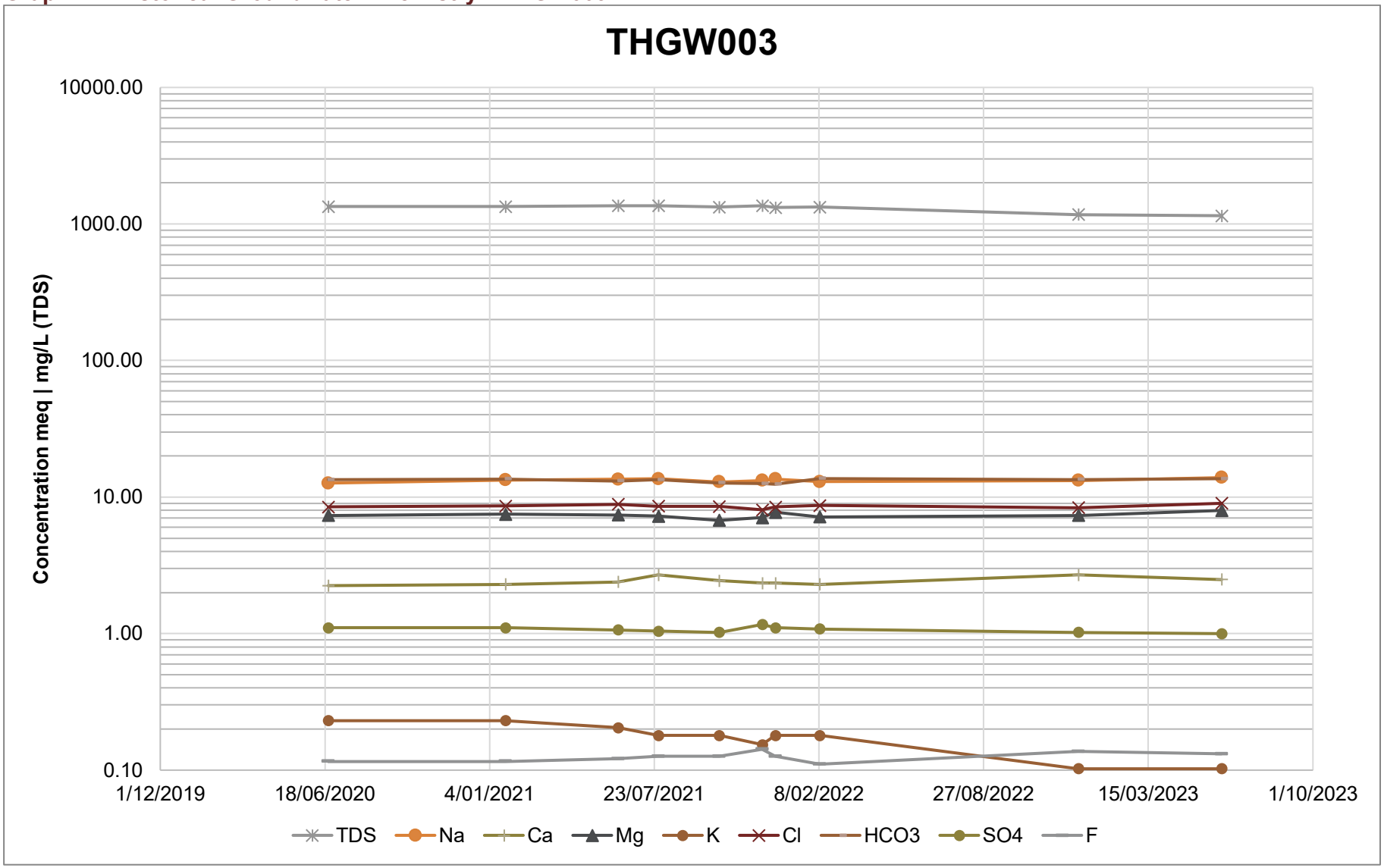
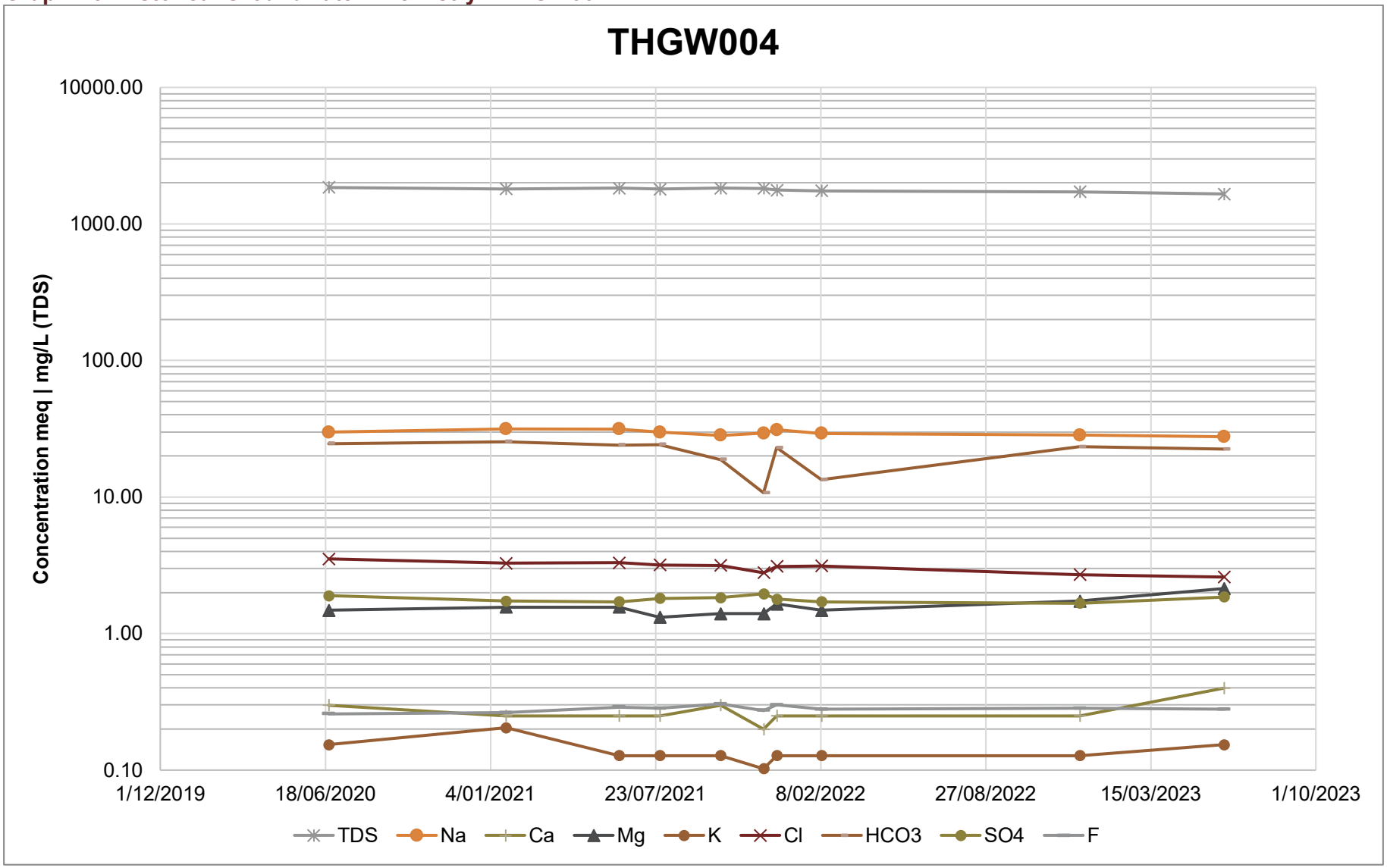


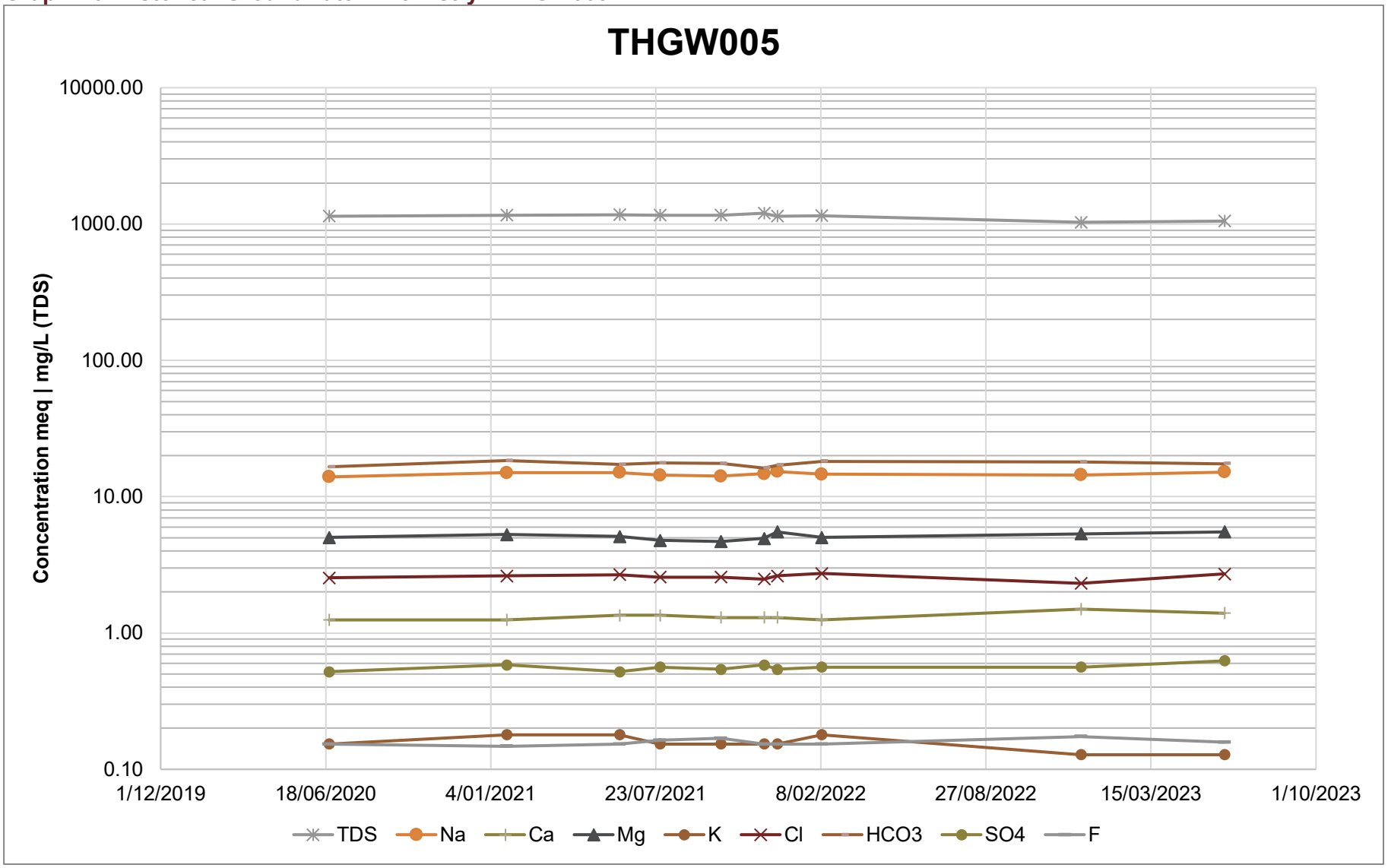
Graph A4. Historical Groundwater Chemistry – THGW003



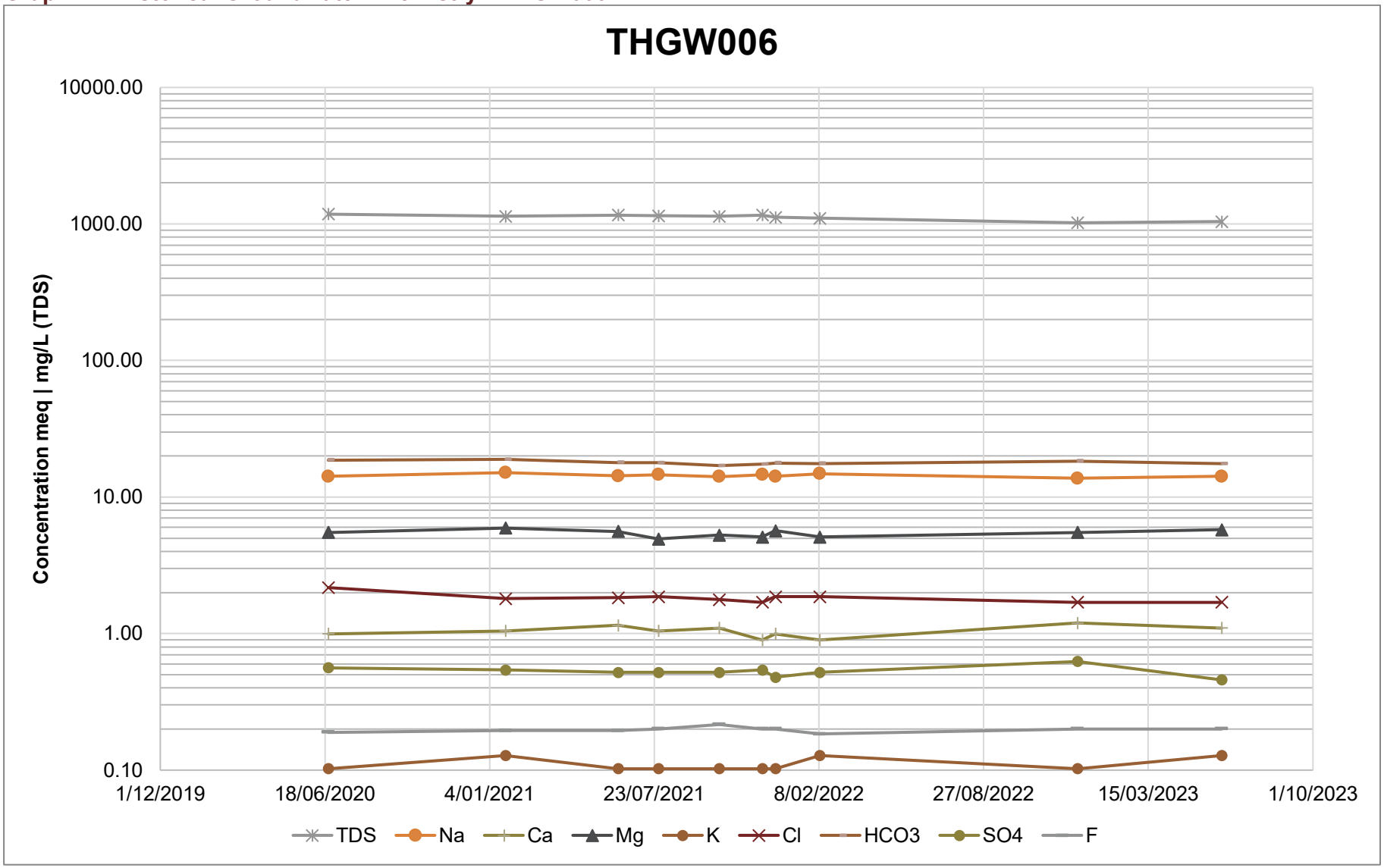
Graph A5. Historical Groundwater Chemistry – THGW004



Graph A6. Historical Groundwater Chemistry – THGW005



Graph A7. Historical Groundwater Chemistry – THGW006



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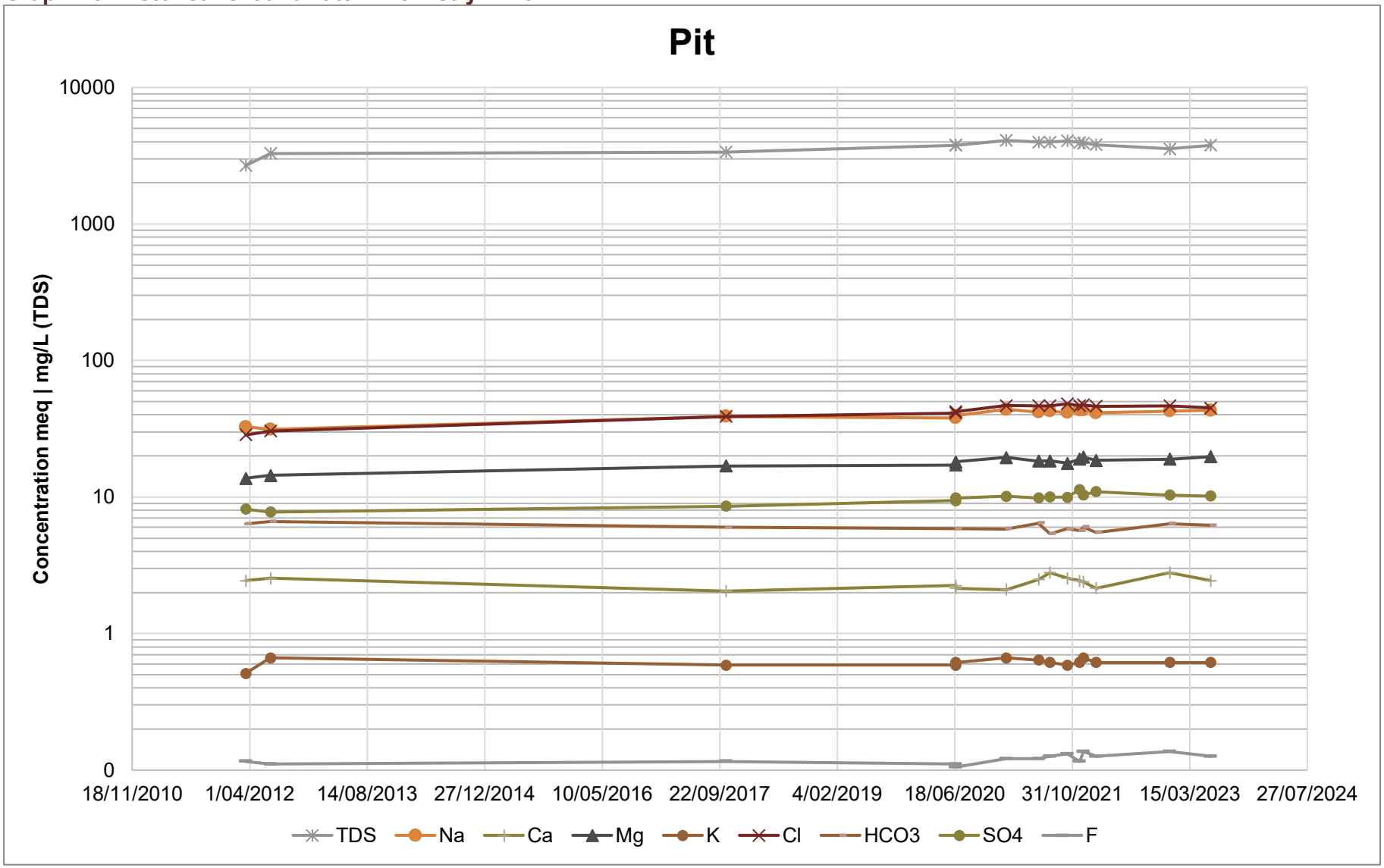
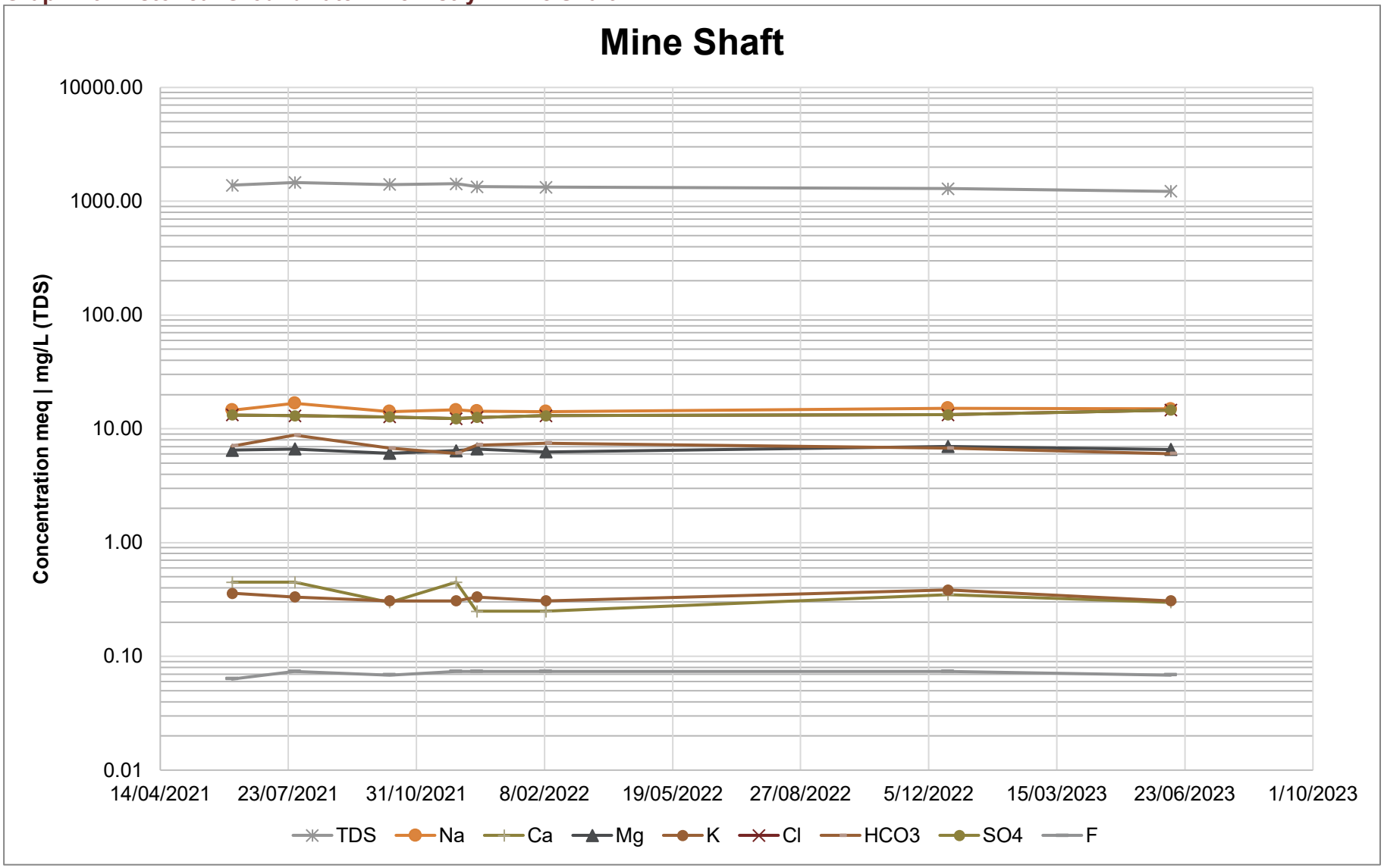
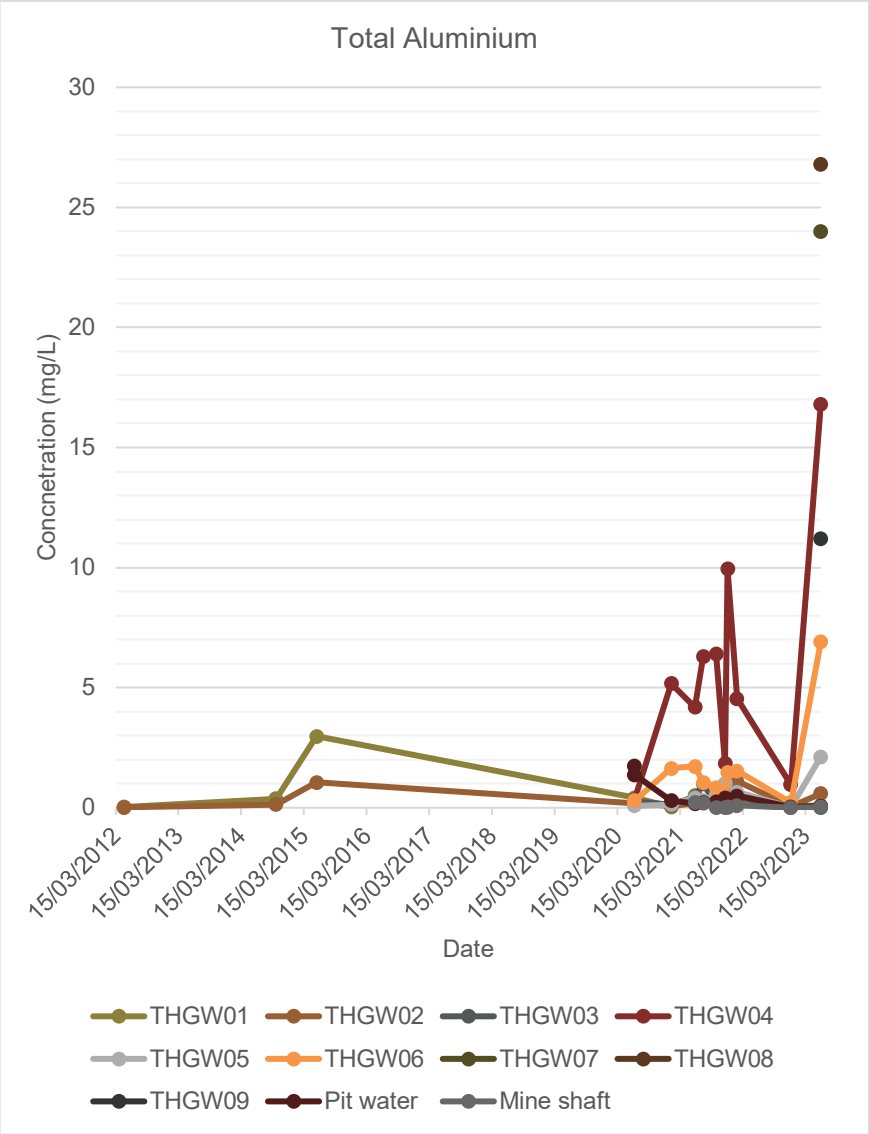
Graph A8. Historical Groundwater Chemistry – Pit

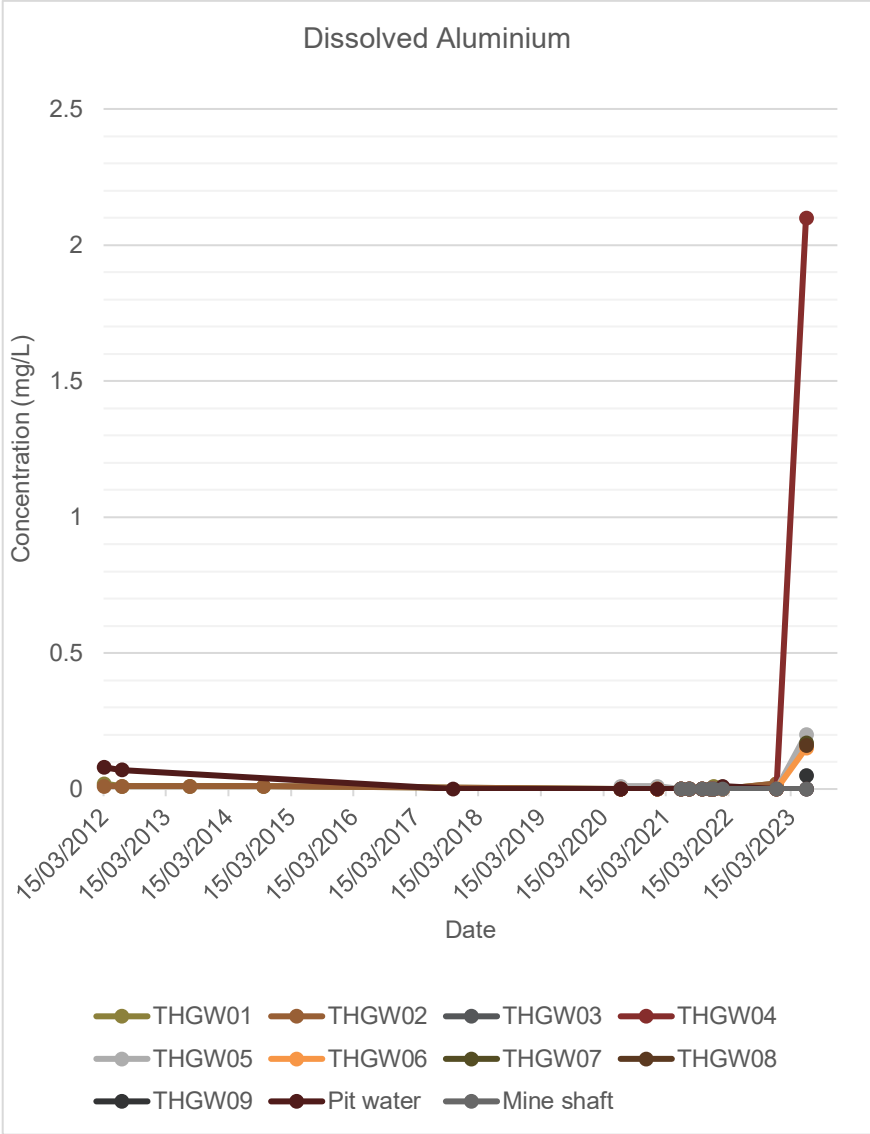


Graph A9. Historical Groundwater Chemistry – Mine Shaft

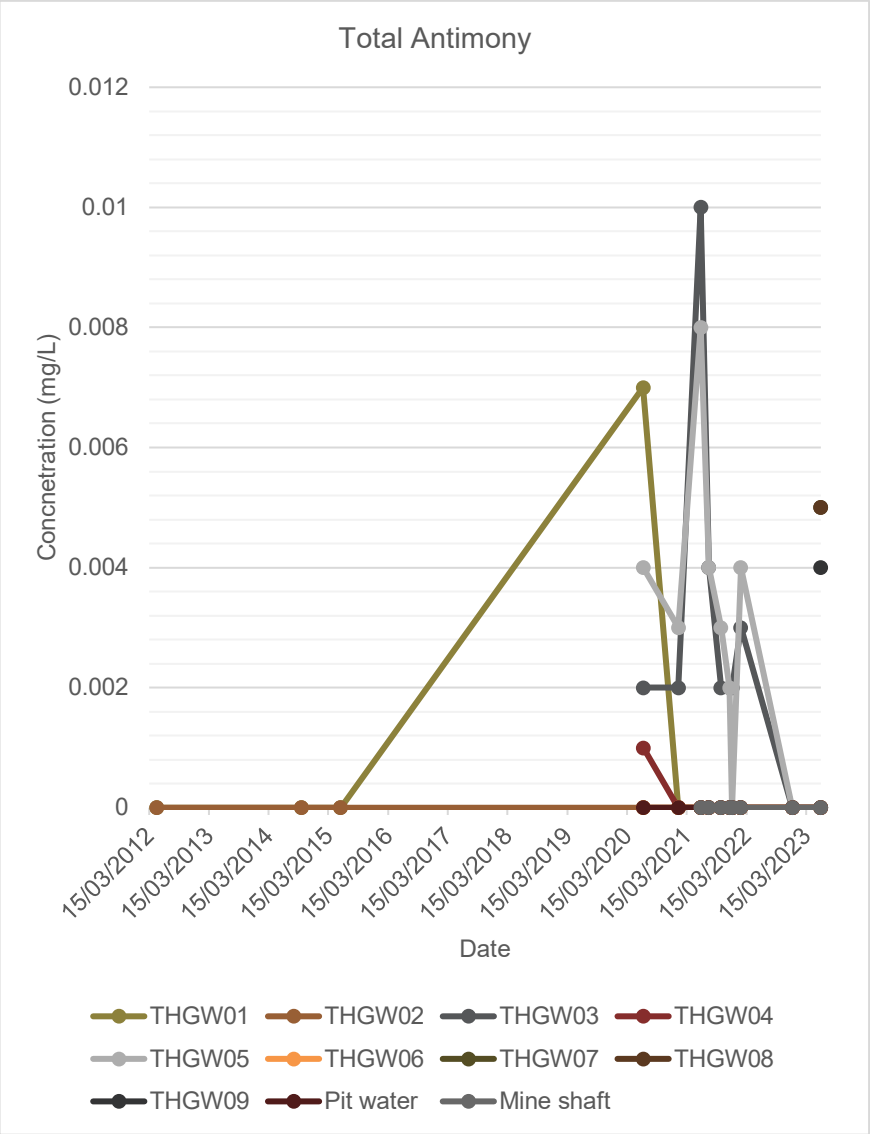


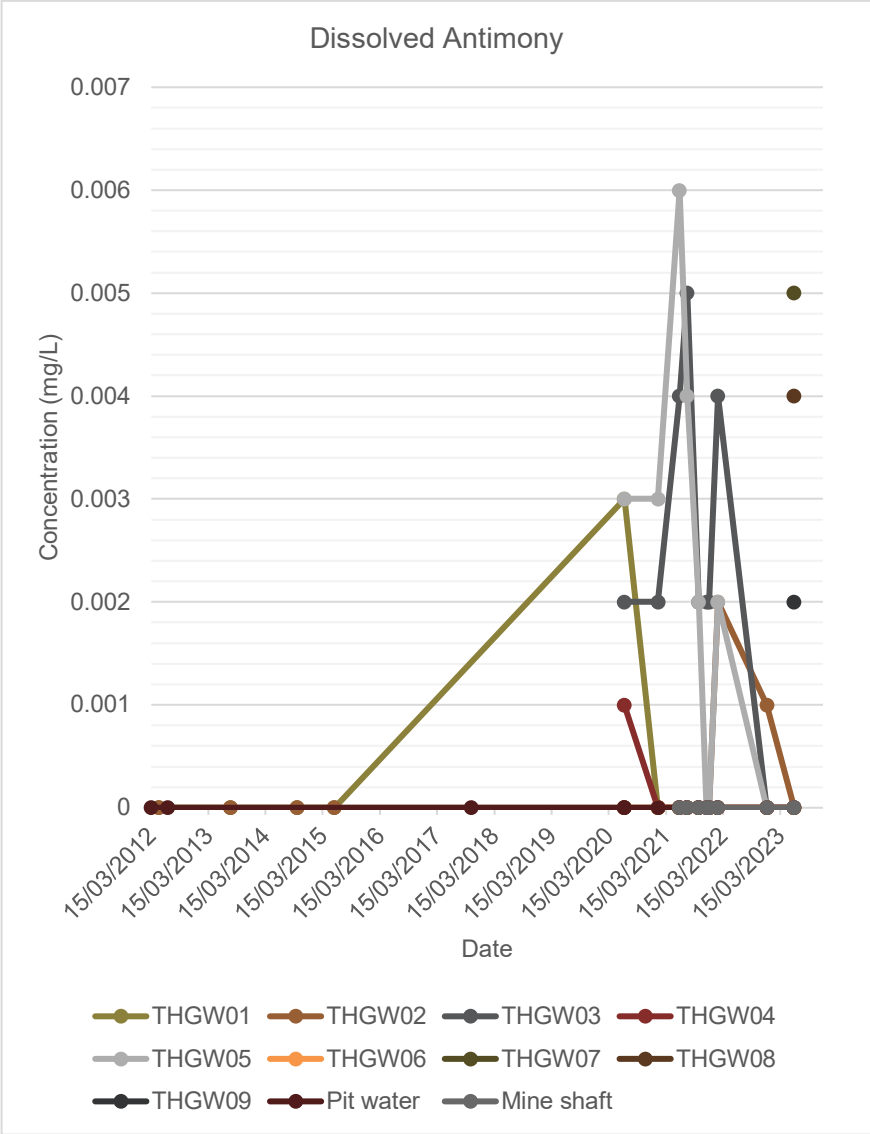
Graph A10. Total and Dissolved metals concentrations in groundwater – Aluminium



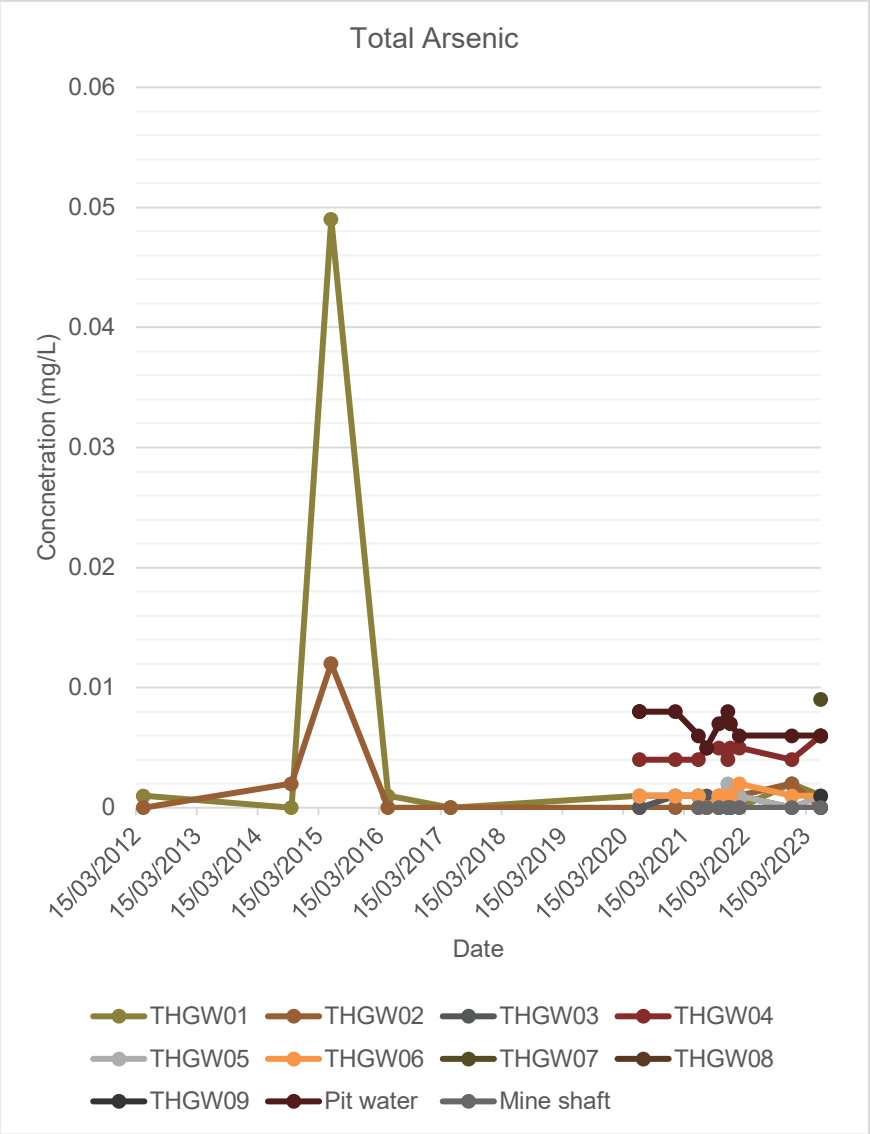


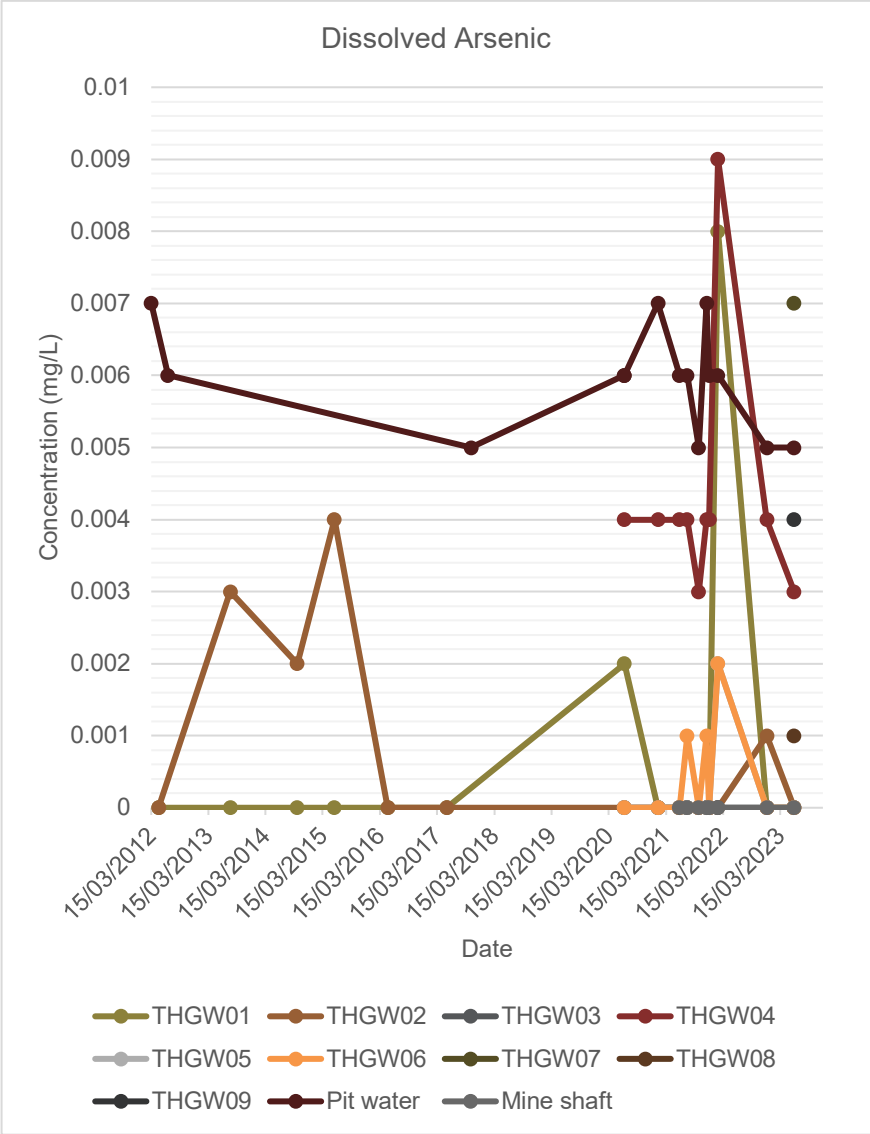
Graph A11. Total and Dissolved metals concentrations in groundwater – Antimony



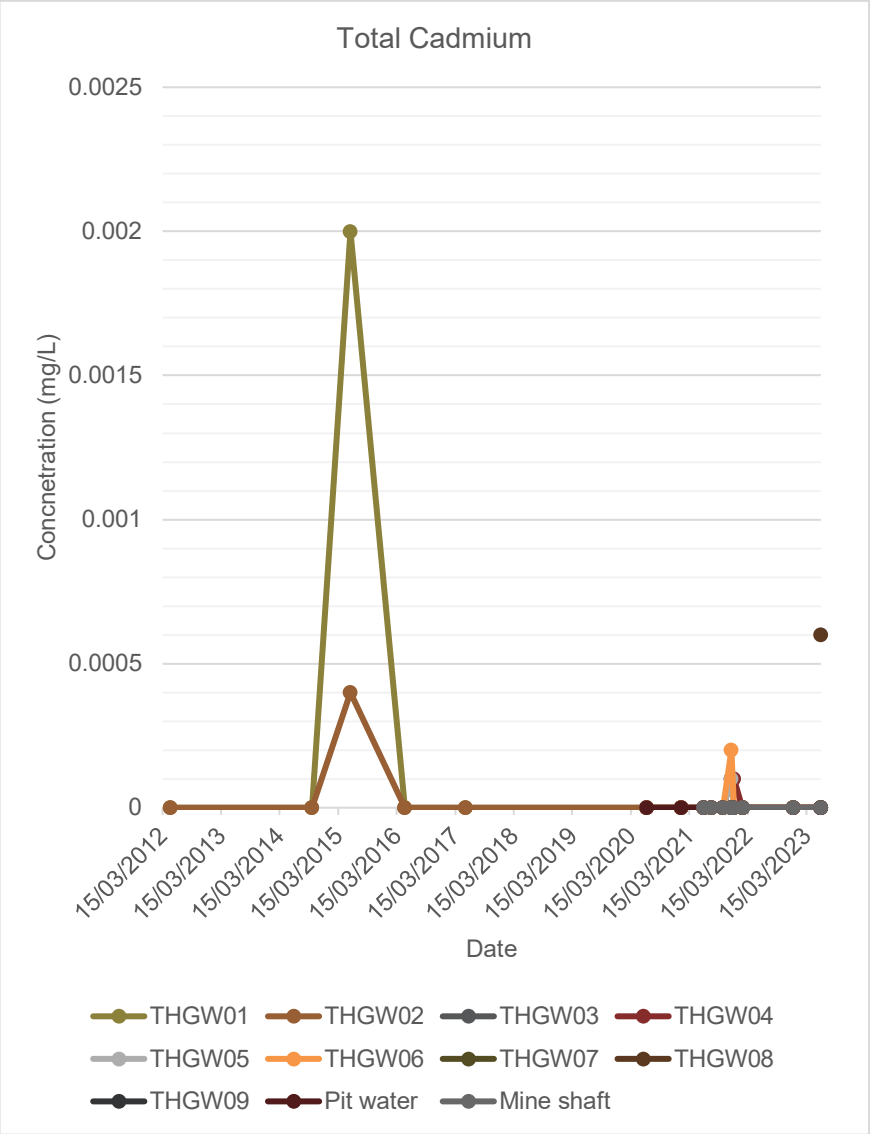


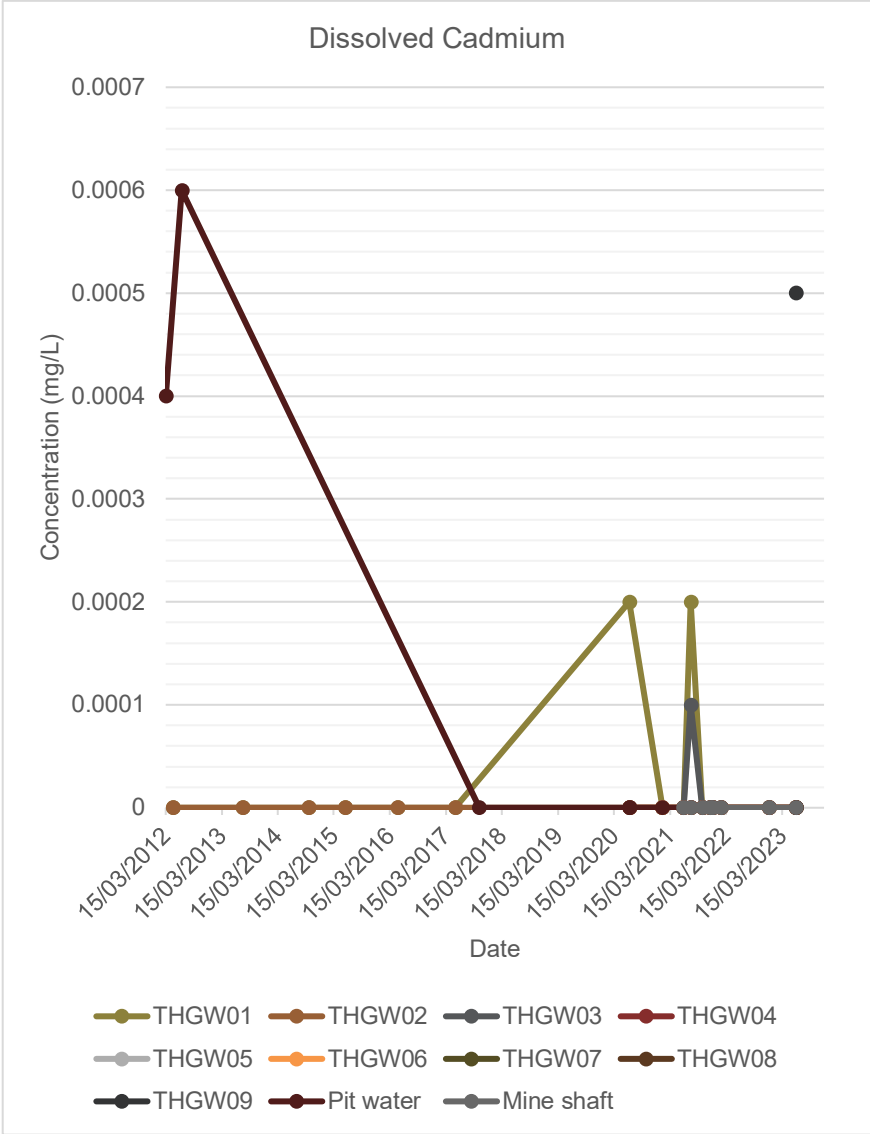
Graph A12. Total and Dissolved metals concentrations in groundwater – Arsenic



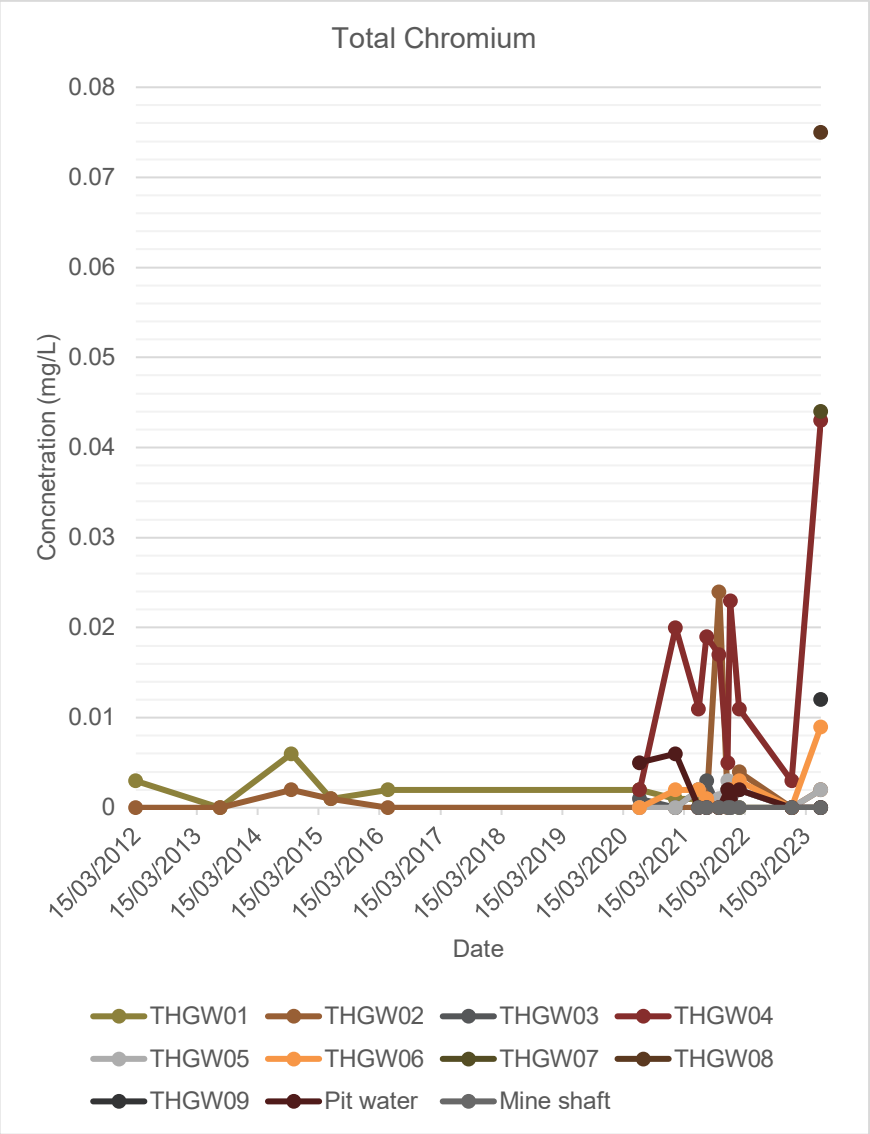


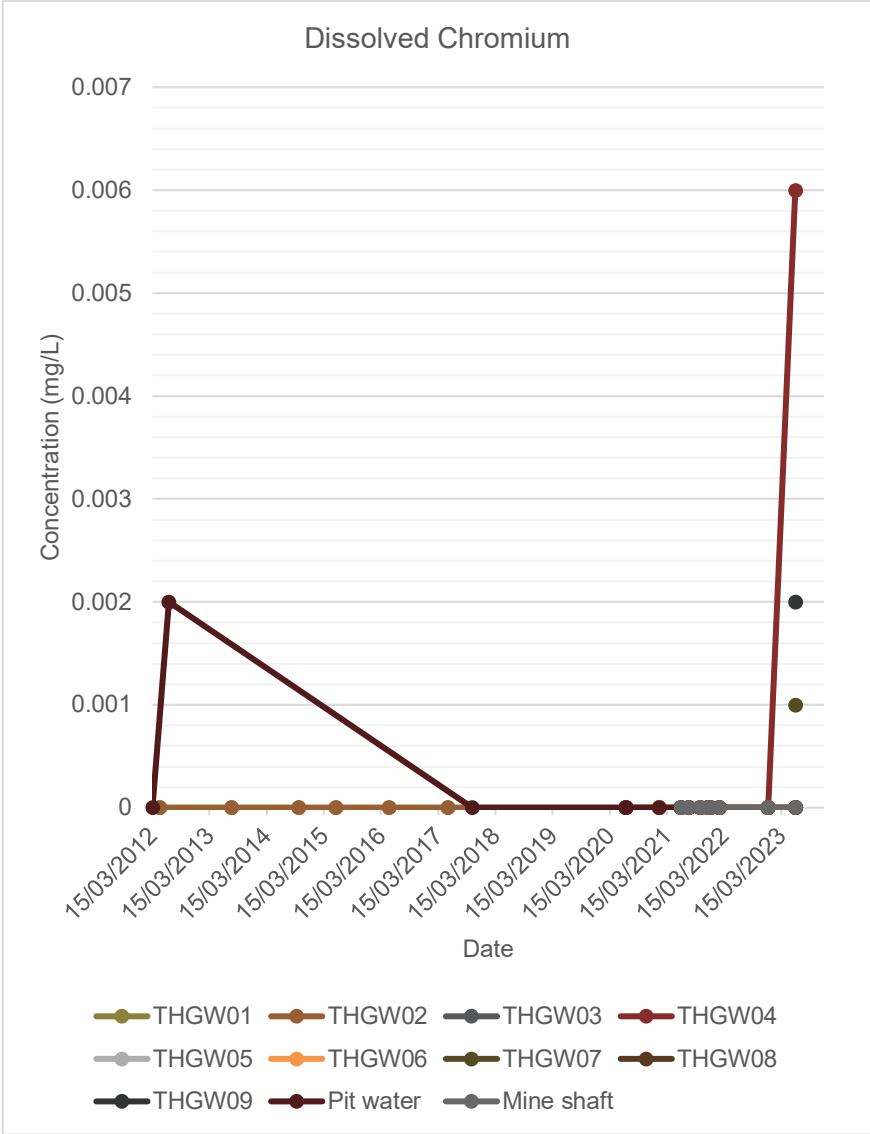
Graph A13. Total and Dissolved metals concentrations in groundwater – Cadmium



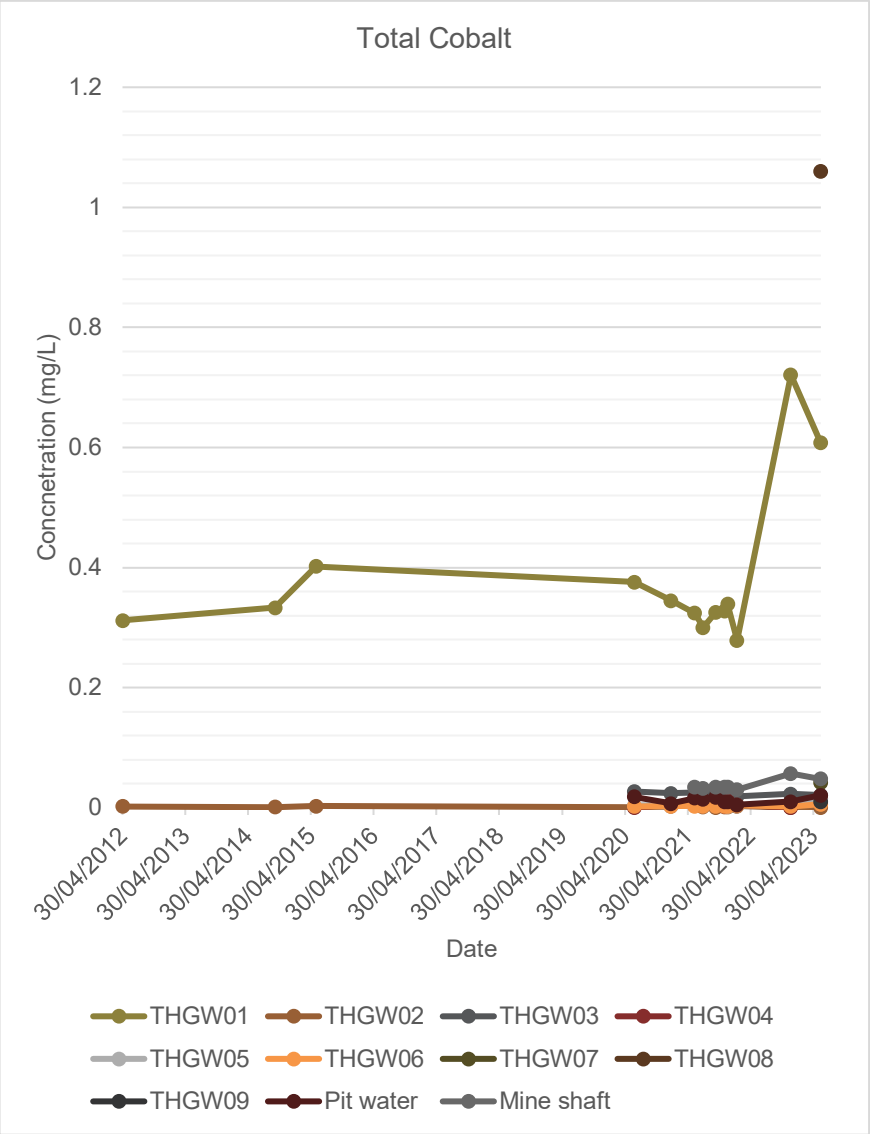


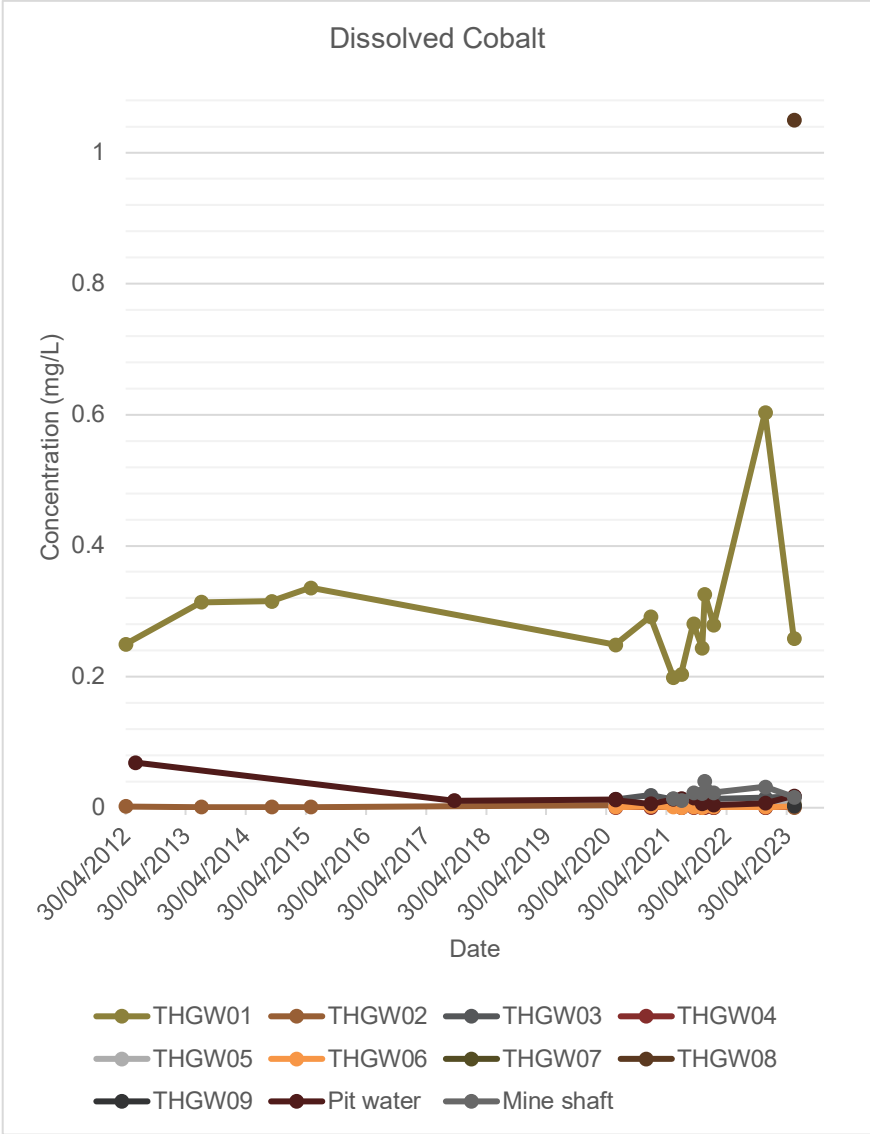
Graph A14. Total and Dissolved metals concentrations in groundwater – Chromium



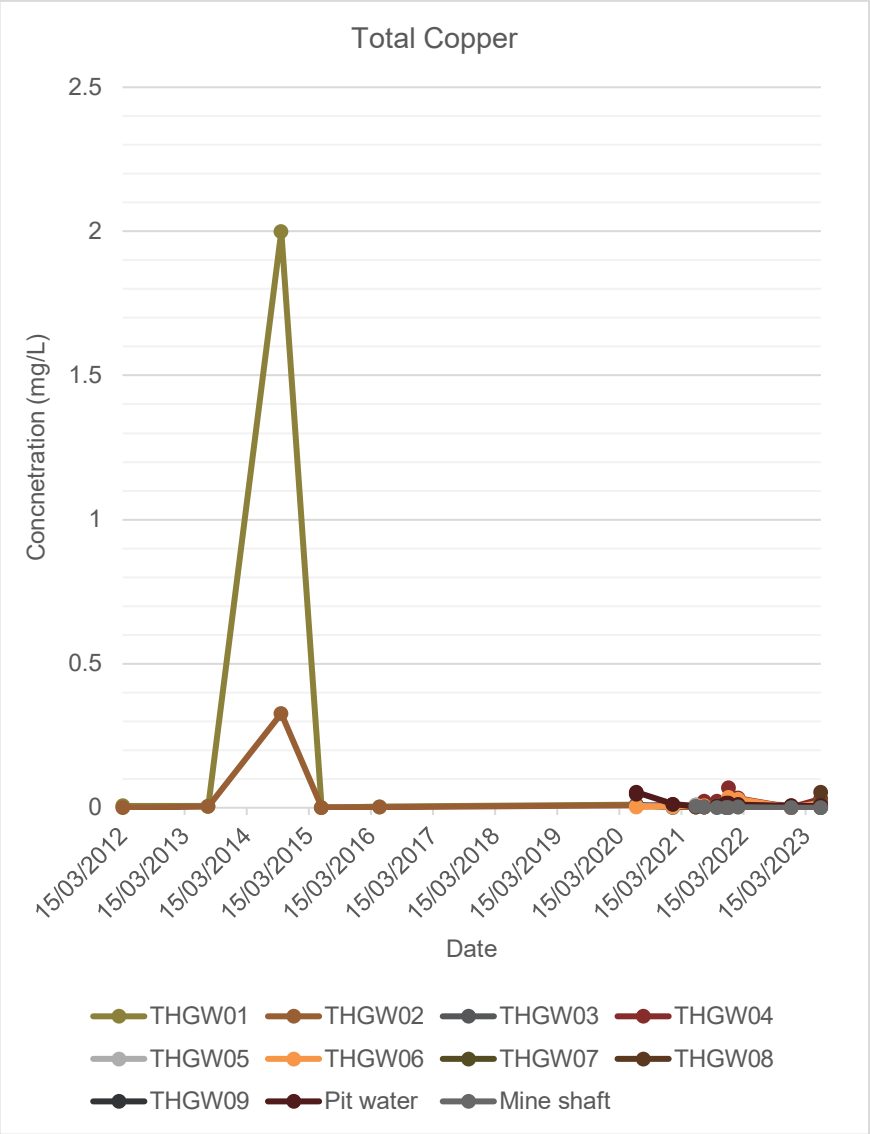


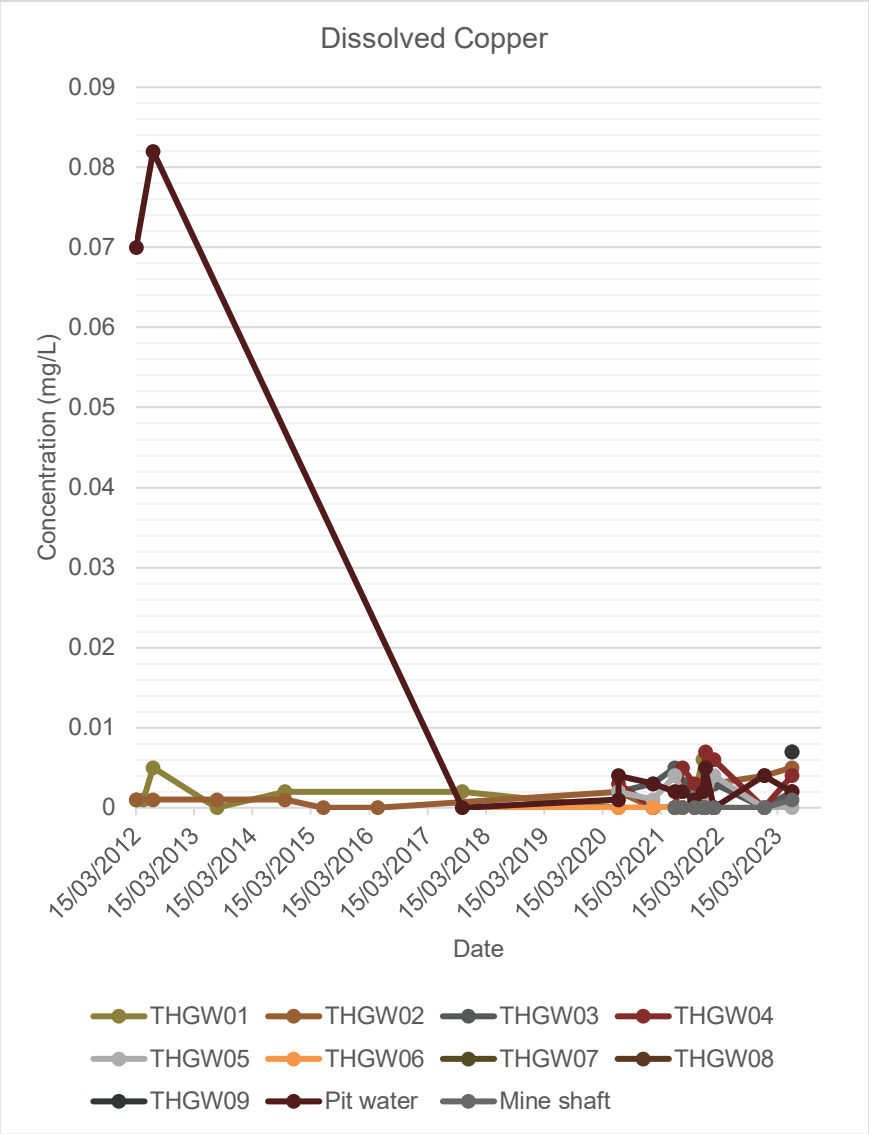
Graph A15. Total and Dissolved metals concentrations in groundwater – Cobalt



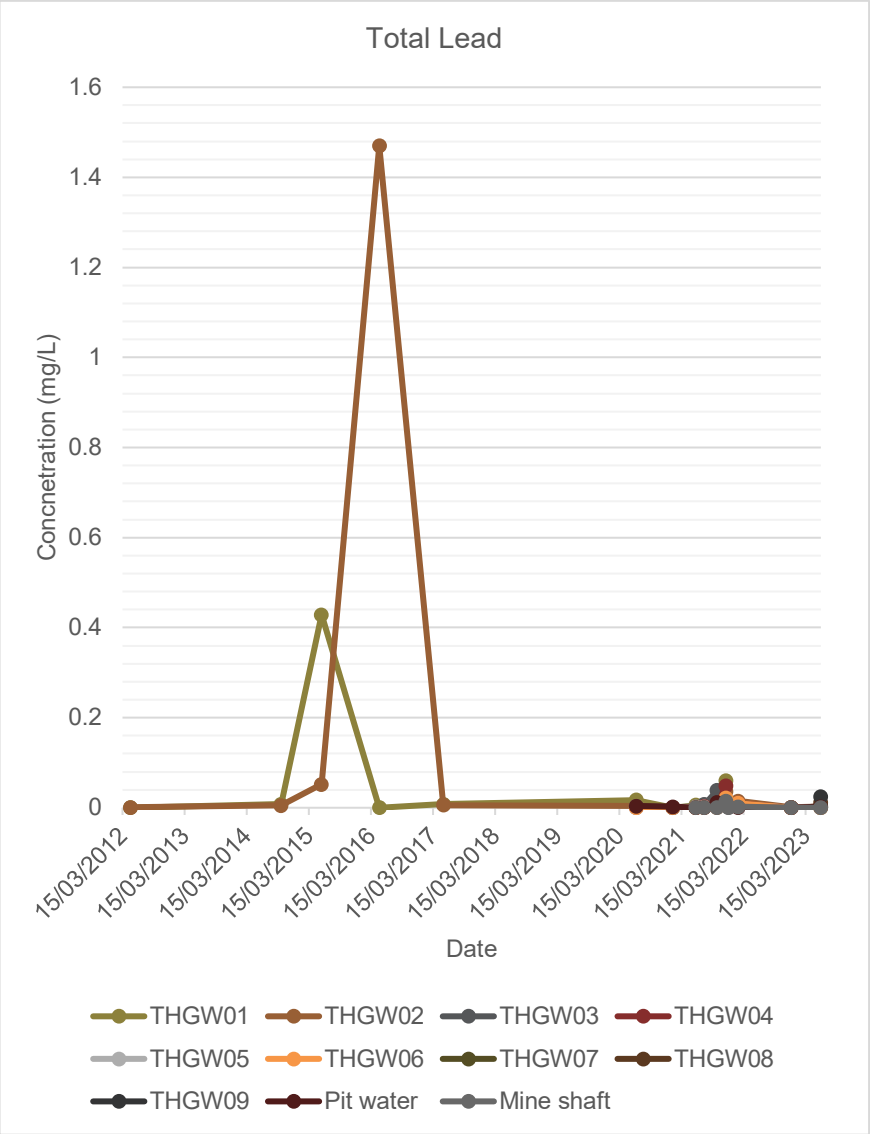


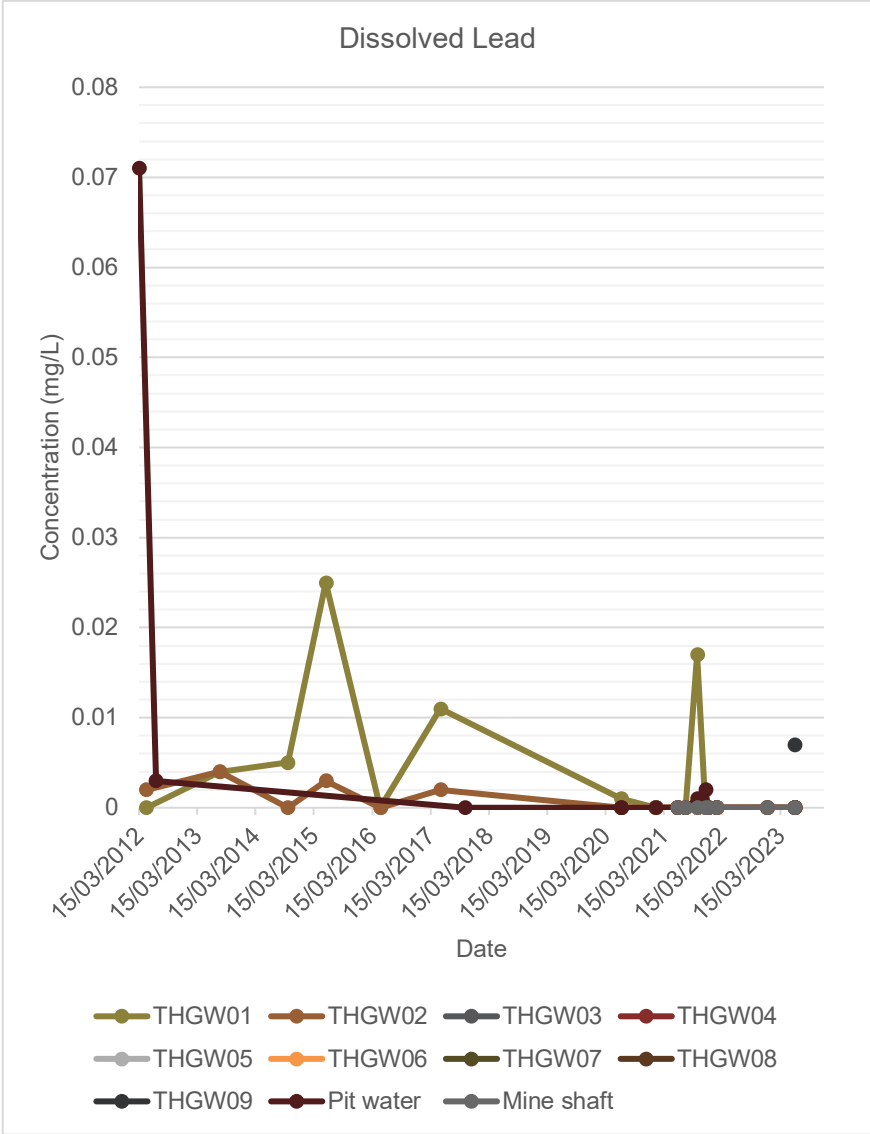
Graph A16. Total and Dissolved metals concentrations in groundwater – Copper



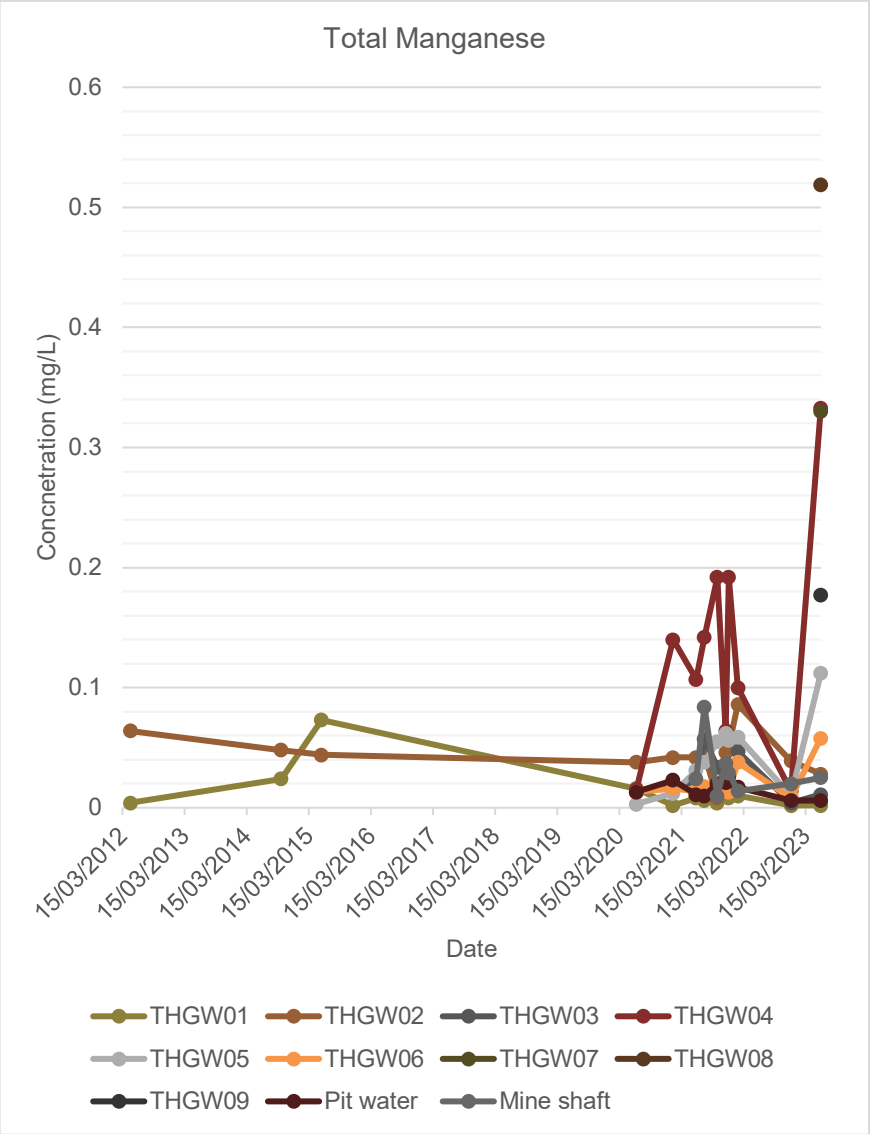


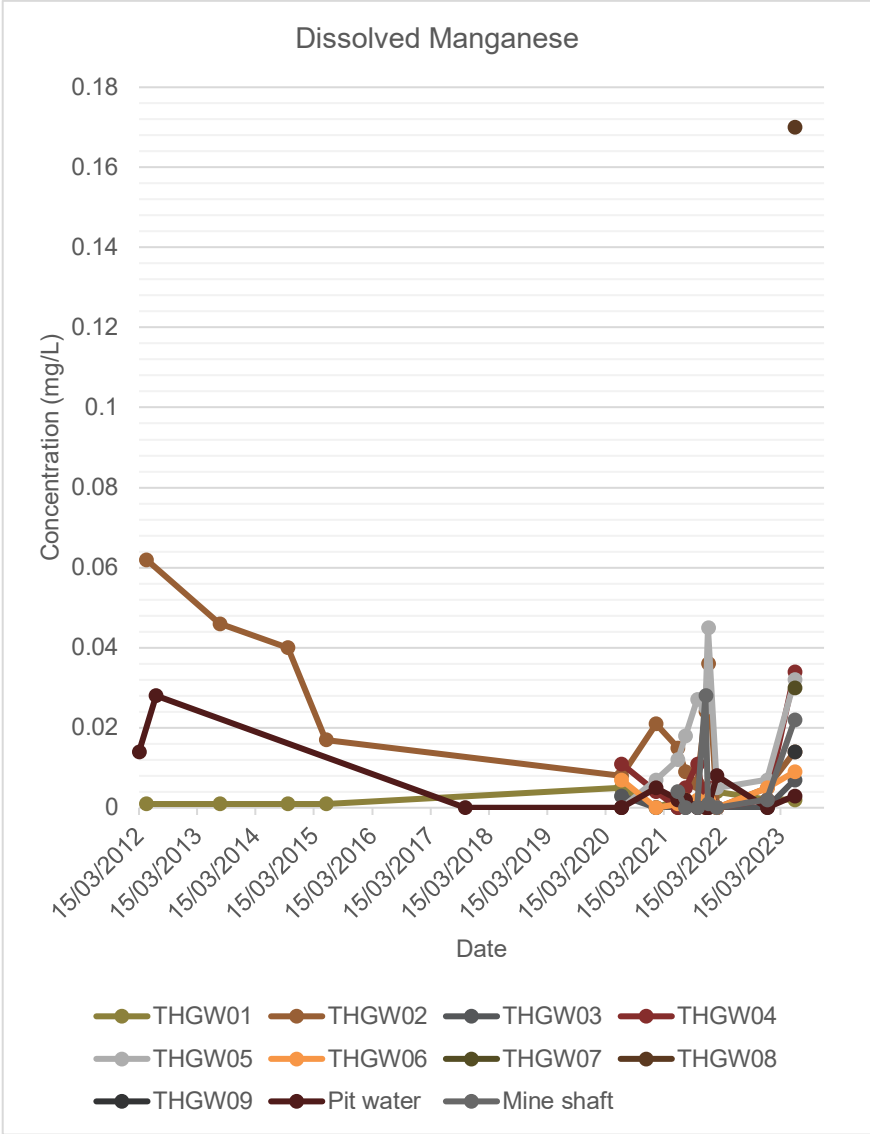
Graph A17. Total and Dissolved metals concentrations in groundwater – Lead



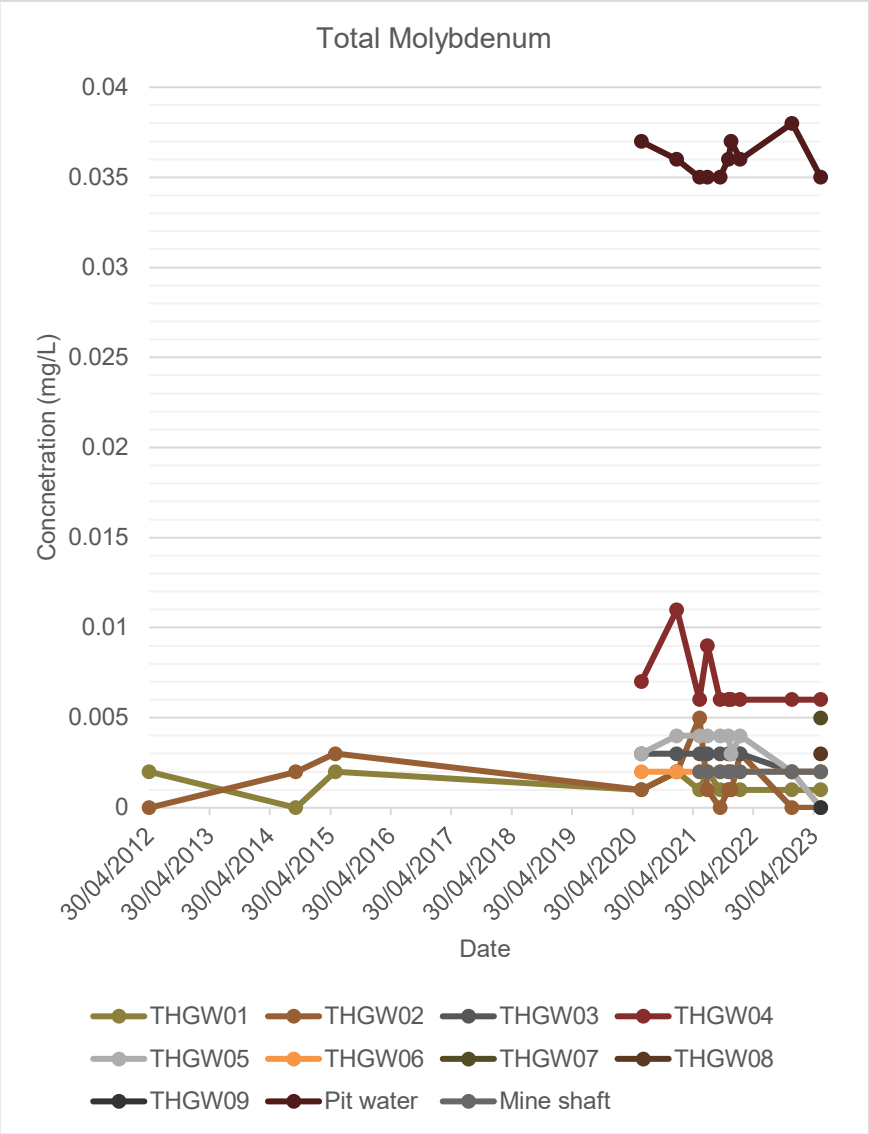


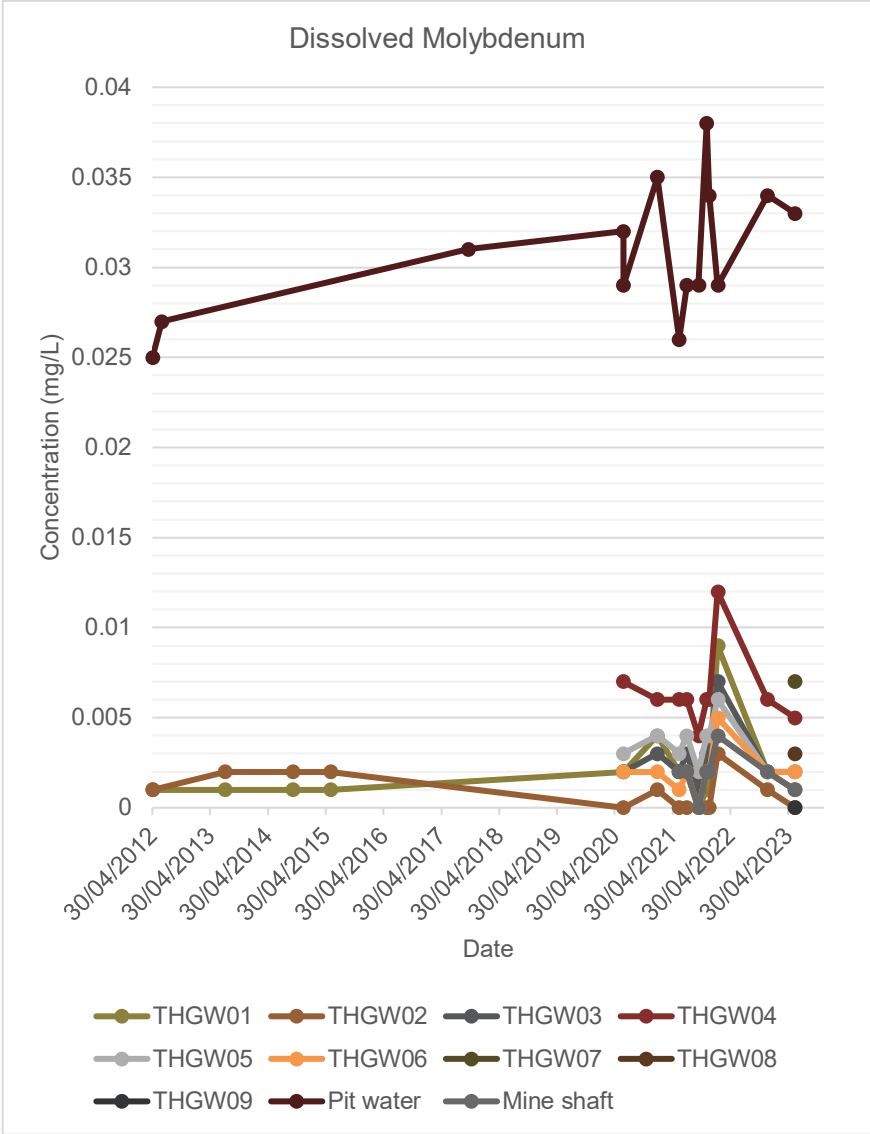
Graph A18. Total and Dissolved metals concentrations in groundwater – Manganese



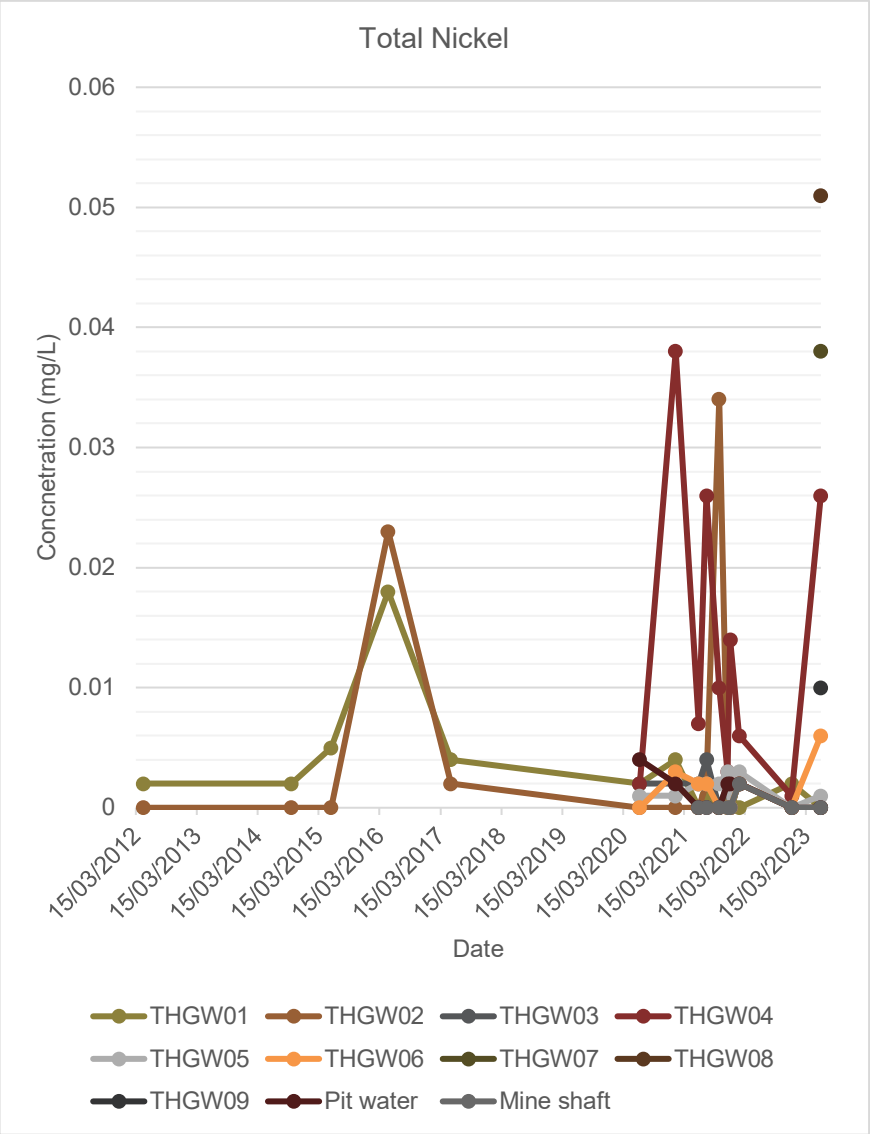


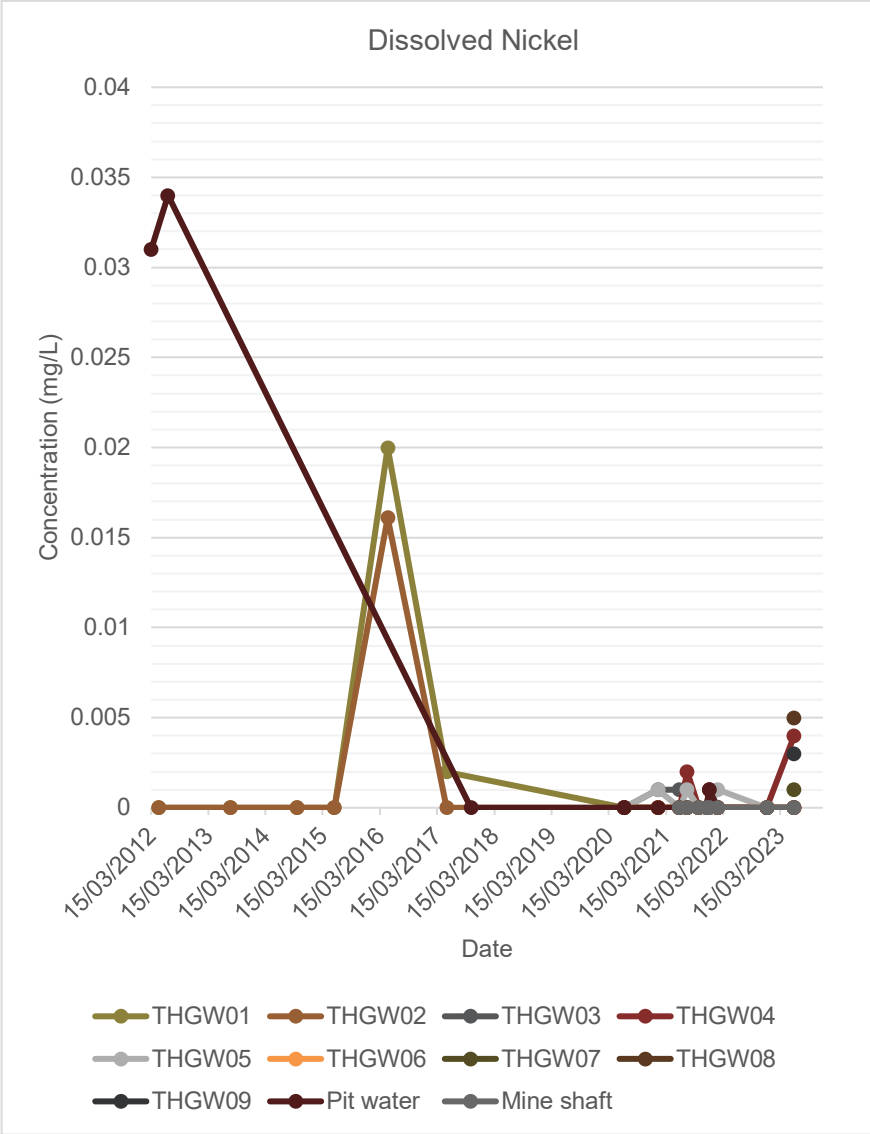
Graph A19. Total and Dissolved metals concentrations in groundwater – Molybdenum



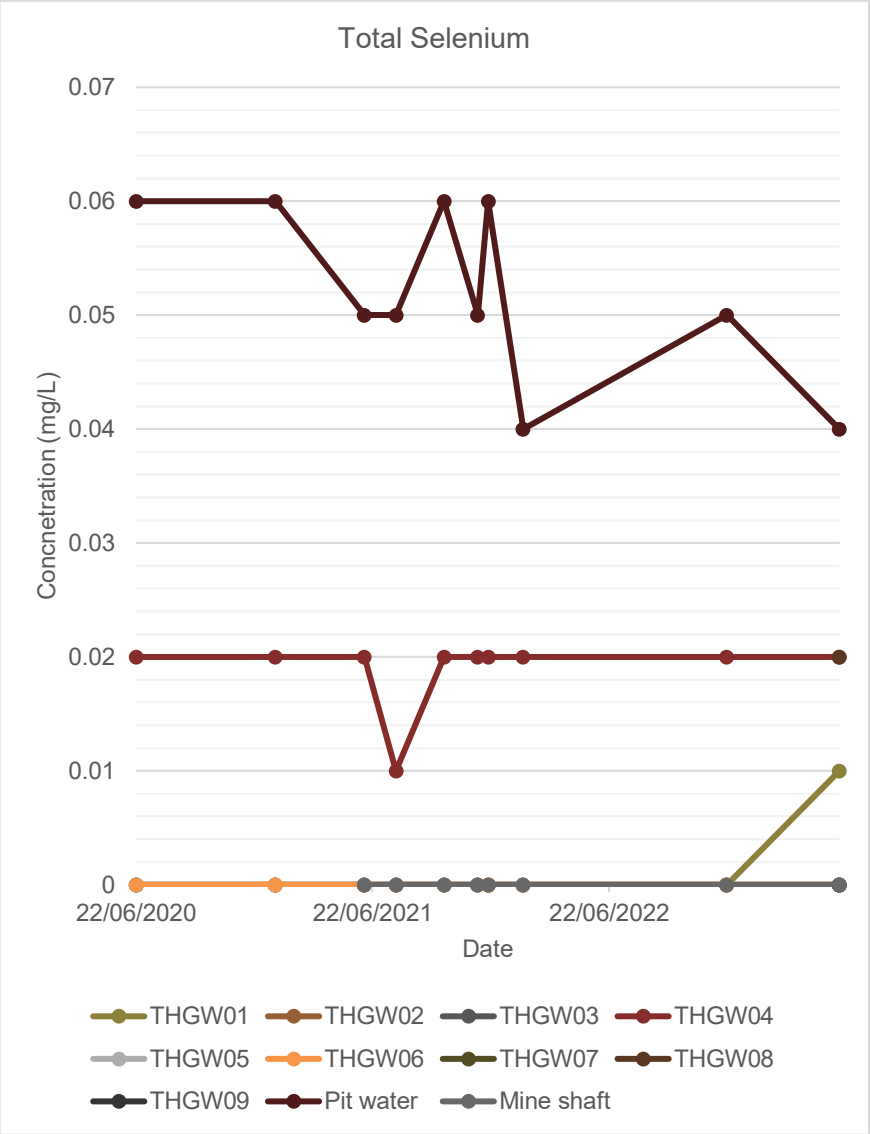


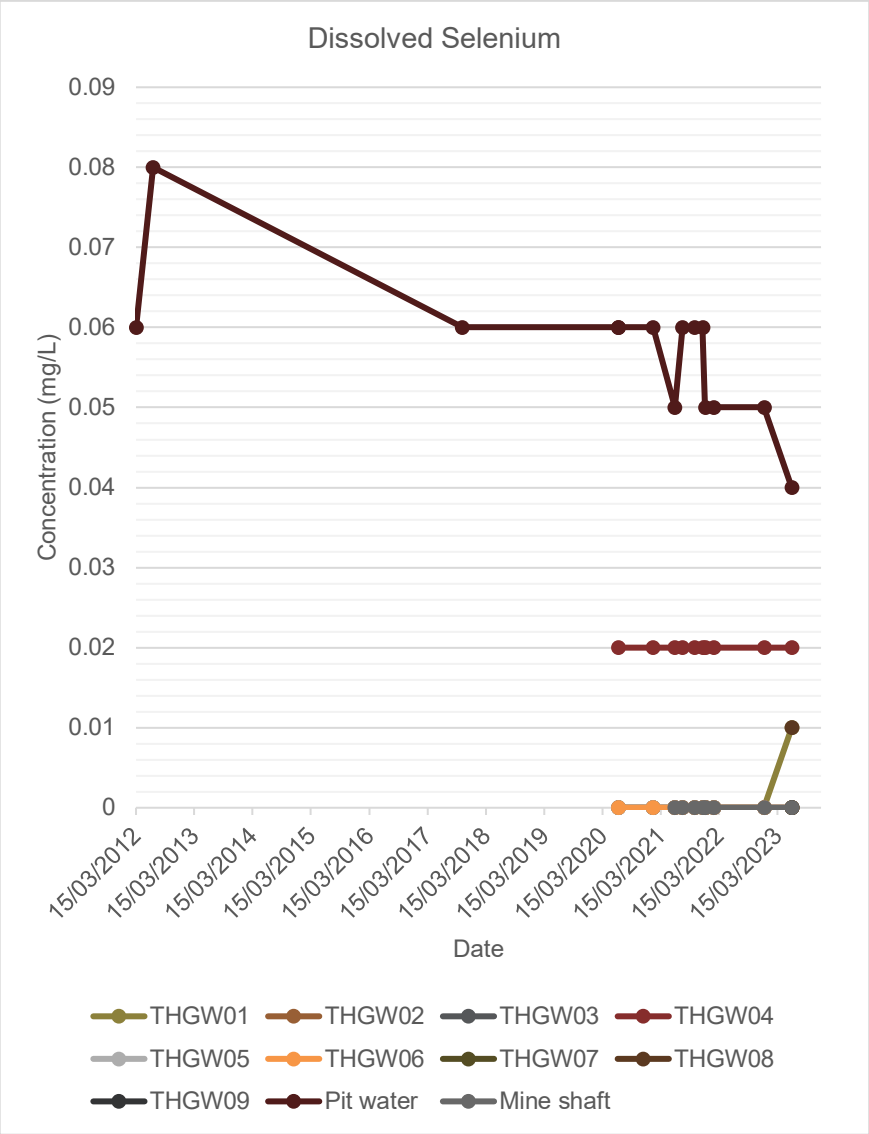
Graph A19. Total and Dissolved metals concentrations in groundwater – Nickel



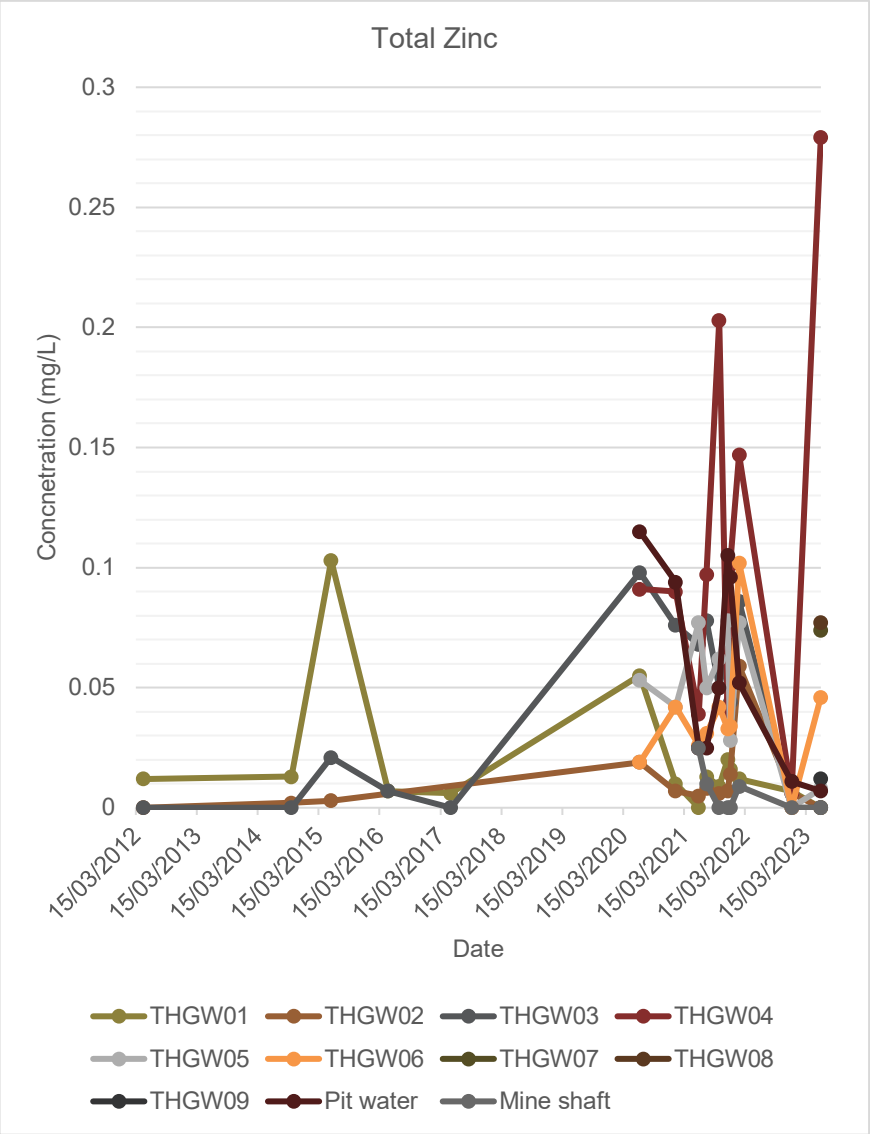


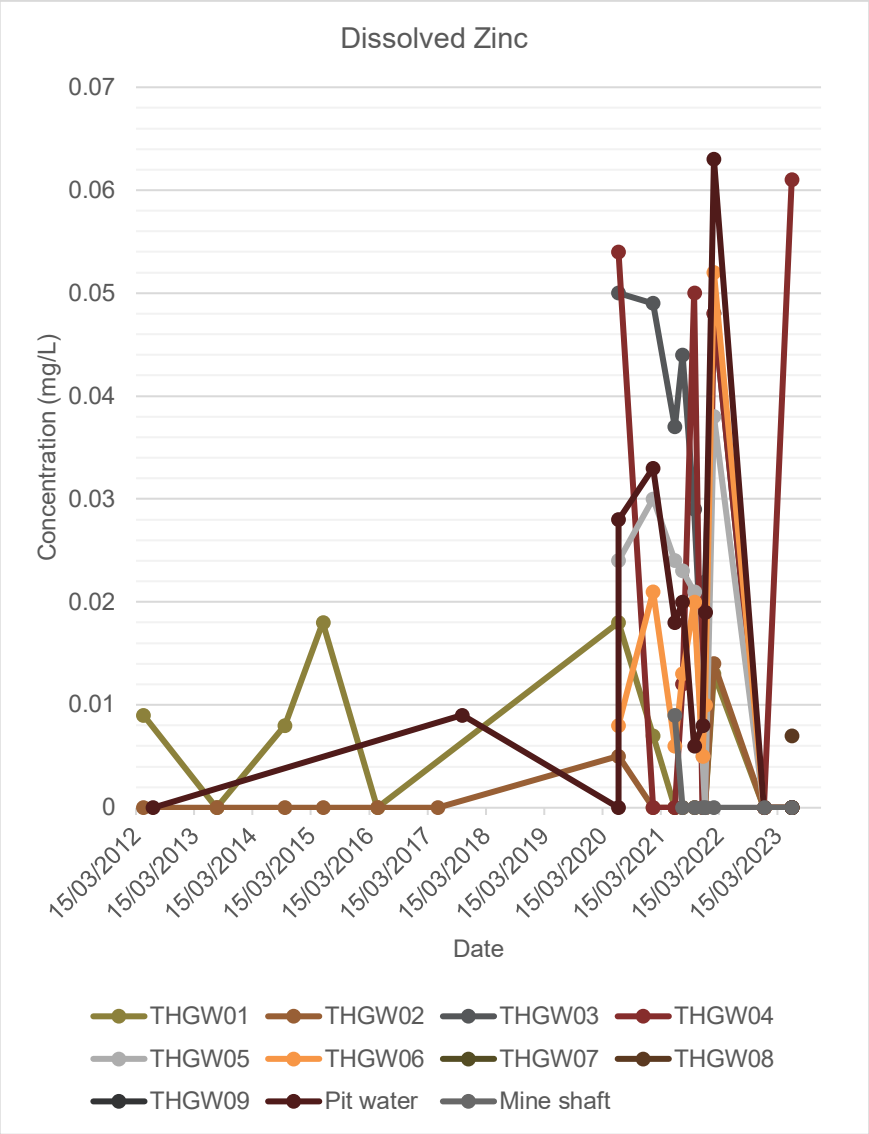
Graph A21. Total and Dissolved metals concentrations in groundwater – Selenium





Graph A22. Total and Dissolved metals concentrations in groundwater – Zinc





TABLES

Job number: 722092
Location: Tick Hill
Client: Carnaby Resources

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Table 26: Groundwater Field Parameters

		Standing water level	Temperature	pH	Electrical Conductivity	Redox	Dissolved Oxygen	Colour	Odour	Volume	Notes
Units		**m(TOC)**	**°C**	**-**	**µS/cm**	**mV**	**mg/L**	**-**	**-**	**L**	**-**
Location	**Date**										
THGW001	**20/12/2022**	26.50	33.1	7.38	3785	35.0	3.37	clear	none	15	
THGW002	**20/12/2022**	30.67	31.0	7.79	582	42.2	2.55	clear	none	3	
THGW003	**20/12/2022**	16.32	31.0	7.07	2388	34.4	2.11	clear	none	100	
THGW004	**19/12/2022**	16.65	31.7	7.60	3048	7.9	1.48	slight grey	organic	100	minor sheen
THGW005	**20/12/2022**	15.77	31.1	7.17	2068	30.3	0.99	clear	none	100	
THGW006	**19/12/2022**	18.73	31.2	7.21	1997	21.6	0.67	grey - clear		100	minor sheen initially
Pit	**19/12/2022**		25.0	8.65	6598	32.5	6.46	clear	none		
Mine shaft	**20/12/2022**	51.45	27.9	8.51	2547	34.7	3.55	clear	none	3	
Tailings pond	**20/12/2022**		28.3	8.60	9096	34.1	6.75	green murky	none		
THGW001	**12/06/2023**	25.89	29.5	7.56	2797	13.4	3.75	clear	none	3	
THGW002	**12/06/2023**	30.51	30.0	7.36	368	-12.8	2.02	clear	none	3	dead tree roots
THGW003	**12/06/2023**	15.69	30.4	7.15	2015	29.0	2.13	clear	none	50	
THGW004	**12/06/2023**	15.22	30.2	7.70	2367	5.3	2.06	brown	swampy	70	
THGW005	**12/06/2023**	14.49	31.1	7.19	1762	33.3	0.82	cloudy	none	25	
THGW006	**12/06/2023**	16.31	31.1	7.24	1681	16.1	0.74	cloudy	none	40	
THGW007	**12/06/2023**	30.20	29.9	7.65	1497	27.6	3.15	red-brown	none	15	
THGW008	**12/06/2023**	28.60	30.0	7.22	5294	33.7	2.79	brown	none	25	
THGW009	**12/06/2023**	14.51	31.0	7.60	1114	29.6	1.84	clear	none	30	
Pit	**12/06/2023**		20.5	8.10	4842	-4.6	7.58	clear	none		
Mine shaft	12/06/2023	49.89	25.2	8.87	1917	19.6	3.15	clear	minor sulfur	3	

Job number: 722092
Location: Tick Hill
Client: Carnaby Resources

Table 27: Groundwater Analytical Results - Ionic Balance and Cyanide

Analyte	Units	LOR	Human Health Criteria	Ecological Criteria	Stock watering	THGW01	THGW02	THGW03	THGW04	THGW05	THGW06	THGW07	THGW08	THGW09	PIT	Mine Shaft	TSF
			Drinking water	95% species protection													
Date						12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	
pH Value	pH Unit	0.01	6.5 - 8.5			7.97	7.88	7.91	8.08	7.83	7.9	8.18	7.59	7.4	8.46	**8.84**	
Total Dissolved Solids	mg/L	10	600		4000	**1780**	256	1150	1660	1050	1040	1020	3790	697	3780	1220	
Bicarbonate Alkalinity as CaCO3	mg/L	1				703	181	682	1120	872	876	757	727	604	311	302	
Total Alkalinity as CaCO3	mg/L	1				703	181	682	1120	872	876	757	727	604	334	355	
Sulfate as SO4	mg/L	1	500		1000	139	20	48	89	30	22	33	474	14	488	125	
Chloride	mg/L	1	250			**560**	16	**319**	92	96	60	75	**1260**	11	**1590**	**517**	
Calcium	mg/L	1			1000	65	20	50	8	28	22	22	104	52	49	6	
Magnesium	mg/L	1			600	145	20	97	26	67	70	41	310	86	240	80	
Sodium	mg/L	1	180			**397**	46	**319**	**636**	**349**	**326**	**345**	**717**	96	**992**	**343**	
Potassium	mg/L	1				7	4	4	6	5	5	6	16	5	24	12	
Fluoride	mg/L	0.1	1.5		2	**2.6**	0.4	**2.5**	**5.3**	**3**	**3.8**	**3.6**	**2.4**	**1.9**	**2.4**	1.3	
Ammonia as N	mg/L	0.01	0.5	0.9		0.14	0.66	0.09	0.23	0.12	0.1	**1.03**	0.49	0.11	0.12	0.02	
Nitrite as N	mg/L	0.01				<0.01	<0.01	<0.01	0.03	0.11	<0.01	0.26	0.86	0.01	<0.01	<0.01	
Nitrate as N	mg/L	0.01	11.3	2.4	90	**14.3**	0.43	3.42	**29.1**	2.15	4.15	0.86	**13.4**	0.53	0.79	<0.01	
Total Phosphorus as P	mg/L	0.01				0.02	0.58	0.01	6.52	0.05	0.22	7.31	1.79	1.28	0.01	0.01	
Reactive Phosphorus as P	mg/L	0.01				<0.01	0.41	0.01	0.08	<0.01	0.02	5.1	1.28	0.16	<0.01	<0.01	
Ionic Balance																	
Total Anions	meq/L	0.01				32.7	4.48	23.6	26.8	20.8	19.6	17.9	59.9	12.7	61.7	24.3	
Total Cations	meq/L	0.01				32.6	4.75	24.4	30.4	22.2	21.2	19.6	62.3	14	66	22.1	
Ionic Balance	%	0.01				0.17	2.85	1.73	6.17	3.41	3.71	4.54	1.93	4.9	3.35	4.68	
Free Cyanide	mg/L	0.002	0.08	0.007		0.007	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.025	<0.002	<0.002	<0.002	
Total Cyanide	mg/L	0.002				0.204	<0.002	0.019	<0.002	0.009	<0.002	0.007	0.881	<0.002	0.003	0.025	
Weak Acid Dissociable Cyanide	mg/L	0.002				0.003	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.022	<0.002	<0.002	<0.002	
Date						20/12/2022	20/12/2022	20/12/2022	19/12/2022	20/12/2022	19/12/2022				19/12/2022	20/12/2022	20/12/2022
pH Value	pH Unit	0.01	6.5 - 8.5			7.79	7.81	7.58	8.04	7.6	7.67				**8.68**	**8.87**	**8.66**
Total Dissolved Solids	mg/L	10	600		4000	**2090**	421	**1170**	**1720**	**1030**	**1020**				**3550**	**1290**	**5510**
Bromide	mg/L	0.02				1.96	0.24	1.11	0.61	0.44	0.33				6.15	1.61	7.95
Bicarbonate Alkalinity as CaCO3	mg/L	1				742	257	673	1170	897	918				319	337	237
Total Alkalinity as CaCO3	mg/L	1				742	257	673	1170	897	918				374	400	283
Sulfate as SO4	mg/L	1	500		1000	142	22	49	80	27	30				496	118	**879**
Chloride	mg/L	1	250			**589**	54	296	96	82	60				**1650**	**471**	**2250**
Calcium	mg/L	1			1000	71	21	54	5	30	24				56	7	107
Magnesium	mg/L	1			600	152	26	89	21	65	67				230	85	276
Sodium	mg/L	1	180			**419**	88	**304**	**653**	**332**	**316**				**979**	**348**	**1390**
Potassium	mg/L	1				8	5	4	5	5	4				24	15	34
Fluoride	mg/L	0.1	1.5		2	**2.4**	0.8	**2.6**	**5.4**	**3.3**	**3.8**				**2.6**	1.4	**2**
Ammonia as N	mg/L	0.01	0.5	0.9		0.02	**1.27**	0.09	0.23	0.23	0.17				0.12	0.12	0.24
Nitrite as N	mg/L	0.01				<0.01	<0.01	<0.01	<0.01	0.03	<0.01				0.01	<0.01	<0.01
Nitrate as N	mg/L	0.01	11.3	2.4	90	10.1	0.77	3.4	**23.2**	2.49	3.69				0.52	0.01	<0.01
Reactive Phosphorus as P	mg/L	0.01				0.02	0.77	0.01	0.08	<0.01	0.02				<0.01	<0.01	0.02
Total Anions	meq/L	0.01				34.4	7.12	22.8	27.8	20.8	20.6				64.3	23.7	87.4
Total Cations	meq/L	0.01				34.5	7.14	23.3	30.5	21.4	20.6				64.9	22.9	89.4
Ionic Balance	%	0.01				0.12	0.19	1.14	4.74	1.46	0.24				0.45	1.86	1.11
Free Cyanide	mg/L	0.002	0.08	0.007		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002				<0.002	<0.002	0.023
Total Cyanide	mg/L	0.002				0.446	<0.002	0.023	<0.002	0.003	<0.002				<0.002	0.033	0.028
Weak Acid Dissociable Cyanide	mg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002				<0.002	<0.002	0.022

Note:
Exceedances of human health criteria Bold.
Exceedances of ecological criteria shaded
Exceedances of stock watering criteria underline

Job number: 722092
Location: Tick Hill
Client: Carnaby Resources

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Table 28: Groundwater Analytical Results - Dissolved metals

			Human Health Criteria	Ecological Criteria	Stock watering	THGW01	THGW02	THGW03	THGW04	THGW05	THGW06	THGW07	THGW08	THGW09	PIT	Mine Shaft	TSF
Analyte	Units	LOR	Drinking water	95% species protection													
Date						12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	
Aluminium	mg/L	0.01		0.055	5	0.02	0.02	<0.01	2.1	0.2	0.15	0.17	0.16	0.05	<0.01	<0.01	
Antimony	mg/L	0.001	0.003	0.009		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.005**	0.004	0.002	<0.001	<0.001	
Arsenic	mg/L	0.001	0.01	0.024	0.5	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	0.007	0.001	0.004	0.005	<0.001	
Barium	mg/L	0.001	2	0.625		0.156	0.015	0.224	0.078	0.133	0.14	0.062	0.158	0.074	0.079	0.006	
Cadmium	mg/L	0.0001	0.002	0.003	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0005	<0.0001	<0.0001	
Chromium	mg/L	0.001	0.05	0.01	1	<0.001	<0.001	<0.001	0.006	<0.001	<0.001	0.001	<0.001	0.002	<0.001	<0.001	
Cobalt	mg/L	0.001	0.06			**0.258**	<0.001	0.017	0.002	0.009	0.002	0.004	**1.05**	0.002	0.018	0.016	
Copper	mg/L	0.001	2	0.0014	0.5	<0.001	0.005	0.002	0.004	<0.001	<0.001	<0.001	0.007	0.007	0.002	0.001	
Lead	mg/L	0.001	0.01	0.148	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.007	<0.001	<0.001	
Manganese	mg/L	0.001	0.5	1.9	10	0.002	0.014	0.007	0.034	0.032	0.009	0.03	0.17	0.014	0.003	0.022	
Molybdenum	mg/L	0.001	0.05		0.15	0.001	<0.001	0.002	0.005	0.002	0.002	0.007	0.003	<0.001	0.033	0.001	
Nickel	mg/L	0.001	0.02	0.125	1	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	0.001	0.005	0.003	<0.001	<0.001	
Selenium	mg/L	0.01	0.01	0.011	0.02	0.01	<0.01	<0.01	**0.02**	<0.01	<0.01	<0.01	0.01	<0.01	**0.04**	<0.01	
Strontium	mg/L	0.001				0.736	0.155	0.424	0.142	0.291	0.338	0.227	1.36	0.22	0.753	0.053	
Titanium	mg/L	0.01				<0.01	<0.01	<0.01	0.12	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Uranium	mg/L	0.001	0.017			**0.031**	0.001	**0.033**	**0.063**	**0.035**	**0.024**	**0.024**	**0.049**	0.005	**0.07**	0.015	
Vanadium	mg/L	0.01	0.036			**0.12**	0.02	**0.07**	**0.37**	**0.08**	**0.18**	**0.12**	**0.08**	**0.04**	**0.04**	<0.01	
Zinc	mg/L	0.005	3	0.091	20	<0.005	<0.005	<0.005	0.061	<0.005	<0.005	<0.005	0.007	<0.005	<0.005	<0.005	
Iron	mg/L	0.05				0.06	<0.05	<0.05	1.9	0.11	0.16	0.09	0.45	<0.05	<0.05	0.85	
Tungsten	mg/L	0.001				<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	
						20/12/2022	20/12/2022	20/12/2022	19/12/2022	20/12/2022	19/12/2022				19/12/2022	20/12/2022	20/12/2022
Aluminium	mg/L	0.01		0.055	5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01	<0.01
Antimony	mg/L	0.001	0.003	0.009		<0.001	0.001	<0.001	<0.001	<0.001	<0.001				<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	0.01	0.024	0.5	<0.001	0.001	<0.001	0.004	<0.001	<0.001				0.005	<0.001	**0.116**
Barium	mg/L	0.001	2	0.625		0.144	0.02	0.192	0.05	0.11	0.114				0.107	0.003	0.152
Cadmium	mg/L	0.0001	0.002	0.003	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001				<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	0.05	0.01	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	0.06			**0.603**	<0.001	0.015	<0.001	0.003	0.001				0.007	0.032	0.009
Copper	mg/L	0.001	2	0.0014	0.5	0.002	0.004	<0.001	<0.001	<0.001	<0.001				0.004	<0.001	0.022
Lead	mg/L	0.001	0.01	0.148	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				<0.001	<0.001	<0.001
Manganese	mg/L	0.001	0.5	1.9	10	0.002	0.005	<0.001	0.002	0.007	0.005				<0.001	0.002	0.147
Molybdenum	mg/L	0.001	0.05		0.15	0.002	0.001	0.002	0.006	0.002	0.002				0.034	0.002	0.059
Nickel	mg/L	0.001	0.02	0.125	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				<0.001	<0.001	0.002
Selenium	mg/L	0.01	0.01	0.011	0.02	<0.01	<0.01	<0.01	**0.02**	<0.01	<0.01				**0.05**	<0.01	**0.04**
Strontium	mg/L	0.001				0.728	0.19	0.387	0.132	0.247	0.332				0.769	0.048	0.519
Titanium	mg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01	<0.01
Uranium	mg/L	0.001	0.017			**0.029**	0.006	**0.022**	**0.05**	**0.026**	**0.021**				**0.069**	**0.018**	**0.022**
Vanadium	mg/L	0.01	0.036			**0.08**	0.02	**0.04**	**0.34**	**0.07**	**0.14**				**0.02**	<0.01	0.01
Zinc	mg/L	0.005	3	0.091	20	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005				<0.005	<0.005	<0.005
Iron	mg/L	0.05				0.08	<0.05	<0.05	<0.05	<0.05	<0.05				<0.05	<0.05	<0.05
Tungsten	mg/L	0.001				0.002	<0.001	<0.001	<0.001	<0.001	<0.001				0.001	<0.001	<0.001

Note:
Exceedances of human health criteria Bold.
Exceedances of ecological criteria shaded
Exceedances of stock watering criteria underline

Job number: 722092
Location: Tick Hill
Client: Carnaby Resources

Table 29: Groundwater Analytical Results - Total metals

			THGW01	THGW02	THGW03	THGW04	THGW05	THGW06	THGW07	THGW08	THGW09	PIT	Mine Shaft	TSF
Analyte	**Units**	**LOR**												
Date			12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	12/06/2023	
Aluminium	mg/L	0.01	0.1	0.59	0.02	16.8	2.12	6.91	24	26.8	11.2	0.07	0.03	
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.005	0.005	0.004	<0.001	<0.001	
Arsenic	mg/L	0.001	0.001	<0.001	<0.001	0.006	0.001	0.001	0.009	0.006	0.001	0.006	<0.001	
Barium	mg/L	0.001	0.152	0.018	0.211	0.2	0.158	0.17	0.229	0.51	0.223	0.079	0.005	
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0006	<0.0001	<0.0001	<0.0001	
Chromium	mg/L	0.001	<0.001	0.002	<0.001	0.043	0.002	0.009	0.044	0.075	0.012	<0.001	<0.001	
Cobalt	mg/L	0.001	0.608	<0.001	0.021	0.015	0.012	0.006	0.042	1.06	0.01	0.021	0.048	
Copper	mg/L	0.001	<0.001	0.009	<0.001	0.031	0.003	0.018	0.018	0.054	0.008	0.007	<0.001	
Lead	mg/L	0.001	<0.001	0.002	<0.001	0.003	0.001	<0.001	0.005	0.012	0.025	0.002	<0.001	
Manganese	mg/L	0.001	0.002	0.028	0.011	0.333	0.112	0.058	0.33	0.519	0.177	0.006	0.025	
Molybdenum	mg/L	0.001	0.001	<0.001	0.002	0.006	<0.001	0.002	0.005	0.003	<0.001	0.035	0.002	
Nickel	mg/L	0.001	<0.001	<0.001	<0.001	0.026	0.001	0.006	0.038	0.051	0.01	<0.001	<0.001	
Selenium	mg/L	0.01	0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	0.04	<0.01	
Strontium	mg/L	0.001	0.794	0.129	0.397	0.2	0.274	0.369	0.296	1.29	0.415	0.801	0.052	
Titanium	mg/L	0.01	<0.01	0.03	<0.01	2.8	0.01	0.16	0.31	2.58	1.53	<0.01	<0.01	
Uranium	mg/L	0.001	0.036	0.001	0.031	0.068	0.033	0.03	0.032	0.049	0.01	0.076	0.016	
Vanadium	mg/L	0.01	0.11	0.02	0.07	0.51	0.1	0.22	0.2	0.22	0.11	0.04	<0.01	
Zinc	mg/L	0.005	<0.005	<0.005	<0.005	0.279	0.008	0.046	0.074	0.077	0.012	0.007	<0.005	
Iron	mg/L	0.05	0.2	1	<0.05	17.8	1.42	6.58	27.5	48.9	14.8	0.32	1.4	
Tungsten	mg/L	0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	0.001	0.001	0.002	0.002	<0.001	
			20/12/2022	20/12/2022	20/12/2022	19/12/2022	20/12/2022	19/12/2022				19/12/2022	20/12/2022	20/12/2022
Aluminium	mg/L	0.01	0.06	0.05	0.02	0.96	0.02	0.22				0.03	<0.01	0.27
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	0.002	0.002	<0.001	0.004	<0.001	0.001				0.006	<0.001	0.124
Barium	mg/L	0.001	0.183	0.034	0.236	0.086	0.145	0.158				0.129	0.006	0.177
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001				<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001				<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	0.721	<0.001	0.023	<0.001	0.004	0.002				0.01	0.057	0.011
Copper	mg/L	0.001	0.003	0.008	<0.001	0.001	<0.001	<0.001				0.007	<0.001	0.036
Lead	mg/L	0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001				<0.001	<0.001	<0.001
Manganese	mg/L	0.001	0.002	0.039	0.004	0.014	0.01	0.008				0.006	0.02	0.208
Molybdenum	mg/L	0.001	0.001	<0.001	0.002	0.006	0.002	0.002				0.038	0.002	0.066
Nickel	mg/L	0.001	0.002	<0.001	<0.001	0.001	<0.001	<0.001				<0.001	<0.001	0.002
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01				0.05	<0.01	0.04
Strontium	mg/L	0.001	0.848	0.236	0.417	0.148	0.262	0.359				0.868	0.076	0.564
Titanium	mg/L	0.01	<0.01	<0.01	<0.01	0.24	<0.01	0.01				<0.01	<0.01	<0.01
Uranium	mg/L	0.001	0.037	0.006	0.032	0.072	0.036	0.029				0.087	0.023	0.025
Vanadium	mg/L	0.01	0.12	0.03	0.07	0.44	0.1	0.2				0.04	<0.01	0.02
Zinc	mg/L	0.005	0.007	0.006	<0.005	0.006	<0.005	<0.005				0.011	<0.005	0.016
Iron	mg/L	0.05	0.18	0.08	<0.05	1.09	<0.05	0.17				0.1	0.33	0.21
Tungsten	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				0.002	<0.001	<0.001

Job number: 722092
Location: Tick Hill
Client: Carnaby Resources

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Table 30: Groundwater Analytical Results - Organic Compounds and PFAS

			Human Health Criteria	Ecological Criteria	THGW01	THGW02	THGW03	THGW04	THGW05	THGW06	THGW07	THGW08	THGW09	PIT	Mine Shaft
Analyte	**Units**	**LOR**			**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**	**12/06/2023**
Total Recoverable Hydrocarbons - NEPM 2013 Fractions															
C6 - C10 Fraction	µg/L	20			<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
C6 - C10 Fraction minus BTEX (F1)	µg/L	20			<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
>C10 - C16 Fraction	µg/L	100			<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	----
>C16 - C34 Fraction	µg/L	100			<100	<100	<100	<100	<100	<100	<100	<100	140	<100	----
>C34 - C40 Fraction	µg/L	100			<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	----
>C10 - C40 Fraction (sum)	µg/L	100			<100	<100	<100	<100	<100	<100	<100	<100	140	<100	----
>C10 - C16 Fraction minus Naphthalene (F2)	µg/L	100			<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	----
EP080: BTEXN															
Benzene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	µg/L	2			<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Ethylbenzene	µg/L	2			<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
meta- & para-Xylene	µg/L	2			<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
ortho-Xylene	µg/L	2			<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Total Xylenes	µg/L	2			<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Sum of BTEX	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Naphthalene	µg/L	5			<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Perfluoroalkyl Sulfonic Acids															
Perfluorobutane sulfonic acid (PFBS)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluoropentane sulfonic acid (PFPeS)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorohexane sulfonic acid (PFHxS)	µg/L	0.002	0.07		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.009	<0.002
Perfluoroheptane sulfonic acid (PFHpS)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorooctane sulfonic acid (PFOS)	µg/L	0.002	0.07	0.00023	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.009	0.014
Perfluorodecane sulfonic acid (PFDS)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluoroalkyl Carboxylic Acids															
Perfluorobutanoic acid (PFBA)	µg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluoropentanoic acid (PFPeA)	µg/L	0.002			<0.002	0.006	<0.002	0.003	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorohexanoic acid (PFHxA)	µg/L	0.002			<0.002	0.002	<0.002	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluoroheptanoic acid (PFHpA)	µg/L	0.002			<0.002	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorooctanoic acid (PFOA)	µg/L	0.002	0.56	19	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.013
Perfluorononanoic acid (PFNA)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorodecanoic acid (PFDA)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluoroundecanoic acid (PFUnDA)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorododecanoic acid (PFDoDA)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorotridecanoic acid (PFTrDA)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorotetradecanoic acid (PFTeDA)	µg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Perfluoroalkyl Sulfonamides															
Perfluorooctane sulfonamide (FOSA)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
N-Methyl perfluorooctane sulfonamide (MeFOSA)	µg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	µg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	µg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	µg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	µg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
(n:2) Fluorotelomer Sulfonic Acids															
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	µg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	µg/L	0.005			0.006	<0.005	0.006	0.04	0.01	<0.005	0.203	0.195	<0.005	<0.005	<0.005
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	µg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	µg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
PFAS Sums															
Sum of PFAS	µg/L	0.002			0.006	0.01	0.006	0.045	0.01	<0.002	0.203	0.195	<0.002	<0.002	0.027
Sum of PFHxS and PFOS	µg/L	0.002	0.07		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.009	0.014
Sum of PFAS (WA DER List)	µg/L	0.002			0.006	0.01	0.006	0.045	0.01	<0.002	0.203	0.195	<0.002	<0.002	0.027

Job number: 722092
Location: Tick Hill
Client: Carnaby Resources

Table 31: Tailings Analytical Results - total and ASLP leach

Location and depth (m)			Human Health Criteria HIL-D Commercial / Industrial	Ecological Criteria Commercial / Industrial	THT01 0.5	THT01 1.0	THT02 1.0	THT03 0.5	THT03 1.0	THT05 0.5	THT05 1.0	THT06 0.5	THT06 1.0	THT07 0.2	THT07 0.3	THT08 0.1	THT09 1.0 - 1.5	THT09 2.5 - 3.0	THT09 4.2 - 4.5	THT09 5.0 - 5.5	THT10 1.0 - 1.5	THT10 2.5 - 3.0	THT10 4.0 - 4.5	THT10 5.0 - 5.5	THT11 1.2 - 1.5	THT11 2.5 - 3.0	THT11 4.0 - 4.4	THT11 5.0 - 5.5
	Units	LOR			9/06/2023	9/06/2023	9/06/2023	9/06/2023	9/06/2023	9/06/2023	9/06/2023	9/06/2023	9/06/2023	9/06/2023	9/06/2023	9/06/2023	11/06/2023	11/06/2023	11/06/2023	11/06/2023	11/06/2023	11/06/2023	11/06/2023	11/06/2023	11/06/2023	11/06/2023	11/06/2023	11/06/2023
pH Value	pH Unit	0.1			8.9	8.3						9.8	9.9				9.9	9.5	10.0	9.9								
Electrical Conductivity	µS/cm	1			94	713						199	845				210	274	246	253								
Chromium Reducible Sulphur	%	0.005		0.3*		0.098							0.15					0.06		0.05								
Total Phosphorus as P	mg/kg	2					480												335								360	
Reactive Phosphorus as P	mg/kg	0.1					<0.1												0.1								<0.1	
Aluminium	mg/kg	50										5840					5080	5220	5650	5200								
Iron	mg/kg	50										13200					12200	11600	12300	11200								
Arsenic	mg/kg	0.1	3000	160								6					3	3.2	3	2.7								
Selenium	mg/kg	1	10000									2					<1	<1	<1	<1								
Barium	mg/kg	0.1										14					39.1	17.6	19.8	16.7								
Cadmium	mg/kg	0.1	900									<0.1					<0.1	<0.1	<0.1	<0.1								
Cobalt	mg/kg	0.1	4000									24.4					13.6	15	15.6	14.5								
Chromium	mg/kg	0.1	3600	429								15.6					12.7	10.3	12	14.9								
Copper	mg/kg	0.1	240000	162								99.8					52.4	55.3	76.5	80.1								
Manganese	mg/kg	0.1	60000									91.3					82.3	83.2	79.5	86								
Strontium	mg/kg	0.1										4					4.8	3.2	4.4	4.3								
Tungsten	mg/kg	0.1										0.1					<0.1	<0.1	<0.1	<0.1								
Molybdenum	mg/kg	0.1										0.8					0.5	0.3	0.3	0.6								
Nickel	mg/kg	0.1	6000	86								18.2					13	12.3	13.6	12.2								
Lead	mg/kg	0.1	1500	1804								4.7					2.5	2.2	1.7	2.2								
Antimony	mg/kg	0.1										<0.1					<0.1	<0.1	<0.1	<0.1								
Uranium	mg/kg	0.1										1.5					0.8	1	1	1.3								
Zinc	mg/kg	0.5	400000	405								13.4					9.3	8.1	8.5	9.6								
Vanadium	mg/kg	1										18					22	20	21	18								
Titanium	mg/kg	1										212					126	123	134	125								
Free Cyanide	mg/kg	1	1500					<1	<1	<1	<1	<1		<1	<1	<1					<1	<1	<1	<1	<1	<1	<1	<1
Total Cyanide	mg/kg	1						68	28	82	71	118		81	52	57					453	96	78	564	41	201	37	12
Weak Acid Dissociable Cyanide	mg/kg	1						<1	<1	<1	<1	<1		<1	<1	<1					<1	<1	<1	<1	<1	<1	<1	<1
ASLP leach																												
Antimony	mg/L	0.001																				<0.001		0.001				
Arsenic	mg/L	0.001																				0.006		0.008				
Barium	mg/L	0.001																				0.64		0.692				
Cadmium	mg/L	0.0001																				0.0001		0.0002				
Chromium	mg/L	0.001																				0.024		0.016				
Cobalt	mg/L	0.001																				0.031		0.062				
Copper	mg/L	0.001																				0.096		0.017				
Lead	mg/L	0.001																				0.003		0.002				
Manganese	mg/L	0.001																				0.062		0.04				
Molybdenum	mg/L	0.001																				0.005		0.004				
Nickel	mg/L	0.001																				0.006		0.004				
Selenium	mg/L	0.01																				<0.01		<0.01				
Strontium	mg/L	0.001																				0.017		0.016				
Titanium	mg/L	0.01																				0.08		0.04				
Uranium	mg/L	0.001																				0.001		0.002				
Vanadium	mg/L	0.01																				0.02		0.04				
Zinc	mg/L	0.005																				0.063		0.073				
Tungsten	mg/L	0.001																				<0.001		<0.001				
Free Cyanide	mg/L	0.002						<0.002	<0.002	<0.002	<0.002										<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Total Cyanide	mg/L	0.002																			0.634			0.286		0.19		
Total Cyanide bioavailability factor	%																				0.028			0.010		0.019		

Note:
Exceedances of human health criteria Bold.
Exceedances of ecological criteria shaded

Job number: 722092
Location: Tick Hill
Client: Carnaby Resources

Table 32: Decant Dam Tailings Analytical Results - total and ASLP leach

Location and depth (mm)			Human Health Criteria	Ecological Criteria	THTSF_DEC 01_0_300	THTSF_DEC 01_300_600	THTSF_DEC 01_600_900	THTSF_DEC 01_900_1200	THTSF_DEC 01_1200_1500	THTSF_DEC 01_1500_1800	THTSF_DEC 01_1800_2100	THTSF_DEC 01_2100_2400	THTSF_DEC 02_0_300	THTSF_DEC 02_300_600	THTSF_DEC 02_600_900	THTSF_DEC 02_900_1200	THTSF_DEC 02_1200_1500	THTSF_DEC 02_1500_1800	THTSF_DEC 02_1800_2100	THTSF_DEC 02_2100_2400	THTSF_DEC 01_2400_2700	THTSF_DEC 01_2700_3000	THTSF_03
	Units	LOR	HIL-C Public Open Space	Commercial / Industrial	22/06/2023	22/06/2023	22/06/2023	22/06/2023	22/06/2023	22/06/2023	22/06/2023	22/06/2023	22/06/2023	22/06/2023	22/06/2023	22/06/2023	22/06/2023	22/06/2023	22/06/2023	22/06/2023	22/06/2023	22/06/2023	22/06/2023
pH Value	pH Unit	0.1			8.6	9.5	9.8	9.9	9.4	9.4	9.4	9.7	9.8	10	9.9	9.7	9.8	9.8	10	9.9	9.8	9.3	8.5
Electrical Conductivity	µS/cm	1			53	84	220	158	436	475	373	916	106	249	201	361	272	283	216	464	680	1310	294
Chromium Reducible Sulphur	%	0.005		0.3*	0.009	0.017	0.042	0.007	0.092	0.012	0.018	0.009	<0.005	<0.005	0.01	0.007	0.01	0.006	0.016	0.008	0.008	0.013	0.024
Aluminium	mg/kg	50			12400	12500	12600	12500	11500	13700	13000	14100	14400	10400	10300	13200	9460	10800	10300	11400	14400	19200	9480
Iron	mg/kg	50			28000	26000	27900	26000	24300	27800	25300	29600	30000	22500	22900	26700	19900	20400	19300	24400	30600	37100	23700
Arsenic	mg/kg	0.1	300	160	1.2	0.9	1.2	0.9	1.5	1.7	1.4	3.1	1.1	1.5	1.5	1.8	1.5	1.4	1.4	2.4	4.9	7.2	4
Selenium	mg/kg	1	700		<1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	<1	<1	1	2	3	1
Barium	mg/kg	0.1			89.2	63.5	66.7	79.4	52.9	142	58.2	81.4	91.2	87.2	77.9	77.3	61.8	52.6	34	50.4	65.2	63.3	43.4
Cadmium	mg/kg	0.1	90		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.4	<0.1
Cobalt	mg/kg	0.1	300		14.4	14.3	13.3	12.5	14.5	15.2	15.2	27.1	15	17	19.5	19.4	14.8	15.5	16.3	21	29.7	47.4	17.2
Chromium	mg/kg	0.1	300	429	19.4	19.3	26	24.5	23.4	27.8	25.3	29.2	27.1	19.8	17.7	24.7	18.9	18.8	16.8	26.9	35.9	35.6	26.2
Copper	mg/kg	0.1	17000	162 | 13600	26.8	26.8	11	11	35.1	43.9	26.6	193	6.2	93.5	48.5	77.7	62.3	43.4	40	132	216	357	83.1
Manganese	mg/kg	0.1	19000		204	174	187	171	187	182	164	182	192	131	175	175	120	124	141	163	171	204	124
Strontium	mg/kg	0.1			19.7	18.8	20.1	20.6	19.1	26.2	19.4	23.6	27.9	25.2	24.8	22.2	19.8	13.5	10.1	13	22.1	25	13.5
Tungsten	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1
Molybdenum	mg/kg	0.1			<0.1	<0.1	0.1	<0.1	0.2	0.3	0.1	0.6	<0.1	0.2	0.2	0.3	0.3	0.2	0.2	0.3	0.7	1.4	0.6
Nickel	mg/kg	0.1	1200	86	15.4	15.8	17.3	15.3	20.3	18.9	18.1	25.8	20.7	20.1	17.7	20.6	17	17.2	15.1	20.4	26.3	37.5	16
Lead	mg/kg	0.1	300	1804	2.7	1.7	2	1.4	3.3	3.3	2.9	6.6	1.6	3.7	2	3.8	2.8	2.5	2.6	3.5	5.8	14.4	4.3
Antimony	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Uranium	mg/kg	0.1			0.6	0.6	0.7	0.7	0.9	0.9	1	1.4	0.5	0.8	0.8	1	0.8	0.9	0.8	1.3	2	3.1	1.5
Zinc	mg/kg	0.5	30000	405	19.9	17.3	13.9	13.3	14.6	16	16.1	23.6	26.1	18.7	17.2	22	15.8	15.3	13.8	19	25.8	46.7	16.1
Vanadium	mg/kg	1			48	44	49	46	49	54	44	54	47	40	36	46	37	34	31	38	53	62	37
Titanium	mg/kg	1			338	199	357	305	262	349	310	234	178	240	112	205	200	199	187	156	192	205	152
Free Cyanide	mg/kg	1	240		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total Cyanide	mg/kg	1			<1	<1	<1	<1	7	20	1	192	1	22	<1	47	24	18	12	224	459	336	58
Weak Acid Dissociable Cyanide	mg/kg	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
ASLP leach																							
Water Leachable Metals																							
Antimony	mg/L	0.001			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001			<0.001	<0.001	<0.001	0.001	0.002	0.002	0.002	0.008	0.001	0.002	<0.001	0.006	0.003	0.001	0.002	0.005	0.014	0.022	0.002
Barium	mg/L	0.001			0.428	0.391	0.484	0.902	0.952	1.15	0.74	3.41	1.57	0.819	0.486	0.79	0.811	0.52	0.669	1.69	1.41	1.19	0.513
Cadmium	mg/L	0.0001			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0002	0.0008	0.0003	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0003	0.0002	0.0002	<0.0001
Chromium	mg/L	0.001			0.002	0.011	0.002	0.004	0.005	0.006	0.002	0.044	0.012	0.003	<0.001	0.004	0.004	0.002	0.004	0.022	0.041	0.011	0.002
Cobalt	mg/L	0.001			<0.001	<0.001	0.002	0.001	0.018	0.044	0.01	0.053	0.004	0.003	<0.001	0.015	0.011	0.003	0.005	0.02	0.039	0.047	0.001
Copper	mg/L	0.001			0.003	0.002	0.002	0.003	0.013	0.038	0.003	0.364	0.011	0.038	0.002	0.072	0.058	0.01	0.025	0.183	0.141	0.132	0.008
Lead	mg/L	0.001			<0.001	<0.001	<0.001	<0.001	0.001	0.002	<0.001	0.021	0.003	0.002	<0.001	0.003	0.002	<0.001	0.002	0.006	0.009	0.008	<0.001
Manganese	mg/L	0.001			0.014	0.01	0.011	0.024	0.026	0.023	0.012	0.191	0.063	0.021	0.006	0.02	0.021	0.01	0.023	0.097	0.096	0.039	0.012
Molybdenum	mg/L	0.001			<0.001	<0.001	<0.001	<0.001	0.003	0.004	0.001	0.006	<0.001	<0.001	<0.001	0.003	0.002	0.002	0.001	0.002	0.011	0.014	0.001
Nickel	mg/L	0.001			<0.001	<0.001	<0.001	0.001	0.003	0.003	0.002	0.028	0.006	0.003	<0.001	0.004	0.004	0.001	0.003	0.012	0.016	0.009	<0.001
Selenium	mg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	0.08	<0.01
Strontium	mg/L	0.001			0.031	0.02	0.019	0.025	0.026	0.031	0.029	0.077	0.032	0.018	0.019	0.02	0.022	0.016	0.02	0.033	0.033	0.026	0.028
Titanium	mg/L	0.01			0.02	<0.01	0.03	0.05	0.07	0.08	0.04	0.26	0.1	0.03	<0.01	0.03	0.03	0.02	0.04	0.12	0.13	0.08	0.02
Uranium	mg/L	0.001			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.005	0.003	<0.001
Vanadium	mg/L	0.01			0.02	0.02	0.02	0.04	0.05	0.05	0.04	0.14	0.09	0.03	0.02	0.03	0.03	0.03	0.03	0.06	0.06	0.04	0.02
Zinc	mg/L	0.005			0.114	0.039	0.037	0.071	0.09	0.098	0.06	0.512	0.224	0.068	0.04	0.072	0.07	0.036	0.059	0.264	0.17	0.142	0.024
Tungsten	mg/L	0.001			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Free Cyanide	mg/L	0.004			<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Copper bioavailability factor (BF)	unitless				0.0022	0.0015	0.0036	0.0055	0.0074	0.0173	0.0023	0.0377	0.0355	0.0081	0.0008	0.0185	0.0186	0.0046	0.0125	0.0277	0.0131	0.0074	0.0019
Mean Cu BF			0.0119																				
Tier 2 Cu EIL tailings				13600																			

Note:
Exceedances of human health criteria Bold.
Exceedances of ecological criteria shaded

Job number: 722092
Location: Tick Hill
Client: Carnaby Resources

Table 33: Soil Analytical Results - Inorganics

Location and depth (m)		LOR	Human Health Criteria	Ecological Criteria	THS01 0-0.1	THS02 0-0.1	THS03 0.3-0.35	THS04 0-0.1	THS06 0-0.05	THS08 0-0.1	THS09 0-0.1	THS11 0-0.1	THS12 0-0.1	THS13 0.4-0.5	THS14 0-0.1	THS15 0-0.1	THGW08 2.9
			HIL-C Public Open Space	Ecological significance	10/06/2023	10/06/2023	10/06/2023	10/06/2023	10/06/2023	11/06/2023	11/06/2023	11/06/2023	11/06/2023	11/06/2023	11/06/2023	11/06/2023	8/06/2023
pH Value	pH Unit	0.1			8.3		8.8		8.9					8.7	7.9	9.2	
Electrical Conductivity	µS/cm	1			100		96		67					74	180	48	
Chromium Reducible Sulphur	%	0.005		0.3*					0.01					0.01		0.018	
Total Phosphorus as P	mg/kg	2							499	153		175		272			378
Reactive Phosphorus as P	mg/kg	0.1							1.9	0.3		0.2		0.2			<0.1
Total Organic Carbon	%	0.1													<0.1		
Aluminium	mg/kg	50			8530			4930	7390				11700	9820	9430	9230	
Iron	mg/kg	50			20400			14200	10700				32500	28000	37300	17000	
Arsenic	mg/kg	0.1	300	40	1.9			0.6	0.9				2.1	1.4	1.9	0.9	
Selenium	mg/kg	1	700		<1			<1	<1				<1	<1	<1	<1	
Barium	mg/kg	0.1			55			67.3	93.9				137	131	117	57.9	
Cadmium	mg/kg	0.1	90		<0.1			<0.1	<0.1				<0.1	<0.1	<0.1	<0.1	
Cobalt	mg/kg	0.1	300		11.3			6.5	5.9				14.5	12.7	11.3	11.3	
Chromium	mg/kg	0.1	300	589	18.7			22	13.9				36.4	23.1	30.1	17	
Copper	mg/kg	0.1	17000	116	42			8.7	11				29	22.7	13	37	
Manganese	mg/kg	0.1	19000		175			182	132				266	347	185	160	
Strontium	mg/kg	0.1			14.2			4.5	96.6				19.9	20.5	12.2	25.1	
Tungsten	mg/kg	0.1			<0.1			<0.1	<0.1				<0.1	<0.1	<0.1	<0.1	
Molybdenum	mg/kg	0.1			0.5			<0.1	<0.1				0.3	<0.1	0.2	<0.1	
Nickel	mg/kg	0.1	1200	116	15.3			10.6	8.4				17.9	14.9	10.8	13.6	
Lead	mg/kg	0.1	300	476	3.2			1.6	2.5				6.4	4.2	5.2	1.9	
Antimony	mg/kg	0.1			<0.1			<0.1	<0.1				<0.1	<0.1	<0.1	<0.1	
Uranium	mg/kg	0.1			0.6			0.3	0.8				0.7	0.5	0.4	0.5	
Zinc	mg/kg	0.5	30000	248	16.6			6.9	11.3				17	16.4	14.5	11.8	
Vanadium	mg/kg	1			45			39	42				91	65	83	40	
Titanium	mg/kg	1			201			392	379				468	513	359	248	
Free Cyanide	mg/kg	1	240		<1	<1	<1		<1	<1	<1	<1	<1	<1		<1	<1
Total Cyanide	mg/kg	1			5	<1	<1		<1	<1	<1	<1	<1	<1		<1	<1
Weak Acid Dissociable Cyanide	mg/kg	1			<1	<1	<1		<1	<1	<1	<1	<1	<1		<1	<1
Cation Exchange Capacity	meq%	0.01													16.3		
Exchangeable Sodium Percentage	%	-													0.31		
Exchangeable Sodium	meq%	0.01													0.05		
Exchangeable Potassium	meq%	0.01													1.3		
Exchangeable Calcium	meq%	0.01													12.9		
Exchangeable Magnesium	meq%	0.01													3.4		
Exchangeable Manganese	meq%	0.01													<0.01		
Exchangeable Aluminium	meq%	0.1													<0.1		

Note:
Exceedances of human health criteria Bold.
Exceedances of ecological criteria shaded

Job number: 722092
Location: Tick Hill
Client: Carnaby Resources

Table 34: Soil and Tailings Analytical Results - Organics and PFAS

		Location and depth	Human Health Criteria	Ecological Criteria	THS06 0-0.05	THS14 0-0.1	THS08 0-0.1	THS09 0-0.1	THS07 0-0.1	THS10 0-0.1	THT09 1.0 - 1.5	THT05 1.0
Date		LOR	HIL-C Public Open Space	Public Open Space	10/06/2023	11/06/2023	11/06/2023	11/06/2023	10/06/2023	11/06/2023	11/06/2023	9/06/2023
Analyte	Units											
Total Polychlorinated biphenyls	mg/kg	0.1	1		<0.1	----	<0.1	<0.1	----	<0.1	----	----
Organochlorine Pesticides (OC)												
alpha-BHC	mg/kg	0.05			<0.05	----	<0.05	<0.05	----	<0.05	----	----
Hexachlorobenzene (HCB)	mg/kg	0.05	10		<0.05	----	<0.05	<0.05	----	<0.05	----	----
beta-BHC	mg/kg	0.05			<0.05	----	<0.05	<0.05	----	<0.05	----	----
gamma-BHC	mg/kg	0.05			<0.05	----	<0.05	<0.05	----	<0.05	----	----
delta-BHC	mg/kg	0.05			<0.05	----	<0.05	<0.05	----	<0.05	----	----
Heptachlor	mg/kg	0.05	10		<0.05	----	<0.05	<0.05	----	<0.05	----	----
Aldrin	mg/kg	0.05			<0.05	----	<0.05	<0.05	----	<0.05	----	----
Heptachlor epoxide	mg/kg	0.05			<0.05	----	<0.05	<0.05	----	<0.05	----	----
Total Chlordane (sum)	mg/kg	0.05	70		<0.05	----	<0.05	<0.05	----	<0.05	----	----
trans-Chlordane	mg/kg	0.05			<0.05	----	<0.05	<0.05	----	<0.05	----	----
alpha-Endosulfan	mg/kg	0.05			<0.05	----	<0.05	<0.05	----	<0.05	----	----
cis-Chlordane	mg/kg	0.05			<0.05	----	<0.05	<0.05	----	<0.05	----	----
Dieldrin	mg/kg	0.05			<0.05	----	<0.05	<0.05	----	<0.05	----	----
4.4`-DDE	mg/kg	0.05			<0.05	----	<0.05	<0.05	----	<0.05	----	----
Endrin	mg/kg	0.05	20		<0.05	----	<0.05	<0.05	----	<0.05	----	----
Endosulfan (sum)	mg/kg	0.05	340		<0.05	----	<0.05	<0.05	----	<0.05	----	----
beta-Endosulfan	mg/kg	0.05			<0.05	----	<0.05	<0.05	----	<0.05	----	----
4.4`-DDD	mg/kg	0.05			<0.05	----	<0.05	<0.05	----	<0.05	----	----
Endrin aldehyde	mg/kg	0.05			<0.05	----	<0.05	<0.05	----	<0.05	----	----
Endosulfan sulfate	mg/kg	0.05			<0.05	----	<0.05	<0.05	----	<0.05	----	----
4.4`-DDT	mg/kg	0.2		180	<0.2	----	<0.2	<0.2	----	<0.2	----	----
Endrin ketone	mg/kg	0.05			<0.05	----	<0.05	<0.05	----	<0.05	----	----
Methoxychlor	mg/kg	0.2	400		<0.2	----	<0.2	<0.2	----	<0.2	----	----
Sum of DDD + DDE + DDT	mg/kg	0.05	400		<0.05	----	<0.05	<0.05	----	<0.05	----	----
Sum of Aldrin + Dieldrin	mg/kg	0.05	10		<0.05	----	<0.05	<0.05	----	<0.05	----	----
Total Recoverable Hydrocarbons - NEPM 2013 Fractions			Management limits	Public Open Space								
C6 - C10 Fraction	mg/kg	10	800		<10	<10	<10	<10	----	<10	----	----
C6 - C10 Fraction minus BTEX (F1)	mg/kg	10		180	<10	<10	<10	<10	----	<10	----	----
>C10 - C16 Fraction	mg/kg	50	1000		<50	<50	<50	<50	----	<50	----	----
>C16 - C34 Fraction	mg/kg	100	3500	1300	<100	<100	<100	<100	----	<100	----	----
>C34 - C40 Fraction	mg/kg	100	10000	5600	<100	<100	<100	<100	----	<100	----	----
>C10 - C40 Fraction (sum)	mg/kg	50			<50	<50	<50	<50	----	<50	----	----
>C10 - C16 Fraction minus Naphthalene (F2)	mg/kg	50		120	<50	<50	<50	<50	----	<50	----	----
BTEXN												
Benzene	mg/kg	0.2		65	<0.2	<0.2	<0.2	<0.2	----	<0.2	----	----
Toluene	mg/kg	0.5		105	<0.5	<0.5	<0.5	<0.5	----	<0.5	----	----
Ethylbenzene	mg/kg	0.5		125	<0.5	<0.5	<0.5	<0.5	----	<0.5	----	----
meta- & para-Xylene	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	----	<0.5	----	----
ortho-Xylene	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	----	<0.5	----	----
Total Xylenes	mg/kg	0.5		45	<0.5	<0.5	<0.5	<0.5	----	<0.5	----	----
Sum of BTEX	mg/kg	0.2			<0.2	<0.2	<0.2	<0.2	----	<0.2	----	----
Naphthalene	mg/kg	1		170	<1	<1	<1	<1	----	<1	----	----
PFAS			Public Open Space	Direct | Indirect								
Perfluoroalkyl Sulfonic Acids												
Perfluorobutane sulfonic acid (PFBS)	mg/kg	0.0002			<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
Perfluoropentane sulfonic acid (PFPeS)	mg/kg	0.0002			<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
Perfluorohexane sulfonic acid (PFHxS)	mg/kg	0.0002	1		<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
Perfluoroheptane sulfonic acid (PFHpS)	mg/kg	0.0002			<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
Perfluorooctane sulfonic acid (PFOS)	mg/kg	0.0002	1	1 | 0.01	<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
Perfluorodecane sulfonic acid (PFDS)	mg/kg	0.0002			<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
Perfluoroalkyl Carboxylic Acids												
Perfluorobutanoic acid (PFBA)	mg/kg	0.001			<0.001	----	<0.001	----	<0.001	----	<0.001	<0.001
Perfluoropentanoic acid (PFPeA)	mg/kg	0.0002			<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
Perfluorohexanoic acid (PFHxA)	mg/kg	0.0002			<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
Perfluoroheptanoic acid (PFHpA)	mg/kg	0.0002			<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
Perfluorooctanoic acid (PFOA)	mg/kg	0.0002	10	10	<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
Perfluorononanoic acid (PFNA)	mg/kg	0.0002			<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
Perfluorodecanoic acid (PFDA)	mg/kg	0.0002			<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002

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Table 34: Soil and Tailings Analytical Results - Organics and PFAS

		Location and depth	Human Health Criteria	Ecological Criteria	THS06 0-0.05	THS14 0-0.1	THS08 0-0.1	THS09 0-0.1	THS07 0-0.1	THS10 0-0.1	THT09 1.0 - 1.5	THT05 1.0
Date		**LOR**	**HIL-C Public Open Space**	**Public Open Space**	**10/06/2023**	**11/06/2023**	**11/06/2023**	**11/06/2023**	**10/06/2023**	**11/06/2023**	**11/06/2023**	**9/06/2023**
Perfluoroundecanoic acid (PFUnDA)	mg/kg	0.0002			<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
Perfluorododecanoic acid (PFDoDA)	mg/kg	0.0002			<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
Perfluorotridecanoic acid (PFTrDA)	mg/kg	0.0002			<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
Perfluorotetradecanoic acid (PFTeDA)	mg/kg	0.0005			<0.0005	----	<0.0005	----	<0.0005	----	<0.0005	<0.0005
Perfluoroalkyl Sulfonamides												
Perfluorooctane sulfonamide (FOSA)	mg/kg	0.0002			<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
N-Methyl perfluorooctane sulfonamide (MeFOSA)	mg/kg	0.0005			<0.0005	----	<0.0005	----	<0.0005	----	<0.0005	<0.0005
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	mg/kg	0.0005			<0.0005	----	<0.0005	----	<0.0005	----	<0.0005	<0.0005
N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	mg/kg	0.0005			<0.0005	----	<0.0005	----	<0.0005	----	<0.0005	<0.0005
N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	mg/kg	0.0005			<0.0005	----	<0.0005	----	<0.0005	----	<0.0005	<0.0005
N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	mg/kg	0.0002			<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	mg/kg	0.0002			<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
(n:2) Fluorotelomer Sulfonic Acids												
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	mg/kg	0.0005			<0.0005	----	<0.0005	----	<0.0005	----	<0.0005	<0.0005
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	mg/kg	0.0005			<0.0005	----	<0.0005	----	<0.0005	----	<0.0005	<0.0005
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	mg/kg	0.0005			<0.0005	----	<0.0005	----	<0.0005	----	<0.0005	<0.0005
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	mg/kg	0.0005			<0.0005	----	<0.0005	----	<0.0005	----	<0.0005	<0.0005
PFAS Sums												
Sum of PFAS	mg/kg	0.0002			<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
Sum of PFHxS and PFOS	mg/kg	0.0002	1		<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002
Sum of PFAS (WA DER List)	mg/kg	0.0002			<0.0002	----	<0.0002	----	<0.0002	----	<0.0002	<0.0002

Note:
Exceedances of human health criteria Bold.
Exceedances of ecological criteria shaded

Job number: 722092
Location: Tick Hill
Client: Carnaby Resources

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Table 35: Relative Percentage Difference Calculations

Analyte	units	LOR	THS14 0-0.1	BD02	THS14 0-0.1	RPD1	RPD2	Screening criteria	5xLOR	10xLOR
Dates			**11/06/2023**	**11/06/2023**	**11/06/2023**					
Laboratory			**ALS**	**ALS**	**SAL**					
Aluminium	mg/kg	50	9430	8700	14000	8%	39%	<50%	250	500
Iron	mg/kg	50	37300	33700	30000	10%	22%	<50%	250	500
Arsenic	mg/kg	0.1	1.9	1.7	4	11%	71%	<50%	0.5	1
Selenium	mg/kg	1	<1	<1	<0.5	N/C	N/C	N/A	5	10
Barium	mg/kg	0.1	117	101	83	15%	34%	<50%	0.5	1
Cadmium	mg/kg	0.1	<0.1	<0.1	<0.5	N/C	N/C	N/A	0.5	1
Cobalt	mg/kg	0.1	11.3	9.6	6	16%	61%	<50%	0.5	1
Chromium	mg/kg	0.1	30.1	27.3	18	10%	50%	<50%	0.5	1
Copper	mg/kg	0.1	13	11.9	15	9%	14%	<50%	0.5	1
Manganese	mg/kg	0.1	185	154	195	18%	5%	<50%	0.5	1
Strontium	mg/kg	0.1	12.2	10.4	15	16%	21%	<50%	0.5	1
Tungsten	mg/kg	0.1	<0.1	<0.1	-	N/C	N/C	N/A	0.5	1
Molybdenum	mg/kg	0.1	0.2	0.1	1	67%	133%	No Limit	0.5	1
Nickel	mg/kg	0.1	10.8	9.7	6.5	11%	50%	<50%	0.5	1
Lead	mg/kg	0.1	5.2	4.5	7.5	14%	36%	<50%	0.5	1
Antimony	mg/kg	0.1	<0.1	<0.1	<0.5	N/C	N/C	N/A	0.5	1
Uranium	mg/kg	0.1	0.4	0.4	-	0%	N/C	No Limit	0.5	1
Zinc	mg/kg	0.5	14.5	19.3	23	28%	45%	<50%	2.5	5
Vanadium	mg/kg	1	83	76	20	9%	122%	<50%	5	10
Titanium	mg/kg	1	359	320	<10	11%	N/C	<50%	5	10
Analyte			**THGW05**	**BD01**	**SD01**	**RPD1**	**RPD2**	**Screening criteria**	**5xLOR**	**10xLOR**
Dates	**Units**	**LOR**	**20/12/2022**	**20/12/2022**	**20/12/2022**					
Laboratory			**ALS**	**ALS**	**Eurofins**					
pH Value	pH Unit	0.01	7.6	7.77	7.6	2%	0%	<50%	0.05	0.1
Total Dissolved Solids	mg/L	10	1030	1060	-	3%	N/C	<50%	50	100
Bromide	mg/L	0.02	0.44	0.44	-	0%	N/C	<50%	0.1	0.2
Bicarbonate Alkalinity as CaCO3	mg/L	1	897	871	1800	3%	67%	<50%	5	10
Total Alkalinity as CaCO3	mg/L	1	897	871	1800	3%	67%	<50%	5	10
Sulfate as SO4	mg/L	1	27	27	28	0%	4%	<50%	5	10
Chloride	mg/L	1	82	83	91	1%	10%	<50%	5	10
Calcium	mg/L	1	30	30	19	0%	45%	<50%	5	10
Magnesium	mg/L	1	65	65	53	0%	20%	<50%	5	10
Sodium	mg/L	1	332	335	280	1%	17%	<50%	5	10
Potassium	mg/L	1	5	5	4.3	0%	15%	<80%	5	10
Fluoride	mg/L	0.1	3.3	3.6	1.9	9%	54%	<50%	0.5	1
Ammonia as N	mg/L	0.01	0.23	0.02	< 0.01	168%	N/C	<50%	0.05	0.1
Nitrite as N	mg/L	0.01	0.03	0.03	0.04	0%	29%	No Limit	0.05	0.1
Nitrate as N	mg/L	0.01	2.49	2.4	3	4%	19%	<50%	0.05	0.1
Reactive Phosphorus as P	mg/L	0.01	<0.01	<0.01	0.1	N/C	N/C	N/A	0.05	0.1
Dissolved metals										
Aluminium	mg/L	0.01	<0.01	<0.01	< 0.05	N/C	N/C	N/A	0.05	0.1
Antimony	mg/L	0.001	<0.001	<0.001	< 0.005	N/C	N/C	N/A	0.005	0.01
Arsenic	mg/L	0.001	<0.001	<0.001	< 0.001	N/C	N/C	N/A	0.005	0.01
Barium	mg/L	0.001	0.11	0.108	0.13	2%	17%	<50%	0.005	0.01
Cadmium	mg/L	0.0001	<0.0001	<0.0001	< 0.0002	N/C	N/C	N/A	0.0005	0.001
Chromium	mg/L	0.001	<0.001	<0.001	< 0.001	N/C	N/C	N/A	0.005	0.01
Cobalt	mg/L	0.001	0.003	0.003	0.004	0%	29%	No Limit	0.005	0.01
Copper	mg/L	0.001	<0.001	<0.001	< 0.001	N/C	N/C	N/A	0.005	0.01
Lead	mg/L	0.001	<0.001	<0.001	< 0.001	N/C	N/C	N/A	0.005	0.01
Manganese	mg/L	0.001	0.007	0.007	0.008	0%	13%	<80%	0.005	0.01
Molybdenum	mg/L	0.001	0.002	0.003	< 0.005	40%	N/C	No Limit	0.005	0.01
Nickel	mg/L	0.001	<0.001	<0.001	< 0.001	N/C	N/C	N/A	0.005	0.01
Selenium	mg/L	0.01	<0.01	<0.01	0.001	N/C	N/C	N/A	0.05	0.1
Strontium	mg/L	0.001	0.247	0.246	0.22	0%	12%	<50%	0.005	0.01
Titanium	mg/L	0.01	<0.01	<0.01	< 0.005	N/C	N/C	N/A	0.05	0.1
Uranium	mg/L	0.001	0.026	0.027	0.012	4%	74%	<50%	0.005	0.01
Vanadium	mg/L	0.01	0.07	0.07	0.091	0%	26%	<80%	0.05	0.1
Zinc	mg/L	0.005	<0.005	<0.005	< 0.005	N/C	N/C	N/A	0.025	0.05
Iron	mg/L	0.05	<0.05	<0.05	< 0.05	N/C	N/C	N/A	0.25	0.5
Tungsten	mg/L	0.001	<0.001	<0.001	-	N/C	N/C	N/A	0.005	0.01
Total Metals										
Aluminium	mg/L	0.01	0.02	0.02	< 0.05	0%	N/C	No Limit	0.05	0.1
Antimony	mg/L	0.001	<0.001	<0.001	< 0.005	N/C	N/C	N/A	0.005	0.01
Arsenic	mg/L	0.001	<0.001	<0.001	< 0.001	N/C	N/C	N/A	0.005	0.01
Barium	mg/L	0.001	0.145	0.149	0.13	3%	11%	<50%	0.005	0.01
Cadmium	mg/L	0.0001	<0.0001	<0.0001	< 0.0002	N/C	N/C	N/A	0.0005	0.001
Chromium	mg/L	0.001	<0.001	<0.001	< 0.001	N/C	N/C	N/A	0.005	0.01
Cobalt	mg/L	0.001	0.004	0.004	0.004	0%	0%	No Limit	0.005	0.01
Copper	mg/L	0.001	<0.001	<0.001	< 0.001	N/C	N/C	N/A	0.005	0.01
Lead	mg/L	0.001	<0.001	<0.001	< 0.001	N/C	N/C	N/A	0.005	0.01
Manganese	mg/L	0.001	0.01	0.01	0.009	0%	11%	<50%	0.005	0.01
Molybdenum	mg/L	0.001	0.002	0.002	< 0.005	0%	N/C	No Limit	0.005	0.01
Nickel	mg/L	0.001	<0.001	<0.001	< 0.001	N/C	N/C	N/A	0.005	0.01
Selenium	mg/L	0.01	<0.01	<0.01	0.002	N/C	N/C	N/A	0.05	0.1
Strontium	mg/L	0.001	0.262	0.271	0.26	3%	1%	<50%	0.005	0.01
Titanium	mg/L	0.01	<0.01	<0.01	< 0.005	N/C	N/C	N/A	0.05	0.1
Uranium	mg/L	0.001	0.036	0.037	0.033	3%	9%	<50%	0.005	0.01
Vanadium	mg/L	0.01	0.1	0.1	0.091	0%	9%	<50%	0.05	0.1
Zinc	mg/L	0.005	<0.005	<0.005	0.006	N/C	N/C	N/A	0.025	0.05
Iron	mg/L	0.05	<0.05	<0.05	< 0.05	N/C	N/C	N/A	0.25	0.5
Tungsten	mg/L	0.001	<0.001	<0.001	-	N/C	N/C	N/A	0.005	0.01
Free Cyanide	mg/L	0.002	<0.002	<0.002	< 0.005	N/C	N/C	N/A	0.01	0.02
Total Cyanide	mg/L	0.002	0.003	0.004	< 0.005	29%	N/C	No Limit	0.01	0.02
Weak Acid Dissociable Cyanide	mg/L	0.002	<0.002	<0.002	< 0.005	N/C	N/C	N/A	0.01	0.02
Analyte	**Units**	**LOR**	**THT06 0.5**	**BD01**	**SD01**	**RPD1**	**RPD2**	**Screening criteria**	**5xLOR**	**10xLOR**
Dates			**9/06/2023**	**9/06/2023**	**9/06/2023**					
Laboratory			**ALS**	**ALS**	**Eurofins**					
pH Value	pH Unit	0.1	9.8	-	-	N/C	N/C	N/A	0.5	1
Electrical Conductivity	µS/cm	1	199	-	-	N/C	N/C	N/A	5	10
Aluminium	mg/kg	50	5840	5090	9800	14%	51%	<50%	250	500
Iron	mg/kg	50	13200	9710	25000	30%	62%	<50%	250	500
Arsenic	mg/kg	0.1	6	4.5	8.7	29%	37%	<50%	0.5	1
Selenium	mg/kg	1	2	2	3.7	0%	60%	No Limit	5	10
Barium	mg/kg	0.1	14	13.2	19	6%	30%	<50%	0.5	1
Cadmium	mg/kg	0.1	<0.1	<0.1	< 0.5	N/C	N/C	<50%	0.5	1
Cobalt	mg/kg	0.1	24.4	19.1	36	24%	38%	<50%	0.5	1
Chromium	mg/kg	0.1	15.6	13.8	28	12%	57%	<50%	0.5	1
Copper	mg/kg	0.1	99.8	76	140	27%	34%	<50%	0.5	1
Manganese	mg/kg	0.1	91.3	81	150	12%	49%	<50%	0.5	1
Strontium	mg/kg	0.1	4	3.8	< 10	5%	N/C	<50%	0.5	1
Tungsten	mg/kg	0.1	0.1	<0.1	-	N/C	N/C	N/A	0.5	1
Molybdenum	mg/kg	0.1	0.8	0.6	< 5	29%	N/C	<80%	0.5	1
Nickel	mg/kg	0.1	18.2	15.8	28	14%	42%	<50%	0.5	1
Lead	mg/kg	0.1	4.7	4.9	8.7	4%	60%	<50%	0.5	1
Antimony	mg/kg	0.1	<0.1	<0.1	< 10	N/C	N/C	N/A	0.5	1
Uranium	mg/kg	0.1	1.5	1.6	< 10	6%	N/C	<50%	0.5	1
Zinc	mg/kg	0.5	13.4	12.5	20	7%	40%	<50%	2.5	5
Vanadium	mg/kg	1	18	15	47	18%	89%	<50%	5	10
Titanium	mg/kg	1	212	145	460	38%	74%	<50%	5	10
Free Cyanide	mg/kg	1	<1	<1	< 5	N/C	N/C	N/A	5	10
Total Cyanide	mg/kg	1	118	58	69	68%	52%	<50%	5	10
Weak Acid Dissociable Cyanide	mg/kg	1	<1	<1	< 5	N/C	N/C	<50%	5	10

Job number: 722092
Location: Tick Hill
Client: Carnaby Resources

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Analyte	Units	LOR	THGW08	GWBD01	GWSD01	RPD1	RPD2	Screening criteria	5xLOR	10xLOR
Dates			**12/06/2023**	**12/06/2023**	**12/06/2023**					
Laboratory			**ALS**	**ALS**	**Eurofins**					
pH Value	pH Unit	0.01	7.59	7.91	8.7	4%	14%	<50%	0.05	0.1
Total Dissolved Solids	mg/L	10	3790	3730	2500	2%	41%	<50%	50	100
Bicarbonate Alkalinity as CaCO3	mg/L	1	727	707	920	3%	23%	<50%	5	10
Total Alkalinity as CaCO3	mg/L	1	727	707	1200	3%	49%	<50%	5	10
Sulfate as SO4 - Turbidimetric	mg/L	1	474	483	450	2%	5%	<50%	5	10
Chloride	mg/L	1	1260	1260	1300	0%	3%	<50%	5	10
Calcium	mg/L	1	104	104	100	0%	4%	<50%	5	10
Magnesium	mg/L	1	310	308	290	1%	7%	<50%	5	10
Sodium	mg/L	1	717	723	640	1%	11%	<50%	5	10
Potassium	mg/L	1	16	16	14	0%	13%	<50%	5	10
Fluoride	mg/L	0.1	2.4	2.3	2.2	4%	9%	<50%	0.5	1
Ammonia as N	mg/L	0.01	0.49	0.63	0.41	25%	18%	<50%	0.05	0.1
Nitrite as N	mg/L	0.01	0.86	0.77	0.75	11%	14%	<50%	0.05	0.1
Nitrate as N	mg/L	0.01	13.4	13.5	12	1%	11%	<50%	0.05	0.1
Total Phosphorus as P	mg/L	0.01	1.79	2.02	-	12%	N/C	<50%	0.05	0.1
Reactive Phosphorus as P	mg/L	0.01	1.28	0.8	0.81	46%	45%	<50%	0.05	0.1
Dissolved metals										
Aluminium	mg/L	0.01	0.16	0.18	< 0.05	12%	N/C	<50%	0.05	0.1
Antimony	mg/L	0.001	0.004	0.004	< 0.005	0%	N/C	No Limit	0.005	0.01
Arsenic	mg/L	0.001	0.001	0.001	0.001	0%	0%	No Limit	0.005	0.01
Barium	mg/L	0.001	0.158	0.16	0.16	1%	1%	<50%	0.005	0.01
Cadmium	mg/L	0.0001	<0.0001	<0.0001	< 0.0002	N/C	N/C	N/A	0.0005	0.001
Chromium	mg/L	0.001	<0.001	0.001	< 0.001	N/C	N/C	N/A	0.005	0.01
Cobalt	mg/L	0.001	1.05	1.09	1.1	4%	5%	<50%	0.005	0.01
Copper	mg/L	0.001	0.007	0.008	0.006	13%	15%	<80%	0.005	0.01
Lead	mg/L	0.001	<0.001	<0.001	< 0.001	N/C	N/C	N/A	0.005	0.01
Manganese	mg/L	0.001	0.17	0.172	0.15	1%	13%	<50%	0.005	0.01
Molybdenum	mg/L	0.001	0.003	0.003	< 0.005	0%	N/C	No Limit	0.005	0.01
Nickel	mg/L	0.001	0.005	0.005	0.005	0%	0%	<80%	0.005	0.01
Selenium	mg/L	0.01	0.01	0.02	0.017	67%	52%	No Limit	0.05	0.1
Strontium	mg/L	0.001	1.36	1.36	1.6	0%	16%	<50%	0.005	0.01
Titanium	mg/L	0.01	<0.01	<0.01	< 0.005	N/C	N/C	N/A	0.05	0.1
Uranium	mg/L	0.001	0.049	0.048	0.041	2%	18%	<50%	0.005	0.01
Vanadium	mg/L	0.01	0.08	0.08	0.069	0%	15%	<80%	0.05	0.1
Zinc	mg/L	0.005	0.007	0.007	< 0.005	0%	N/C	No Limit	0.025	0.05
Iron	mg/L	0.05	0.45	0.47	0.22	4%	69%	<80%	0.25	0.5
Tungsten	mg/L	0.001	<0.001	<0.001	-	N/C	N/C	N/A	0.005	0.01
Total metals										
Aluminium	mg/L	0.01	26.8	24.4	24	9%	11%	<50%	0.05	0.1
Antimony	mg/L	0.001	0.005	0.005	< 0.005	0%	N/C	<80%	0.005	0.01
Arsenic	mg/L	0.001	0.006	0.005	0.005	18%	18%	<80%	0.005	0.01
Barium	mg/L	0.001	0.51	0.441	0.4	15%	24%	<50%	0.005	0.01
Cadmium	mg/L	0.0001	0.0006	0.0006	0.0005	0%	18%	<80%	0.0005	0.001
Chromium	mg/L	0.001	0.075	0.064	0.057	16%	27%	<50%	0.005	0.01
Cobalt	mg/L	0.001	1.06	1.03	1	3%	6%	<50%	0.005	0.01
Copper	mg/L	0.001	0.054	0.032	0.025	51%	73%	<50%	0.005	0.01
Lead	mg/L	0.001	0.012	0.012	0.011	0%	9%	<50%	0.005	0.01
Manganese	mg/L	0.001	0.519	0.478	0.43	8%	19%	<50%	0.005	0.01
Molybdenum	mg/L	0.001	0.003	0.003	< 0.005	0%	N/C	No Limit	0.005	0.01
Nickel	mg/L	0.001	0.051	0.043	0.037	17%	32%	<50%	0.005	0.01
Selenium	mg/L	0.01	0.02	0.02	0.013	0%	42%	No Limit	0.05	0.1
Strontium	mg/L	0.001	1.29	1.28	1.6	1%	21%	<50%	0.005	0.01
Titanium	mg/L	0.01	2.58	2.18	1.9	17%	30%	<50%	0.05	0.1
Uranium	mg/L	0.001	0.049	0.05	0.043	2%	13%	<50%	0.005	0.01
Vanadium	mg/L	0.01	0.22	0.2	0.17	10%	26%	<50%	0.05	0.1
Zinc	mg/L	0.005	0.077	0.07	0.066	10%	15%	<50%	0.025	0.05
Iron	mg/L	0.05	48.9	41.8	44	16%	11%	<50%	0.25	0.5
Tungsten	mg/L	0.001	0.001	0.001	-	0%	N/C	No Limit	0.005	0.01
Cyanide										
Free Cyanide	mg/L	0.002	0.025	0.023	0.11	8%	126%	<50%	0.01	0.02
Total Cyanide	mg/L	0.002	0.881	0.86	0.89	2%	1%	<50%	0.01	0.02
Weak Acid Dissociable Cyanide	mg/L	0.002	0.022	0.019	0.23	15%	165%	<50%	0.01	0.02
C6 - C10 Fraction	µg/L	20	<20	<20	<20	N/C	N/C	N/A	100	200
C6 - C10 Fraction minus BTEX (F1)	µg/L	20	<20	<20	<20	N/C	N/C	N/A	100	200
>C10 - C16 Fraction	µg/L	100	<100	<100	<50	N/C	N/C	N/A	500	1000
>C16 - C34 Fraction	µg/L	100	<100	120	<100	N/C	N/C	N/A	500	1000
>C34 - C40 Fraction	µg/L	100	<100	<100	<100	N/C	N/C	N/A	500	1000
>C10 - C40 Fraction (sum)	µg/L	100	<100	120	<100	N/C	N/C	N/A	500	1000
>C10 - C16 Fraction minus Naphthalene (F2)	µg/L	100	<100	<100	<50	N/C	N/C	N/A	500	1000
Benzene	µg/L	1	<1	<1	<1	N/C	N/C	N/A	5	10
Toluene	µg/L	2	<2	<2	<1	N/C	N/C	N/A	10	20
Ethylbenzene	µg/L	2	<2	<2	<1	N/C	N/C	N/A	10	20
meta- & para-Xylene	µg/L	2	<2	<2	<2	N/C	N/C	N/A	10	20
ortho-Xylene	µg/L	2	<2	<2	<1	N/C	N/C	N/A	10	20
Total Xylenes	µg/L	2	<2	<2	<3	N/C	N/C	N/A	10	20
Sum of BTEX	µg/L	1	<1	<1	<3	N/C	N/C	N/A	5	10
Naphthalene	µg/L	5	<5	<5	<10	N/C	N/C	N/A	25	50
PFAS										
Perfluorobutane sulfonic acid (PFBS)	µg/L	0.002	<0.002	<0.002	< 0.01	N/C	N/C	N/A	0.01	0.02
Perfluoropentane sulfonic acid (PFPeS)	µg/L	0.002	<0.002	<0.002	< 0.01	N/C	N/C	N/A	0.01	0.02
Perfluorohexane sulfonic acid (PFHxS)	µg/L	0.002	<0.002	<0.002	< 0.01	N/C	N/C	N/A	0.01	0.02
Perfluoroheptane sulfonic acid (PFHpS)	µg/L	0.002	<0.002	<0.002	< 0.01	N/C	N/C	N/A	0.01	0.02
Perfluorooctane sulfonic acid (PFOS)	µg/L	0.002	<0.002	<0.002	< 0.01	N/C	N/C	N/A	0.01	0.02
Perfluorodecane sulfonic acid (PFDS)	µg/L	0.002	<0.002	<0.002	< 0.01	N/C	N/C	N/A	0.01	0.02
Perfluorobutanoic acid (PFBA)	µg/L	0.01	<0.01	<0.01	< 0.05	N/C	N/C	N/A	0.05	0.1
Perfluoropentanoic acid (PFPeA)	µg/L	0.002	<0.002	<0.002	< 0.01	N/C	N/C	N/A	0.01	0.02
Perfluorohexanoic acid (PFHxA)	µg/L	0.002	<0.002	<0.002	< 0.01	N/C	N/C	N/A	0.01	0.02
Perfluoroheptanoic acid (PFHpA)	µg/L	0.002	<0.002	<0.002	< 0.01	N/C	N/C	N/A	0.01	0.02
Perfluorooctanoic acid (PFOA)	µg/L	0.002	<0.002	<0.002	< 0.01	N/C	N/C	N/A	0.01	0.02
Perfluorononanoic acid (PFNA)	µg/L	0.002	<0.002	<0.002	< 0.01	N/C	N/C	N/A	0.01	0.02
Perfluorodecanoic acid (PFDA)	µg/L	0.002	<0.002	<0.002	< 0.01	N/C	N/C	N/A	0.01	0.02
Perfluoroundecanoic acid (PFUnDA)	µg/L	0.002	<0.002	<0.002	< 0.01	N/C	N/C	N/A	0.01	0.02
Perfluorododecanoic acid (PFDoDA)	µg/L	0.002	<0.002	<0.002	< 0.01	N/C	N/C	N/A	0.01	0.02
Perfluorotridecanoic acid (PFTrDA)	µg/L	0.002	<0.002	<0.002	< 0.01	N/C	N/C	N/A	0.01	0.02
Perfluorotetradecanoic acid (PFTeDA)	µg/L	0.005	<0.005	<0.005	< 0.01	N/C	N/C	N/A	0.025	0.05
Perfluorooctane sulfonamide (FOSA)	µg/L	0.002	<0.002	<0.002	< 0.05	N/C	N/C	N/A	0.01	0.02
N-Methyl perfluorooctane sulfonamide (MeFOSA)	µg/L	0.005	<0.005	<0.005	< 0.05	N/C	N/C	N/A	0.025	0.05
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	µg/L	0.005	<0.005	<0.005	< 0.05	N/C	N/C	N/A	0.025	0.05
N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	µg/L	0.005	<0.005	<0.005	< 0.05	N/C	N/C	N/A	0.025	0.05
N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	µg/L	0.005	<0.005	<0.005	< 0.05	N/C	N/C	N/A	0.025	0.05
N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	µg/L	0.002	<0.002	<0.002	< 0.05	N/C	N/C	N/A	0.01	0.02
N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	µg/L	0.002	<0.002	<0.002	< 0.05	N/C	N/C	N/A	0.01	0.02
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	µg/L	0.005	<0.005	<0.005	< 0.01	N/C	N/C	N/A	0.025	0.05
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	µg/L	0.005	0.195	0.218	0.26	11%	29%	<50%	0.025	0.05
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	µg/L	0.005	<0.005	<0.005	< 0.01	N/C	N/C	N/A	0.025	0.05
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	µg/L	0.005	<0.005	<0.005	< 0.01	N/C	N/C	N/A	0.025	0.05

Job number: 722092
Location: Tick Hill
Client: Carnaby Resources

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Table 36: Rinsate blanks

			Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Manganese	Nickel	Zinc	Iron	Mercury	Total Cyanide
units			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
LOR			0.01	0.001	0.0001	0.001	0.001	0.001	0.001	0.001	0.005	0.05	0.0001	0.002
Field ID	**Date**													
RB01	**12 Jun 2023**	**Groundwater sampling equipment**	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.05	----	<0.002
RB02	**12 Jun 2023**	**Soil sampling equipment**	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.05	<0.0001	----

Table 37: Historical Groundwater monitoring results

Sample Date:	Units	LOR	Human Health Criteria	Ecological Criteria	Stock watering	22/06/2020	23/01/2021	9/06/2021	28/07/2021	10/10/2021	1/12/2021	17/12/2021	9/02/2022
Bore ID			Drinking water	95% species protection		THGW001	THGW001	THGW001	THGW001	THGW001	THGW001	THGW001	THGW001
pH Value	pH Unit	0.01	6.5 - 8.5			8.08	7.85	8	7.58	8.18	8.13	8.09	8.15
EC	µS/cm	1				2600	2590	2560	2530	2380	2520	2450	2380
TDS	mg/L	1	600		4000	1690	1680	1660	1640	1550	1640	1590	1550
Total Hardness as CaCO3	mg/L	1				604	606	595	599	551	552	581	550
Hydroxide Alkalinity	mg/L	1				<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity	mg/L	1				<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity	mg/L	1				743	752	752	764	764	736	740	714
Total Alkalinity	mg/L	1				743	752	752	764	764	736	740	714
Sulfate as SO4	mg/L	1	500		1000	97	93	88	134	95	104	91	88
Chloride	mg/L	1	250			391	402	402	383	392	366	382	381
Calcium	mg/L	1			1000	44	45	47	52	46	43	43	42
Magnesium	mg/L	1			600	120	120	116	114	106	108	115	108
Sodium	mg/L	1				376	386	387	387	361	366	370	360
Potassium	mg/L	1				7	8	7	7	6	7	7	7
Dissolved Metals													
Aluminium	mg/L	0.01		0.055	5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Antimony	mg/L	0.001	0.003	0.009		0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	0.01	0.024	0.5	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.008
Cadmium	mg/L	0.0002	0.002	0.003	0.01	0.0002	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	0.05	0.01	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	0.06			**0.249**	**0.292**	**0.199**	**0.204**	**0.281**	**0.244**	**0.326**	**0.279**
Copper	mg/L	0.001	2	0.0014	0.5	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.006
Lead	mg/L	0.001	0.01	0.148	0.1	0.001	<0.001	<0.001	<0.001	0.017	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	0.5	1.9	10	0.005	<0.001	0.002	0.001	0.001	0.002	0.002	0.004
Molybdenum	mg/L	0.001	0.05		0.15	0.002	0.004	0.002	0.002	<0.001	0.001	0.002	0.009
Nickel	mg/L	0.001	0.02	0.125	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	mg/L	0.01	0.01	0.011	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005	3	0.091	20	0.018	0.007	<0.005	<0.005	<0.005	<0.005	<0.005	0.013
Tungsten	mg/L	0.001				<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.001	<0.001
Total Metals													
Aluminium	mg/L	0.01				0.41	0.03	0.51	0.22	0.07	0.67	0.29	0.28
Antimony	mg/L	0.001				0.007	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001				0.001	0.001	0.001	<0.001	<0.001	0.001	<0.001	<0.001
Cadmium	mg/L	1.00E-04				<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001				0.002	0.001	0.001	0.001	<0.001	0.002	<0.001	<0.001
Cobalt	mg/L	0.001				0.376	0.345	0.324	0.3	0.326	0.328	0.339	0.279
Copper	mg/L	0.001				0.011	<0.001	0.003	0.002	0.002	0.004	0.006	0.003
Lead	mg/L	0.001				0.017	<0.001	0.006	0.002	0.02	0.06	0.004	0.004
Manganese	mg/L	0.001				0.016	0.002	0.008	0.006	0.004	0.022	0.008	0.01
Molybdenum	mg/L	0.001				0.001	0.002	0.001	0.002	0.001	0.001	0.001	0.001
Zinc	mg/L	0.005				0.055	0.01	<0.005	0.013	0.009	0.02	0.016	0.012
Nickel	mg/L	0.001				0.002	0.004	<0.001	0.001	<0.001	<0.001	0.001	<0.001
Selenium	mg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005				0.055	0.01	<0.005	0.013	0.009	0.02	0.016	0.012
Tungsten	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Free Cyanide	mg/L	0.004	0.08	0.007		0.011	**0.151**	0.015	0.025	<0.004	0.009	0.01	0.012
Total Cyanide	mg/L	0.004				0.236	0.35	0.238	0.236	0.221	0.23	0.224	0.162
WAD Cyanide	mg/L	0.004				0.006	0.146	0.014	0.028	<0.004	0.009	0.01	0.013
Fluoride	mg/L	0.1	1.5		2	**2.5**	**2.5**	**2.6**	**2.7**	**2.8**	**2.9**	**2.5**	**2.3**
Ionic Balance													
Total Anions	meq/L	0.01				27.9	28.3	28.2	28.8	28.3	27.2	27.4	26.8
Total Cations	meq/L	0.01				28.6	29.1	28.9	29	26.9	27.1	27.9	26.8
Ionic Balance	%	0.01				1.26	1.42	1.24	0.23	2.58	0.11	0.77	0.04

Job number: 722092 **Location:** Tick Hill **Client:** Carnaby Resources

Sample Date:	Units	LOR	Human Health Criteria	Ecological Criteria	Stock watering	22/06/2020	23/01/2021	09/06/2021	28/07/2021	10/10/2021	01/12/2021	17/12/2021	09/02/2022
Sample ID			Drinking water	95% species protection		THGW002	THGW002	THGW002	THGW002	THGW002	THGW002	THGW002	THGW002
pH Value	pHUnit	0.01	6.5 - 8.5			8.17	7.94	8.07	7.82	8.19	8.2	8.11	8
EC	µS/cm	1				1240	1220	1340	1330	1300	1310	1240	972
TDS	mg/L	1	600		4000	**806**	**793**	**871**	**864**	**845**	**852**	**806**	**632**
Total Hardness as CaCO3	mg/L	1				282	272	291	292	269	268	281	235
Hydroxide Alkalinity	mg/L	1				<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity	mg/L	1				<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity	mg/L	1				445	458	490	497	490	428		348
Total Alkalinity	mg/L	1				445	458	490	497	490	428	451	348
Sulfate as SO4	mg/L	1	500		1000	16	10	2	2	2	3	4	13
Chloride	mg/L	1	250			142	140	160	155	158	139	140	108
Calcium	mg/L	1			1000	32	30	34	36	32	30	30	28
Magnesium	mg/L	1			600	49	48	50	49	46	47	50	40
Sodium	mg/L	1				177	179	191	192	181	181	183	137
Potassium	mg/L	1				7	7	7	7	7	7	7	7
Dissolved Metals													
Aluminium	mg/L	0.01		0.055	5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony	mg/L	0.001	0.003	0.009		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Arsenic	mg/L	0.001	0.01	0.024	0.5	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0001	0.002	0.003	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	0.05	0.01	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	0.06			0.004	0.002	0.004	<0.001	0.001	<0.001	0.002	<0.001
Copper	mg/L	0.001	2	0.0014	0.5	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003
Lead	mg/L	0.001	0.01	0.148	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	0.5	1.9	10	0.008	0.021	0.015	0.009	0.006	0.024	0.036	<0.001
Molybdenum	mg/L	0.001	0.05		0.15	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003
Nickel	mg/L	0.001	0.02	0.125	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	mg/L	0.01	0.01	0.011	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005	3	0.091	20	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.014
Tungsten	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total Metals													
Aluminium	mg/L	0.01				0.17	0.08	0.19	0.24	0.8	0.52	0.81	1.11
Antimony	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Cadmium	mg/L	0.0001				<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	0.024	0.001	0.001	0.004
Cobalt	mg/L	0.001				0.001	0.002	0.005	0.001	<0.001	0.001	0.001	0.003
Copper	mg/L	0.001				0.009	0.002	0.002	0.002	0.005	0.003	0.014	0.016
Lead	mg/L	0.001				0.004	<0.001	0.001	0.002	<0.001	0.036	0.004	0.015
Manganese	mg/L	0.001				0.038	0.042	0.042	0.044	0.008	0.046	0.051	0.086
Molybdenum	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.005				0.019	0.007	0.005	0.008	0.006	0.007	0.014	0.059
Nickel	mg/L	0.001				<0.001	<0.001	<0.001	0.002	0.034	0.002	<0.001	0.002
Selenium	mg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005				0.019	0.007	0.005	0.008	0.006	0.007	0.014	0.059
Tungsten	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Free Cyanide	mg/L	0.004	0.08	0.007		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Total Cyanide	mg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
WAD Cyanide	mg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Fluoride	mg/L	0.1	1.5		2	1.4	1.3	1.4	**1.6**	**1.6**	**1.7**	1.3	1.1
Ionic Balance													
Total Anions	meq/L	0.01				13.2	13.3	14.3	14.3	14.3	12.5	13	10.3
Total Cations	meq/L	0.01				13.5	13.4	14.3	14.4	13.4	13.4	13.8	10.8
Ionic Balance	%	0.01				1.04	0.39	0.16	0.05	3.08	3.4	2.64	2.64

Job number: 722092 **Location:** Tick Hill **Client:** Carnaby Resources

Sample Date:	Units	LOR	Human Health Criteria	Ecological Criteria	Stock watering	22/06/2020	23/01/2021	09/06/2021	28/07/2021	10/10/2021	01/12/2021	17/12/2021	09/02/2022
Sample ID			Drinking water	95% species protection		THGW003	THGW003	THGW003	THGW003	THGW003	THGW003	THGW003	THGW003
pH Value	pH Unit	0.01	6.5 - 8.5			8.17	8.08	8.09	7.63	8.18	8.2	8.18	8.16
EC	µS/cm	1				2070	2060	2090	2090	2040	2100	2030	2050
TDS	mg/L	1	600		4000	**1340**	**1340**	**1360**	**1360**	**1330**	**1360**	**1320**	**1330**
Total Hardness as CaCO3	mg/L	1				479	490	490	497	460	472	504	473
Hydroxide Alkalinity	mg/L	1				<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity	mg/L	1				<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity	mg/L	1				669	679	657	670	635	628	621	683
Total Alkalinity	mg/L	1				669	679	657	670	635	628	621	683
Sulfate as SO4	mg/L	1	500		1000	53	53	51	50	49	56	53	52
Chloride	mg/L	1	250			300	305	314	304	302	286	300	307
Calcium	mg/L	1			1000	45	46	48	54	49	47	47	46
Magnesium	mg/L	1			600	89	91	90	88	82	86	94	87
Sodium	mg/L	1				291	306	310	313	296	304	312	298
Potassium	mg/L	1				9	9	8	7	7	6	7	7
Dissolved Metals													
Aluminium	mg/L	0.01		0.055	5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony	mg/L	0.001	0.003	0.009		0.002	0.002	0.004	0.005	0.002	0.002	0.002	0.004
Arsenic	mg/L	0.001	0.01	0.024	0.5	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0001	0.002	0.003	0.01	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	0.05	0.01	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	0.06			0.013	0.019	0.013	0.01	0.014	0.013	0.021	0.014
Copper	mg/L	0.001	2	0.0014	0.5	0.002	0.003	0.005	0.003	0.001	<0.001	0.002	0.003
Lead	mg/L	0.001	0.01	0.148	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	0.5	1.9	10	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Molybdenum	mg/L	0.001	0.05		0.15	0.002	0.003	0.002	0.003	0.001	0.003	0.003	0.007
Nickel	mg/L	0.001	0.02	0.125	1	<0.001	0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Selenium	mg/L	0.01	0.01	0.011	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005	3	0.091	20	0.05	0.049	0.037	0.044	0.029	0.013	0.022	0.048
Tungsten	mg/L	0.001				0.002	0.002	0.002	0.002	0.001	0.001	0.002	0.001
Total Metals													
Aluminium	mg/L	0.01				0.26	0.14	0.44	1	0.16	0.4	0.06	0.44
Antimony	mg/L	0.001				0.002	0.002	0.01	0.004	0.002	0.002	0.002	0.003
Arsenic	mg/L	0.001				<0.001	0.001	0.001	0.001	0.001	0.001	<0.001	0.001
Cadmium	mg/L	0.0001				<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001				0.001	<0.001	0.002	0.003	<0.001	0.002	<0.001	0.002
Cobalt	mg/L	0.001				0.027	0.024	0.025	0.022	0.022	0.022	0.021	0.019
Copper	mg/L	0.001				0.008	0.005	0.009	0.013	0.004	0.006	0.005	0.015
Lead	mg/L	0.001				0.003	0.001	0.002	0.007	0.039	0.009	0.002	0.008
Manganese	mg/L	0.001				0.013	0.018	0.022	0.057	0.034	0.035	0.015	0.047
Molybdenum	mg/L	0.001				0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Zinc	mg/L	0.005				0.098	0.076	0.068	0.078	0.05	0.068	0.044	0.086
Nickel	mg/L	0.001				0.002	0.002	0.002	0.004	<0.001	0.002	<0.001	0.002
Selenium	mg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005				0.098	0.076	0.068	0.078	0.05	0.068	0.044	0.086
Tungsten	mg/L	0.001				0.003	0.002	0.003	0.002	0.002	0.001	0.002	0.001
Free Cyanide	mg/L	0.004	0.08	0.007		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Total Cyanide	mg/L	0.004				0.012	0.014	0.009	0.009	0.008	0.008	0.009	0.008
WAD Cyanide	mg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Fluoride	mg/L	0.1	1.5		2	**2.2**	**2.2**	**2.3**	**2.4**	**2.4**	**2.7**	**2.4**	**2.1**
EN055: Ionic Balance													
Total Anions	meq/L	0.01				22.9	23.3	23	23	22.2	21.8	22	23.4
Total Cations	meq/L	0.01				22.4	23.3	23.5	23.7	22.2	22.8	23.8	22.6
Ionic Balance	%	0.01				1.04	0.11	0.96	1.56	0.05	2.28	4.06	1.72

Job number: 722092 **Location:** Tick Hill **Client:** Carnaby Resources

Sample Date:	Units	LOR	Human Health Criteria	Ecological Criteria	Stock watering	22/06/2020	23/01/2021	09/06/2021	28/07/2021	10/10/2021	01/12/2021	17/12/2021	09/02/2022
Sample ID			Drinking water	95% species protection		THGW004	THGW004	THGW004	THGW004	THGW004	THGW004	THGW004	THGW004
pH Value	pH Unit	0.01	6.5 - 8.5			8.23	8.2	8.35	7.92	8.36	8.35	8.28	8.43
EC	µS/cm	1				2850	2780	2810	2770	2810	2800	2730	2690
TDS	mg/L	1	600		4000	**1850**	**1810**	**1830**	**1800**	**1830**	**1820**	**1770**	**1750**
Total Hardness as CaCO3	mg/L	1				89	91	91	78	85	80	95	87
Hydroxide Alkalinity	mg/L	1				<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity	mg/L	1				<1	<1	8	<1	156	610	<1	470
Bicarbonate Alkalinity	mg/L	1				1230	1270	1200	1210	940	537	1150	670
Total Alkalinity	mg/L	1				1230	1270	1210	1210	1100	1150	1150	1140
Sulfate as SO4	mg/L	1	500		1000	91	83	82	87	88	94	86	82
Chloride	mg/L	1	250			125	116	117	113	112	99	110	111
Calcium	mg/L	1			1000	6	5	5	5	6	4	5	5
Magnesium	mg/L	1			600	18	19	19	16	17	17	20	18
Sodium	mg/L	1				686	725	724	687	650	674	716	673
Potassium	mg/L	1				6	8	5	5	5	4	5	5
Dissolved Metals													
Aluminium	mg/L	0.01		0.055	5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony	mg/L	0.001	0.003	0.009		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	0.01	0.024	0.5	0.004	0.004	0.004	0.004	0.003	0.004	0.004	0.009
Cadmium	mg/L	0.0001	0.002	0.003	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	0.05	0.01	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	0.06			<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	2	0.0014	0.5	0.003	<0.001	<0.001	0.005	0.003	0.001	0.007	0.006
Lead	mg/L	0.001	0.01	0.148	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	0.5	1.9	10	0.011	0.004	<0.001	0.005	0.011	<0.001	0.005	<0.001
Molybdenum	mg/L	0.001	0.05		0.15	0.007	0.006	0.006	0.006	0.004	0.006	0.006	0.012
Nickel	mg/L	0.001	0.02	0.125	1	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	0.001	<0.001
Selenium	mg/L	0.01	0.01	0.011	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Zinc	mg/L	0.005	3	0.091	20	0.054	<0.005	<0.005	0.012	0.05	<0.005	<0.005	0.048
Tungsten	mg/L	0.001				0.001	<0.001	0.001	<0.001	<0.001	0.001	0.002	0.001
Total Metals													
Aluminium	mg/L	0.01				0.34	5.17	4.19	6.31	6.41	1.86	9.95	4.55
Antimony	mg/L	0.001				0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001				0.004	0.004	0.004	0.005	0.005	0.004	0.005	0.005
Cadmium	mg/L	0.0001				<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0001	<0.0001
Chromium	mg/L	0.001				0.002	0.02	0.011	0.019	0.017	0.005	0.023	0.011
Cobalt	mg/L	0.001				<0.001	0.005	0.005	0.006	0.008	0.002	0.011	0.005
Copper	mg/L	0.001				0.007	0.011	0.008	0.022	0.023	0.006	0.07	0.033
Lead	mg/L	0.001				<0.001	0.001	0.001	0.003	0.006	0.049	0.006	0.01
Manganese	mg/L	0.001				0.015	0.14	0.107	0.142	0.192	0.064	0.192	0.1
Molybdenum	mg/L	0.001				0.007	0.011	0.006	0.009	0.006	0.006	0.006	0.006
Zinc	mg/L	0.005				0.091	0.09	0.039	0.097	0.203	0.04	0.101	0.147
Nickel	mg/L	0.001				0.002	0.038	0.007	0.026	0.01	0.003	0.014	0.006
Selenium	mg/L	0.01				0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02
Zinc	mg/L	0.005				0.091	0.09	0.039	0.097	0.203	0.04	0.101	0.147
Tungsten	mg/L	0.001				0.002	0.002	0.002	0.002	0.001	0.001	0.002	0.001
Free Cyanide	mg/L	0.004	0.08	0.007		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Total Cyanide	mg/L	0.004				<0.004	0.008	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
WAD Cyanide	mg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Fluoride	mg/L	0.1	1.5		2	**4.9**	**5**	**5.5**	**5.4**	**5.8**	**5.2**	**5.7**	**5.3**
Ionic Balance													
Total Anions	meq/L	0.01				30	30.4	29.2	29.2	27	27.7	27.9	27.6
Total Cations	meq/L	0.01				31.8	33.6	33.4	31.6	30.1	31	33.2	31.1
Ionic Balance	%	0.01				2.88	4.97	6.79	3.95	5.48	5.6	8.68	5.99

Job number: 722092 **Location:** Tick Hill **Client:** Carnaby Resources

Sample Date:	Units	LOR	Human Health Criteria	Ecological Criteria	Stock watering	22/06/2020	23/01/2021	09/06/2021	28/07/2021	10/10/2021	01/12/2021	17/12/2021	09/02/2022
Sample ID			Drinking water	95% species protection		THGW005	THGW005	THGW005	THGW005	THGW005	THGW005	THGW005	THGW005
pH Value	pH Unit	0.01	6.5 - 8.5			8.33	8.2	8.38	7.99	8.03	8.41	8.21	8.4
EC	µS/cm	1				1750	1790	1800	1790	1790	1840	1760	1770
TDS	mg/L	1	600		4000	**1140**	**1160**	**1170**	**1160**	**1160**	**1200**	**1140**	**1150**
Total Hardness as CaCO3	mg/L	1				314	326	323	306	300	312	341	314
Hydroxide Alkalinity	mg/L	1				<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity	mg/L	1				<1	<1	13	<1	<1	488	<1	<1
Bicarbonate Alkalinity	mg/L	1				828	920	861	881	874	323	851	908
Total Alkalinity	mg/L	1				828	920	874	881	874	811	851	908
Sulfate as SO4	mg/L	1	500		1000	25	28	25	27	26	28	26	27
Chloride	mg/L	1	250			90	93	95	91	91	88	93	97
Calcium	mg/L	1			1000	25	25	27	27	26	26	26	25
Magnesium	mg/L	1			600	61	64	62	58	57	60	67	61
Sodium	mg/L	1				321	344	345	331	325	338	351	336
Potassium	mg/L	1				6	7	7	6	6	6	6	7
Dissolved Metals													
Aluminium	mg/L	0.01		0.055	5	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony	mg/L	0.001	0.003	0.009		0.003	0.003	**0.006**	**0.004**	0.002	<0.001	<0.001	0.002
Arsenic	mg/L	0.001	0.01	0.024	0.5	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Cadmium	mg/L	0.0001	0.002	0.003	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	0.05	0.01	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	0.06			0.004	0.003	0.003	0.002	0.003	0.002	0.003	0.002
Copper	mg/L	0.001	2	0.0014	0.5	0.002	0.001	0.004	0.002	0.001	0.002	<0.001	0.004
Lead	mg/L	0.001	0.01	0.148	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	0.5	1.9	10	<0.001	0.007	0.012	0.018	0.027	0.025	0.045	0.005
Molybdenum	mg/L	0.001	0.05		0.15	0.003	0.004	0.003	0.004	0.002	0.004	0.004	0.006
Nickel	mg/L	0.001	0.02	0.125	1	<0.001	0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.001
Selenium	mg/L	0.01	0.01	0.011	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005	3	0.091	20	0.024	0.03	0.024	0.023	0.021	0.005	<0.005	0.038
Tungsten	mg/L	0.001				0.008	0.005	0.007	0.002	0.006	0.005	0.005	0.003
Total Metals													
Aluminium	mg/L	0.01				0.08	0.13	0.42	0.3	0.54	1.02	0.02	0.65
Antimony	mg/L	0.001				0.004	0.003	0.008	0.004	0.003	0.002	<0.001	0.004
Arsenic	mg/L	0.001				0.001	0.001	0.001	<0.001	0.001	0.002	<0.001	0.001
Cadmium	mg/L	0.0001				<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001				<0.001	<0.001	0.002	<0.001	0.001	0.003	<0.001	0.002
Cobalt	mg/L	0.001				0.004	0.004	0.004	0.004	0.005	0.005	0.003	0.004
Copper	mg/L	0.001				0.006	0.003	0.01	0.006	0.008	0.01	<0.001	0.02
Lead	mg/L	0.001				<0.001	<0.001	0.002	0.002	0.007	0.018	<0.001	0.008
Manganese	mg/L	0.001				0.003	0.012	0.031	0.038	0.055	0.062	0.056	0.059
Molybdenum	mg/L	0.001				0.003	0.004	0.004	0.004	0.004	0.004	0.003	0.004
Zinc	mg/L	0.005				0.053	0.042	0.077	0.05	0.062	0.078	0.028	0.077
Nickel	mg/L	0.001				0.001	0.001	0.002	0.002	0.002	0.003	<0.001	0.003
Selenium	mg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005				0.053	0.042	0.077	0.05	0.062	0.078	0.028	0.077
Tungsten	mg/L	0.001				0.008	0.007	0.007	0.006	0.006	0.005	0.005	0.004
Free Cyanide	mg/L	0.004	0.08	0.007		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Total Cyanide	mg/L	0.004				<0.004	0.006	0.016	<0.004	<0.004	<0.004	<0.004	<0.010
WAD Cyanide	mg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Fluoride	mg/L	0.1	1.5		2	**2.9**	**2.8**	**2.9**	**3.1**	**3.2**	**2.9**	**2.9**	**2.9**
Ionic Balance													
Total Anions	meq/L	0.01				19.6	21.6	20.7	20.7	20.6	19.3	20.2	21.4
Total Cations	meq/L	0.01				20.4	21.6	21.6	20.7	20.3	21.1	22.2	21.1
Ionic Balance	%	0.01				1.95	0.16	2.3	0.14	0.71	4.51	4.87	0.89

Job number: 722092 **Location:** Tick Hill **Client:** Carnaby Resources

Sample Date:	Units	LOR	Human Health Criteria	Ecological Criteria	Stock watering	22/06/2020	23/01/2021	09/06/2021	28/07/2021	10/10/2021	01/12/2021	17/12/2021	09/02/2022
Sample ID			Drinking water	95% species protection		THGW006	THGW006	THGW006	THGW006	THGW006	THGW006	THGW006	THGW006
pH Value	pH Unit	0.01	6.5 - 8.5			8.16	7.99	8.06	7.6	8.18	8.08	8.21	8.35
EC	µS/cm	1				1820	1760	1780	1770	1760	1790	1720	1700
TDS	mg/L	1	600		4000	**1180**	**1140**	**1160**	**1150**	**1140**	**1160**	**1120**	**1100**
Total Hardness as CaCO3	mg/L	1				326	349	337	300	318	300	334	300
Hydroxide Alkalinity	mg/L	1				<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity	mg/L	1				<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity	mg/L	1				931	945	894	890	850	870	889	881
Total Alkalinity	mg/L	1				931	945	894	890	850	870	889	881
Sulfate as SO4	mg/L	1	500		1000	27	26	25	25	25	26	23	25
Chloride	mg/L	1	250			77	64	65	66	63	60	66	66
Calcium	mg/L	1			1000	20	21	23	21	22	18	20	18
Magnesium	mg/L	1			600	67	72	68	60	64	62	69	62
Sodium	mg/L	1				326	347	329	335	325	335	326	341
Potassium	mg/L	1				4	5	4	4	4	4	4	5
Dissolved Metals													
Aluminium	mg/L	0.01		0.055	5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony	mg/L	0.001	0.003	0.009		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	0.01	0.024	0.5	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	0.002
Cadmium	mg/L	0.0001	0.002	0.003	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	0.05	0.01	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	0.06			0.001	0.002	0.001	<0.001	0.001	<0.001	0.002	0.001
Copper	mg/L	0.001	2	0.0014	0.5	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.006	0.005
Lead	mg/L	0.001	0.01	0.148	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	0.5	1.9	10	0.007	<0.001	0.001	0.002	0.002	<0.001	0.002	<0.001
Molybdenum	mg/L	0.001	0.05		0.15	0.002	0.002	0.001	0.002	<0.001	0.002	0.002	0.005
Nickel	mg/L	0.001	0.02	0.125	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	mg/L	0.01	0.01	0.011	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005	3	0.091	20	0.008	0.021	0.006	0.013	0.02	0.005	0.01	0.052
Tungsten	mg/L	0.001				0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total Metals													
Aluminium	mg/L	0.01				0.3	1.64	1.72	1.04	0.84	0.19	1.47	1.54
Antimony	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001				0.001	0.001	0.001	<0.001	0.001	0.001	0.001	0.002
Cadmium	mg/L	0.0001				<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001
Chromium	mg/L	0.001				<0.001	0.002	0.002	0.001	<0.001	<0.001	0.002	0.003
Cobalt	mg/L	0.001				0.002	0.003	0.003	0.003	0.003	0.002	0.003	0.004
Copper	mg/L	0.001				0.002	0.006	0.006	0.007	0.006	0.003	0.037	0.03
Lead	mg/L	0.001				<0.001	<0.001	<0.001	0.001	0.006	0.022	0.003	0.01
Manganese	mg/L	0.001				0.013	0.016	0.014	0.018	0.018	0.016	0.013	0.038
Molybdenum	mg/L	0.001				0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Zinc	mg/L	0.005				0.019	0.042	0.026	0.031	0.042	0.033	0.034	0.102
Nickel	mg/L	0.001				<0.001	0.003	0.002	0.002	<0.001	<0.001	<0.001	0.002
Selenium	mg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005				0.019	0.042	0.026	0.031	0.042	0.033	0.034	0.102
Tungsten	mg/L	0.001				0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Free Cyanide	mg/L	0.004	0.08	0.007		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Total Cyanide	mg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
WAD Cyanide	mg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Fluoride	mg/L	0.1	1.5		2	**3.6**	**3.7**	**3.7**	**3.8**	**4.1**	**3.8**	**3.8**	**3.5**
Ionic Balance													
Total Anions	meq/L	0.01				21.3	21.2	20.2	20.2	19.3	19.6	20.1	20
Total Cations	meq/L	0.01				20.8	22.2	21.2	20.7	20.6	20.7	21	21
Ionic Balance	%	0.01				1.28	2.23	2.27	1.21	3.32	2.63	2.08	2.38

Job number: 722092 **Location:** Tick Hill **Client:** Carnaby Resources

Sample Date:	Units	LOR	Human Health Criteria	Ecological Criteria	Stock watering	22/06/2020	22/06/2020	23/01/2021	9/06/2021	28/07/2021	10/10/2021	1/12/2021	17/12/2021	9/02/2022
Sample ID			Drinking water	95% species protection		THPWOO1	THPWOO2	Pit Water	Pit Water	Pit Water	Pit Water	Pit Water	Pit Water	Pit Water
pH Value	pH Unit	0.01	6.5 - 8.5			**8.52**	8.47	**8.66**	**8.57**	**9.06**	**8.52**	**8.6**	**8.68**	8.5
EC	µS/cm	1				5800	5800	6290	6120	6130	6240	6080	6020	5860
TDS	mg/L	1	600		4000	**3770**	**3770**	**4090**	**3980**	**3980**	**4060**	**3950**	**3910**	**3810**
Total Hardness as CaCO3	mg/L	1				973	1010	1080	1040	1060	1010	1070	1100	1040
Hydroxide Alkalinity	mg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity	mg/L	1				32	30	59	28	110	36	39	56	19
Bicarbonate Alkalinity	mg/L	1				293	293	292	322	269	293	283	302	276
Total Alkalinity	mg/L	1				325	323	351	350	380	330	323	358	294
Sulfate as SO4	mg/L	1	500		1000	452	474	486	474	480	478	**546**	498	**527**
Chloride	mg/L	1	250			**1460**	**1500**	**1660**	**1650**	**1650**	**1710**	**1650**	**1680**	**1640**
Calcium	mg/L	1			1000	45	43	42	50	56	51	49	48	43
Magnesium	mg/L	1			600	209	220	237	223	224	215	230	238	226
Sodium	mg/L	1				873	907	1010	963	981	954	1000	998	953
Potassium	mg/L	1				23	24	26	25	24	23	24	26	24
Dissolved Metals														
Aluminium	mg/L	0.01		0.055	5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Antimony	mg/L	0.001	0.003	0.009		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	0.01	0.024	0.5	0.006	0.006	0.007	0.006	0.006	0.005	0.007	0.006	0.006
Cadmium	mg/L	0.0001	0.002	0.003	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	0.05	0.01	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	0.06			0.013	0.012	0.006	0.013	0.014	0.015	0.006	0.008	0.004
Copper	mg/L	0.001	2	0.0014	0.5	0.001	0.004	0.003	0.002	0.002	0.001	0.002	0.005	<0.001
Lead	mg/L	0.001	0.01	0.148	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.002	<0.001	<0.001
Manganese	mg/L	0.001	0.5	1.9	10	<0.001	<0.001	0.005	0.002	0.002	<0.001	<0.001	<0.001	0.008
Molybdenum	mg/L	0.001	0.05		0.15	0.032	0.029	0.035	0.026	0.029	0.029	0.038	0.034	0.029
Nickel	mg/L	0.001	0.02	0.125	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Selenium	mg/L	0.01	0.01	0.011	0.02	0.06	0.06	0.06	0.05	0.06	0.06	0.06	0.05	0.05
Zinc	mg/L	0.005	3	0.091	20	0.02	0.028	0.033	0.018	0.02	0.006	0.008	0.019	0.063
Tungsten	mg/L	0.001				0.002	0.002	0.002	0.001	0.001	0.002	0.002	0.002	0.002
Total Metals														
Aluminium	mg/L	0.01				1.74	1.37	0.29	0.17	0.22	0.24	0.41	0.3	0.5
Antimony	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001				0.008	0.008	0.008	0.006	0.005	0.007	0.008	0.007	0.006
Cadmium	mg/L	0.0001				<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001				0.006	0.005	0.006	<0.001	<0.001	<0.001	0.002	0.001	0.002
Cobalt	mg/L	0.001				0.018	0.018	0.007	0.016	0.014	0.017	0.01	0.01	0.005
Copper	mg/L	0.001				0.048	0.054	0.012	0.004	0.004	0.008	0.017	0.017	0.011
Lead	mg/L	0.001				0.002	0.004	0.002	<0.001	0.001	0.012	0.006	0.002	<0.001
Manganese	mg/L	0.001				0.017	0.013	0.023	0.011	0.01	0.02	0.021	0.026	0.017
Molybdenum	mg/L	0.001				0.036	0.037	0.036	0.035	0.035	0.035	0.036	0.037	0.036
Zinc	mg/L	0.005				0.119	0.115	0.094	0.025	0.025	0.05	0.105	0.096	0.052
Nickel	mg/L	0.001				0.004	0.004	0.002	<0.001	<0.001	<0.001	0.002	0.002	0.002
Selenium	mg/L	0.01				0.06	0.06	0.06	0.05	0.05	0.06	0.05	0.06	0.04
Zinc	mg/L	0.005				0.119	0.115	0.094	0.025	0.025	0.05	0.105	0.096	0.052
Tungsten	mg/L	0.001				0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Free Cyanide	mg/L	0.004	0.08	0.007		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Total Cyanide	mg/L	0.004				0.007	0.005	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
WAD Cyanide	mg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Fluoride	mg/L	0.1	1.5		2	**2.1**	**2**	**2.3**	**2.3**	**2.4**	**2.5**	**2.2**	**2.6**	**2.4**
Ionic Balance														
Total Anions	meq/L	0.01				57.1	58.6	64	63.4	64.1	64.8	64.4	64.9	63.1
Total Cations	meq/L	0.01				58	60.3	66.2	63.4	64.5	62.3	65.5	66	62.8
Ionic Balance	%	0.01				0.8	1.41	1.72	0.02	0.3	1.93	0.86	0.88	0.23

Job number: 722092 **Location:** Tick Hill **Client:** Carnaby Resources

Sample Date:	Units	LOR	Human Health Criteria	Ecological Criteria	Stock watering	09/06/2021	28/07/2021	10/10/2021	01/12/2021	17/12/2021	09/02/2022
Sample ID			Drinking water	95% species protection		Mine Shaft	Mine Shaft	Mine Shaft	Mine Shaft	Mine Shaft	Mine Shaft
pH Value	pH Unit	0.01	6.5 - 8.5			**8.8**	**9.54**	**8.88**	**8.65**	**8.85**	**8.85**
EC	µS/cm	1				2130	2240	2160	2190	2060	2050
TDS	mg/L	1	600		4000	**1380**	**1460**	**1400**	**1420**	**1340**	**1330**
Total Hardness as CaCO3	mg/L	1				348	356	320	344	346	325
Hydroxide Alkalinity	mg/L	1				<1	<1	<1	<1	<1	<1
Carbonate Alkalinity	mg/L	1				39	193	60	32	56	61
Bicarbonate Alkalinity	mg/L	1				313	246	278	274	304	314
Total Alkalinity	mg/L	1				352	440	338	305	360	375
Sulfate as SO4	mg/L	1	500		1000	119	120	129	139	116	124
Chloride	mg/L	1	250			**469**	**461**	**450**	**436**	**446**	**461**
Calcium	mg/L	1			1000	9	9	6	9	5	5
Magnesium	mg/L	1			600	79	81	74	78	81	76
Sodium	mg/L	1				335	385	325	337	329	325
Potassium	mg/L	1				14	13	12	12	13	12
Dissolved Metals											
Aluminium	mg/L	0.01		0.055	5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony	mg/L	0.001	0.003	0.009		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	0.01	0.024	0.5	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0001	0.002	0.003	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	0.05	0.01	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	0.06			0.014	0.011	0.023	0.022	0.04	0.023
Copper	mg/L	0.001	2	0.0014	0.5	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	mg/L	0.001	0.01	0.148	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	0.5	1.9	10	0.004	<0.001	<0.001	0.028	0.001	<0.001
Molybdenum	mg/L	0.001	0.05		0.15	0.002	0.002	<0.001	0.002	0.002	0.004
Nickel	mg/L	0.001	0.02	0.125	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	mg/L	0.01	0.01	0.011	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005	3	0.091	20	0.009	<0.005	<0.005	<0.005	<0.005	<0.005
Tungsten	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total Metals											
Aluminium	mg/L	0.01				0.21	0.19	0.02	0.02	0.03	0.09
Antimony	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0001				<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001				0.034	0.032	0.035	0.035	0.034	0.03
Copper	mg/L	0.001				0.005	0.002	<0.001	<0.001	<0.001	0.002
Lead	mg/L	0.001				<0.001	<0.001	0.001	0.014	<0.001	0.002
Manganese	mg/L	0.001				0.024	0.084	0.01	0.037	0.029	0.014
Molybdenum	mg/L	0.001				0.002	0.002	0.002	0.002	0.002	0.002
Zinc	mg/L	0.005				0.025	0.01	<0.005	<0.005	<0.005	0.009
Nickel	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Selenium	mg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005				0.025	0.01	<0.005	<0.005	<0.005	0.009
Tungsten	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Free Cyanide	mg/L	0.004	0.08	0.007		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Total Cyanide	mg/L	0.004				0.022	0.024	0.02	0.02	0.019	0.016
WAD Cyanide	mg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Fluoride	mg/L	0.1	1.5		2	1.2	1.4	1.3	1.4	1.4	1.4
Ionic Balance											
Total Anions	meq/L	0.01				22.7	24.3	22.1	21.3	22.2	23.1
Total Cations	meq/L	0.01				21.9	24.2	20.8	21.8	21.6	20.9
Ionic Balance	%	0.01				1.93	0.2	3.02	1.27	1.44	4.84

Job number: 722092 **Location:** Tick Hill **Client:** Carnaby Resources

Sample Location			Human Health Criteria	Ecological Criteria	Stock watering	VoidShallow	VoidShallow	VoidShallow	Void deep	VoidShallow
Sampling Date			Drinking water	95% species protection		15/03/2012	28/06/2012	18/10/2017	22/06/2020	22/06/2020
pH Value	pH Unit	0.01	6.5 - 8.5			8.34	8.31	**8.62**	**8.52**	8.47
EC	µS/cm	1				4720	4790	5790	5800	5800
TDS	mg/L		600		4000	**2680**	**3280**	**3360**	**3770**	**3770**
Hydroxide Alkalinity	mg/L	1				<1	<1	<1	<1	<1
Carbonate Alkalinity	mg/L	1				11	5	45	32	30
Bicarbonate Alkalinity	mg/L	1				318	331	300	293	293
Total Alkalinity	mg/L	1				329	337	345	325	323
Sulfate	mg/L	1	500		1000	392	373	412	452	474
Chloride	mg/L	1	250			**1010**	**1080**	**1380**	**1460**	**1500**
Calcium	mg/L	1			1000	49	51	41	45	43
Magnesium	mg/L	1			600	167	175	205	209	220
Sodium	mg/L	1				751	720	897	873	907
Potassium	mg/L	1				20	26	23	23	24
Total Hardness	mg/L	1				810	848	946	973	1010
Dissolved Metals by ICP-MS										
Aluminium	mg/L	0.01		0.055	5				<0.01	<0.01
Antimony	mg/L	0.001	0.003	0.009					<0.001	<0.001
Arsenic	mg/L	0.001	0.01	0.024	0.5				0.006	0.006
Cadmium	mg/L	0.0001	0.002	0.003	0.01				<0.0001	<0.0001
Chromium	mg/L	0.001	0.05	0.01	1				<0.001	<0.001
Cobalt	mg/L	0.001	0.06						0.013	0.012
Copper	mg/L	0.001	2	0.0014	0.5				0.001	0.004
Lead	mg/L	0.001	0.01	0.148	0.1				<0.001	<0.001
Manganese	mg/L	0.001	0.5	1.9	10				<0.001	<0.001
Molybdenum	mg/L	0.001	0.05		0.15				0.032	0.029
Nickel	mg/L	0.001	0.02	0.125	1				<0.001	<0.001
Selenium	mg/L	0.01	0.01	0.011	0.02				**0.06**	**0.06**
Zinc	mg/L	0.005	3	0.091	20				0.02	0.028
Tungsten	mg/L	0.001							0.002	0.002
Total Metals by ICP-MS										
Aluminium	mg/L	0.01				0.08	0.07	<0.01	1.74	1.37
Antimony	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001				0.007	0.006	0.005	0.008	0.008
Cadmium	mg/L	0.0001				0.0004	0.0006	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001				<0.001	0.002	<0.001	0.006	0.005
Cobalt	mg/L	0.001					0.069	0.011	0.018	0.018
Copper	mg/L	0.001				0.07	0.082	<0.001	0.048	0.054
Lead	mg/L	0.001				0.071	0.003	<0.001	0.002	0.004
Manganese	mg/L	0.001				0.014	0.028	<0.001	0.017	0.013
Molybdenum	mg/L	0.001				0.025	0.027	0.031	0.036	0.037
Nickel	mg/L	0.001				0.031	0.034	<0.001	0.004	0.004
Selenium	mg/L	0.01				0.06	0.08	0.06	0.06	0.06
Zinc	mg/L	0.005					<0.005	0.009	0.119	0.115
Free Cyanide	mg/L	0.004	0.08	0.007					<0.004	<0.004
Total Cyanide	mg/L	0.004				<0.004	<0.004	<0.004	0.007	0.005
WAD Cyanide	mg/L								<0.004	<0.004
Fluoride	mg/L	0.1	1.5		2	**2.2**	**2.1**	**2.2**	**2.1**	**2**

Job number: 722092 **Location:** Tick Hill **Client:** Carnaby Resources

Analyte			THGW001	THGW001	THGW001	THGW001	THGW001	THGW001	THGW002	THGW002	THGW002	THGW002	THGW002	THGW002
	units	LOR	30/04/2012	1/08/2013	3/10/2014	29/05/2015	4/05/2016	15/05/2017	30/04/2012	1/08/2013	3/10/2014	29/05/2015	4/05/2016	15/05/2017
pH		0.01	8.14	7.87	8.11	7.84	7.81	8.41	8.22	7.9	8.44	7.93	7.9	8.43
Electrical Conductivity	µS/cm	1	2610	2680	2990	3160	3180	3230	1510	1450	1540	1570	1490	1420
TDS	mg/L	10	1510						972					
Total Hardness as CaCO3	mg/L	1	604	642	654	623	738	790	350	348	344	308	334	328
Hydroxide Alkalinity as CaCO3	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate alkalinity as CaCO3	mg/L	1	<1	<1	<1	<1	<1	44	<1	<1	27	<1	<1	29
Bicarbonate alkalinity as CaCO3	mg/L	1	692	739	771	782	711	724	631	558	514	503	490	445
Total alkalinity as CaCO3	mg/L	1	692	739	771	782	711	769	631	558	541	503	490	474
Sulfate as SO4	mg/L	1	131	116	135	160	163	160	<1	35	51	77	61	43
Chloride	mg/L	1	390	515	475	541	581	590	120	175	171	172	180	166
Sulfate: Chloride ratio			0.34	0.23	0.28	0.3	0.28	0.27	0.004	0.2	0.3	0.45	0.34	0.26
Calcium	mg/L	1	49	51	51	50	50	56	38	37	37	36	33	34
Magnesium	mg/L	1	117	125	128	121	149	158	62	62	61	53	61	59
Potassium	mg/L	1	6	6	7	7	8	8	6	6	6	6	6	6
Sodium	mg/L	1	382	391	424	369	441	452	212	209	219	183	206	200
Cyanide(Total)	mg/L	0.004	0.209	0.202	0.269	0.372	0.336	0.486	0.006	0.004	0.04	0.004	<0.004	<0.004
Dissolved metals														
Aluminium	µg/L	10	20	10	10	10			10	10	10	10		
Antimony	µg/L	1	<1	<1	<1	<1			<1	<1	<1	<1		
Arsenic	µg/L	1	<1	<1	<1	<1	<1	<1	<1	3	2	4	<1	<1
Boron	µg/L	50	160	230	190	130			150	210	200	160		
Cadmium	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<0.1
Chromium	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cobalt	µg/L	1	250	314	315	336			2	1	1	1		
Copper	µg/L	1	5	1	1	5	<1	2	1	1	1	1	<1	<1
Lead	µg/L	1	<1	4	5	25	<1	11	2	4	<1	3	<1	2
Manganese	µg/L	1	1	1	1	1			62	46	40	17		
Molybdenum	µg/L	1	1	1	1	1			1	2	2	2		
Nickel	µg/L	1	<1	<1	<1	<1	20	2	<1	<1	<1	<1	16.1	<1
Selenium	µg/L	10	<10	10	10	10			<10	10	10	10		
Zinc	µg/L	5	9	<5	8	18	<5		<5	<5	<5	<5	<5	<5
Fluoride	mg/L	0.1	3	2.7	2	2.8	2.4	2.9	2.4	2	1.5	1.8	1.5	1.7
Total metals														
Aluminium	µg/L	10	30		380	2980			20		140	1060		
Antimony	µg/L	1	<1		<1	<1			<1		<1	<1		
Arsenic	µg/L	1	1		<1	49	1	<1	<1		2	12	<1	<1
Boron	µg/L	50	160		300	220			110		250	230		
Cadmium	µg/L	0.1	<0.1		<0.1	2	<0.1	<1	<0.1		<0.1	0.4	<0.1	<0.1
Chromium	µg/L	1	3		<1	6	1	2	<1		<1	2	1	<1
Cobalt	µg/L	1	312		333	402			2		1	3		
Copper	µg/L	1	7		6	2000	<1	4	<1		5	327	1	2
Lead	µg/L	1	<1		8	429	<0.1	8	1		5	52	1470	6
Manganese	µg/L	1	4		24	73			64		48	44		
Molybdenum	µg/L	1	2		<1	2			<1		2	3		
Nickel	µg/L	1	2		2	5	18	4	<1		<1	<1	23	2
Selenium	µg/L	10	<10		<10	<10			<10		<10	<10		
Zinc	µg/L	5	12		13	103	7	6	<5		<5	21	7	<5
Mercury	µg/L	0.1	0.1		0.2	0.8	0.2	0.8	<0.1		<0.1	<0.1	0.1	<0.1
Chromium VI	mg/L	0.001	0.003	<0.001					<0.001	<0.001				

Job number: 722092
Location: Tick Hill
Client: Carnaby Resources

Table 38: Historical surface water monitoring results

Sample ID	Units	LOR	Human Health Criteria	Ecological Criteria	Stock watering	THPC01	THPC01_1	THSW01	THSW01_2	THSW02	THSW02_3	THSWR01	THSWR01_4
Sample Location			Drinking water	95% species protection		Downstream	Downstream	WRD Ck	WRD Ck	TSF Ck	TSF Ck	Ref Ck	Ref Ck
Date						5/04/2015	6/03/2018	5/04/2015	6/03/2018	5/04/2015	6/03/2018	5/04/2015	6/03/2018
pH Value	pHUnit	0.01	6.5 - 8.5			7.41	7.07	7.11	7.19	7.1	6.79	7.18	6.78
Electrical Conductivity	µS/cm	1				158	99	245	144	84	44	52	56
Suspended Solids (SS)	mg/L	5				90	5990	137	575	40	962	210	3910
Turbidity	NTU	0.1				70.8	2640	113	775	40.6	921	498	3640
Hydroxide Alkalinity	mg/L	1				<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity	mg/L	1				<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity	mg/L	1				75	67	106	63	10	22	13	30
Total Alkalinity as CaCO3	mg/L	1				75	67	106	63	10	22	13	30
Sulfate	mg/L	1	500		1000	2	<1	3	2	2	<1	2	1
Chloride	mg/L	1	250			2	1	6	2	2	1	1	<1
Calcium	mg/L	1			1000	15	12	11	4	4	2	3	3
Magnesium	mg/L	1			600	5	3	4	2	2	<1	1	2
Sodium	mg/L	1				3	2	5	1	3	<1	2	<1
Potassium	mg/L	1				6	3	16	10	9	5	4	5
Total Hardness as CaCO3	mg/L	1				58	42	44	18	18	5	12	16
Dissolved metals													
Aluminium	mg/L	0.01		0.055	5	<0.01	0.03	<0.01	0.02	0.02	0.1	0.39	0.05
Antimony	mg/L	0.001	0.003	0.009		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	0.01	0.024	0.5	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Beryllium	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0001	0.002	0.003	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	0.05	0.01	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	0.06			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	2	0.0014	0.5	<0.001	<0.001	0.003	0.002	0.001	0.002	0.001	0.001
Lead	mg/L	0.001	0.01	0.148	0.1	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	0.5	1.9	10	0.006	0.055	0.002	<0.001	<0.001	0.002	<0.001	<0.001
Molybdenum	mg/L	0.001	0.05		0.15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.001	0.02	0.125	1	<0.001	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	mg/L	0.01	0.01	0.011	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	0.1	0.00005		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	mg/L	0.001	0.017			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	mg/L	0.01	0.036			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005	3	0.091	20	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Boron	mg/L	0.05	4	0.37		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury	mg/L	0.0001	0.001	0.00006		<0.0001		<0.0001		<0.0001		<0.0001	
Total Metals													
Aluminium	mg/L	0.01				0.92	61	2.16	17.6	0.34	22.1	9.37	65.2
Antimony	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001				<0.001	0.002	0.002	0.001	<0.001	0.002	<0.001	0.003
Beryllium	mg/L	0.001				<0.001	0.004	<0.001	<0.001	<0.001	0.002	<0.001	0.005
Boron	mg/L	0.05				<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	mg/L	0.0001				<0.0001	0.0002	0.0001	0.0001	<0.0001	0.0002	<0.0001	0.0003
Chromium	mg/L	0.001				0.002	0.089	0.004	0.026	<0.001	0.049	0.014	0.115
Cobalt	mg/L	0.001				0.001	0.056	0.008	0.017	<0.001	0.016	0.002	0.074
Copper	mg/L	0.001				0.003	0.087	0.01	0.038	0.003	0.047	0.007	0.111
Lead	mg/L	0.001				<0.001	0.026	0.039	0.011	<0.001	0.017	0.012	0.033
Manganese	mg/L	0.001				0.069	1.63	0.372	0.448	0.009	0.345	0.038	1.75
Mercury	mg/L	0.0001				<0.0001		<0.0001		<0.0001		<0.0001	<0.001
Molybdenum	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.001				0.002	0.064	0.005	0.021	0.001	0.024	0.006	0.086
Selenium	mg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	mg/L	0.001				<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Vanadium	mg/L	0.01				<0.01	0.18	0.02	0.1	<0.01	0.1	0.03	0.19
Zinc	mg/L	0.005				0.005	0.115	0.087	0.062	<0.005	0.051	0.013	0.088
Total Cyanide	mg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Fluoride	mg/L	0.1	1.5		2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	<0.1
Ammonia as N	mg/L	0.01	0.5	0.9		**1.56**	0.2	**9.89**	**8.11**	0.04	0.43	0.07	0.04
Total Phosphorus	mg/L	0.01				0.18	1.92	2.63	1.37	0.12	0.66	0.28	2.54
Sulfide as S2-	mg/L	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

APPENDIX A: ENVIRONMENTAL AUTHORITY

Permit

Environmental Protection Act 1994

Environmental authority EPML00820613

This DRAFT environmental authority is issued by the administering authority under Chapter 5 of the Environmental Protection Act 1994.

Environmental authority number: EPML00820613

Environmental authority takes effect on

The anniversary date of this environmental authority is 5 April each year.

Environmental authority holder(s)

Name(s)	Registered address
Carnaby Resources (Holdings) Pty Ltd	Office 1 Level 2 16 Ord St WEST PERTH WA 6005 Australia

Environmentally relevant activity and location details

Environmentally relevant activity/activities	Location(s)
Resource Activity, Schedule 3, 21: A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20	ML7097
Resource Activity, Schedule 3, 21: A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20	ML7094
Resource Activity, Schedule 3, 21: A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20	ML7096
Ancillary, Schedule 2, 31: Mineral processing 2(a) - Processing, in a year, the following quantities of mineral products, other than coke – 1,000t to 100,000t	ML7094
Ancillary, Schedule 2, 60 – Waste Disposal 2: Operating a facility for disposing of, in a year, the following quantity of waste mentioned in subsection (1)(b)(a) less than 2,000 t.	ML7094

Queensland Government

Additional information for applicants

Environmentally relevant activities

The description of any environmentally relevant activity (ERA) for which an environmental authority (EA) is issued is a restatement of the ERA as defined by legislation at the time the EA is issued. Where there is any inconsistency between that description of an ERA and the conditions stated by an EA as to the scale, intensity or manner of carrying out an ERA, the conditions prevail to the extent of the inconsistency.

An EA authorises the carrying out of an ERA and does not authorise any environmental harm unless a condition stated by the EA specifically authorises environmental harm.

A person carrying out an ERA must also be a registered suitable operator under the *Environmental Protection Act 1994* (EP Act).

Contaminated land

It is a requirement of the EP Act that an owner or occupier of contaminated land give written notice to the administering authority if they become aware of the following:

- the happening of an event involving a hazardous contaminant on the contaminated land (notice must be given within 24 hours); or
- a change in the condition of the contaminated land (notice must be given within 24 hours); or
- a notifiable activity (as defined in Schedule 3) having been carried out, or is being carried out, on the contaminated land (notice must be given within 20 business days)

that is causing, or is reasonably likely to cause, serious or material environmental harm.

For further information, including the form for giving written notice, refer to the Queensland Government website www.qld.gov.au, using the search term 'duty to notify'.

Take effect

Please note that, in accordance with section 200 of the EP Act, an EA has effect:

a) if the authority is for a prescribed ERA and it states that it takes effect on the day nominated by the holder of the authority in a written notice given to the administering authority-on the nominated day; or

b) if the authority states a day or an event for it to take effect-on the stated day or when the stated event happens; or

c) otherwise- one the day the authority is issued.

However, if the EA is authorising an activity that requires an additional authorisation (a relevant tenure for a resource activity, a development permit under the *Planning Act 2016* or an SDA Approval under the *State Development and Public Works Organisation Act 1971*), this EA will not take effect until the additional authorisation has taken effect.

If this EA takes effect when the additional authorisation takes effect, you must provide the administering authority written notice within 5 business days of receiving notification of the related additional authorisation taking effect.

The payment of the annual fee will be due each year on the anniversary day of this environmental authority. An annual return will be due each year on 1 April.

If you have incorrectly claimed that an additional authorisation is not required, carrying out the ERA without the additional authorisation is not legal and could result in your prosecution for providing false or misleading information or operating without a valid environmental authority.

	1 April 2022
Signature	Date

Teale Gibbs
Department of Environment and Science
Delegate of the administering authority
Environmental Protection Act 1994

Enquiries:
Minerals Business Centre
Department of Environment and Science
Telephone: 07 4222 5352
Email: ESCairns@des.qld.gov.au

Obligations under the *Environmental Protection Act 1994*

In addition to the requirements found in the conditions of this environmental authority, the holder must also meet their obligations under the EP Act, and the regulations made under the EP Act. For example, the holder must comply with the following provisions of the Act:

- general environmental duty (section 319)
- duty to notify environmental harm (section 320-320G)
- offence of causing serious or material environmental harm (sections 437-439)
- offence of causing environmental nuisance (section 440)
- offence of depositing prescribed water contaminants in waters and related matters (section 440ZG)
- offence to place contaminant where environmental harm or nuisance may be caused (section 443)

Other permits required

This permit only provides an approval under the *Environmental Protection Act 1994*. In order to lawfully operate you may also require permits / approvals from your local government authority, other business units within the department and other State Government agencies prior to commencing any activity at the site. For example, this may include permits / approvals with your local Council (for planning approval), the Department of Transport and Main Roads (to access state controlled roads), the Department of Natural Resources, Mines and Energy (to clear vegetation), and the Department of Agriculture and Fisheries (to clear marine plants or to obtain a quarry material allocation).

Conditions of environmental authority

Relevant activity: The environmentally relevant activity conducted at the location as described above must be conducted in accordance with the following site specific conditions of approval.

Condition number	Condition
A1	This **environmental authority** authorises **environmental harm** referred to in the conditions. Where there is no condition or this **environmental authority** is silent on a matter, the lack of a condition or silence does not authorise **environmental harm**.
A2	**Contaminants** resulting from the authorised mining activities must not be released to the **receiving environment**.
A3	The **environmental authority** holder will not cause **environmental nuisance** outside the mining lease boundaries.
A4	In carrying out the mining activity authorised by this **environmental authority**, the holder of this **environmental authority** must comply with Schedule A – Table 1 (Authorised Activities).
A5	The holder of this **environmental authority** must: a) Install all measures, plant and equipment necessary to ensure compliance with the conditions of this **environmental authority**; b) Maintain such measures, plant and equipment in a proper and efficient condition; c) Operate such measures, plant and equipment in a proper and efficient manner; and d) Ensure all instruments and devices used for the measurement or monitoring of any parameter under any condition of this **environmental authority** are properly calibrated.
A6	The activities authorised by this **environmental authority** are limited to: a) **Care and maintenance** as defined in the definitions of this **environmental authority**; and b) The reclamation of tailings from the Tailings Storage Facility defined in Schedule A Figure 1a (Project Infrastructure Layout – Mine area) and Schedule A Figure 1b (Project Infrastructure Layout – Support Infrastructure) for processing on site, in accordance with the following criteria: i. a maximum re-disturbance area of 6.5 hectares; ii. processing using **gravity separation** methods only; c) Exploration activities in accordance with condition A15 of this **environmental authority**.
A7	The **environmental authority** holder must ensure that an estimated rehabilitation cost decision is in effect for the activity; and a) a contribution has been paid to the scheme fund in the amount and form required; or b) a surety has been given for the authority in the amount and form required.
A8	Where a change in activities will, or is likely to, increase the maximum amount of disturbance caused by the activity, or the estimated rehabilitation cost for the activity, the holder must re-apply for an estimated rehabilitation cost decision.
A9	The holder of this **environmental authority** must notify the **administering authority** by written notification within twenty-four (24) hours, after becoming aware of any emergency or incident which results in the **release** of **contaminants** not in accordance, or reasonably expected to be not in accordance with the conditions of this **environmental authority**.

A10	Within ten (10) business days following the initial notification of an emergency or incident, or receipt of monitoring results, whichever is the latter, further written advice must be provided to the **administering authority**, including the following: a) Results and interpretation of any samples taken and analysed; b) Outcomes of actions taken at the time to prevent or minimise unlawful **environmental harm**; and c) Proposed actions to prevent a recurrence of the emergency or incident.
A11	The holder of this **environmental authority** must record all environmental complaints received about the mining activities including the following details: a) Name, address and contact number of the complainant; b) Time and date of complaint; c) Reasons for the complaint; d) Investigations undertaken; e) Conclusions formed; f) Actions taken to resolve the complaint; g) Any abatement measures implemented; and h) Person responsible for resolving the complaint.
A12	The holder of this **environmental authority** must, when requested by the **administering authority**, undertake relevant specified monitoring within a reasonable timeframe nominated or agreed to by the **administering authority** to investigate any complaint of **environmental harm**. The results of the investigation (including an analysis and interpretation of the monitoring results) and abatement measures, where implemented, must be provided to the **administering authority** within ten (10) business days of completion of the investigation, or no later than ten (10) business days after the end of the timeframe nominated by the **administering authority** to undertake the investigation.
A13	By 11 October 2021, the holder of this environmental authority must: a) obtain from an appropriately qualified person a report on compliance with the conditions of this environmental authority b) obtain further such reports at regular intervals, not exceeding three yearly intervals, from the completion of the report referred to above c) provide each report to the administering authority within ninety (90) days of its completion.

A14	Where a condition of this **environmental authority** requires compliance with a standard, policy or guideline published externally to this **environmental authority** and the standard is amended or changed subsequent to the issue of this **environmental authority** the holder of this **environmental authority** must: a) Comply with the amended or changed standard within two (2) years of the amendment or change being made, unless a different period is specified in the amended standard or relevant legislation; and b) Until compliance with the amended or changed standard is achieved, continue to remain in compliance with the standard that was current immediately prior to the relevant amendment or change.
A15	All exploration activity carried out on a mining lease listed in this **environmental authority** must comply with the provisions detailed in the **administering authority's** *Code of Environmental Compliance for Exploration and Mineral Development Projects* (*the Code*). Where there is a discrepancy between *the Code* and this **environmental authority**, the conditions of this **environmental authority** apply.
A16	Land disturbance must be rehabilitated in accordance with the most recent edition of the **administering authority's** guideline *Rehabilitation requirements for mining projects.*
A17	All buildings, structures, mining equipment and plant erected and/or used for the mining activities must be removed from the site prior to surrender, except where agreed in writing by the **administering authority** and the landowner.
A18	The environmental authority holder may dispose of up to 15 tonne per year of general waste generated at the mine for mining activities into the waste disposal trench facility located on ML7094 and identified in Schedule A Figure 2 (Latitude 21.642937, Longitude 131.928231).
A19	The environmental authority holder must bury general waste using the following or similar measures: - locate the waste pit so as to ensure that the waste will not contaminate any watercourse, waterway, groundwater, wetland or lake; - divert stormwater runoff from entering the pit; - crush drums and other containers to reduce the volume of waste; - make the pit safe and protect it from scavengers; - backfill the pit when the level of rubbish in the pit is not less than 1m below the surface; and - sufficiently overfill the pit to allow for settlement.
A20	All regulated waste must be removed from the site to a facility that is lawfully able to accept the waste under the *Environmental Protection Act 1994*.
A21	Contaminants that will, or have the potential to cause environmental harm must not be released directly or indirectly to any waters as a result of the authorised mining activities, except as permitted under the conditions of this environmental authority.
A22	All regulated **dams** must be designed, operated, maintained and decommissioned in accordance with the most recent edition of the **administering authority's** guideline *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams.*

A23	The **environmental authority** holder must develop and implement an environmental monitoring program sufficient to demonstrate compliance with the conditions of this **environmental authority** by **1 December 2020** or prior to commencement of reclaimation of tailings activities (whichever comes first).
A24	The environmental monitoring program required by Condition A23 must include quarterly surface water monitoring of the open cut pit and reclaimed TSF footprint for the parameters listed in Table B2.
A25	Except where specified otherwise in another condition of this authority, all monitoring records or reports required by this **environmental authority** must be kept for a period of not less than five (5) years.
A26	The environmental authority holder must ensure analyses and tests required to be conducted under this **environmental authority** are carried out by an **appropriately qualified person** and analysed by a laboratory that has NATA accreditation for such analyses and tests, except as otherwise authorised by the **administering authority.**
A27	**Significant residual impacts** to prescribed environmental matters are not authorised under this environmental authority or the *Environmental Offsets Act 2014*.
A28	Records demonstrating that each impact to a **prescribed environmental matter** did not, or is not likely to, result in a significant residual impact to that matter must be: a) completed by an appropriately qualified person; and b) kept for the life of the **environmental authority**.
B1	The holder of the environmental authority must not directly or indirectly release fuels, oils, lubricants or other contaminants to land.
B2	The holder of the environmental authority must ensure that all chemical, fuel and oil storage facilities less than 10 000L on a mining tenement, must be designed and operated in accordance with Australian Standard 1940 – 'The storage and handling of flammable and combustible liquids', Section 2, Minor Storage.
B3	Contaminants must not be released directly or indirectly to any groundwater.
B4	Groundwater must be monitored: (a) at the locations specified in **Table B1 - Groundwater monitoring locations and frequency**; and (b) at the frequencies specified in **Table B1 - Groundwater monitoring locations and frequency**; and (c) for the quality characteristics identified in **Table B2 - Groundwater contaminant limits** for the aquifer in which the bore is located.
B5	Groundwater measured from any monitoring bore specified in **Table B1 - Groundwater monitoring locations and frequency** must not exceed the corresponding Limit A specified in **Table B2 – Groundwater contaminant limits** on any five (5) consecutive sampling occasions as defined in **Table B1 - Groundwater monitoring locations and frequency.**

B6	Groundwater measured from any monitoring bore specified in **Table B1 - Groundwater monitoring locations and frequency** must not exceed the corresponding Limit B specified in **Table B2 – Groundwater quality limits** on any three consecutive sampling occasions.
Table B1	

Table B1 – Groundwater monitoring locations and frequency

Monitoring Point	Location MGA54		Bore Details	Monitoring Frequency	
	Easting	Northing	Surface RL (m)[1]	Standing Water Level	Groundwater Quality
THGW001	TBA[1] (see Schedule A - Figure 2)	TBA[1] (see Schedule A - Figure 2)	TBA[1]	Quarterly	Quarterly
THGW002	TBA[1] (see Schedule A - Figure 2)	TBA[1] (see Schedule A - Figure 2)	TBA[1]	Quarterly	Quarterly
THGW003	-21.64841841	139.9203194	TBA[1]	Quarterly	Quarterly
THGW004	-21.64085402	139.92961307	TBA[1]	Quarterly	Quarterly
THGW005	-21.65258985	139.92416338	TBA[1]	Quarterly	Quarterly
THGW006	-21.6464215	139.92722393	TBA[1]	Quarterly	Quarterly

[1] TBA to the administering authority by 21 April 2022

Table B2

Table B2 – Groundwater contaminant limits

Parameter	Units	Contaminant Limit	
		Limit A	Limit B
Depth to groundwater	SWL m RL	TBA[1]	TBA[1]
pH	pH units	TBA[1]	TBA[1]
Electrical conductivity	µS/cm	TBA[1]	TBA[1]
Total dissolved solids	mg/L	TBA[1]	TBA[1]
Suspended solids	mg/L	TBA[1]	TBA[1]
Total Hardness (as $CaCo_3$)	mg/L	Interpretation purposes only	
Hydroxide alkalinity (as $CaCo_3$)	mg/L	Interpretation purposes only	
Bicarbonate alkalinity (as $CaCo_3$)	mg/L	Interpretation purposes only	
Total alkalinity (as $CaCo_3$)	mg/L	Interpretation purposes only	
Sulfate (as SO_4)	mg/L	TBA[1]	TBA[1]
Chloride	mg/L	Interpretation purposes only	
Sulfate to Chloride Ratio		Interpretation purposes only	
Calcium	mg/L	Interpretation purposes only	
Magnesium	mg/L	Interpretation purposes only	
Potassium	mg/L	Interpretation purposes only	
Sodium	mg/L	Interpretation purposes only	

	Ionic balance		Interpretation purposes only	
	Aluminium	µg/L	TBA[1]	TBA[1]
	Antimony	µg/L	TBA[1]	TBA[1]
	Arsenic	µg/L	TBA[1]	TBA[1]
	Boron	µg/L	TBA[1]	TBA[1]
	Cadmium	µg/L	TBA[1]	TBA[1]
	Chromium	µg/L	TBA[1]	TBA[1]
	Cobalt	µg/L	TBA[1]	TBA[1]
	Copper	µg/L	TBA[1]	TBA[1]
	Lead	µg/L	TBA[1]	TBA[1]
	Manganese	µg/L	TBA[1]	TBA[1]
	Molybdenum	µg/L	TBA[1]	TBA[1]
	Nickel	µg/L	TBA[1]	TBA[1]
	Selenium	µg/L	TBA[1]	TBA[1]
	Zinc	µg/L	TBA[1]	TBA[1]
	Fluoride	mg/L	TBA[1]	TBA[1]
	Cyanide (Total)	mg/L	TBA[1]	TBA[1]
	Cyanide (Free)	mg/L	TBA[1]	TBA[1]
	Cyanide (WAD)	mg/L	TBA[1]	TBA[1]
	Ammonia	mg/L	TBA[1]	TBA[1]
	Total nitrogen	mg/L	TBA[1]	TBA[1]
	Nitrate	mg/L	TBA[1]	TBA[1]
	Nitrite	mg/L	TBA[1]	TBA[1]
	[1] TBA means to be advised by means of an EA amendment application made by the environmental authority holder to the administering authority by 21 April 2022 and calculated in accordance with the methodology outlined in the DSITI guideline “Using monitoring data to assess groundwater quality an potential environmental impacts, March 2017, Version 1”.			
B7	If groundwater measured from any bore specified in T**able B1 - Groundwater monitoring locations and frequency** exceeds the corresponding Limit specified in **Table B2 – Groundwater contaminant limits** on any one (1) sampling occasion the environmental authority holder must resample the groundwater within the compliance bore for all exceeding parameters within 10 business days of receipt of results.			
B8	Monitoring and sampling must be carried out in accordance with the requirements of the latest version of the following documents unless otherwise approved by the administering authority: a) for waters and aquatic environments, the Queensland Government’s Monitoring and Sampling Manual 2009 – Environmental Protection (Water) Policy 2009; and b) for groundwater, Groundwater Sampling and Analysis – A Field Guide (2009:27 GeoCat#6890.1) and Australian Standard AS/NZS 5667.11:1998 Water Quality – Sampling – Guidance on sampling of groundwaters; and c) for subterranean aquatic fauna, the Guideline for the Environmental Assessment of Subterranean Aquatic Fauna.			

B9	The consequence category of any structure, including existing structures, must be assessed by a suitably qualified and experienced person in accordance with the Manual for assessing consequence categories and hydraulic performance of structures (ESR/2016/1933 – the Manual) at the following times: a) prior to the commencement of the reclamation activities under condition A6; or b) prior to any change in its purpose or the nature of its stored contents.
B10	The consequence category assessment completed under Condition B9 must be submitted to the administering authority at least 30 days (unless otherwise agreed to a shorter period) prior to the commencement of the activities that triggered the preparation of the consequence category assessment.
B11	All existing structures must comply with the timetable for any further assessments in accordance with Condition B9 and specified in **Table B3 – Transitional hydraulic performance requirements for existing structures**, depending on the consequence category for each existing structure assessed in the most recent previous certification for that structure.
B12	Table B3 ceases to apply for a structure once any of the following events has occurred: a) it has been brought into compliance with the hydraulic performance criteria applicable to the structure under the Manual; or b) it has been decommissioned; or c) it has been certified as no longer being assessed as a regulated structure.

Table B3

Table B3 – Transitional hydraulic performance requirements for existing structures

Transition period required for existing structures to achieve the requirements of the Manual for Assessing Consequence Categories and Hydraulic Performance of Dams			
Compliance with criteria	High consequence	Significant consequence	Low consequence
>90% and a history of good compliance performance in last 5 years	No transition required	No transition required	No transitional conditions apply. Review consequence assessment every 7 years.
>70%-≤90%	Within 7 years, unless otherwise agreed with the administering authority, based on no history of unauthorised releases.	Within 10 years, unless otherwise agreed with the administering authority, based on no history of unauthorised releases.	No transitional conditions apply. Review consequence assessment every 7 years.
>50-≤70%	Within 5 years unless otherwise agreed with the administering authority, based on no history of unauthorised releases.	Within 7 years unless otherwise agreed with the administering authority, based on no history of unauthorised releases.	Review consequence assessment every 7 years.
≤50%	Within 5 years or as per compliance requirements (e.g. TEP timing)	Within 5 years or as per compliance requirements (e.g. TEP timing).	Review consequence assessment every 5 years.
Regulated levee designed to prevent the ingress of clean flood water <100% compliant	Within 5 years unless otherwise agreed with the administering authority.		

B13

Certification of the transitional assessment required by condition B11 (as applicable) must be provided to the administering authority by 4 October 2022.

Definitions

Key terms and/or phrases used in this document are defined in this section. Where a term is not defined, the definition in the *Environmental Protection Act 1994*, its regulations or environmental protection policies must be used. If a word remains undefined it has its ordinary meaning.

"administering authority" means the Department of Environment and Resource Management or its successor.

"appropriately qualified person" means a person who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis on performance relative to the subject matter using the relevant protocols, standards, methods or literature.

"care and maintenance" means a mining project where production has ceased (whether temporary or permanent) and the mining activity is limited to maintenance of mine infrastructure, rehabilitation and any other environmental management of significantly disturbed land.

"consecutive sampling occasions" means successive sampling events and includes resampling of groundwaters that is required under condition B7.

"contaminant" has the same meaning given in section 10 of the *Environmental Protection Act 1994*.

"dam" means a land-based structure or a void that is designed to contain, divert or control flowable substances, and includes any substances that are thereby contained, diverted or controlled by that land-based structure or void and associated works. However; a dam does *not* mean a fabricated or manufactured tank or container designed to a recognised standard, *nor* does a dam mean a land-based structure where that structure is designed to an Australian Standard. In case there is any doubt, a levee (dyke or bund) is a dam, but (for example) a bund designed for spill containment to AS1940 is *not* a dam.

"environmental authority" means an environmental authority granted in relation to an environmentally relevant activity under the *Environmental Protection Act 1994*.

"environmental harm" has the same meaning given in section 14 of the *Environmental Protection Act 1994*.

"environmental nuisance" has the same meaning given in section 15 of the *Environmental Protection Act 1994*.

"**existing structure**" means a structure that prior to the issue of this environmental authority meets any or both of the following, a structure:

(a) with a design that is in accordance with the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (ESR/2016/1933) and that is considerably in progress;

(b) that is under considerable construction or that is constructed.

"flowable substance" means matter or a mixture of materials which can flow under any conditions potentially affecting that substance. Constituents of a flowable substance can include water, other liquids fluids or solids, or a mixture that includes water and any other liquids fluids or solids either in solution or suspension.

"**gravity separation**" means mineral processing that excludes the use of any reagent such as cyanide and onsite heavy metal processing such as refining and smelting.

"hazard" in relation to a dam as defined, means the potential for environmental harm resulting from the collapse or failure of the dam to perform its primary purpose of containing, diverting or controlling flowable substances.

“hazard category” means a category, either low significant or high, into which a dam is assessed as a result of the application of tables and other criteria in “Manual for Assessing Hazard Categories and Hydraulic Performance of Dams”, prepared by the Department of Environment and Resource Management, as amended from time to time.

‘**prescribed environmental matters’** has the meaning in section 10 of *the Environmental Offsets Act 2014*, limited to the matters of State environmental significant listed in schedule 2 of the *Environmental Offsets Regulation 2014.*

"regulated dam" means any dam in the significant or high hazard category as assessed using the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams* published by the administering authority.

“receiving environment” in relation to an activity that causes or may cause environmental harm, means the part of the environment to which the harm is, or may be, caused. The receiving environment includes (but is not limited to):

(a) a watercourse;
(b) groundwater; and
(c) an area that is not specified in Schedule A – Table 1 (Authorised Activities)of this environmental authority

“release” in relation to release of a contaminant to the receiving environment has the same meaning given in Schedule 4 of the *Environmental Protection Act 1994*.

‘**significant residual impact’** has meaning in section 8 of the *Environmental Offsets Act 2014.*

"watercourse" has the same meaning given in the *Water Act 2000*.

“waters” Includes river, stream, lake, lagoon, pond, swamp, wetland, unconfined surface water, unconfined water in natural or artificial watercourses, bed and bank of any waters, dams, non-tidal or tidal waters (including the sea), stormwater channel, stormwater drain, roadside gutter, stormwater run-off, and groundwater or any part-thereof**.**

Schedule A – Tables and maps

Schedule A – Table 1 (Authorised Activities)

Mine Feature Name	Location (GDA94 Zone 54)		Maximum Disturbance Area (hectares)
	Easting	Northing	
Waste rock dump	389044	7606382	6.9
	389279	7606423	
	389290	7606376	
	389333	7606355	
	389247	7606163	
	388978	7606151	
Tailings dam (including decant ponds)	388396	7605918	10.89
	388606	7605918	
	388604	7605746	
	388660	7605685	
	388772	7605685	
	388779	7605470	
	388580	7605316	
	388371	7605437	
	388364	7605671	
	388394	7605704	
Tailings dam reclamation area (part of the 17.4 ha of Tailings Dam)	388595	7605627	6.51
	388761	7605632	
	388772	7605459	
	388592	7605352	
	388413	7605457	
	388411	7605539	
	388592	7605534	
Open Pit	388831	7606053	3
	388904	7606021	
	388920	7605964	
	388859	7605828	
	388808	7605807	
	388772	7605828	
	388744	7605869	
	388743	7605947	
	388775	7606011	
Infrastructure (including processing plant area)	388826	7605717	6.66
	389012	7605723	
	389010	7605361	
	388818	7605356	
Borrow pit (part of infrastructure)	TBA	TBA	0.24
Access tracks	Not applicable	Not applicable	2.0

Mine Feature Name	Location (GDA94 Zone 54)		Maximum Disturbance Area (hectares)
	Easting	Northing	
Borrow pits	Not applicable	Not applicable	13.9
Exploration	Not applicable	Not applicable	Less than 1

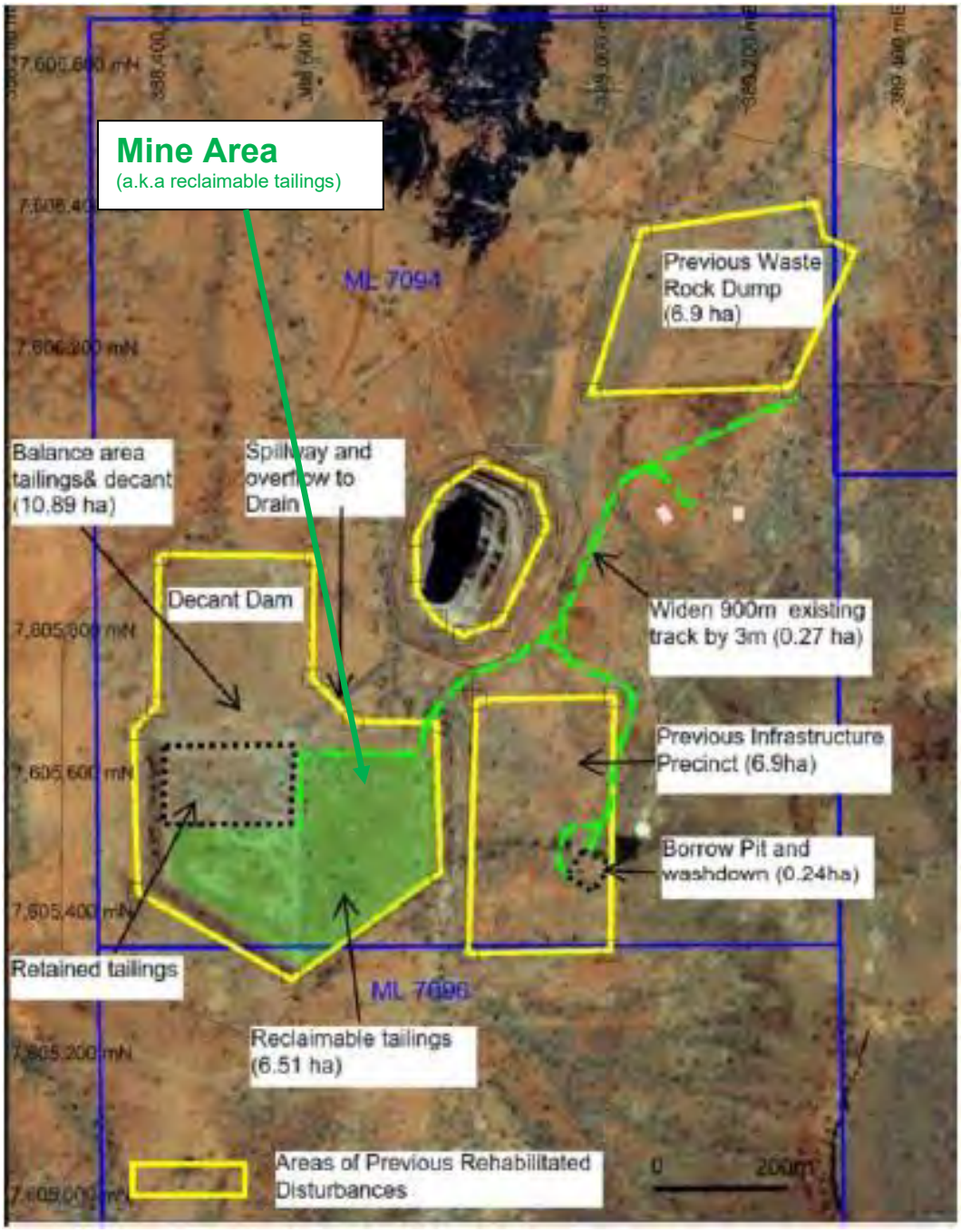


Figure 1a: Project Infrastructure Layout – Mine area

Figure 1b: Project Infrastructure Layout – Supporting Infrastructure

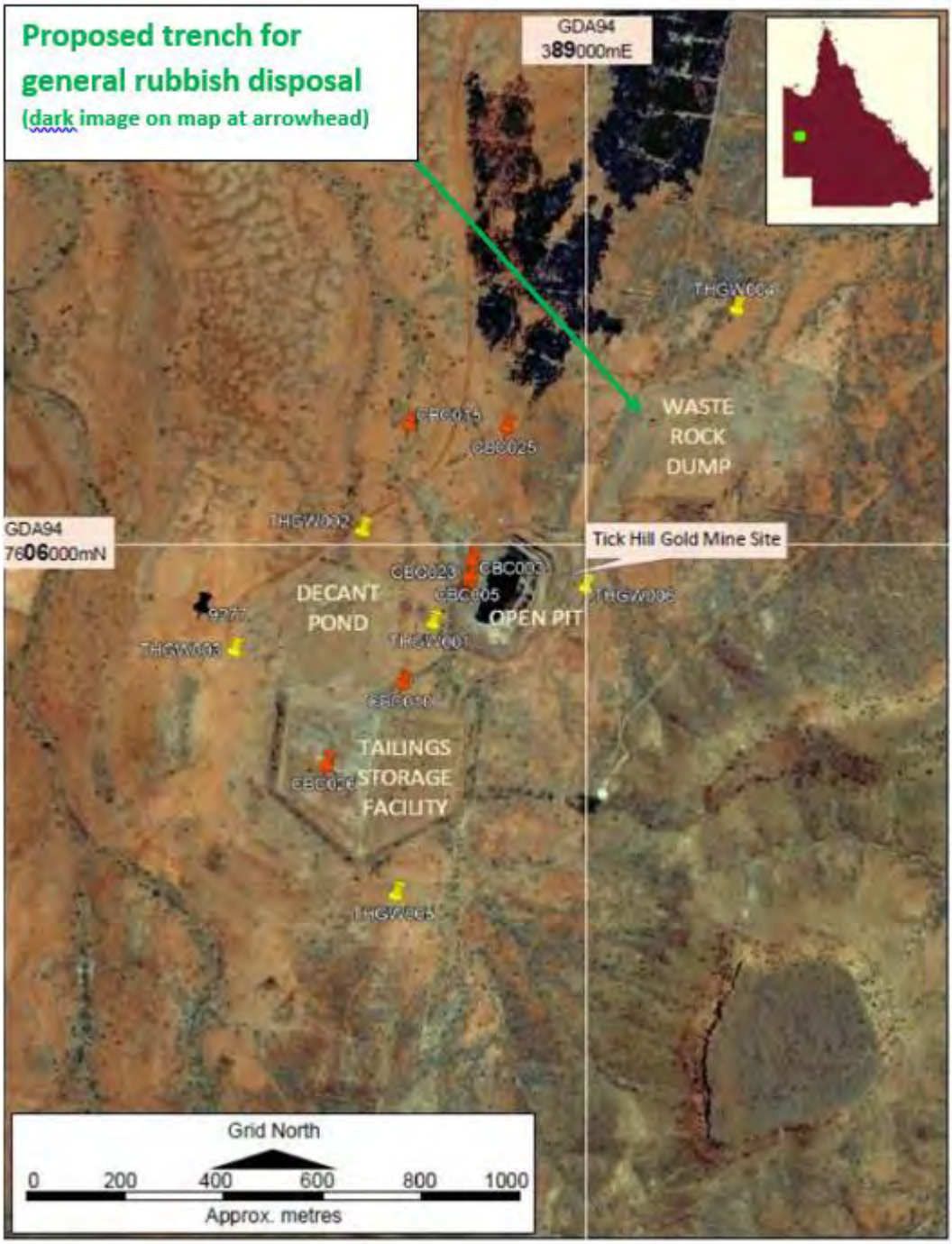
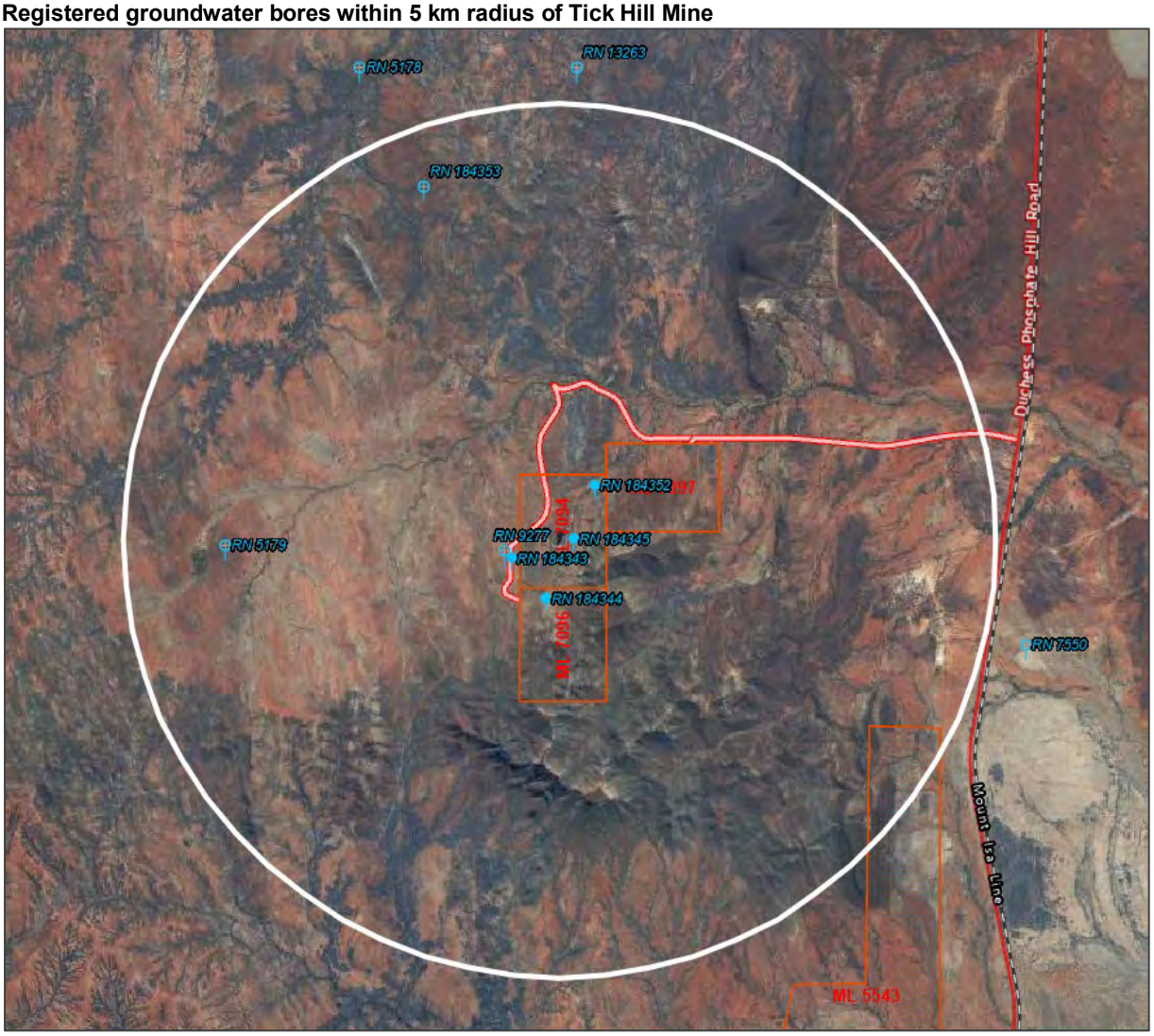


Figure 2: Groundwater monitoring locations (shown in yellow) and trench for waste disposal (green).

END OF ENVIRONMENTAL AUTHORITY

APPENDIX B: REGISTERED GROUNDWATER BORES

Registered groundwater bores within 5 km radius of Tick Hill Mine



Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
5179	Sub-Artesian Facility	Abandoned and Destroyed		Longreach	2450 - CLONCURRY

Details

Description	STANBROKE HLD		
Parish	4310 - STANBROKE		
Original Name			
Driller Name			
Drill Company			
Const Method			
Bore Line			
D/O File No	17/10/S/3	**Polygon**	
R/O File No		**Equipment**	
H/O File No	L2672B	**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles			

Location

Latitude	21-38-50	**Basin**	0012
Longitude	139-53-18	**Sub-area**	
GIS Latitude	-21.647101511	**Lot**	
GIS Longitude	139.88841749	**Plan**	
Easting	384981		
Northing	7605806	**Map Scale**	254 - 1: 250 000
Zone	54	**Map Series**	M - Metric Series
Accuracy		**Map No**	SF54-6
GPS Accuracy		**Map Name**	DUCHESS
Checked	No	**Prog Section**	

Casing

0 ***records for RN*** **5179**

Strata Logs

0 ***records for RN*** **5179**

Stratigraphies

0 ***records for RN*** **5179**

Aquifers

0 ***records for RN*** **5179**

Pump Tests Part 1

0 ***records for RN*** **5179**

Pump Tests Part 2

0 ***records for RN*** **5179**

Bore Report

From Year:

Bore Conditions	**0**	*records for RN*	**5179**
Elevations	**0**	*records for RN*	**5179**
Water Analysis Part 1	**0**	*records for RN*	**5179**
Water Analysis Part 2	**0**	*records for RN*	**5179**
Water Levels	**0**	*records for RN*	**5179**
Wire Line Logs	**0**	*records for RN*	**5179**
Field Measurements	**0**	*records for RN*	**5179**
Special Water Analysis	**0**	*records for RN*	**5179**

Bore Report

From Year:

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Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
7550	Sub-Artesian Facility	Abandoned and Destroyed	01/01/1920	Longreach	2450 - CLONCURRY

Details

Description	CHATSWORTH HOLDING		
Parish	4428 - TALPIN		
Original Name	PRICKLEY BUSH BORE		
Driller Name			
Drill Company			
Const Method	CABLE TOOL		
Bore Line			
D/O File No	17/10/C/02	**Polygon**	
R/O File No	17/10/C/02	**Equipment**	WL
H/O File No	L03461B	**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles			

Location

Latitude	21-39-27	**Basin**	0012
Longitude	139-58-39	**Sub-area**	
GIS Latitude	-21.657378473	**Lot**	
GIS Longitude	139.977583743	**Plan**	
Easting	394212		
Northing	7604740	**Map Scale**	254 - 1: 250 000
Zone	54	**Map Series**	M - Metric Series
Accuracy		**Map No**	SF54-6
GPS Accuracy		**Map Name**	DUCHESS
Checked	No	**Prog Section**	

Casing

3 ***records for RN*** **7550**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	01/01/1920	1	0.00	5.10	Steel Casing		WT - Wall Thickness	203
A	01/01/1920	2		64.90	Steel Casing		WT - Wall Thickness	152
A	01/01/1920	3	68.00	68.00	Open End			

Strata Logs

2 ***records for RN*** **7550**

Bore Report

From Year:

Rec	Top (m)	Bottom (m)	Strata Description
902			00/00/1920 SWL -30.50 M TMP NUL C
903			00/00/1920 DISCH 163.8 M3D ESTIMAT

Stratigraphies

1 *records for RN* 7550

Source	Rec	Top (m)	Bottom (m)	Strata Description
DNR	1	0.00	67.10	INCA FORMATION

Aquifers

1 *records for RN* 7550

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	0.00									XX	INCA FORMATION

Pump Tests Part 1

0 *records for RN* 7550

Pump Tests Part 2

0 *records for RN* 7550

Bore Conditions

0 *records for RN* 7550

Elevations

0 *records for RN* 7550

Water Analysis Part 1

0 *records for RN* 7550

Water Analysis Part 2

0 *records for RN* 7550

Water Levels

1 *records for RN* 7550

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project	Quality
X	01/01/1920		-30.50	N	Natural Surface		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality

From Year:

Wire Line Logs

0 *records for RN* 7550

Field Measurements

0 *records for RN* 7550

Special Water Analysis

0 *records for RN* 7550

Bore Report

From Year:

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Report Date: 18/05/2023 13:20

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
9277	Sub-Artesian Facility	Abandoned and Destroyed		Longreach	2450 - CLONCURRY

Details

Description	STANBROKE HLD		
Parish	4310 - STANBROKE		
Original Name			
Driller Name			
Drill Company			
Const Method			
Bore Line			
D/O File No	17/10/S/3	**Polygon**	
R/O File No		**Equipment**	
H/O File No	L6784B	**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles			

Location

Latitude	21-38-52	**Basin**	0012
Longitude	139-55-10	**Sub-area**	
GIS Latitude	-21.647656844	**Lot**	
GIS Longitude	139.919528273	**Plan**	
Easting	388181		
Northing	7605791	**Map Scale**	254 - 1: 250 000
Zone	54	**Map Series**	M - Metric Series
Accuracy		**Map No**	SF54-6
GPS Accuracy		**Map Name**	DUCHESS
Checked	No	**Prog Section**	

Casing

0 *records for RN* 9277

Strata Logs

0 *records for RN* 9277

Stratigraphies

0 *records for RN* 9277

Aquifers

0 *records for RN* 9277

Pump Tests Part 1

0 *records for RN* 9277

Pump Tests Part 2

0 *records for RN* 9277

Bore Report

From Year:

Bore Conditions	**0**	*records for RN*	**9277**
Elevations	**0**	*records for RN*	**9277**
Water Analysis Part 1	**0**	*records for RN*	**9277**
Water Analysis Part 2	**0**	*records for RN*	**9277**
Water Levels	**0**	*records for RN*	**9277**
Wire Line Logs	**0**	*records for RN*	**9277**
Field Measurements	**0**	*records for RN*	**9277**
Special Water Analysis	**0**	*records for RN*	**9277**

Bore Report

From Year:

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Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
184343	Sub-Artesian Facility	Existing	11/01/2020	Longreach	2450 - CLONCURRY

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name	THGW003		
Driller Name	HARGRAVE, TREVOR		
Drill Company	AMWD		
Const Method	ROTARY AIR		
Bore Line			
D/O File No		Polygon	
R/O File No		Equipment	
H/O File No		RN of Bore Replaced	
Log Received Date	14/01/2020	Data Owner	
Roles	Mine Monitoring		

Location

Latitude	21-38-54	Basin	0012
Longitude	139-55-13	Sub-area	
GIS Latitude	-21.64841841	Lot	16
GIS Longitude	139.9203194	Plan	CW62
Easting	388277		
Northing	7605699	Map Scale	
Zone	54	Map Series	
Accuracy		Map No	
GPS Accuracy		Map Name	
Checked	Yes	Prog Section	

Casing

7 *records for RN* 184343

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	11/01/2020	1	0.00	40.50	Polyvinyl Chloride	6.000	WT - Wall Thickness	68
A	11/01/2020	2	28.00	40.00	Screen	1.000	AP - Aperture Size	68
X	11/01/2020	3	0.00	5.50	Polyvinyl Chloride	7.000	WT - Wall Thickness	168
X	11/01/2020	4	0.00	6.10	Grout			155
X	11/01/2020	5	6.10	25.00	Cuttings or other fill between casing and hole wall			133

Bore Report

From Year:

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	11/01/2020	6	25.00	26.70	Bentonite Seal			133
X	11/01/2020	7	26.70	40.50	Gravel Pack			133

Strata Logs

4 *records for RN* **184343**

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.00	TOPSOIL
2	1.00	30.00	GRANITE
3	30.00	32.00	FRACTURED GRANITE
4	32.00	40.50	GRANITE

Stratigraphies

0 *records for RN* **184343**

Aquifers

1 *records for RN* **184343**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	30.00	32.00	GNTE - Acid Intrusive, Granite	11/01/2020	-18.70	N	POTABLE		Y	FR	CORELLA FORMATION

Pump Tests Part 1

0 *records for RN* **184343**

Pump Tests Part 2

0 *records for RN* **184343**

Bore Conditions

0 *records for RN* **184343**

Elevations

0 *records for RN* **184343**

Water Analysis Part 1

0 *records for RN* **184343**

Bore Report

From Year:

Water Analysis Part 2

0 *records for RN* **184343**

Water Levels

0 *records for RN* **184343**

Wire Line Logs

0 *records for RN* **184343**

Field Measurements

1 *records for RN* **184343**

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
A	11/01/2020		950	8.5						AI	Air Lifting	GB	Groundwater - from Bore

Special Water Analysis

0 *records for RN* **184343**

Bore Report

From Year:

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Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
184344	Sub-Artesian Facility	Existing	11/01/2020	Longreach	2450 - CLONCURRY

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name	THGW005		
Driller Name	HARGRAVE, TREVOR		
Drill Company	AMWD		
Const Method	ROTARY AIR		
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	14/01/2020	**Data Owner**	
Roles	Mine Monitoring		

Location

Latitude	21-39-09	**Basin**	0012
Longitude	139-55-27	**Sub-area**	
GIS Latitude	-21.65258985	**Lot**	16
GIS Longitude	139.92416338	**Plan**	CW62
Easting	388678		
Northing	7605240	**Map Scale**	
Zone	54	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

9 *records for RN* **184344**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	11/01/2020	1	0.00	42.00	Polyvinyl Chloride	6.000	WT - Wall Thickness	68
A	11/01/2020	2	29.00	41.50	Perforated or Slotted Casing	1.000	AP - Aperture Size	68
X	11/01/2020	3	0.00	5.50	Polyvinyl Chloride	7.000	WT - Wall Thickness	168
X	11/01/2020	4	0.00	5.50	Grout			155
X	11/01/2020	5	5.50	6.10	Grout			133

Bore Report

From Year:

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	11/01/2020	6	6.10	26.60	Cuttings or other fill between casing and hole wall			133
X	11/01/2020	7	26.60	28.00	Bentonite Seal			133
X	11/01/2020	8	28.00	42.00	Gravel Pack			133
X	11/01/2020	9		41.00	Centraliser			

Strata Logs

3 *records for RN* 184344

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	31.00	GRANITE
2	31.00	32.00	FRACTURED GRANITE
3	32.00	40.00	GRANITE

Stratigraphies

0 *records for RN* 184344

Aquifers

1 *records for RN* 184344

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	31.00	32.00	GNTE - Acid Intrusive, Granite	11/01/2020	-18.70	N	POTABLE		Y	FR	CORELLA FORMATION

Pump Tests Part 1

0 *records for RN* 184344

Pump Tests Part 2

0 *records for RN* 184344

Bore Conditions

0 *records for RN* 184344

Elevations

0 *records for RN* 184344

Water Analysis Part 1

0 *records for RN* 184344

From Year:

Water Analysis Part 2

0 ***records for RN*** **184344**

Water Levels

0 ***records for RN*** **184344**

Wire Line Logs

0 ***records for RN*** **184344**

Field Measurements

1 ***records for RN*** **184344**

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
A	11/01/2020		950	8.5						AI	Air Lifting	GB	Groundwater - from Bore

Special Water Analysis

0 ***records for RN*** **184344**

Bore Report

From Year:

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Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
184345	Sub-Artesian Facility	Existing	11/01/2020	Longreach	2450 - CLONCURRY

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name	THGW006		
Driller Name	HARGRAVE, TREVOR		
Drill Company	AMWD		
Const Method	ROTARY AIR		
Bore Line			
D/O File No		Polygon	
R/O File No		Equipment	
H/O File No		RN of Bore Replaced	
Log Received Date	14/01/2020	Data Owner	
Roles	Mine Monitoring		

Location

Latitude	21-38-47	Basin	0012
Longitude	139-55-38	Sub-area	
GIS Latitude	-21.6464215	Lot	16
GIS Longitude	139.92722393	Plan	CW62
Easting	388990		
Northing	7605925	Map Scale	
Zone	54	Map Series	
Accuracy		Map No	
GPS Accuracy		Map Name	
Checked	Yes	Prog Section	

Casing

7 *records for RN* 184345

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	11/01/2020	1	0.00	30.00	Polyvinyl Chloride	6.000	WT - Wall Thickness	68
A	11/01/2020	2	17.50	29.50	Perforated or Slotted Casing	1.000	AP - Aperture Size	68
X	11/01/2020	3	0.00	5.50	Polyvinyl Chloride	7.000	WT - Wall Thickness	168
X	11/01/2020	4	0.00	6.50	Grout			154
X	11/01/2020	5	6.50	14.80	Cuttings or other fill between casing and hole wall			154

Bore Report

From Year:

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	11/01/2020	6	14.80	16.00	Bentonite Seal			154
X	11/01/2020	7	16.00	30.00	Gravel Pack			154

Strata Logs

3 *records for RN* **184345**

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	18.00	QUARTZ
2	18.00	21.00	CLAY AND QUARTZ
3	21.00	30.00	DARK GRANITE

Stratigraphies

0 *records for RN* **184345**

Aquifers

1 *records for RN* **184345**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	20.00		QUAR - Quartz	11/01/2020	-18.40	N	POTABLE		Y	PS	CORELLA FORMATION

Pump Tests Part 1

0 *records for RN* **184345**

Pump Tests Part 2

0 *records for RN* **184345**

Bore Conditions

0 *records for RN* **184345**

Elevations

0 *records for RN* **184345**

Water Analysis Part 1

0 *records for RN* **184345**

Water Analysis Part 2

0 *records for RN* **184345**

Water Levels

0 *records for RN* **184345**

Bore Report

From Year:

Wire Line Logs

0 *records for RN* **184345**

Field Measurements

1 *records for RN* **184345**

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
A	11/01/2020		1750	8.5						AI	Air Lifting	GB	Groundwater - from Bore

Special Water Analysis

0 *records for RN* **184345**

Bore Report

From Year:

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Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
184352	Sub-Artesian Facility	Existing	11/01/2020	Longreach	2450 - CLONCURRY

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name	THGW004		
Driller Name	HARGRAVE, TREVOR		
Drill Company	AMWD		
Const Method	ROTARY AIR		
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	14/01/2020	**Data Owner**	
Roles	Mine Monitoring		

Location

Latitude	21-38-27	**Basin**	0012
Longitude	139-55-47	**Sub-area**	
GIS Latitude	-21.64085402	**Lot**	13
GIS Longitude	139.92961307	**Plan**	SP223510
Easting	389233		
Northing	7606543	**Map Scale**	
Zone	54	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

7 ***records for RN*** **184352**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	11/01/2020	1	0.00	27.50	Polyvinyl Chloride	6.000	WT - Wall Thickness	68
A	11/01/2020	2	15.00	27.00	Perforated or Slotted Casing	1.000	AP - Aperture Size	68
X	11/01/2020	3	0.00	5.50	Polyvinyl Chloride	7.000	WT - Wall Thickness	168
X	11/01/2020	4	0.00	6.50	Grout			155
X	11/01/2020	5	6.50	12.00	Cuttings or other fill between casing and hole wall			133

Bore Report

From Year:

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	11/01/2020	6	12.00	13.60	Bentonite Seal			133
X	11/01/2020	7	13.60	27.50	Gravel Pack			133

Strata Logs

4 *records for RN* 184352

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.00	TOPSOIL
2	1.00	15.00	FRACTURED GRANITE
3	15.00	16.00	FRACTURED GRANITE AND CLAY
4	16.00	27.50	GRANITE

Stratigraphies

0 *records for RN* 184352

Aquifers

1 *records for RN* 184352

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	14.60		GNTE - Acid Intrusive, Granite	11/01/2020	-14.60	N	POTABLE		Y	FR	CORELLA FORMATION

Pump Tests Part 1

0 *records for RN* 184352

Pump Tests Part 2

0 *records for RN* 184352

Bore Conditions

0 *records for RN* 184352

Elevations

0 *records for RN* 184352

Water Analysis Part 1

0 *records for RN* 184352

Bore Report

From Year:

Water Analysis Part 2

0 *records for RN* **184352**

Water Levels

0 *records for RN* **184352**

Wire Line Logs

0 *records for RN* **184352**

Field Measurements

1 *records for RN* **184352**

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
A	11/01/2020		2760	8.8						XX	Unknown	GB	Groundwater - from Bore

Special Water Analysis

0 *records for RN* **184352**

Bore Report

From Year:

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Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
184353	Sub-Artesian Facility	Abandoned and Destroyed	11/01/2020	Longreach	2450 - CLONCURRY

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name	MBWB1		
Driller Name	HARGRAVE, TREVOR		
Drill Company	AMWD		
Const Method	ROTARY AIR		
Bore Line			
D/O File No		Polygon	
R/O File No		Equipment	
H/O File No		RN of Bore Replaced	
Log Received Date	14/01/2020	Data Owner	
Roles	Water Supply		

Location

Latitude	21-36-36	Basin	0012
Longitude	139-54-38	Sub-area	
GIS Latitude	-21.60999707	Lot	16
GIS Longitude	139.91052892	Plan	CW62
Easting	387234		
Northing	7609945	Map Scale	
Zone	54	Map Series	
Accuracy		Map No	
GPS Accuracy		Map Name	
Checked	Yes	Prog Section	

Casing

4 *records for RN* 184353

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	11/01/2020	1	0.00	4.00	Grout			311
X	11/01/2020	2	4.00	6.00	Grout			133
X	11/01/2020	3	6.00	21.00	Cuttings or other fill between casing and hole wall			133
X	11/01/2020	4	0.00	4.00	Polyvinyl Chloride			280

Strata Logs

4 *records for RN* 184353

Bore Report

From Year:

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.00	TOPSOIL
2	1.00	11.00	GRANITE
3	11.00	12.00	FRACTURED GRANITE AND CLAY
4	12.00	21.00	GRANITE

Stratigraphies
0 *records for RN* 184353

Aquifers
0 *records for RN* 184353

Pump Tests Part 1
0 *records for RN* 184353

Pump Tests Part 2
0 *records for RN* 184353

Bore Conditions
0 *records for RN* 184353

Elevations
0 *records for RN* 184353

Water Analysis Part 1
0 *records for RN* 184353

Water Analysis Part 2
0 *records for RN* 184353

Water Levels
0 *records for RN* 184353

Wire Line Logs
0 *records for RN* 184353

Field Measurements
0 *records for RN* 184353

Special Water Analysis
0 *records for RN* 184353

Bore Report

From Year:

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APPENDIX C: ENVIRONMENTALLY SENSITIVE AREAS

ENVIRONMENTALLY SENSITIVE AREAS - Mining Activities

Selected Mining Lease (ML)

CATEGORY A

- National Parks
- Conservation Parks
- Forest Reserves
- Special Wildlife Reserve
- Wet Tropics World Heritage Area
- Great Barrier Reef Marine Park Area
- Marine Parks other than General Use Zones

CATEGORY B

- Queensland Heritage Register Places
- Ramsar Sites
- Cultural Heritage Registered Areas and DLA's other than Stanbroke
- Special Forestry Areas
- Seaward Side of Highest Astronomical Tide
- Fish Habitat Areas
- Coordinated Conservation Areas
- Endangered Regional Ecosystems - regrowth and remnant (Biodiversity Status)
- General Use Zones of Marine Parks
- Marine Plants

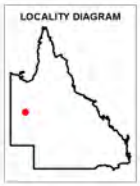
CATEGORY C

- Nature Refuges
- Resources Reserve
- State Forests
- Timber Reserves
- River Improvement Areas
- Stanbroke DLA
- Coastal Management District
- Dams and Weirs

OTHERS

- Towns
- Roads
- Repealed Wild River Nominated Waterways
- Repealed Wild River Preservation Areas
- Repealed Wild River High Preservation Areas
- Mahogany Glider Habitat
- Directory of Important Wetlands
- Queensland

LOCALITY DIAGRAM



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0 110 220 330 440 550 m

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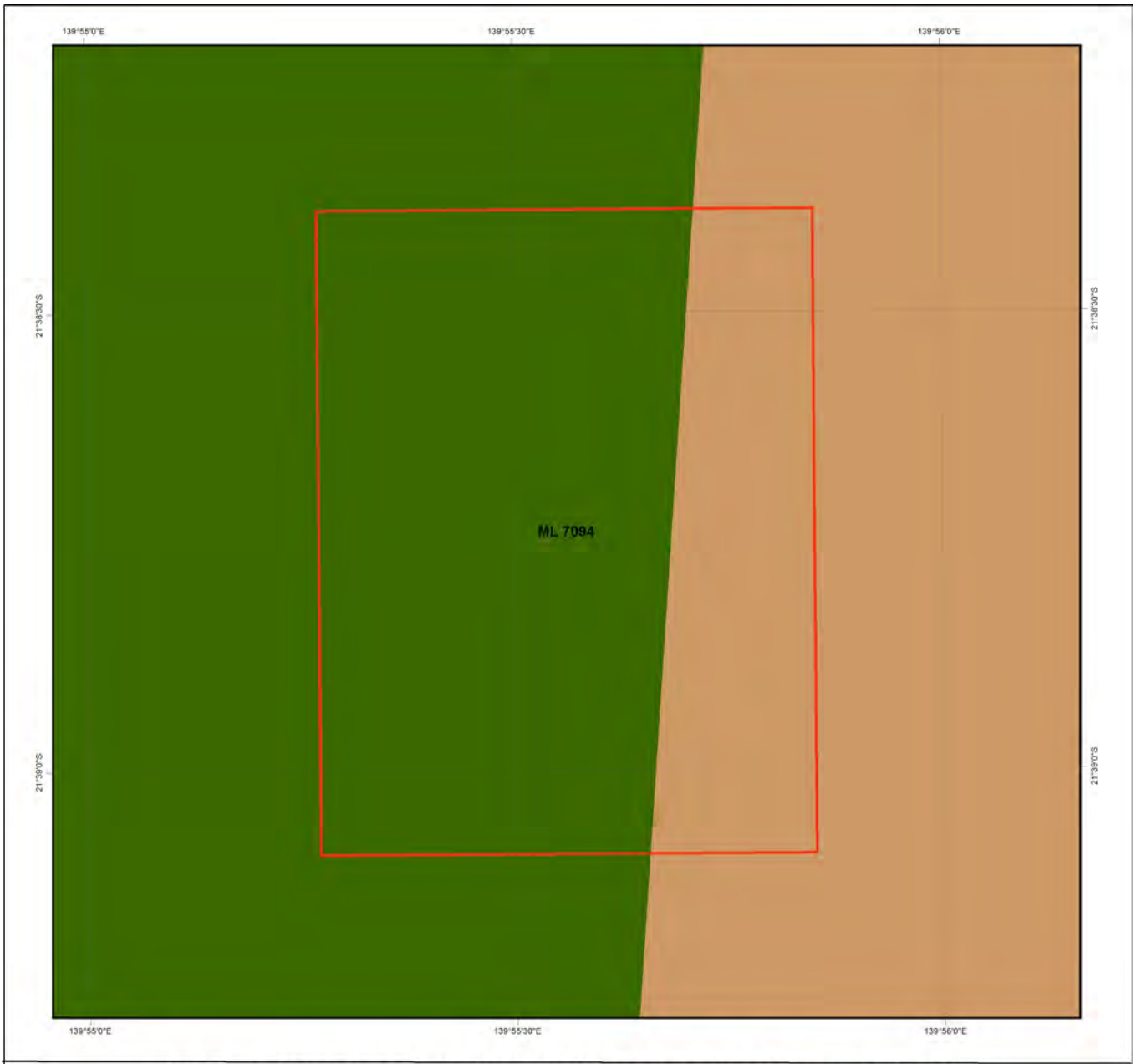


ENVIRONMENTALLY SENSITIVE AREAS - Mining Activities

Selected Mining Lease (ML)

CATEGORY A

- National Parks
- Conservation Parks
- Forest Reserves
- Special Wildlife Reserve
- Wet Tropics World Heritage Area
- Great Barrier Reef Marine Park Area
- Marine Parks other than General Use Zones

CATEGORY B

- Queensland Heritage Register Places
- Ramsar Sites
- Cultural Heritage Registered Areas and DLA's other than Stanbroke
- Special Forestry Areas
- Seaward Side of Highest Astronomical Tide
- Fish Habitat Areas
- Coordinated Conservation Areas
- Endangered Regional Ecosystems - regrowth and remnant (Biodiversity Status)
- General Use Zones of Marine Parks
- Marine Plants

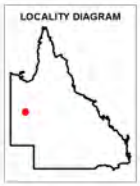
CATEGORY C

- Nature Refuges
- Resources Reserve
- State Forests
- Timber Reserves
- River Improvement Areas
- Stanbroke DLA
- Coastal Management District
- Dams and Weirs

OTHERS

- Towns
- Roads
- Repealed Wild River Nominated Waterways
- Repealed Wild River Preservation Areas
- Repealed Wild River High Preservation Areas
- Mahogany Glider Habitat
- Directory of Important Wetlands
- Queensland

LOCALITY DIAGRAM



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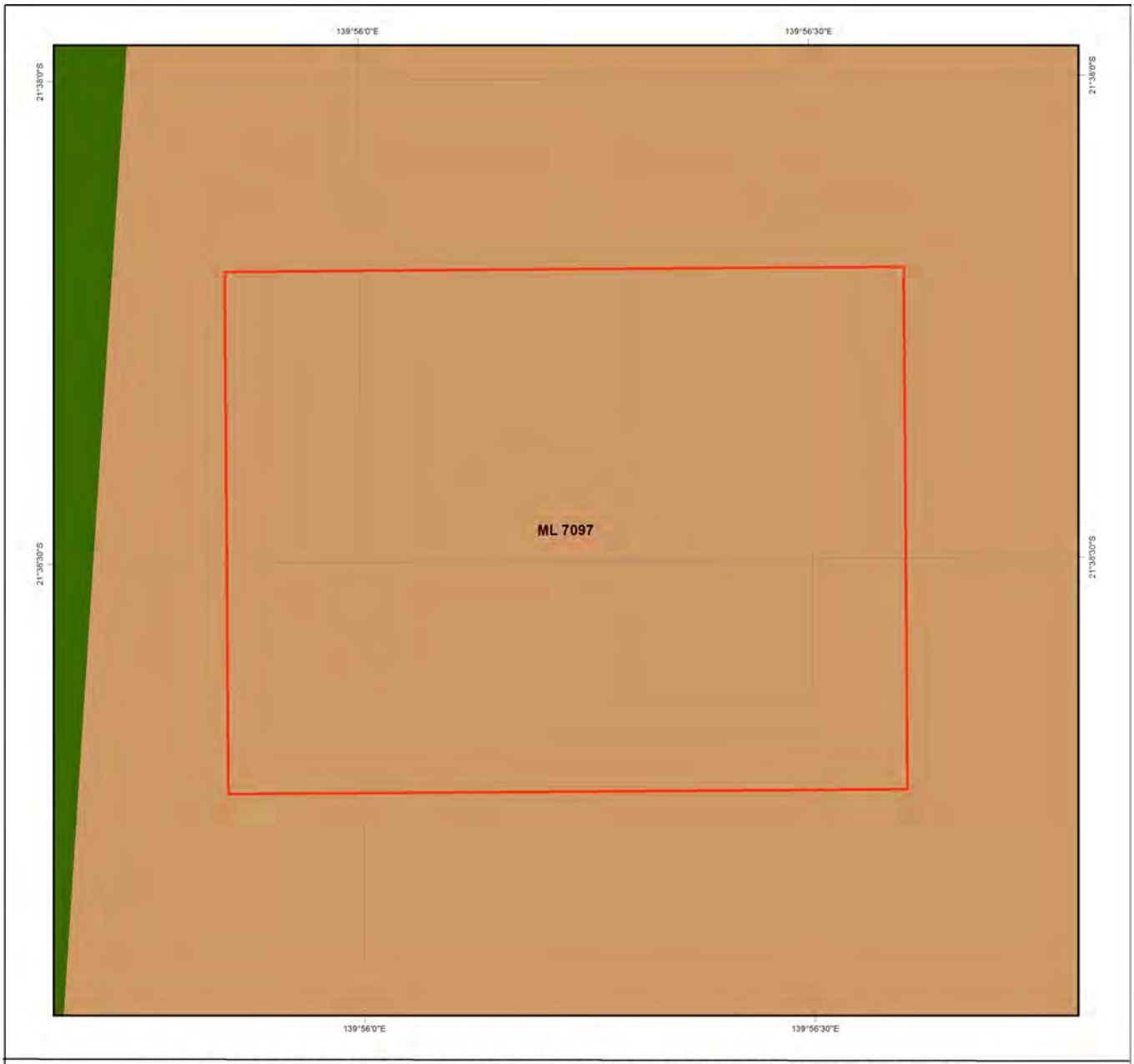

ENVIRONMENTALLY SENSITIVE AREAS - Mining Activities

Selected Mining Lease (ML)

CATEGORY A

- National Parks
- Conservation Parks
- Forest Reserves
- Special Wildlife Reserve
- Wet Tropics World Heritage Area
- Great Barrier Reef Marine Park Area
- Marine Parks other than General Use Zones

CATEGORY B

- Queensland Heritage Register Places
- Ramsar Sites
- Cultural Heritage Registered Areas and DLA's other than Stanbroke
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- Seaward Side of Highest Astronomical Tide
- Fish Habitat Areas
- Coordinated Conservation Areas
- Endangered Regional Ecosystems - regrowth and remnant (Biodiversity Status)
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- Repealed Wild River Preservation Areas
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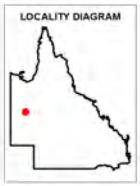
LOCALITY DIAGRAM



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APPENDIX D: ENVIRONMENTAL INVESTIGATION LEVEL CALCULATION DATA

Predicted background metal concentrations				Soil																					
Sample	Fe (%)	a values						c values						log [M]						**[M]**	**mg/kg**				
Field_ID	% FE	As	Cr	Cu	Ni	Pb	Zn	As	Cr	Cu	Ni	Pb	Zn	As	Cr	Cu	Ni	Pb	Zn	**As**	**Cr**	**Cu**	**Ni**	**Pb**	**Zn**
THS01 0-0.1	2.04	1.064	1.916	1.235	1.381	0.558	1.529	1.064	1.916	1.235	1.381	0.558	1.529	1.393446	2.5092514	1.617393	1.808599	0.730774	2.002425	**24.74**	**323.04**	**41.44**	**64.36**	**5.38**	**100.56**
THS04 0-0.1	1.42	1.064	1.916	1.235	1.381	0.558	1.529	1.064	1.916	1.235	1.381	0.558	1.529	1.226035	2.20778447	1.423076	1.59131	0.642977	1.761849	**16.83**	**161.36**	**26.49**	**39.02**	**4.40**	**57.79**
THS06 0-0.05	1.07	1.064	1.916	1.235	1.381	0.558	1.529	1.064	1.916	1.235	1.381	0.558	1.529	1.095264	1.97229932	1.271289	1.421579	0.574396	1.573928	**12.45**	**93.82**	**18.68**	**26.40**	**3.75**	**37.49**
THS12 0-0.1	3.25	1.064	1.916	1.235	1.381	0.558	1.529	1.064	1.916	1.235	1.381	0.558	1.529	1.608644	2.89676852	1.867176	2.087911	0.843631	2.31167	**40.61**	**788.44**	**73.65**	**122.44**	**6.98**	**204.96**
THS13 0.4-0.5	2.8	1.064	1.916	1.235	1.381	0.558	1.529	1.064	1.916	1.235	1.381	0.558	1.529	1.539776	2.77275479	1.78724	1.998525	0.807514	2.212705	**34.66**	**592.59**	**61.27**	**99.66**	**6.42**	**163.19**
THS14 0-0.1	3.73	1.064	1.916	1.235	1.381	0.558	1.529	1.064	1.916	1.235	1.381	0.558	1.529	1.672298	3.01139412	1.94106	2.17053	0.877014	2.403143	**47.02**	**1026.58**	**87.31**	**148.09**	**7.53**	**253.01**
THS15 0-0.1	1.7	1.064	1.916	1.235	1.381	0.558	1.529	1.064	1.916	1.235	1.381	0.558	1.529	1.309198	2.35754013	1.519604	1.69925	0.68659	1.881356	**20.38**	**227.79**	**33.08**	**50.03**	**4.86**	**76.10**
Mean	**2.33**																		**Mean**	**28.10**	**459.09**	**48.85**	**78.57**	**5.62**	**127.59**
St Dev	**0.99**																		**St Dev**	**12.83**	**346.61**	**25.49**	**45.22**	**1.40**	**80.11**
CV	**0.42**																		**CV**	**0.46**	**0.75**	**0.52**	**0.58**	**0.25**	**0.63**

Predicted background metal concentrations				Tailings																					
Sample	Fe (%)	a values						c values						log [M]						**[M]**	**mg/kg**				
Field_ID	% FE	As	Cr	Cu	Ni	Pb	Zn	As	Cr	Cu	Ni	Pb	Zn	As	Cr	Cu	Ni	Pb	Zn	**As**	**Cr**	**Cu**	**Ni**	**Pb**	**Zn**
THT06 0.5	1.3	1.064	1.916	1.235	1.381	0.558	1.529	1.064	1.916	1.235	1.381	0.558	1.529	1.192291	2.14701965	1.383909	1.547513	0.62528	1.713358	**15.57**	**140.29**	**24.21**	**35.28**	**4.22**	**51.68**
THT09 1.0 - 1.5	1.22	1.064	1.916	1.235	1.381	0.558	1.529	1.064	1.916	1.235	1.381	0.558	1.529	1.155887	2.08146544	1.341654	1.500263	0.606189	1.661044	**14.32**	**120.63**	**21.96**	**31.64**	**4.04**	**45.82**
THT09 2.5 - 3.0	1.16	1.064	1.916	1.235	1.381	0.558	1.529	1.064	1.916	1.235	1.381	0.558	1.529	1.132583	2.03950151	1.314606	1.470016	0.593968	1.627556	**13.57**	**109.52**	**20.64**	**29.51**	**3.93**	**42.42**
THT09 4.2 - 4.5	1.23	1.064	1.916	1.235	1.381	0.558	1.529	1.064	1.916	1.235	1.381	0.558	1.529	1.159659	2.08825819	1.346033	1.505159	0.608167	1.666465	**14.44**	**122.53**	**22.18**	**32.00**	**4.06**	**46.39**
THT09 5.0 - 5.5	1.12	1.064	1.916	1.235	1.381	0.558	1.529	1.064	1.916	1.235	1.381	0.558	1.529	1.116368	2.01030173	1.295784	1.44897	0.585464	1.604254	**13.07**	**102.40**	**19.76**	**28.12**	**3.85**	**40.20**
Mean	**1.18**																		**Mean**	**14.19**	**119.08**	**21.75**	**31.31**	**4.02**	**45.30**
St Dev	**0.04**																		**St Dev**	**0.56**	**8.23**	**0.99**	**1.59**	**0.08**	**2.53**
CV	**0.04**																		**CV**	**0.04**	**0.07**	**0.05**	**0.05**	**0.02**	**0.06**

APPENDIX E: HISTORICAL AERIAL PHOTOGRAPHS

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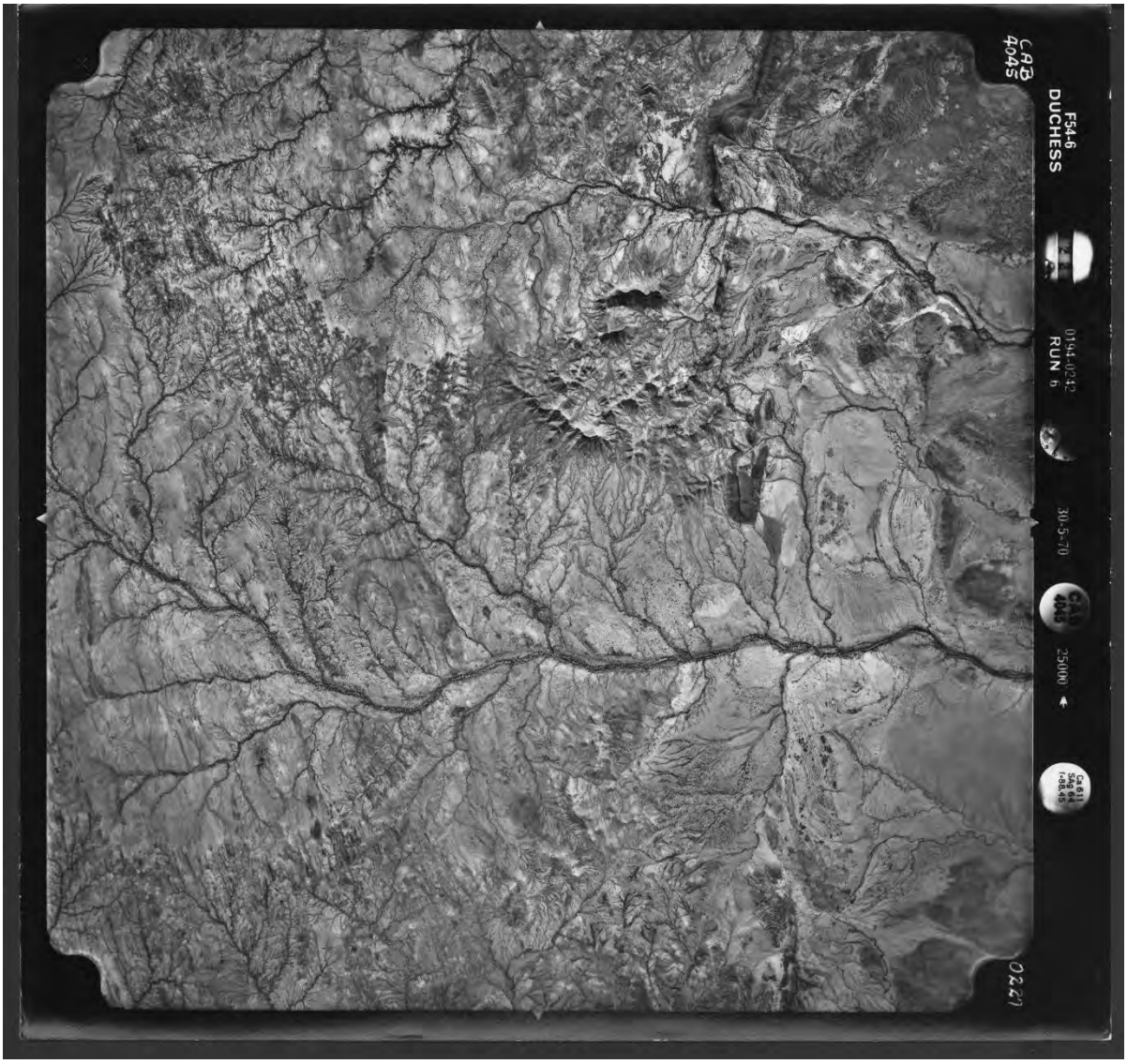

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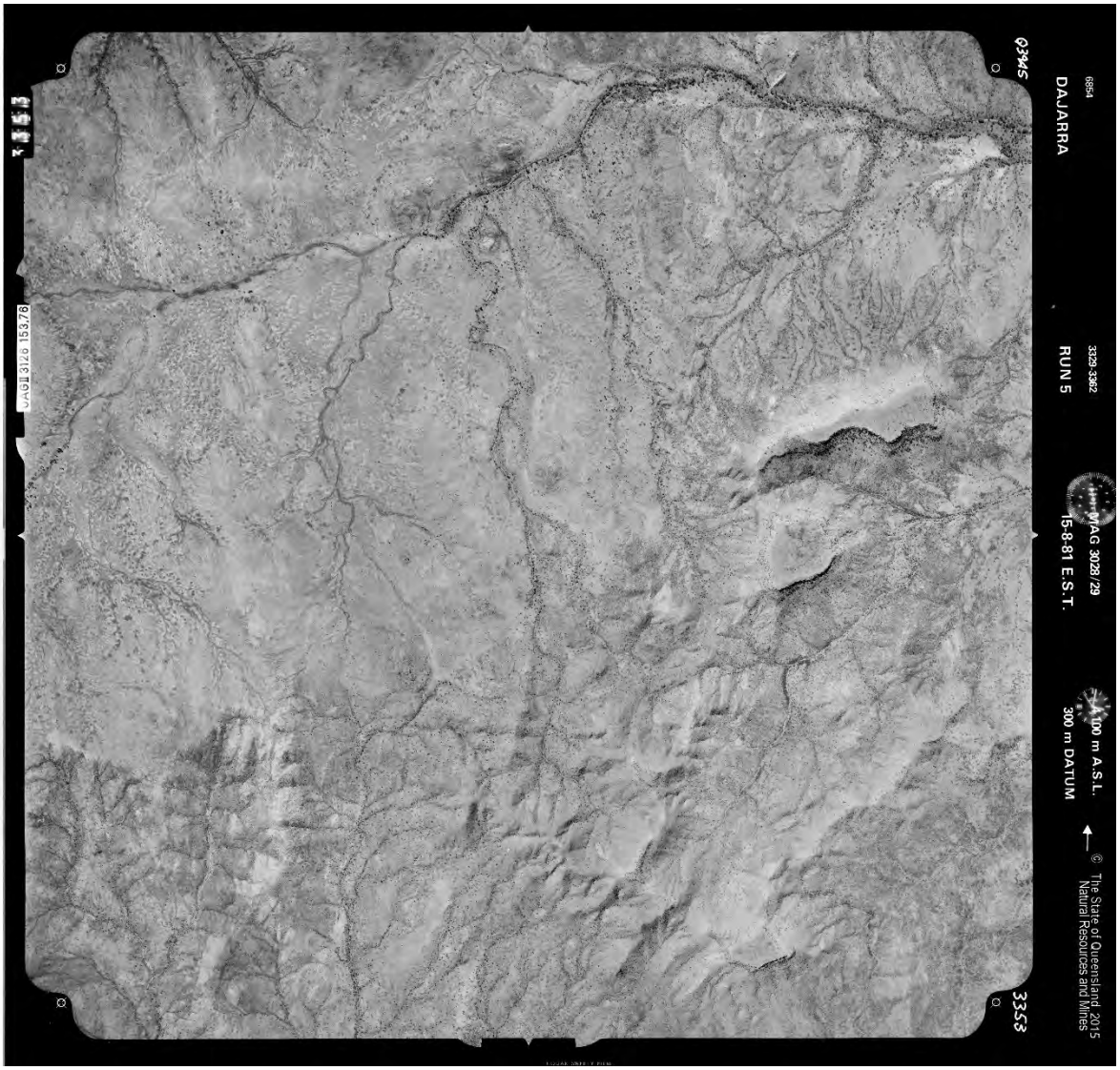
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RUN 5
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© The State of Queensland 2015
Natural Resources and Mines
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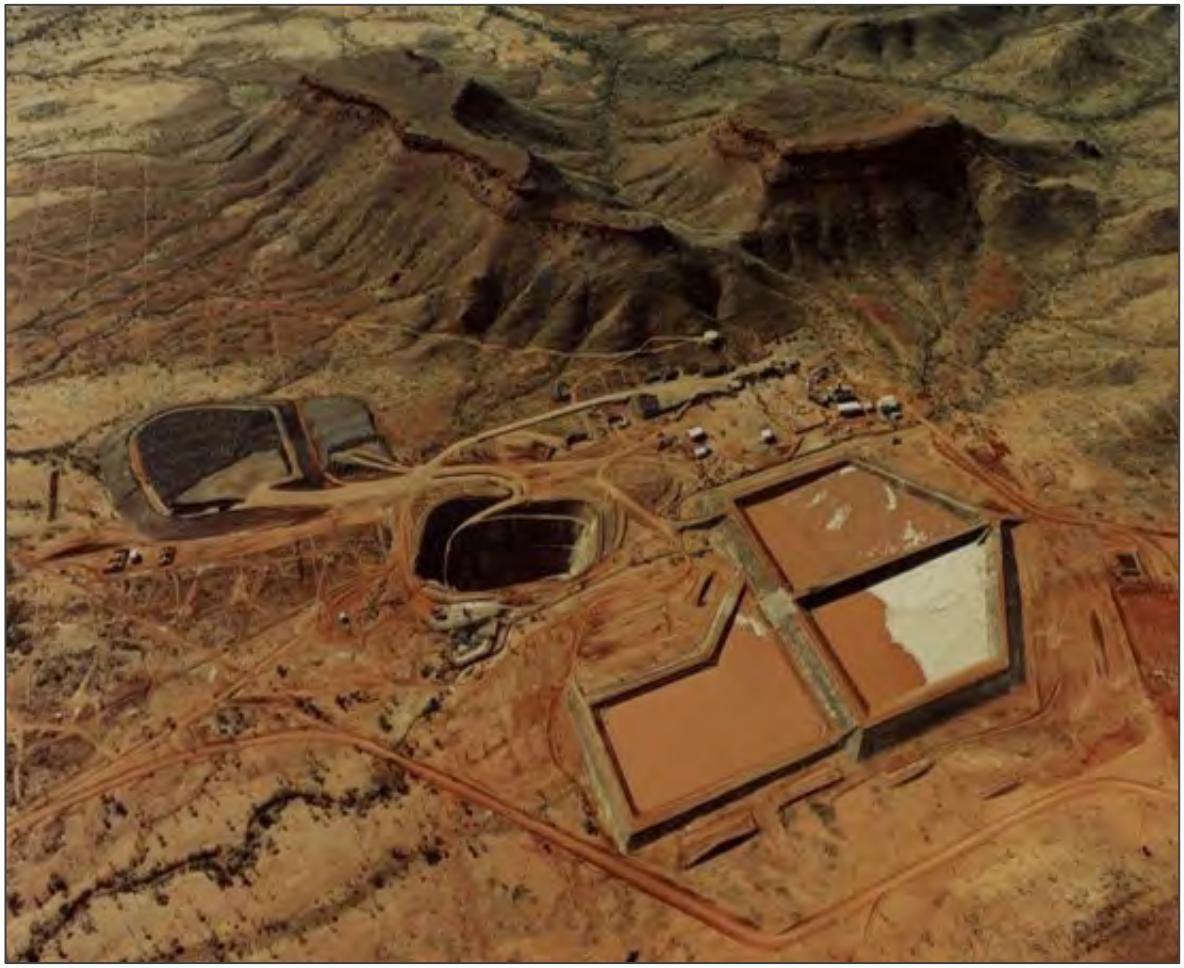
3358
JAGI 3126 153.76

Date unknown



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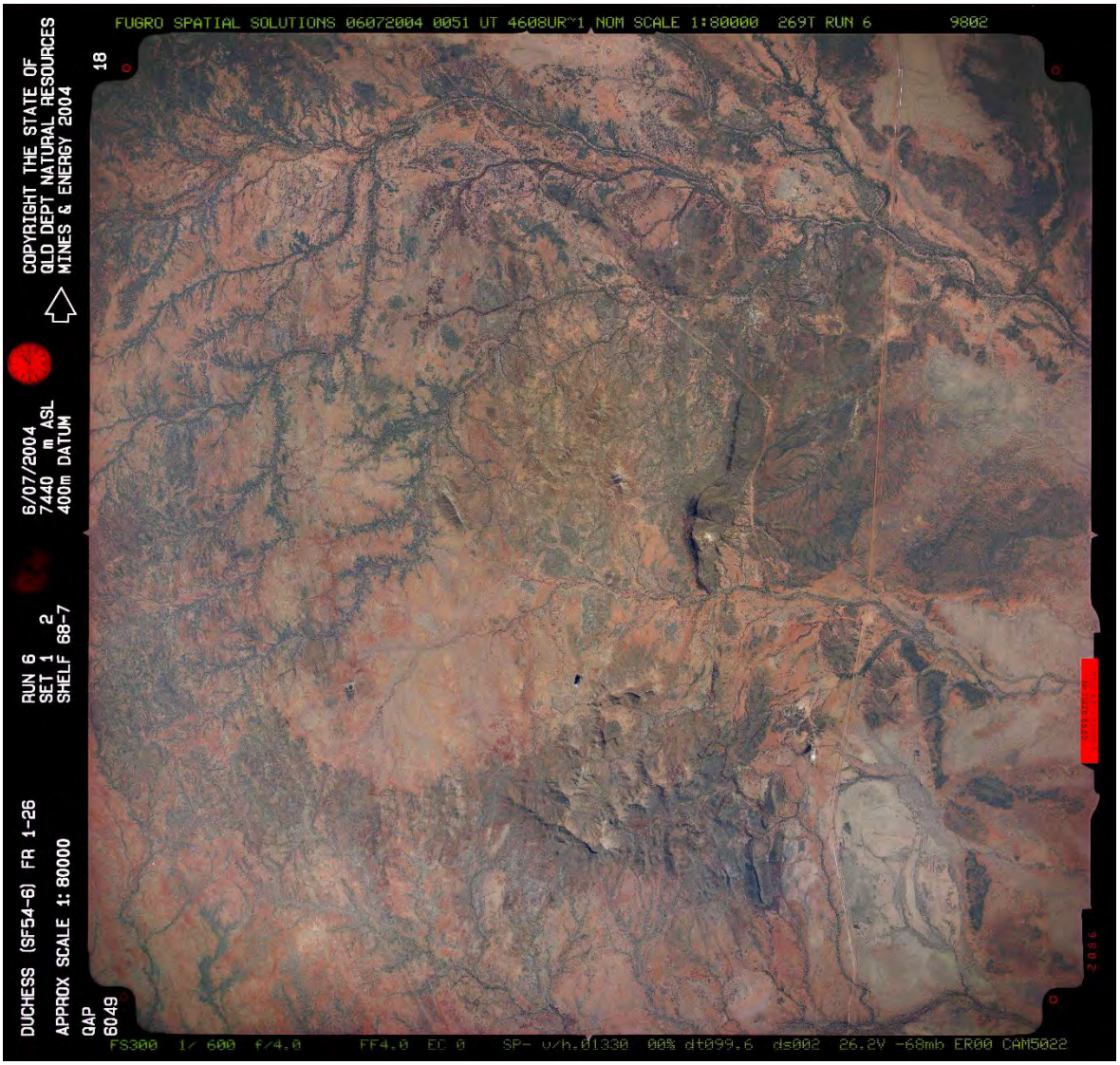
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18
COPYRIGHT THE STATE OF
QLD DEPT NATURAL RESOURCES
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6/07/2004
7440 m ASL
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RUN 6
SET 1 2
SHELF 68-7
DUCHESS (SF54-6) FR 1-26
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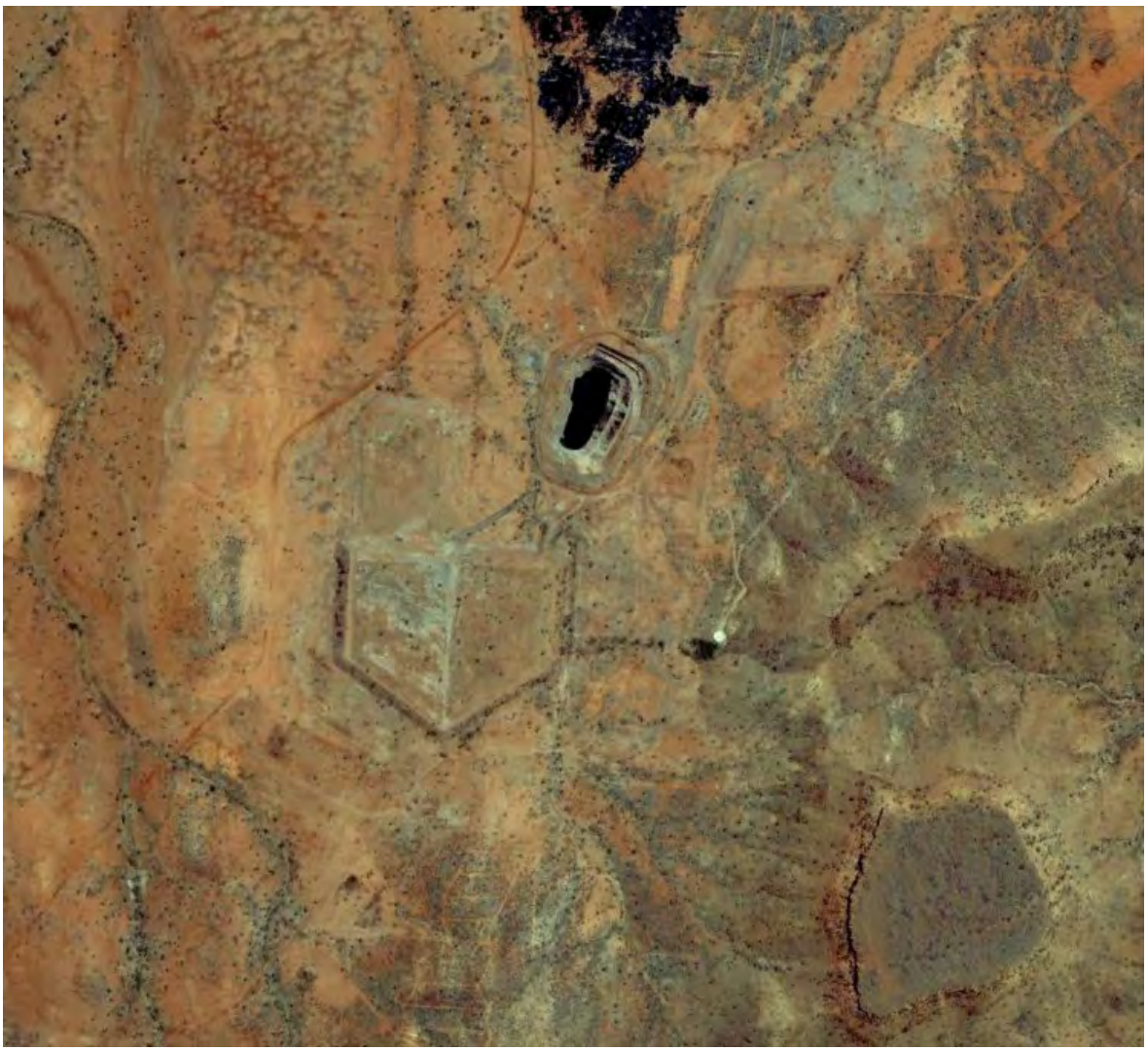
2006 – Google Earth



2018

2021 – Google Earth

2022 – Google Earth

APPENDIX F: RESPONSE TO ENVIRONMENTAL EVALUATION NOTICE

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

To: **Paul Tan**, Carnaby Resources Pty Ltd

From: Dr Anna Sheldon, Principal Soil Scientist (Author)
Kat Spruth, Principal Environmental Scientist (Reviewer)

Date: 13 July 2023

Subject: Technical Memo, 722092
722092 Response to EE comments on Environmental Evaluation Groundwater Geochemistry Report

---

1 Introduction

The attached comments (Appendix A) provide brief responses to the Department of Environment and Science (DES) comments on the Environmental Evaluation Groundwater Geochemistry Report.

Please also refer to the environmental site assessment (ESA) (Environmental Earth Sciences, 2023) for detailed data interrogation, interpretation and updated conceptual site model. This additional investigation was completed to address the further comments in response to the EE and address data gaps that remained after previous assessments.

2 References

Department of Environment and Science (undated) Comments on Tick Hill Environmental Evaluation Groundwater Geochemistry Report.

Environmental Earth Sciences (2023) Environmental Site Assessment - Tick Hill Gold Mine. Prepared for Carnaby Resources Pty Ltd. Version 1. 12 July 2023.

PA Scott Consulting (2022) Tick Hill Environmental Evaluation Groundwater Geochemistry Report. ML7097, ML7094, ML7096. Environmental Authority EPML00820613. Prepared for Carnaby Resources Pty Ltd, 20 April 2022.

3 Limitations

This report has been prepared by Environmental Earth Sciences QLD ACN 109 442 284 in response to and subject to the following limitations:

1. The specific instructions received from Carnaby Resources Pty Ltd;

2. The specific scope of works set out in PO722108 V2 issued by Environmental Earth Sciences for and on behalf of Carnaby Resources;

3. May not be relied upon by any third party not named in this report for any purpose except with the prior written consent of Environmental Earth Sciences QLD (which consent may or may not be given at the discretion of Environmental Earth Sciences QLD);

4. This report comprises the formal report, documentation sections, tables, figures and appendices as referred to in the index to this report and must not be released to any third party or copied in part without all the material included in this report for any reason;

5. The report only relates to the site referred to in the scope of works being located at Tick Hill Gold Mine ("the site");

6. The report relates to the site as at the date of the report as conditions may change thereafter due to natural processes and/or site activities;

7. No warranty or guarantee is made in regard to any other use than as specified in the scope of works and only applies to the depth tested and reported in this report;

8. Fill, soil, groundwater and rock to the depth tested on the site may be fit for the use specified in this report. Unless it is expressly stated in this report, the fill, soil and/or rock may not be suitable for classification as clean fill if deposited off site;

9. This report is not a geotechnical or planning report suitable for planning or zoning purposes; and

10. Our General Limitations set out at the back of the body of this report.

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

ENVIRONMENTAL EARTH SCIENCES GENERAL LIMITATIONS

Scope of services
The work presented in this report is Environmental Earth Sciences response to the specific scope of works requested by, planned with and approved by the client. It cannot be relied on by any other third party for any purpose except with our prior written consent. Client may distribute this report to other parties and in doing so warrants that the report is suitable for the purpose it was intended for. However, any party wishing to rely on this report should contact us to determine the suitability of this report for their specific purpose.

Data should not be separated from the report
A report is provided inclusive of all documentation sections, limitations, tables, figures and appendices and should not be provided or copied in part without all supporting documentation for any reason, because misinterpretation may occur.

Subsurface conditions change
Understanding an environmental study will reduce exposure to the risk of the presence of contaminated soil and or groundwater. However, contaminants may be present in areas that were not investigated, or may migrate to other areas. Analysis cannot cover every type of contaminant that could possibly be present. When combined with field observations, field measurements and professional judgement, this approach increases the probability of identifying contaminated soil and or groundwater. Under no circumstances can it be considered that these findings represent the actual condition of the site at all points.

Environmental studies identify actual sub-surface conditions only at those points where samples are taken, when they are taken. Actual conditions between sampling locations differ from those inferred because no professional, no matter how qualified, and no sub-surface exploration program, no matter how comprehensive, can reveal what is hidden below the ground surface. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from that predicted. Nothing can be done to prevent the unanticipated. However, steps can be taken to help minimize the impact. For this reason, site owners should retain our services.

Problems with interpretation by others
Advice and interpretation is provided on the basis that subsequent work will be undertaken by Environmental Earth Sciences QLD. This will identify variances, maintain consistency in how data is interpreted, conduct additional tests that may be necessary and recommend solutions to problems encountered on site. Other parties may misinterpret our work and we cannot be responsible for how the information in this report is used. If further data is collected or comes to light we reserve the right to alter their conclusions.

Obtain regulatory approval
The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party. When approval from a statutory authority is required for a project, that approval should be directly sought by the client.

Limit of liability
This study has been carried out to a particular scope of works at a specified site and should not be used for any other purpose. This report is provided on the condition that Environmental Earth Sciences QLD disclaims all liability to any person or entity other than the client in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by any such person in reliance, whether in whole or in part, on the contents of this report. Furthermore, Environmental Earth Sciences QLD disclaims all liability in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by the client, or any such person in reliance, whether in whole or any part of the contents of this report of all matters not stated in the brief outlined in Environmental Earth Sciences QLD's proposal number and according to Environmental Earth Sciences general terms and conditions and special terms and conditions for contaminated sites.

To the maximum extent permitted by law, we exclude all liability of whatever nature, whether in contract, tort or otherwise, for the acts, omissions or default, whether negligent or otherwise for any loss or damage whatsoever that may arise in any way in connection with the supply of services. Under circumstances where liability cannot be excluded, such liability is limited to the value of the purchased service.

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

APPENDIX A: RESPONSE TO ENVIRONMENTAL EVALUATION COMMENTS

Table 1: Response to DES comments on Environmental Evaluation requirements

Requirement	DES Comment	Response
1. Develop a conceptual groundwater model that identifies all groundwater systems, which may be impacted on as a result of activities conducted under environmental authority EPML00820613, with reference to all mine features, depth to groundwater, and direction of groundwater flow.	a) The report does not adequately identify and characterise all groundwater systems which may be impacted at the site. Based on the results of the model, the report concludes the groundwater system is limited to a fractured hard-rock aquifer under unconfined conditions. The report then goes onto identify a regolith aquifer present above the fractured rock in section 2.6 of the report, however there are no details regarding its hydrogeology and no monitoring bores present within this geological unit. b) Groundwater flow direction has not been sufficiently determined. The report states that due to scarce groundwater information available for the site, groundwater flow directions for intermediate and regional scale groundwater systems are conjectural. Furthermore, the conceptual model infers that groundwater flows west from groundwater bore THGW002 and regional groundwater flows south. However, the report states that groundwater bore 5 is upgradient of the mine site and the Tailings Storage Facility (TSF) and decant pond are upgradient of the open cut pit, indicating groundwater flow may be to the north. c) The report concludes that the pit is likely acting as a groundwater sink, however then goes onto state further assessment of the hydrogeological model is required using the recently acquired monitoring data. From the conceptual model presented, it appears that THGW002 is not within the influence of the pit and that THGW006 is at the edge of pit influence, based on the water table. Further evidence is required to support the conceptual model and the extent of drawdown or radial flow towards the pit.	a) The site hydrogeological model has been substantially updated based on review of available data and installation of additional monitoring bores. The updated hydrogeological conceptual site model (CSM) is developed within the environmental site assessment (ESA) report (Environmental Earth Sciences [EES], 2023). b) The groundwater flow direction has been recalculated in consideration of existing infrastructure and data obtained from newly installed monitoring bores. This is presented in Figure 9. The available data and recalculated contours indicate that the pit is a groundwater sink for the majority of the site, although influence of the open pit as a sink in the southwestern corner of the site may be limited, and groundwater in the area of the waste rock dump is not substantially influenced by the pit. Groundwater in the pit vicinity appears to be influenced by the underground workings to the northwest. Regional groundwater flow is to the northwest, as would be expected based on topography. Groundwater flow from the TSF and decant dam are within the hydrogeological influence of the open pit. Conceptual cross sections (Figures 15 and 16) are used to further illustrate the hydrogeological influence of the pit. c) The conditions described are not supported by the current CSM.

Requirement	DES Comment	Response
2. Identify all contaminants potentially generated by mine features, including characterisation of materials contained in mine features.	The Report does not explicitly identify all contaminants of concern. The report provides some characterisation of materials contained in the TSF, decant pond and open cut pit. However, it does not characterise materials in other mine features, such as the waste rock dump (WRD).	Chemicals of potential concern (CoPCs) were identified via desktop review (identification of historical and current potentially contaminating activities) and site inspection. These CoPCs were then incorporated into the supplementary soil and groundwater assessment undertaken at the site in 2023 (EES, 2023). Previous investigations have characterised the waste rock dump and potential associated issues. This investigation (EES, 2023) identified residual impacts to groundwater due to nitrate leaching, likely due to explosive residue in waste rock.
3. Consider all environmental values and identify those that are potentially impacted. Consider groundwater migration, interaction with surface water, and any	a. Environmental values have been identified in section 2.3 of the report, however groundwater migration, interaction with surface water, and any potential future use of the water have not been sufficiently considered. b. Insufficient justification is provided in the report in determining potentially affected groundwater environmental values, for example the applicability of aquatic ecosystems groundwater environmental values.	a) Potential interactions between groundwater and surface water are further developed when discussing site impacts. b) Selection of relevant environmental values is further discussed.
4. By 21 July 2020, design and implement a groundwater monitoring program, capable of detecting and assessing impacts from mining activities to groundwater	a. Groundwater monitoring bores have been nominated in the report, however insufficient justification has been provided to demonstrate their geographic locations and geology are adequate for their intended purpose, including their suitability as reference and impact bores based on groundwater flow direction. Furthermore, the report contains inconsistencies in relation to groundwater bore classifications and naming conventions, for example in section 2.2 of the report THGW006 is referred to as an impact bore, however, is then presented as a reference bore in the report. b. Sample results obtained from the TSF and decant pond detected contaminants including barium, iron, strontium, vanadium, phosphorus and titanium. These contaminants were not tested for in the groundwater monitoring	a) The purpose and relevance of groundwater monitoring bores to characterise hydrogeological conditions at the site is further discussed, along with the justification for locations of additional monitoring bores. b) Tailings, soil and groundwater were analysed for the same metals suite. Total and available phosphorus were also analysed. The distribution of metal concentrations and trends is discussed in the report, along with the potential for environmental harm. Several of the metals that exceed screening criteria show evidence of natural mineralisation across the site.

Requirement	DES Comment	Response
	program. Furthermore, the notice issued on 14 May 2020 identified elevated concentrations of vanadium in monitoring bores.	
5. Identify the source(s) of all contaminants that are being, or have been released from mine features to groundwater	a. Graphs are presented in the report depicting concentrations of some contaminants at some bores, however minimal interpretation or analysis of other results is provided. Furthermore, the data presented is restricted to sampling conducted post 2020 and does not consider monitoring data prior to this. b. An assessment of groundwater chemistry against stock water guideline values derived from ANZECC & ARMCANZ (2000) water quality guidelines (ANZECC 2000) is provided in section 2.4 of the report, however this is limited to one sampling occasion (i.e. 22 June 2020), does not consider other potentially relevant guidelines values such as aquatic ecosystems, and does not adequately consider their sources for example relevant mine features. c. Section 2.5 of the report states the: detection of cyanide in groundwater bores 2, 4 and 5 is most likely due to cross-contamination from sampling equipment or water level measuring equipment. Although the raw data does not show a detection of cyanide in groundwater bore THGW002, further information is required to justify the source of the cyanide results detected in groundwater bores THGW004 and THGW005.	a) Where sufficient data are available, graphs of monitoring results have been presented to aid in the interpretation of results. Interpretation of trends and exceedances for all graphed data is supplied. Where available, monitoring data from 2012 is included. b) Monitoring results are compared with relevant screening criteria for human health, ecosystems and stock watering. Exceedances are discussed in relation to source and potential for impact to the relevant sensitive receptors. c) Distribution and concentrations of cyanide across the site is discussed, along with potential impacts to sensitive receptors. Previous potentially anomalous results are discussed in the context of long term trends.
6. Identify and describe the pathways and mechanisms for the release and transport of contaminants to groundwater from mine features. Include a description of any existing barriers incorporated in mine features (e.g. Capping and lining of features containing contaminants) and assess their integrity.	a. The report concludes that local groundwater flow is towards the pit, however the following indicates uncertainty and additional potential pathways which have not been described: i. The pit maybe acting as a storage sink, however further assessment of the hydrogeological model is required using contemporary monitoring data. ii. Based on the PSM (2020) investigation, the larger fraction of TSF seepage migrates down-valley and to lower aquifers.	a) The influence of the pit as a sink in relation to groundwater across the site is further discussed and modelled. The comments relating to down-valley flow and regolith flow are not supported by the updated CSM. b) Assessment of waste materials at the site since prior to commencement of mine operations has indicated that total sulfur concentrations are low and

Requirement	DES Comment	Response
	iii. Regolith is present above the fractured rock, however no details are presented regarding its hydrogeology and no monitoring bores are present within this geological unit. b. The report concludes that the contribution of metals and sulfate from the WRD and TSF to the pit is minor to limited, however there is no justification provided to support this statement. c. A description of existing barriers incorporated into mine features and their integrity, is not included in the report.	there is no potential for sulfide oxidation and associated acid generation. Sulfate is not considered to be a chemical of potential concern associated with mine operations. Concentrations of major anions and cations, along with overall salinity increase between the aquifer and open pit due to evapo-concentration. Exceedances and trends of metal concentrations in groundwater are discussed. While the pit is the sink for groundwater in the vicinity of the TSF, groundwater in the area around the WRD flows towards the north, as illustrated in Figure 9. c) Current condition of the waste rock dump, tailings storage facility and decant dam is discussed.
7. Estimate the current lateral and vertical geographical extents of contaminants released to groundwater, from mine features.	The report concludes that the extent of contaminants is confined to the mine site and is controlled by the open cut pit acting as a groundwater sink, however based on the groundwater monitoring data presented in the report, this statement requires further justification. For example, groundwater bore THGW003 is off-lease and is considered to be a mine influenced bore. In addition, groundwater bores THGW004 (northernmost) and THGW005 (southernmost) have detected cyanide which indicates all groundwater systems may not flow to the open cut pit.	The extent of impacts to groundwater at and about the mine are evaluated and discussed, with consideration of the extent of influence of the pit as a groundwater sink. Groundwater impacts should be considered in the context of the nearly 30 years since mine operations ceased and that current conditions are reflective of stable or decreasing impacts. Minor detections of chemicals of concern along site boundaries are therefore not indicative of potential for off-site environmental harm.
8. To the extent necessary to prevent environmental harm, identify and prioritise potential options for a) the prevention of further contaminant releases from the premises to groundwater and b) remedial measures to reduce contaminant concentrations in groundwater.	The report concludes that further monitoring and assessment is required to define the source, cause and extent of contamination and suggests cyanide contamination is likely from the TSF, decant pond, or both. Remedial options are identified; however, no options analysis, prioritisation or evaluation for these options was presented.	Rectification works are required for the exposed tailings in the TSF, with a range of potential remediation options available which may reduce the footprint of the TSF and decant dam. These works are primarily required to stabilise the site and prevent dispersal of tailings material. As the source of free cyanide in the TSF and decant dam is assessed as being substantially depleted, further remediation or modification of other site structures, such as the WRD is not required.

Requirement	DES Comment	Response
9. The final report must include the results of all studies, assessments or analyses that were carried out during this investigation.	The assessment of environmental values in section 2.3 of the report, references '**Annexure 11 Envirofin 2020**', however this is not attached to the report.	This report can be supplied on request.
10. The final report must include the raw data for all results drawn upon in this investigation.	a. Groundwater monitoring raw data collected between 2020 and 2022 has been attached to the report in Appendix C and Appendix D, however the report indicates that data for THGW001 and THGW002 are available from 30 April 2012 to 22 June 2020. This data has not been provided with the raw data. b. Groundwater monitoring bore depths and associated groundwater water depth measurements are provided in the report, however the raw data, including groundwater bore logs and screened intervals, were not provided in support of these measurements. c. Section 3.3 of Appendix A of the report summarises surface water monitoring data collected in 2015 and 2018, however this raw data has not been provided in the report.	a) Data from 2012 has been included in the data tables and graphs. b) All available information relating to groundwater bore logs and installation are provided. c) Surface water data is provided in the tables appendix.
11. The final report must include nomination of appropriate water quality objectives to determine if environmental harm is being caused.	Water quality objectives for the site are nominated in section 2.9 of the report as livestock drinking water (sourced from ANZECC 2000), however insufficient details of the methodology and assessment has been provided in the report to justify this. Groundwater water quality objectives should be based on site-specific groundwater quality data with the objective to protect groundwater quality. Furthermore, the environmental value assessment provided in section 2.3 of the report identifies aquatic ecosystems as an applicable environmental value for surface waters. Where multiple environmental values have been identified, surface or groundwater quality should be managed to comply with the most conservative water quality guideline.	The applicability of various water quality guidelines in relation to identified exposure pathways to potential receptors is discussed, along with the potential for environmental harm in relation to exceedances of relevant screening criteria.

APPENDIX G: SITE INVESTIGATION BORELOGS

Geological Borelog

LOCATION Tick Hill Tailings		**Borehole Log: THGW07**	**Logged by** Anna Sheldon
SURFACE ELEVATION	**JOB NUMBER** 722092		
GROUNDWATER	**DATUM**	**PROJECT:** Tick Hill	**Proj. Manager** Anna Sheldon
DRILL METHOD SFA/AH	**DATE DRILLED** 9/06/23		

STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES: Undisturbed	SAMPLES: Disturbed	SAMPLES: Lost	SAMPLES: Duplicate	Moisture Content	PID/FID: Background	PID/FID: Reading	pH: pH - soil	pH: pH - water	Construction Details	Comments
Soil Red gravelly clay		1.0					D					Grout	
Red clay		2.0											
Red brown, gravelly clay		3.0					D						
Rock Heavily weathered biotite granofel. Brown clayey sand with mica		4.0 5.0											
Red and grey granofels, hard and weathered.		6.0					D					Backfill	Refusal AH
		7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0											
White Quartzite		15.0											
Weathered biotite granofel. Green-grey and red, hard		16.0 17.0 18.0 19.0 20.0 21.0											
White Quartzite		22.0											
Weathered Red and grey biotite granofel		23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0										Sand Pack Bentonite Seal	
Pink and grey quartz granofel. very hard		31.0 32.0 33.0 34.0 35.0 36.0											
End of borehole at 36 m		37.0 38.0											

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Geological Borelog

LOCATION Tick Hill Tailings		**Borehole Log: THGW08**	**Logged by** Anna Sheldon
SURFACE ELEVATION	**JOB NUMBER** 722092		
GROUNDWATER	**DATUM**	**PROJECT:** Tick Hill	**Proj. Manager** Anna Sheldon
DRILL METHOD SFA/AH	**DATE DRILLED** 9/06/23		

STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES: Undisturbed	SAMPLES: Disturbed	SAMPLES: Lost	SAMPLES: Duplicate	Moisture Content	PID/FID: Background	PID/FID: Reading	pH: pH - soil	pH: pH - water	Construction Details	Comments
Soil Red-brown sandy clay		1.0					D					Grout	
Brown and grey clayey sand with gravel -coarse, angular weathered biotite granofel gravel		2.0											
		3.0					D						
Rock Very hard black biotite granofel with minor quartz -bands of weathered clay		4.0											
		5.0											
White quartzite with minor biotite granofel		6.0					D						Refusal AH
Very hard black biotite granofel.		7.0										Backfill	
White quartzite with minor biotite		8.0											
		9.0											
		10.0					D						
		11.0											
		12.0											
		13.0											
Very hard Biotite shcist		14.0											
Dark grey biotite granofel		15.0					D						
		16.0											
		17.0											
White quartzite with pink weathering		18.0											
		19.0											
		20.0					D						
		21.0											
Very hard black biotite granofel with monir quartz and muscovitel		22.0											
		23.0											
		24.0											
		25.0					D						
		26.0											
		27.0											
Very hard black biotite granofel with pink quartzite		28.0										Sand Pack	
		29.0											
		30.0					D						
		31.0											
		32.0											
		33.0											
		34.0											
		35.0					D						
		36.0											
End of borehole at 36 m		37.0											
		38.0											

Bentonite Seal

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Geological Borelog

LOCATION Tick Hill Tailings		**Borehole Log: THGW09**	**Logged by** Anna Sheldon
SURFACE ELEVATION	**JOB NUMBER** 722092		
GROUNDWATER	**DATUM**	**PROJECT:** Tick Hill	**Proj. Manager** Anna Sheldon
DRILL METHOD AH	**DATE DRILLED** 9/06/23		

STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES: Undisturbed	SAMPLES: Disturbed	SAMPLES: Lost	SAMPLES: Duplicate	Moisture Content	PID/FID: Background	PID/FID: Reading	pH: pH - soil	pH: pH - water	Construction Details	Comments
Rock Heavily weathered granofel wit hquartz, biotite/amphibole and red clay		1.0 2.0					D D					Grout	
Grey-white-pink quartz-biotite granofel with hard green-grey layers		3.0											
Very hard, dark grey biotite granofel with minor quartz and k-feldspar		4.0 5.0 6.0											Refusal AH
Very hard, Pink and grey biotite-feldspar granofel with minor plagiolcase		7.0 8.0 9.0										Backfill	
Dark grey biotite granofel with feldspar,quartz, amphibole		10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0										Bentonite Seal Sand Pack	
End of borehole at 21 m		22.0 23.0 24.0											

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Geological Borelog

LOCATION Tick Hill Tailings		**Borehole Log: THT01**	**Logged by** Samuel Weiss
SURFACE ELEVATION	**JOB NUMBER** 722092		
GROUNDWATER	**DATUM**	**PROJECT:** Tick Hill	**Proj. Manager** Anna Sheldon
DRILL METHOD HA	**DATE DRILLED** 10/06/23		

STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES				Moisture Content	PID/FID		pH		Comments
			Undisturbed	Disturbed	Lost	Duplicate		Background	Reading	pH - soil	pH - water	
Fill Loose, brown, SAND - medium to fine grain		0.1 0.2 0.3 0.4 0.5 0.6 0.7		■			DM					Bulk sample from 0.5 to 1
Loose, brown, clayey SAND - medium to fine grain. - Red + grey mottle (5%)		0.8 0.9 1.0		■			DM					
Limit of investigation 1 m		1.1 1.2 1.3										

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Geological Borelog

LOCATION Tick Hill Tailings		**Borehole Log: THT02**	**Logged by** Samuel Weiss
SURFACE ELEVATION	**JOB NUMBER** 722092		
GROUNDWATER	**DATUM**	**PROJECT:** Tick Hill	**Proj. Manager** Anna Sheldon
DRILL METHOD HA	**DATE DRILLED** 10/06/23		

STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES				Moisture Content	PID/FID		pH		Comments
			Undisturbed	Disturbed	Lost	Duplicate		Background	Reading	pH - soil	pH - water	
Fill Loose, brown, SAND - medium to fine grain		0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0		■			M M					Bulk sample 0.5-1.0
Limit of investigation 1 m		1.1 1.2 1.3										

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Geological Borelog

LOCATION Tick Hill Tailings		**Borehole Log: THT03**	**Logged by** Samuel Weiss
SURFACE ELEVATION	**JOB NUMBER** 722092		
GROUNDWATER	**DATUM**	**PROJECT:** Tick Hill	**Proj. Manager** Anna Sheldon
DRILL METHOD HA	**DATE DRILLED** 09/06/23		

STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES				Moisture Content	PID/FID		pH		Comments
			Undisturbed	Disturbed	Lost	Duplicate		Background	Reading	pH - soil	pH - water	
Fill Loose, brown, sand, medium to fine grain		0.1										
		0.2										
		0.3										
		0.4										
		0.5		■			M					Bulk sample 0.5-1.0
		0.6										
		0.7										
		0.8										
		0.9										
		1.0		■			M					
Limit of investigation 1 m		1.1										
		1.2										
		1.3										

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Geological Borelog

LOCATION Tick Hill Tailings		**Borehole Log: THT04**	**Logged by** Samuel Weiss
SURFACE ELEVATION	**JOB NUMBER** 722092		
GROUNDWATER	**DATUM**	**PROJECT:** Tick Hill	**Proj. Manager** Anna Sheldon
DRILL METHOD HA	**DATE DRILLED** 09/06/23		

STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES				Moisture Content	PID/FID		pH		Comments
			Undisturbed	Disturbed	Lost	Duplicate		Background	Reading	pH - soil	pH - water	
Fill Loose, brown-grey, SAND -medium- fine grained		0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0		■								Bulk sample 0.5 - 1.0
Limit of investigation 1 m		1.1 1.2 1.3										

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Geological Borelog

LOCATION Tick Hill Tailings		**Borehole Log: THT05**	**Logged by** Samuel Weiss
SURFACE ELEVATION	**JOB NUMBER** 722092		
GROUNDWATER	**DATUM**	**PROJECT:** Tick Hill	**Proj. Manager** Anna Sheldon
DRILL METHOD HA	**DATE DRILLED** 10/06/23		

STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES				Moisture Content	PID/FID		pH		Comments
			Undisturbed	Disturbed	Lost	Duplicate		Background	Reading	pH - soil	pH - water	
Fill Loose, bown-grey, medium-fine sand		0.1										
		0.2										
		0.3										
		0.4										
		0.5		■			M					Bulk sample 0.5-1.0
		0.6										
		0.7										
		0.8										
		0.9										
				■			M					PFAS samples
		1.0										
Limit of investigation 1 m		1.1										
		1.2										
		1.3										

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Geological Borelog

LOCATION Tick Hill Tailings		**Borehole Log: THT06**	**Logged by** Samuel Weiss
SURFACE ELEVATION	**JOB NUMBER** 722092		
GROUNDWATER	**DATUM**	**PROJECT:** Tick Hill	**Proj. Manager** Anna Sheldon
DRILL METHOD HA	**DATE DRILLED** 10/06/23		

STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES				Moisture Content	PID/FID		pH		Comments
			Undisturbed	Disturbed	Lost	Duplicate		Background	Reading	pH - soil	pH - water	
Fill Loose, dark brown/grey, SAND -medium to fine grained		0.1										
		0.2										
		0.3										
		0.4										
		0.5		■			M					BD01 & SD01
		0.6										Bulk sample 0.5-1.0
		0.7										Wet/saturated soil. Only pieces
		0.8										
		0.9										
				■			M					
		1.0										
Limit of investigation 1 m		1.1										
		1.2										
		1.3										

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Geological Borelog

LOCATION Tick Hill Tailings		**Borehole Log: THT07**	**Logged by** Samuel Weiss
SURFACE ELEVATION	**JOB NUMBER** 722092		
GROUNDWATER	**DATUM**	**PROJECT:** Tick Hill	**Proj. Manager** Anna Sheldon
DRILL METHOD HA	**DATE DRILLED** 10/06/23		

STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES				Moisture Content	PID/FID		pH		Comments
			Undisturbed	Disturbed	Lost	Duplicate		Background	Reading	pH - soil	pH - water	
Fill Loose, brown/grey, fine-medium coarse SAND		0.1					D					
Natural Soft, red, clayey, medium-fine SAND - Gravel (1%)		0.2					M					PFAS
Limit of investigation 0.3 m		0.3 0.4 0.5										

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Geological Borelog

LOCATION Tick Hill Tailings		**Borehole Log: THT08**	**Logged by** Samuel Weiss
SURFACE ELEVATION	**JOB NUMBER** 722092		
GROUNDWATER	**DATUM**	**PROJECT:** Tick Hill	**Proj. Manager** Anna Sheldon
DRILL METHOD HA	**DATE DRILLED** 10/06/23		

STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES				Moisture Content	PID/FID		pH		Comments
			Undisturbed	Disturbed	Lost	Duplicate		Background	Reading	pH - soil	pH - water	
Natural Firm, red, clayey SAND - Minor gravel		0.1 0.2 0.3 0.4 0.5		■			D M					
Limit of investigation 0.5 m		0.6 0.7										

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Geological Borelog

LOCATION Tick Hill Tailings		**Borehole Log: THT09**	**Logged by** Anna Sheldon
SURFACE ELEVATION	**JOB NUMBER** 722092		
GROUNDWATER	**DATUM**	**PROJECT:** Tick Hill	**Proj. Manager** Anna Sheldon
DRILL METHOD PT	**DATE DRILLED** 11/06/23		

STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES: Undisturbed	SAMPLES: Disturbed	SAMPLES: Lost	SAMPLES: Duplicate	Moisture Content	PID/FID: Background	PID/FID: Reading	pH: pH - soil	pH: pH - water	Construction Details	Comments
Cover Brown, clayey GRAVEL. Compacted.							D						
Tailings Fine, pale, pink-brown SAND		1.0											Bulk tailings sample, jar, pfas
							D						
		2.0											
Brown, sandy													
							SM						Large Jar
		3.0											
							D						
		4.0											
Very fine, grey, clayey SAND							D					▼	Saturated at 4.2m Large Jar
Layers, grey fine, clayey SAND													
		5.0											Large jar
End of borehole at 5.6 m		6.0											

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Geological Borelog

LOCATION Tick Hill Tailings		**Borehole Log: THT10**	**Logged by** Anna Sheldon
SURFACE ELEVATION	**JOB NUMBER** 722092		
GROUNDWATER	**DATUM**	**PROJECT:** Tick Hill	**Proj. Manager** Anna Sheldon
DRILL METHOD PT	**DATE DRILLED** 11/06/23		

STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES				Moisture Content	PID/FID		pH		Construction Details	Comments
			Undisturbed	Disturbed	Lost	Duplicate		Background	Reading	pH - soil	pH - water		
Cap Brown, clayey GRAVEL. Dense.							D						Large Jars
Tailings Grey, fine, SAND. Fine layers of brown clayey fine sand.		1.0					D						
		2.0											
Mainly Brown		3.0					SM						
							D						
Mainly grey		4.0					D						
Dark grey. saturated		5.0											
End of borehole at 5.6 m		6.0											

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Geological Borelog

LOCATION Tick Hill Tailings		**Borehole Log: THT11**	**Logged by** Anna Sheldon
SURFACE ELEVATION	**JOB NUMBER** 722092		
GROUNDWATER	**DATUM**	**PROJECT:** Tick Hill	**Proj. Manager** Anna Sheldon
DRILL METHOD PT	**DATE DRILLED** 11/06/23		

STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES				Moisture Content	PID/FID		pH		Construction Details	Comments
			Undisturbed	Disturbed	Lost	Duplicate		Background	Reading	pH - soil	pH - water		
Cap Red brown, clayey gravel.													
Tailings grey gravel. Hard		1.0					D						All samples in Pfas jars
Pale grey brown sandy. Fine roots		2.0					D						
Pale grey		3.0											
Grey pale, grey brown sandy		4.0					SM						
moist - sandy. Minimal clay layers		5.0					M M						
End of borehole at 5.6 m		6.0											

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

MACQUARIE FRANKLIN

Consultants for business, agriculture and environment

Borehole log for Groundwater

ID THGW 003
Sheet 1 of 1

Project: TICK HILL
Location: TICK HILL (CARNABY RESOURCES)

Coordinates: 388276.7E 7605898.6N
Datum: MGA94-54
RL: 341.0
Inclination: VERTICAL
Bearing: –

Drill type: RC
Equipment: DE 810
Drill fluid(s): –

Hole started: 9/1/20
Hole finished: 9/1/20
Drilled by: DOAN PKYRITSIS (AMWD)
Logged by: PAUL TAN
Checked by:

Bit types/size	Water	Penetration 1 2 3 4	Notes samples and tests	Metres KL	Metres Depth	Graphic log	USCS Symbol	Materials Soil type, colour, plasticity or particle characteristics, secondary and minor components	Moisture condition	Consistency density index	Casing details	Structure, geology and interpretation
HAMMER 117mm								COLLUVIUM (BROWN CLAY)	D	F/H		CLAY
								PARA AMPHIBOLITE, MODERATE OX	D	H/D		ROCK
								PEGMATITE	D	H/VD		ROCK
				5				PEGMATITE MODERATELY OXIDISED. WHITE-BROWN	D	H/VD	CEMENT	ROCK
								QUARTZ BIOTITE GRANOFELS WEAKLY WEATHERED - BROWN-GREEN	D	H/VD		ROCK
				10				PEGMATITE. FRESH. PINK-GREY	D	H/VD		ROCK
								QUARTZ BIOTITE GRANOFELS FRESH. PINK GREY	D	H/VD		ROCK
HAMMER 133mm				15				BIOTITE SCHIST FRESH, BLACK	D	H/VD	DOG CUTTINGS	ROCK
HAMMER 122mm				20				~~PEGMATITE. FRESH PINK-GREY~~ QUARTZ BIOTITE GRANOFELS. FRESH. PINK-BLACK	D	H/VD		ROCK
				25				PEGMATITE. FRESH PINK-GREY	D	H/VD	BENTONITE	ROCK
				30				PEGMATITE WITH QUARTZ BIOTITE GRANOFELS - FRESH.	M	H/VD	GRAVEL	ROCK
				35				PEGMATITE, PINK, FRESH	D	H/VD		ROCK
								PEGMATITE, PINK, FRESH	M	H/VD		ROCK
				40				PEGMATITE, PINK, FRESH.	D	H/VD		ROCK
								Conductivity 950 uS pH 6.5				

MOISTURE
D = Dry
M = Moist
W = Wet
mbgl = m below ground level
magl = m above ground level

WATER
Water level
Water inflow
Water outflow
GNE = Groundwater not encountered

PENETRATION
1 2 3 4
No resistance
Refusal

GRAPHIC LOG KEY
CLAY (CH, CI)
SILT (SM)
ROOTS
COBBLES (63-200mm)
BOULDERS (>200mm)
SAND (SP)
GRAVEL (GP, GW)
FRACTURES

Collar 8.5m above gl

CONSISTENCY (silt, clay, sandy clay, silty clay) VS = Very soft (<25kPa; exudes in fingers when squeezed); S = Soft (25 – 50kPa; easily penetrated by fist); F = Firm (50 – 100kPa; easily penetrated by thumb); St = Stiff (100 – 200kPa; indented by thumb, penetrated with difficulty); VSt = Very Stiff (200 – 400kPa; easily indented by thumbnail; H = Hard (>400kPa; indented by thumbnail with difficulty); Fb = Friable (crumbles or powders when scraped by thumbnail.
RELATIVE DENSITY (sand and gravel) VL = Very loose (ravelling); L = Loose (easy shovelling); MD = Medium dense (hard shovelling); D = Dense *picking); VD = Very dense (hard picking)

PVC Installation
0-6m 150mm CLASS 9 PVC COLLAR PIPE
collar - 28m Plain 50mm PVC
28m - 40m Slotted 50mm PVC
40 - 40.5m Plain 50mm PVC
+ alued cap.

0-6.1m Cement Kill
6.1m - 25m RC drill cuttings
25m - 26.7m Bentonite
26.7m - 40.5m Gravel

MACQUARIE FRANKLIN

Consultants for business, agriculture and environment

Borehole log for Groundwater

ID THGW 00 K

Sheet 1 of 1

Project: TICK HILL

Location: TICK HILL (CARNABY RESOURCES)

Coordinates: 389233.9E 7606543.5N

Datum: MGA94-54

RL: 327.3

Inclination: VERTICAL

Bearing: –

Drill type: RC

Equipment: DE 810

Drill fluid(s): –

Hole started: 9/1/20

Hole finished: 9/1/20

Drilled by: DEAN KYRITSIS (AMWD)

Logged by: PAUL TAN

Checked by:

Bit types/size	Water	Penetration 1 2 3 4	Notes samples and tests	Metres KL	Metres Depth	Graphic log	USCS Symbol	Materials Soil type, colour, plasticity or particle characteristics, secondary and minor components	Moisture condition	Consistency density index	Casing details	Structure, geology and interpretation
HAMMER 172mm								COLLUVIUM, BROWN, CLAY RICH	D	ST/MD		CLAY
				5				STRONGLY WEATHERED QUARTZ BIOTITE GRANOFELS SAPROCK HIGH CLAY %. GREEN/GREY + BROWN	D	VST/D	DRILL CUTTINGS CEMENT	CLAY
133mm				10				WEAKLY OXIDISED QTZ-BIOTITE GRANOFELS PINK-BROWN	D	H/VD		ROCK
								FRESH QUARTZ BIOTITE GRANOFELS PINK-GREY		H/VD	BENTONITE	ROCK
HAMMER				15				PEGMATITE, FRESH, PINK WHITE	D	H/VD		ROCK
								PEGMATITE + QTZ BIOTITE GRANOFELS	M	H/VD		ROCK
				20				PEGMATITE, FRESH, PINK WHITE	D	H/VD	GRAVEL BACKFILL	ROCK
				25				QUARTZ BIOTITE GRANOFELS FRESH, BLACK	D	H/VD		ROCK
								Conductivity 2.76 mS pH 8.8				

MOISTURE
D = Dry
M = Moist
W = Wet
mbgl = m below ground level
magl = m above ground level

WATER
Water level
Water inflow
Water outflow
GNE = Groundwater not encountered

PENETRATION
1 2 3 4
No resistance
Refusal

GRAPHIC LOG KEY
CLAY (CH, CI)
SILT (SM)
ROOTS
COBBLES (63-200mm)
BOULDERS (>200mm)
SAND (SP)
GRAVEL (GP, GW
FRACTURES

Collar 8.5 m above gl

CONSISTENCY (silt, clay, sandy clay, silty clay) VS = Very soft (<25kPa; exudes in fingers when squeezed); S = Soft (25 – 50kPa; easily penetrated by fist); F = Firm (50 – 100kPa; easily penetrated by thumb); St = Stiff (100 – 200kPa; indented by thumb, penetrated with difficulty); VSt = Very Stiff (200 – 400kPa; easily indented by thumbnail; H = Hard (>400kPa; indented by thumbnail with difficulty); Fb = Friable (crumbles or powders when scraped by thumbnail.
RELATIVE DENSITY (sand and gravel) VL = Very loose (shovelling); L = Loose (easy shovelling); MD = Medium dense (hard shovelling); D = Dense (picking); VD = Very dense (hard picking)

PVC INSTALLATION
0-6m 150mm CLASS 9 PVC COLLAR PIPE
Collar-15m PLAIN 50mm PVC
15m - 27m SLOTTED 50mm PVC
27-27.5m PLAIN 50mm PVC
+ GLUED CAP

0-6.5m CEMENT FILL
6.5-12m RC DRILL CUTTINGS
12m-13.6m BENTONITE
13.6m-27.5m GRAVEL

MACQUARIE FRANKLIN

Consultants for business, agriculture and environment

Borehole log for Groundwater

ID: TMGW005

Sheet 1 of 1

Project: TICK HILL

Location: TICK HILL (CARNABY RESOURCES)

Coordinates: 388678.6E 7605239.9N

Datum: MGA94 - 54

RL: 347.57m

Inclination: VERTICAL

Bearing: —

Drill type: RC

Equipment: DE 810

Drill fluid(s): —

Hole started: 8/1/20

Hole finished: 8/1/20

Drilled by: DEAN KAYRITSIS (AMWD)

Logged by: PAUL TAN

Checked by:

Bit types/size	Water	Penetration 1 2 3 4	Notes samples and tests	Metres RL	Metres Depth	Graphic log	USCS Symbol	Materials (Soil type, colour, plasticity or particle characteristics, secondary and minor components)	Moisture condition	Consistency density index	Casing details	Structure, geology and interpretation
								COLLUVIUM / CLAY RED BROWN	D	F/MD		CLAY
								QUARTZ BIOTITE GRANOFELS, MODERATE OX	D	H/VD		ROCK
HAMMER 117mm					5			QUARTZ BIOTITE GRANOFELS, WEAKLY WEATHERED, GREY WHITE	D	H/VD	CEMENT	ROCK
					10			QUARTZ BIOTITE GRANOFELS FRESH PINK-GREY	D	H/VD	CUTTINGS	ROCK
HAMMER 133mm					20			MODERATELY-WEAKLY WEATHERED QUARTZ BIOTITE GRANOFELS WITH SOME CLAY, BROWN	D	H/D	DRILL	ROCK
					25			QUARTZITE, FRESH, PINK	D	H/VD	BENTONITE	ROCK
					30			CALC SILICATE, FRESH GREEN-BROWN / GREY	D	H/VD	GRAVEL	ROCK
					40			Conductivity > 950 uS pH 8.5				

MOISTURE: D = Dry; M = Moist; W = Wet; mbgl = m below ground level; magl = m above ground level

WATER: Water level; Water inflow; Water outflow; GNE = Groundwater not encountered

PENETRATION: 1 2 3 4 — No resistance; Refusal

GRAPHIC LOG KEY: CLAY (CH, CI); SILT (SM); ROOTS; COBBLES (63-200mm); SAND (SP); GRAVEL (GP, GW); FRACTURES; BOULDERS (>200mm)

Collar 8.5m above gl

CONSISTENCY (silt, clay, sandy clay, silty clay) VS = Very soft (<25kPa; exudes in fingers when squeezed); S = Soft (25 – 50kPa; easily penetrated by fist); F = Firm (50 – 100kPa; easily penetrated by thumb); St = Stiff (100 – 200kPa; indented by thumb, penetrated with difficulty); VSt = Very Stiff (200 – 400kPa; easily indented by thumbnail; H = Hard (>400kPa; indented by thumbnail with difficulty); Fb = Friable (crumbles or powders when scraped by thumbnail.

RELATIVE DENSITY (sand and gravel) VL = Very loose (savelling); L = Loose (easy shovelling); MD = Medium dense (hard shovelling); D = Dense *picking); VD = Very dense (hard picking)

PVC Installation
0-6m 150mm CLASS 9 PVC COLLAR PIPE
collar - 29.5m Plain 50mm PVC
29.5 - 41.5m Slotted 50mm PVC
41.5 - 42m Plain 50mm PVC + glued cap.

0 - 6.1m Cement fill
6.1 - 26.6m RC drill cuttings
26.6 - 28m Bentonite
28 - 42m gravel

MACQUARIE FRANKLIN

Consultants for business, agriculture and environment

Borehole log for Groundwater

ID THGW006
Sheet 2 of 1

Project: TICK HILL
Location: TICK HILL (GARNABY RESOURCES)

Coordinates: 388990E 7605926N
Datum: MGA94 / 54
RL: 337.5m
Inclination: VERTICAL
Bearing: —

Drill type: RC
Equipment: DE810
Drill fluid(s): —

Hole started: THGW006 7/11/20
Hole finished: 7/11/20
Drilled by: DEAN KYRITSIS (AMW)
Logged by: PAUL TAN
Checked by:

Bit types/size	Water	Penetration 1 2 3 4	Notes samples and tests	Metres RL	Metres Depth	Graphic log	USCS Symbol	Materials Soil type, colour, plasticity or particle characteristics, secondary and minor components	Moisture condition	Consistency density index	Casing details	Structure, geology and interpretation
HAMMER 172mm								Quartzite, PARTIALLY OXIDISED WHITE - PINK	D	H/VD	COMPLETE	ROCK
					5			Quartzite, MODERATELY OXIDISED WHITE - PINK	D	H/VD		ROCK
								Quartzite with minor clay	D	VST/D		ROCK
HAMMER 133mm					10			QUARTZITE, FRESH RED/PINK & WHITE	D	H/VD	DRILL CUTTINGS	ROCK
					15							BENTONITE
								Qtz BIOTITE GRANOFELS. VERY WEATHERED WITH HIGH % CLAY	M	ST/D		CLAY/ROCK AQUIFER
					20			PARA AMPHIBOLITE FRESH PINK - GREEN 20-21m WEAK OXIDATION	M	H/VD		ROCK
					25			QTZ BIOTITE GRANOFELS FRESH PINK & GREEN/BLACK. 28-29m WEAK OXIDATION	M	H/VD		ROCK
					30			Conductivity 1750 uS pH 8.5				

MOISTURE
D = Dry
M = Moist
W = Wet
mbgl = m below ground level
magl = m above ground level

WATER
Water level
Water inflow
Water outflow
GNE = Groundwater not encountered

PENETRATION
1 2 3 4
No resistance
Refusal

GRAPHIC LOG KEY
CLAY (CH, CI)
SILT (SM)
ROOTS
COBBLES (63-200mm)
BOULDERS (>200mm)
SAND (SP)
GRAVEL (GP, GW
FRACTURES

Collar 8.5 m above gl

CONSISTENCY (silt, clay, sandy clay, silty clay) VS = Very soft (<25kPa; exudes in fingers when squeezed); S = Soft (25 – 50kPa; easily penetrated by fist); F = Firm (50 – 100kPa; easily penetrated by thumb); St = Stiff (100 – 200kPa; indented by thumb, penetrated with difficulty); VSt = Very Stiff (200 – 400kPa; easily indented by thumbnail; H = Hard (>400kPa; indented by thumbnail with difficulty); Fb = Friable (crumbles or powders when scraped by thumbnail.
RELATIVE DENSITY (sand and gravel) VL = Very loose (ravelling); L = Loose (easy shovelling); MD = Medium dense (hard shovelling); D = Dense (picking); VD = Very dense (hard picking)

PVC Installation: 0-6m 150m CLASS 9 PVC COLLAR PIPE

Collar - 17.5m Plain 50mm PVC
17.5 - 29.5 Slotted 50mm PVC
29.5 - 30m Plain 50mm PVC + glued cap

0 - 6.5m cement fill
6.5 - 14.8m RC drill cuttings
14.8 - 16m bentonite
16m - 30m gravel

APPENDIX H: CALIBRATION CERTIFICATES

Equipment Calibration Record – Water Quality Monitoring

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

This equipment calibration record is to be scanned and stored in your job folder.

Equipment Number:	YSI 01
Equipment Serial:	17916 2112
Date of Calibration:	~~[illegible]~~ 6/6/23

Note: See over for temperature variations.

Details of Calibration	Buffer Lot	Pre Cal	Post Cal	GLP data
Temperature (°C)	20.5 °C			-
Sp. Conductivity at 2.76 mS/cm	CU29112	2.48	2.5	Cell constant: 4.24 (5.0 ± 1.0)
Sp. Conductivity at 12.90 mS/cm	—			
pH at 7.0	CH150223	6.97	7.02	mV value: -15.2 (0 mV ± 50 mV)
pH at 4.0	CH231122	3.99	6.00	mV value: 156.5 (+165 to +180 from buffer 7)
pH at 10.0	—			mV value: (-165 to -180 from buffer 7)
				pH Slope: 57.73 (≈ 55 to 60 mV/pH, 59 ideal)
Redox Potential 223 mV (@ 25°C – see over)	22M100225	230.5	230.5	-
Barometric pressure	767.1 mmHg			-
Dissolved Oxygen at 0.00 ppm	24/6/23	-0.2	—	Sensor value: 5.52 (@25°C & 760 mmHg min 4.31 uA, max 8.00 uA)
Dissolved Oxygen at 100% Air Saturation	-	99.8	100	
Turbidity at 1 NTU	—			-
Turbidity at 10 NTU				-
Turbidity at 100 NTU				-
Turbidity at 1,000 NTU				-

Passed calibration: (Y) / N

Name: Nick Neary Date: 6 / 6 / 23 Signed: [signature]

Equipment Calibration Record – Water Quality Monitoring

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

pH at 4.0

T °C	pH
5	4.01
10	4.00
15	4.00
20	4.00
25	4.01
30	4.01
35	4.02
40	4.03
Accepted calibration variation: ± 0.02 @ 25°C	

Redox Potential 223 mV

T °C	mV
5	252.4
10	245.05
15	237.7
20	230.35
25	223.0
30	215.65
35	208.3
40	200.95
Accepted calibration variation: ± 10 mV @ 25°C	

pH at 7.0

T °C	pH
5	7.09
10	7.06
15	7.04
20	7.02
25	7.00
30	6.99
35	6.98
40	6.97
Accepted calibration variation: ± 0.02 @ 25°C	

Conductivity at 2.76 mS/cm

T °C	mS/cm
16	2.29
18	2.39
20	2.50
22	2.60
25	2.76
28	2.92
30	3.02
35	3.29
Accepted calibration variation: ± 1% @ 25°C	

pH at 10.0

T °C	pH
5	10.24
10	10.19
15	10.12
20	10.06
25	10.00
30	9.95
35	9.92
40	9.90
Accepted calibration variation: ± 0.05 @ 25°C	

Conductivity at 12.90 mS/cm

T °C	mS/cm
16	10.68
18	11.18
20	11.67
22	12.16
25	12.90
28	13.64
30	14.13
35	15.36
Accepted calibration variation: ± 1% @ 25°C	

ENVIRONMENTAL EARTH SCIENCES

Equipment Calibration Record – TPS

This equipment calibration record is to be stored in your job folder

Equipment type/model:	~~TPS Water Quality Meter – 90FL(MV)~~T
Equipment number:	451.
Date calibrated:	18/12/2022
Fieldwork date:	19/12/2022
Calibrated by:	AS
Job number:	722092

Details of Calibration	Reading after calibration	Units	Acceptable range	Conclusion
Visual electrode check (condition):	N/A	N/A	N/A	
Battery reading:	N/A	Volts	6.5 – 8.5	
Temperature reading:	24.9	°C	±1 °C	
pH in 4.01 Solution:	4.01	pH units	3.91 – 4.11	
pH in 7.01 Solution:	7.00	pH units	6.91 – 7.11	
pH in 10.01 Solution:		pH units	9.91 – 10.11	
ORP in 240mV Redox solution:	232.4	mV	205 – 275	temp adjusted.
EC in 2.5 µS cm^{-1} deionised water:		µS cm^{-1}	0 – 7.0	
EC in 2,760 µS cm^{-1} solution:	2706	µS cm^{-1}	2,600 – 2,900	
EC in 12,880 µS cm^{-1} solution:	12520	µS cm^{-1}	12,500 – 13,200	
DO in 0.0% Water & $NaSO_4$ solution:		% DO	0.0 – 1.5	
DO in 100% air saturation:		% DO	99.0 – 101.0	

APPENDIX I: LABORATORY CERTIFICATES AND CHAIN OF CUSTODY DOCUMENTATION

CERTIFICATE OF ANALYSIS

Work Order	: **EB2317957**	Page	: 1 of 46
Amendment	: **1**		
Client	: **ENVIRONMENTAL EARTH SCIENCES**	Laboratory	: Environmental Division Brisbane
Contact	: MS ANNA SHELDON	Contact	: David Wall
Address	: PO BOX 3207 NEWSTEAD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: 07 3852 6666	Telephone	: +61-7-3243 7222
Project	: 722092	Date Samples Received	: 14-Jun-2023 10:35
Order number	: ----	Date Analysis Commenced	: 16-Jun-2023
C-O-C number	: COC#3/4/5-AAE-BR	Issue Date	: 07-Jul-2023 15:50
Sampler	: AS / SW		
Site	: Tick Hill		
Quote number	: EB23ENVEAR0004		
No. of samples received	: 65		
No. of samples analysed	: 55		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Acid Sulphate Soils, Stafford, QLD
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Inorganics, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Keegan Mullane	Senior Chemist - Organics	Brisbane Organics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Mark Hallas	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Matt Frost	Assistant Laboratory Manager	Brisbane Organics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- It is recognised that EK028SF (WAD Cyanide by SFA) is less than EK025SF (Free Cyanide) for sample GWBD01 (EB2317957-012). However, the difference is within experimental variation of the methods.
- It is recognised that EK028SF (WAD Cyanide by SFA) is less than EK025SF (Free Cyanide) for sample THGW08 (EB2317957-008). However, the difference is within experimental variation of the methods.
- It is recognised that EK028SF (WAD Cyanide by SFA) is less than EK025SF (Free Cyanide) for sample THGW01 (EB2317957-001). However, the difference is within experimental variation of the methods.
- EP231X-LL PFAS Low Level: High LCS recovery deemed acceptable as all associated analyte results are less than LOR.
- EK067G (Total Phosphorus as P): Sample EB2318164-001 shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- EP231X - Per- and Polyfluoroalkyl Substances (PFAS): Samples received in 20ml or 125ml bottles have been tested in accordance with the QSM5.3 compliant, NATA accredited method. 60mL or 250mL bottles have been tested to the legacy QSM 5.1 aligned, NATA accredited method.
- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP068: Where reported, Total Chlordane (sum) is the sum of the reported concentrations of cis-Chlordane and trans-Chlordane at or above the LOR.
- EP068: Where reported, Total OCP is the sum of the reported concentrations of all Organochlorine Pesticides at or above LOR.
- As per QWI – EN55-3 Data Interpreting Procedures, Ionic balances are typically calculated using Major Anions - Chloride, Alkalinity and Sulfate; and Major Cations - Calcium, Magnesium, Potassium and Sodium. Where applicable and dependent upon sample matrix, the Ionic Balance may also include the additional contribution of Ammonia, Dissolved Metals by ICPMS and H+ to the Cations and Nitrate, SiO2 and Fluoride to the Anions.
- Amendment (DD/MM/YYYY): This report has been amended and re-released to allow the reporting of additional analytical data, specifically method Free, Total and WAD Cyanide (EK026SF, EK025SF, EK028SF) and Metals EG020T for sample <client ID>> EB2317957_062 (BD01).
- It is recognised that EG020T (Total Metals by ICP-MS) is less than EG020F (Dissolved Metals by ICP-MS) for some samples. However, the difference is within experimental variation of the methods.
- EG020-T (Total Metals by ICP-MS): Sample THS01 0-0.1 (EB2317957-014) shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- EP231X-LL PFAS Low level: The LOR values for PFHxS and PFOS have been raised in sample ‘GWBD01’ (EB2317957-012) due to matrix interference.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.
- EP231: Stable isotope enriched internal standards are added to samples prior to extraction. Target compounds have a direct analogous internal standard with the exception of PFPeS, PFHpA, PFDS, PFTrDA and 10:2 FTS. These compounds use an internal standard that is chemically related and has a retention time close to that of the target compound. The DQO for internal standard response is 50-150% of that established at initial calibration. PFOS is quantified using a certified, traceable standard consisting of linear and branched PFOS isomers. These practices are in line with recommendations in the National Environmental Management Plan for PFAS (Australian HEPA) and also conform to QSM 5.3 (US DoD) requirements.

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)			Sample ID	THT10 2.5 - 3.0	THT10 5.0 - 5.5	----	----	----
			Sampling date / time	11-Jun-2023 00:00	11-Jun-2023 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EB2317957-055	EB2317957-057	--------	--------	--------
				Result	Result	----	----	----
EG020W: Water Leachable Metals by ICP-MS								
Antimony	7440-36-0	0.001	mg/L	<0.001	**0.001**	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.006**	**0.008**	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.640**	**0.692**	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	**0.0001**	**0.0002**	----	----	----
Chromium	7440-47-3	0.001	mg/L	**0.024**	**0.016**	----	----	----
Cobalt	7440-48-4	0.001	mg/L	**0.031**	**0.062**	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.096**	**0.017**	----	----	----
Lead	7439-92-1	0.001	mg/L	**0.003**	**0.002**	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.062**	**0.040**	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.005**	**0.004**	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.006**	**0.004**	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.017**	**0.016**	----	----	----
Titanium	7440-32-6	0.01	mg/L	**0.08**	**0.04**	----	----	----
Uranium	7440-61-1	0.001	mg/L	**0.001**	**0.002**	----	----	----
Vanadium	7440-62-2	0.01	mg/L	**0.02**	**0.04**	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.063**	**0.073**	----	----	----
Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	----	----	----

Analytical Results

Sub-Matrix: ASLP ZHE LEACHATE (Matrix: WATER)			Sample ID	THT03 0.5	THT03 1.0	THT05 0.5	THT05 1.0	THT10 1.0 - 1.5
			Sampling date / time	09-Jun-2023 00:00	09-Jun-2023 00:00	09-Jun-2023 00:00	09-Jun-2023 00:00	11-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-039	EB2317957-040	EB2317957-043	EB2317957-044	EB2317957-054
				Result	Result	Result	Result	Result
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	0.002	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002

Analytical Results

Sub-Matrix: ASLP ZHE LEACHATE (Matrix: WATER)			Sample ID	THT10 2.5 - 3.0	THT10 4.0 - 4.5	THT10 5.0 - 5.5	THT11 1.2 - 1.5	THT11 2.5 - 3.0
			Sampling date / time	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-055	EB2317957-056	EB2317957-057	EB2317957-058	EB2317957-059
				Result	Result	Result	Result	Result
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	0.002	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002

Analytical Results

Sub-Matrix: ASLP ZHE LEACHATE (Matrix: WATER)			Sample ID	THT11 4.0 - 4.4	THT11 5.0 - 5.5	----	----	----
			Sampling date / time	11-Jun-2023 00:00	11-Jun-2023 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EB2317957-060	EB2317957-061	--------	--------	--------
				Result	Result	----	----	----
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	0.002	mg/L	<0.002	<0.002	**----**	**----**	**----**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THS01 0-0.1	THS02 0-0.1	THS03 0.3-0.35	THS04 0-0.1	THS06 0-0.05
			Sampling date / time	10-Jun-2023 00:00	10-Jun-2023 00:00	10-Jun-2023 00:00	10-Jun-2023 00:00	10-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-014	EB2317957-015	EB2317957-017	EB2317957-018	EB2317957-020
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.3	----	8.8	----	8.9
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	100	----	96	----	67
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	----	----	----	----	0.010
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	1.8	3.3	7.0	<0.1	----
Moisture Content	----	1.0	%	----	----	----	----	4.2
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	8530	----	----	4930	7390
Iron	7439-89-6	50	mg/kg	20400	----	----	14200	10700
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.1	mg/kg	1.9	----	----	0.6	0.9
Selenium	7782-49-2	1	mg/kg	<1	----	----	<1	<1
Barium	7440-39-3	0.1	mg/kg	55.0	----	----	67.3	93.9
Cadmium	7440-43-9	0.1	mg/kg	<0.1	----	----	<0.1	<0.1
Cobalt	7440-48-4	0.1	mg/kg	11.3	----	----	6.5	5.9
Chromium	7440-47-3	0.1	mg/kg	18.7	----	----	22.0	13.9
Copper	7440-50-8	0.1	mg/kg	42.0	----	----	8.7	11.0
Manganese	7439-96-5	0.1	mg/kg	175	----	----	182	132
Strontium	7440-24-6	0.1	mg/kg	14.2	----	----	4.5	96.6
Tungsten	7440-33-7	0.1	mg/kg	<0.1	----	----	<0.1	<0.1
Molybdenum	7439-98-7	0.1	mg/kg	0.5	----	----	<0.1	<0.1
Nickel	7440-02-0	0.1	mg/kg	15.3	----	----	10.6	8.4
Lead	7439-92-1	0.1	mg/kg	3.2	----	----	1.6	2.5
Antimony	7440-36-0	0.1	mg/kg	<0.1	----	----	<0.1	<0.1
Uranium	7440-61-1	0.1	mg/kg	0.6	----	----	0.3	0.8
Zinc	7440-66-6	0.5	mg/kg	16.6	----	----	6.9	11.3
Vanadium	7440-62-2	1	mg/kg	45	----	----	39	42
Titanium	7440-32-6	1	mg/kg	201	----	----	392	379
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	1	mg/kg	<1	<1	<1	----	<1
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	5	<1	<1	----	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THS01 0-0.1	THS02 0-0.1	THS03 0.3-0.35	THS04 0-0.1	THS06 0-0.05
			Sampling date / time	10-Jun-2023 00:00	10-Jun-2023 00:00	10-Jun-2023 00:00	10-Jun-2023 00:00	10-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-014	EB2317957-015	EB2317957-017	EB2317957-018	EB2317957-020
				Result	Result	Result	Result	Result
EK026SF: Total CN by Segmented Flow Analyser - Continued								
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	<1	<1	----	<1
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	----	----	----	----	**499**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	----	----	----	----	**1.9**
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	----	----	----	----	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	----	----	----	----	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	----	----	----	----	<0.05
beta-BHC	319-85-7	0.05	mg/kg	----	----	----	----	<0.05
gamma-BHC	58-89-9	0.05	mg/kg	----	----	----	----	<0.05
delta-BHC	319-86-8	0.05	mg/kg	----	----	----	----	<0.05
Heptachlor	76-44-8	0.05	mg/kg	----	----	----	----	<0.05
Aldrin	309-00-2	0.05	mg/kg	----	----	----	----	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg	----	----	----	----	<0.05
^ Total Chlordane (sum)	----	0.05	mg/kg	----	----	----	----	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg	----	----	----	----	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg	----	----	----	----	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg	----	----	----	----	<0.05
Dieldrin	60-57-1	0.05	mg/kg	----	----	----	----	<0.05
4.4`-DDE	72-55-9	0.05	mg/kg	----	----	----	----	<0.05
Endrin	72-20-8	0.05	mg/kg	----	----	----	----	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg	----	----	----	----	<0.05
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	----	----	----	----	<0.05
4.4`-DDD	72-54-8	0.05	mg/kg	----	----	----	----	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg	----	----	----	----	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg	----	----	----	----	<0.05
4.4`-DDT	50-29-3	0.2	mg/kg	----	----	----	----	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg	----	----	----	----	<0.05
Methoxychlor	72-43-5	0.2	mg/kg	----	----	----	----	<0.2
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	----	----	----	----	<0.05

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THS01 0-0.1	THS02 0-0.1	THS03 0.3-0.35	THS04 0-0.1	THS06 0-0.05
			Sampling date / time	10-Jun-2023 00:00	10-Jun-2023 00:00	10-Jun-2023 00:00	10-Jun-2023 00:00	10-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-014	EB2317957-015	EB2317957-017	EB2317957-018	EB2317957-020
				Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued								
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	----	----	----	----	<0.05
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	----	----	----	----	<10
C10 - C14 Fraction	----	50	mg/kg	----	----	----	----	<50
C15 - C28 Fraction	----	100	mg/kg	----	----	----	----	<100
C29 - C36 Fraction	----	100	mg/kg	----	----	----	----	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	----	----	----	----	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	----	----	----	----	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	----	----	----	----	<10
>C10 - C16 Fraction	----	50	mg/kg	----	----	----	----	<50
>C16 - C34 Fraction	----	100	mg/kg	----	----	----	----	<100
>C34 - C40 Fraction	----	100	mg/kg	----	----	----	----	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	----	----	----	----	<50
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	----	----	----	----	<50
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	----	----	----	----	<0.2
Toluene	108-88-3	0.5	mg/kg	----	----	----	----	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	----	----	----	----	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	----	----	----	----	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	----	----	----	----	<0.5
^ Sum of BTEX	----	0.2	mg/kg	----	----	----	----	<0.2
^ Total Xylenes	----	0.5	mg/kg	----	----	----	----	<0.5
Naphthalene	91-20-3	1	mg/kg	----	----	----	----	<1
EP231A: Perfluoroalkyl Sulfonic Acids								
Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg	----	----	----	----	<0.0002
Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.0002	mg/kg	----	----	----	----	<0.0002
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg	----	----	----	----	<0.0002

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THS01 0-0.1	THS02 0-0.1	THS03 0.3-0.35	THS04 0-0.1	THS06 0-0.05
			Sampling date / time	10-Jun-2023 00:00	10-Jun-2023 00:00	10-Jun-2023 00:00	10-Jun-2023 00:00	10-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-014	EB2317957-015	EB2317957-017	EB2317957-018	EB2317957-020
				Result	Result	Result	Result	Result
EP231A: Perfluoroalkyl Sulfonic Acids - Continued								
Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.0002	mg/kg	----	----	----	----	<0.0002
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg	----	----	----	----	<0.0002
Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.0002	mg/kg	----	----	----	----	<0.0002
EP231B: Perfluoroalkyl Carboxylic Acids								
Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg	----	----	----	----	<0.001
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg	----	----	----	----	<0.0002
Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg	----	----	----	----	<0.0002
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg	----	----	----	----	<0.0002
Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg	----	----	----	----	<0.0002
Perfluorononanoic acid (PFNA)	375-95-1	0.0002	mg/kg	----	----	----	----	<0.0002
Perfluorodecanoic acid (PFDA)	335-76-2	0.0002	mg/kg	----	----	----	----	<0.0002
Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.0002	mg/kg	----	----	----	----	<0.0002
Perfluorododecanoic acid (PFDoDA)	307-55-1	0.0002	mg/kg	----	----	----	----	<0.0002
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.0002	mg/kg	----	----	----	----	<0.0002
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.0005	mg/kg	----	----	----	----	<0.0005
EP231C: Perfluoroalkyl Sulfonamides								
Perfluorooctane sulfonamide (FOSA)	754-91-6	0.0002	mg/kg	----	----	----	----	<0.0002
N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8	0.0005	mg/kg	----	----	----	----	<0.0005
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.0005	mg/kg	----	----	----	----	<0.0005
N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.0005	mg/kg	----	----	----	----	<0.0005
N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.0005	mg/kg	----	----	----	----	<0.0005

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THS01 0-0.1	THS02 0-0.1	THS03 0.3-0.35	THS04 0-0.1	THS06 0-0.05
			Sampling date / time	10-Jun-2023 00:00	10-Jun-2023 00:00	10-Jun-2023 00:00	10-Jun-2023 00:00	10-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-014	EB2317957-015	EB2317957-017	EB2317957-018	EB2317957-020
				Result	Result	Result	Result	Result
EP231C: Perfluoroalkyl Sulfonamides - Continued								
N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9	0.0002	mg/kg	----	----	----	----	<0.0002
N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.0002	mg/kg	----	----	----	----	<0.0002
EP231D: (n:2) Fluorotelomer Sulfonic Acids								
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg	----	----	----	----	<0.0005
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg	----	----	----	----	<0.0005
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg	----	----	----	----	<0.0005
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg	----	----	----	----	<0.0005
EP231P: PFAS Sums								
Sum of PFAS	----	0.0002	mg/kg	----	----	----	----	<0.0002
Sum of PFHxS and PFOS	355-46-4/1763-23-1	0.0002	mg/kg	----	----	----	----	<0.0002
Sum of PFAS (WA DER List)	----	0.0002	mg/kg	----	----	----	----	<0.0002
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	----	----	----	----	**96.2**
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.05	%	----	----	----	----	**103**
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.05	%	----	----	----	----	**81.8**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	----	----	----	----	**113**
Toluene-D8	2037-26-5	0.2	%	----	----	----	----	**98.2**
4-Bromofluorobenzene	460-00-4	0.2	%	----	----	----	----	**103**
EP231S: PFAS Surrogate								
13C4-PFOS	----	0.0002	%	----	----	----	----	**99.5**
13C8-PFOA	----	0.0002	%	----	----	----	----	**104**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THS07 0-0.1	THS08 0-0.1	THS09 0-0.1	THS10 0-0.1	THS11 0-0.1
			Sampling date / time	10-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-021	EB2317957-022	EB2317957-023	EB2317957-024	EB2317957-025
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**1.9**	----	----	----	**5.6**
Moisture Content	----	1.0	%	----	**2.9**	**3.7**	**1.5**	----
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	1	mg/kg	----	<1	<1	----	<1
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	----	<1	<1	----	<1
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	1	mg/kg	----	<1	<1	----	<1
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	----	**153**	----	----	**175**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	----	**0.3**	----	----	**0.2**
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	----	<0.1	<0.1	<0.1	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
beta-BHC	319-85-7	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
gamma-BHC	58-89-9	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
delta-BHC	319-86-8	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
Heptachlor	76-44-8	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
Aldrin	309-00-2	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
^ Total Chlordane (sum)	----	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
trans-Chlordane	5103-74-2	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
alpha-Endosulfan	959-98-8	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
cis-Chlordane	5103-71-9	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
Dieldrin	60-57-1	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
4.4`-DDE	72-55-9	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
Endrin	72-20-8	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
beta-Endosulfan	33213-65-9	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
4.4`-DDD	72-54-8	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
Endrin aldehyde	7421-93-4	0.05	mg/kg	----	<0.05	<0.05	<0.05	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THS07 0-0.1	THS08 0-0.1	THS09 0-0.1	THS10 0-0.1	THS11 0-0.1
			Sampling date / time	10-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-021	EB2317957-022	EB2317957-023	EB2317957-024	EB2317957-025
				Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued								
Endosulfan sulfate	1031-07-8	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
4.4`-DDT	50-29-3	0.2	mg/kg	----	<0.2	<0.2	<0.2	----
Endrin ketone	53494-70-5	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
Methoxychlor	72-43-5	0.2	mg/kg	----	<0.2	<0.2	<0.2	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	----	<0.05	<0.05	<0.05	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	----	<10	<10	<10	----
C10 - C14 Fraction	----	50	mg/kg	----	<50	<50	<50	----
C15 - C28 Fraction	----	100	mg/kg	----	<100	<100	<100	----
C29 - C36 Fraction	----	100	mg/kg	----	<100	<100	<100	----
^ C10 - C36 Fraction (sum)	----	50	mg/kg	----	<50	<50	<50	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	----	<10	<10	<10	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	----	<10	<10	<10	----
>C10 - C16 Fraction	----	50	mg/kg	----	<50	<50	<50	----
>C16 - C34 Fraction	----	100	mg/kg	----	<100	<100	<100	----
>C34 - C40 Fraction	----	100	mg/kg	----	<100	<100	<100	----
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	----	<50	<50	<50	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	----	<50	<50	<50	----
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	----	<0.2	<0.2	<0.2	----
Toluene	108-88-3	0.5	mg/kg	----	<0.5	<0.5	<0.5	----
Ethylbenzene	100-41-4	0.5	mg/kg	----	<0.5	<0.5	<0.5	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	----	<0.5	<0.5	<0.5	----
ortho-Xylene	95-47-6	0.5	mg/kg	----	<0.5	<0.5	<0.5	----
^ Sum of BTEX	----	0.2	mg/kg	----	<0.2	<0.2	<0.2	----
^ Total Xylenes	----	0.5	mg/kg	----	<0.5	<0.5	<0.5	----
Naphthalene	91-20-3	1	mg/kg	----	<1	<1	<1	----
EP231A: Perfluoroalkyl Sulfonic Acids								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THS07 0-0.1	THS08 0-0.1	THS09 0-0.1	THS10 0-0.1	THS11 0-0.1
			Sampling date / time	10-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-021	EB2317957-022	EB2317957-023	EB2317957-024	EB2317957-025
				Result	Result	Result	Result	Result
EP231A: Perfluoroalkyl Sulfonic Acids - Continued								
Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
EP231B: Perfluoroalkyl Carboxylic Acids								
Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg	<0.001	<0.001	----	----	----
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluorononanoic acid (PFNA)	375-95-1	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluorodecanoic acid (PFDA)	335-76-2	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluorododecanoic acid (PFDoDA)	307-55-1	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.0005	mg/kg	<0.0005	<0.0005	----	----	----
EP231C: Perfluoroalkyl Sulfonamides								
Perfluorooctane sulfonamide (FOSA)	754-91-6	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8	0.0005	mg/kg	<0.0005	<0.0005	----	----	----
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.0005	mg/kg	<0.0005	<0.0005	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THS07 0-0.1	THS08 0-0.1	THS09 0-0.1	THS10 0-0.1	THS11 0-0.1
			Sampling date / time	10-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-021	EB2317957-022	EB2317957-023	EB2317957-024	EB2317957-025
				Result	Result	Result	Result	Result
EP231C: Perfluoroalkyl Sulfonamides - Continued								
N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.0005	mg/kg	<0.0005	<0.0005	----	----	----
N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.0005	mg/kg	<0.0005	<0.0005	----	----	----
N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
EP231D: (n:2) Fluorotelomer Sulfonic Acids								
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg	<0.0005	<0.0005	----	----	----
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg	<0.0005	<0.0005	----	----	----
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg	<0.0005	<0.0005	----	----	----
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg	<0.0005	<0.0005	----	----	----
EP231P: PFAS Sums								
Sum of PFAS	----	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Sum of PFHxS and PFOS	355-46-4/1763-23-1	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Sum of PFAS (WA DER List)	----	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	----	105	99.9	107	----
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.05	%	----	106	105	110	----
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.05	%	----	79.0	63.3	48.6	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	----	116	101	118	----
Toluene-D8	2037-26-5	0.2	%	----	99.1	87.8	102	----
4-Bromofluorobenzene	460-00-4	0.2	%	----	103	96.5	107	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THS07 0-0.1	THS08 0-0.1	THS09 0-0.1	THS10 0-0.1	THS11 0-0.1
			Sampling date / time	10-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-021	EB2317957-022	EB2317957-023	EB2317957-024	EB2317957-025
				Result	Result	Result	Result	Result
EP231S: PFAS Surrogate								
13C4-PFOS	----	0.0002	%	**107**	**114**	**----**	**----**	**----**
13C8-PFOA	----	0.0002	%	**107**	**110**	**----**	**----**	**----**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THS12 0-0.1	THS13 0.4-0.5	THS14 0-0.1	THS15 0-0.1	BD02
			Sampling date / time	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-026	EB2317957-027	EB2317957-028	EB2317957-029	EB2317957-030
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	----	8.7	----	9.2	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	74	----	48	----
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	----	0.010	----	0.018	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	6.2	5.8	1.3	0.8	2.8
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	11700	9820	9430	9230	8700
Iron	7439-89-6	50	mg/kg	32500	28000	37300	17000	33700
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.1	mg/kg	2.1	1.4	1.9	0.9	1.7
Selenium	7782-49-2	1	mg/kg	<1	<1	<1	<1	<1
Barium	7440-39-3	0.1	mg/kg	137	131	117	57.9	101
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	7440-48-4	0.1	mg/kg	14.5	12.7	11.3	11.3	9.6
Chromium	7440-47-3	0.1	mg/kg	36.4	23.1	30.1	17.0	27.3
Copper	7440-50-8	0.1	mg/kg	29.0	22.7	13.0	37.0	11.9
Manganese	7439-96-5	0.1	mg/kg	266	347	185	160	154
Strontium	7440-24-6	0.1	mg/kg	19.9	20.5	12.2	25.1	10.4
Tungsten	7440-33-7	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	7439-98-7	0.1	mg/kg	0.3	<0.1	0.2	<0.1	0.1
Nickel	7440-02-0	0.1	mg/kg	17.9	14.9	10.8	13.6	9.7
Lead	7439-92-1	0.1	mg/kg	6.4	4.2	5.2	1.9	4.5
Antimony	7440-36-0	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Uranium	7440-61-1	0.1	mg/kg	0.7	0.5	0.4	0.5	0.4
Zinc	7440-66-6	0.5	mg/kg	17.0	16.4	14.5	11.8	19.3
Vanadium	7440-62-2	1	mg/kg	91	65	83	40	76
Titanium	7440-32-6	1	mg/kg	468	513	359	248	320
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	1	mg/kg	<1	<1	----	<1	<1
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	<1	----	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THS12 0-0.1	THS13 0.4-0.5	THS14 0-0.1	THS15 0-0.1	BD02
			Sampling date / time	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-026	EB2317957-027	EB2317957-028	EB2317957-029	EB2317957-030
				Result	Result	Result	Result	Result
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	<1	----	<1	<1
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	----	**272**	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	----	**0.2**	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	----	----	<10	----	----
C10 - C14 Fraction	----	50	mg/kg	----	----	<50	----	----
C15 - C28 Fraction	----	100	mg/kg	----	----	<100	----	----
C29 - C36 Fraction	----	100	mg/kg	----	----	<100	----	----
^ C10 - C36 Fraction (sum)	----	50	mg/kg	----	----	<50	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	----	----	<10	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	----	----	<10	----	----
>C10 - C16 Fraction	----	50	mg/kg	----	----	<50	----	----
>C16 - C34 Fraction	----	100	mg/kg	----	----	<100	----	----
>C34 - C40 Fraction	----	100	mg/kg	----	----	<100	----	----
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	----	----	<50	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	----	----	<50	----	----
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	----	----	<0.2	----	----
Toluene	108-88-3	0.5	mg/kg	----	----	<0.5	----	----
Ethylbenzene	100-41-4	0.5	mg/kg	----	----	<0.5	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	----	----	<0.5	----	----
ortho-Xylene	95-47-6	0.5	mg/kg	----	----	<0.5	----	----
^ Sum of BTEX	----	0.2	mg/kg	----	----	<0.2	----	----
^ Total Xylenes	----	0.5	mg/kg	----	----	<0.5	----	----
Naphthalene	91-20-3	1	mg/kg	----	----	<1	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	----	----	**113**	----	----
Toluene-D8	2037-26-5	0.2	%	----	----	**97.5**	----	----
4-Bromofluorobenzene	460-00-4	0.2	%	----	----	**98.9**	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THGW08 2.9	THT01 0.5	THT01 1.0	THT02 1.0	THT03 0.5
			Sampling date / time	08-Jun-2023 00:00	09-Jun-2023 00:00	09-Jun-2023 00:00	09-Jun-2023 00:00	09-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-034	EB2317957-035	EB2317957-036	EB2317957-038	EB2317957-039
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	----	8.9	8.3	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	94	713	----	----
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	----	----	0.098	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	2.9	----	----	10.0	11.2
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	1	mg/kg	<1	----	----	----	<1
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	----	----	----	68
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	----	----	----	<1
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	378	----	----	480	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	<0.1	----	----	<0.1	----
EN60Z: ASLP Leachate - ZHE								
Extraction Fluid pH	----	0.1	pH Unit	----	----	----	----	5.7

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THT03 1.0	THT05 0.5	THT05 1.0	THT06 0.5	THT06 1.0
			Sampling date / time	09-Jun-2023 00:00	09-Jun-2023 00:00	09-Jun-2023 00:00	09-Jun-2023 00:00	09-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-040	EB2317957-043	EB2317957-044	EB2317957-045	EB2317957-046
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	----	----	----	9.8	9.9
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	----	----	199	845
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	----	----	----	----	0.148
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	7.1	9.8	8.1	9.8	----
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	----	----	5840	----
Iron	7439-89-6	50	mg/kg	----	----	----	13200	----
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.1	mg/kg	----	----	----	6.0	----
Selenium	7782-49-2	1	mg/kg	----	----	----	2	----
Barium	7440-39-3	0.1	mg/kg	----	----	----	14.0	----
Cadmium	7440-43-9	0.1	mg/kg	----	----	----	<0.1	----
Cobalt	7440-48-4	0.1	mg/kg	----	----	----	24.4	----
Chromium	7440-47-3	0.1	mg/kg	----	----	----	15.6	----
Copper	7440-50-8	0.1	mg/kg	----	----	----	99.8	----
Manganese	7439-96-5	0.1	mg/kg	----	----	----	91.3	----
Strontium	7440-24-6	0.1	mg/kg	----	----	----	4.0	----
Tungsten	7440-33-7	0.1	mg/kg	----	----	----	0.1	----
Molybdenum	7439-98-7	0.1	mg/kg	----	----	----	0.8	----
Nickel	7440-02-0	0.1	mg/kg	----	----	----	18.2	----
Lead	7439-92-1	0.1	mg/kg	----	----	----	4.7	----
Antimony	7440-36-0	0.1	mg/kg	----	----	----	<0.1	----
Uranium	7440-61-1	0.1	mg/kg	----	----	----	1.5	----
Zinc	7440-66-6	0.5	mg/kg	----	----	----	13.4	----
Vanadium	7440-62-2	1	mg/kg	----	----	----	18	----
Titanium	7440-32-6	1	mg/kg	----	----	----	212	----
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	1	mg/kg	<1	<1	<1	<1	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	28	82	71	118	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THT03 1.0	THT05 0.5	THT05 1.0	THT06 0.5	THT06 1.0
			Sampling date / time	09-Jun-2023 00:00	09-Jun-2023 00:00	09-Jun-2023 00:00	09-Jun-2023 00:00	09-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-040	EB2317957-043	EB2317957-044	EB2317957-045	EB2317957-046
				Result	Result	Result	Result	Result
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	<1	<1	<1	----
EN60Z: ASLP Leachate - ZHE								
Extraction Fluid pH	----	0.1	pH Unit	**5.7**	**5.7**	**5.7**	----	----
EP231A: Perfluoroalkyl Sulfonic Acids								
Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.0002	mg/kg	----	----	<0.0002	----	----
EP231B: Perfluoroalkyl Carboxylic Acids								
Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg	----	----	<0.001	----	----
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluorononanoic acid (PFNA)	375-95-1	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluorodecanoic acid (PFDA)	335-76-2	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluorododecanoic acid (PFDoDA)	307-55-1	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.0005	mg/kg	----	----	<0.0005	----	----
EP231C: Perfluoroalkyl Sulfonamides								
Perfluorooctane sulfonamide (FOSA)	754-91-6	0.0002	mg/kg	----	----	<0.0002	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THT03 1.0	THT05 0.5	THT05 1.0	THT06 0.5	THT06 1.0
			Sampling date / time	09-Jun-2023 00:00	09-Jun-2023 00:00	09-Jun-2023 00:00	09-Jun-2023 00:00	09-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-040	EB2317957-043	EB2317957-044	EB2317957-045	EB2317957-046
				Result	Result	Result	Result	Result
EP231C: Perfluoroalkyl Sulfonamides - Continued								
N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8	0.0005	mg/kg	----	----	<0.0005	----	----
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.0005	mg/kg	----	----	<0.0005	----	----
N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.0005	mg/kg	----	----	<0.0005	----	----
N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.0005	mg/kg	----	----	<0.0005	----	----
N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9	0.0002	mg/kg	----	----	<0.0002	----	----
N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.0002	mg/kg	----	----	<0.0002	----	----
EP231D: (n:2) Fluorotelomer Sulfonic Acids								
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg	----	----	<0.0005	----	----
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg	----	----	<0.0005	----	----
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg	----	----	<0.0005	----	----
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg	----	----	<0.0005	----	----
EP231P: PFAS Sums								
Sum of PFAS	----	0.0002	mg/kg	----	----	<0.0002	----	----
Sum of PFHxS and PFOS	355-46-4/1763-23-1	0.0002	mg/kg	----	----	<0.0002	----	----
Sum of PFAS (WA DER List)	----	0.0002	mg/kg	----	----	<0.0002	----	----
EP231S: PFAS Surrogate								
13C4-PFOS	----	0.0002	%	----	----	**106**	----	----
13C8-PFOA	----	0.0002	%	----	----	**105**	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THT07 0.2	THT07 0.3	THT08 0.1	THT09 1.0 - 1.5	THT09 2.5 - 3.0
			Sampling date / time	09-Jun-2023 00:00	09-Jun-2023 00:00	09-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-047	EB2317957-048	EB2317957-049	EB2317957-050	EB2317957-051
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	----	----	----	9.9	9.5
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	----	----	210	274
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	----	----	----	----	0.057
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	18.5	16.7	4.1	1.3	2.4
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	----	----	5080	5220
Iron	7439-89-6	50	mg/kg	----	----	----	12200	11600
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.1	mg/kg	----	----	----	3.0	3.2
Selenium	7782-49-2	1	mg/kg	----	----	----	<1	<1
Barium	7440-39-3	0.1	mg/kg	----	----	----	39.1	17.6
Cadmium	7440-43-9	0.1	mg/kg	----	----	----	<0.1	<0.1
Cobalt	7440-48-4	0.1	mg/kg	----	----	----	13.6	15.0
Chromium	7440-47-3	0.1	mg/kg	----	----	----	12.7	10.3
Copper	7440-50-8	0.1	mg/kg	----	----	----	52.4	55.3
Manganese	7439-96-5	0.1	mg/kg	----	----	----	82.3	83.2
Strontium	7440-24-6	0.1	mg/kg	----	----	----	4.8	3.2
Tungsten	7440-33-7	0.1	mg/kg	----	----	----	<0.1	<0.1
Molybdenum	7439-98-7	0.1	mg/kg	----	----	----	0.5	0.3
Nickel	7440-02-0	0.1	mg/kg	----	----	----	13.0	12.3
Lead	7439-92-1	0.1	mg/kg	----	----	----	2.5	2.2
Antimony	7440-36-0	0.1	mg/kg	----	----	----	<0.1	<0.1
Uranium	7440-61-1	0.1	mg/kg	----	----	----	0.8	1.0
Zinc	7440-66-6	0.5	mg/kg	----	----	----	9.3	8.1
Vanadium	7440-62-2	1	mg/kg	----	----	----	22	20
Titanium	7440-32-6	1	mg/kg	----	----	----	126	123
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	1	mg/kg	<1	<1	<1	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	81	52	57	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THT07 0.2	THT07 0.3	THT08 0.1	THT09 1.0 - 1.5	THT09 2.5 - 3.0
			Sampling date / time	09-Jun-2023 00:00	09-Jun-2023 00:00	09-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-047	EB2317957-048	EB2317957-049	EB2317957-050	EB2317957-051
				Result	Result	Result	Result	Result
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	<1	<1	----	----
EP231A: Perfluoroalkyl Sulfonic Acids								
Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg	----	----	----	<0.0002	----
Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.0002	mg/kg	----	----	----	<0.0002	----
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg	----	----	----	<0.0002	----
Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.0002	mg/kg	----	----	----	<0.0002	----
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg	----	----	----	<0.0002	----
Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.0002	mg/kg	----	----	----	<0.0002	----
EP231B: Perfluoroalkyl Carboxylic Acids								
Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg	----	----	----	<0.001	----
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg	----	----	----	<0.0002	----
Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg	----	----	----	<0.0002	----
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg	----	----	----	<0.0002	----
Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg	----	----	----	<0.0002	----
Perfluorononanoic acid (PFNA)	375-95-1	0.0002	mg/kg	----	----	----	<0.0002	----
Perfluorodecanoic acid (PFDA)	335-76-2	0.0002	mg/kg	----	----	----	<0.0002	----
Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.0002	mg/kg	----	----	----	<0.0002	----
Perfluorododecanoic acid (PFDoDA)	307-55-1	0.0002	mg/kg	----	----	----	<0.0002	----
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.0002	mg/kg	----	----	----	<0.0002	----
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.0005	mg/kg	----	----	----	<0.0005	----
EP231C: Perfluoroalkyl Sulfonamides								
Perfluorooctane sulfonamide (FOSA)	754-91-6	0.0002	mg/kg	----	----	----	<0.0002	----
N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8	0.0005	mg/kg	----	----	----	<0.0005	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THT07 0.2	THT07 0.3	THT08 0.1	THT09 1.0 - 1.5	THT09 2.5 - 3.0
			Sampling date / time	09-Jun-2023 00:00	09-Jun-2023 00:00	09-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-047	EB2317957-048	EB2317957-049	EB2317957-050	EB2317957-051
				Result	Result	Result	Result	Result
EP231C: Perfluoroalkyl Sulfonamides - Continued								
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.0005	mg/kg	----	----	----	<0.0005	----
N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.0005	mg/kg	----	----	----	<0.0005	----
N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.0005	mg/kg	----	----	----	<0.0005	----
N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9	0.0002	mg/kg	----	----	----	<0.0002	----
N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.0002	mg/kg	----	----	----	<0.0002	----
EP231D: (n:2) Fluorotelomer Sulfonic Acids								
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg	----	----	----	<0.0005	----
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg	----	----	----	<0.0005	----
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg	----	----	----	<0.0005	----
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg	----	----	----	<0.0005	----
EP231P: PFAS Sums								
Sum of PFAS	----	0.0002	mg/kg	----	----	----	<0.0002	----
Sum of PFHxS and PFOS	355-46-4/1763-23-1	0.0002	mg/kg	----	----	----	<0.0002	----
Sum of PFAS (WA DER List)	----	0.0002	mg/kg	----	----	----	<0.0002	----
EP231S: PFAS Surrogate								
13C4-PFOS	----	0.0002	%	----	----	----	**109**	----
13C8-PFOA	----	0.0002	%	----	----	----	**103**	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THT09 4.2 - 4.5	THT09 5.0 - 5.5	THT10 1.0 - 1.5	THT10 2.5 - 3.0	THT10 4.0 - 4.5
			Sampling date / time	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-052	EB2317957-053	EB2317957-054	EB2317957-055	EB2317957-056
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	10.0	9.9	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	246	253	----	----	----
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	----	0.049	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	8.6	13.2	15.4	4.5	14.3
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	5650	5200	----	----	----
Iron	7439-89-6	50	mg/kg	12300	11200	----	----	----
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.1	mg/kg	3.0	2.7	----	----	----
Selenium	7782-49-2	1	mg/kg	<1	<1	----	----	----
Barium	7440-39-3	0.1	mg/kg	19.8	16.7	----	----	----
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	----	----	----
Cobalt	7440-48-4	0.1	mg/kg	15.6	14.5	----	----	----
Chromium	7440-47-3	0.1	mg/kg	12.0	14.9	----	----	----
Copper	7440-50-8	0.1	mg/kg	76.5	80.1	----	----	----
Manganese	7439-96-5	0.1	mg/kg	79.5	86.0	----	----	----
Strontium	7440-24-6	0.1	mg/kg	4.4	4.3	----	----	----
Tungsten	7440-33-7	0.1	mg/kg	<0.1	<0.1	----	----	----
Molybdenum	7439-98-7	0.1	mg/kg	0.3	0.6	----	----	----
Nickel	7440-02-0	0.1	mg/kg	13.6	12.2	----	----	----
Lead	7439-92-1	0.1	mg/kg	1.7	2.2	----	----	----
Antimony	7440-36-0	0.1	mg/kg	<0.1	<0.1	----	----	----
Uranium	7440-61-1	0.1	mg/kg	1.0	1.3	----	----	----
Zinc	7440-66-6	0.5	mg/kg	8.5	9.6	----	----	----
Vanadium	7440-62-2	1	mg/kg	21	18	----	----	----
Titanium	7440-32-6	1	mg/kg	134	125	----	----	----
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	1	mg/kg	----	----	<1	<1	<1
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	----	----	453	96	78

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THT09 4.2 - 4.5	THT09 5.0 - 5.5	THT10 1.0 - 1.5	THT10 2.5 - 3.0	THT10 4.0 - 4.5
			Sampling date / time	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-052	EB2317957-053	EB2317957-054	EB2317957-055	EB2317957-056
				Result	Result	Result	Result	Result
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	1	mg/kg	----	----	<1	<1	<1
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	335	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	0.1	----	----	----	----
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Final pH	----	0.1	pH Unit	----	----	----	9.3	----
EN60Z: ASLP Leachate - ZHE								
Extraction Fluid pH	----	0.1	pH Unit	----	----	5.7	5.7	5.7

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THT10 5.0 - 5.5	THT11 1.2 - 1.5	THT11 2.5 - 3.0	THT11 4.0 - 4.4	THT11 5.0 - 5.5
			Sampling date / time	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00	11-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-057	EB2317957-058	EB2317957-059	EB2317957-060	EB2317957-061
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	20.9	6.3	4.2	2.9	5.1
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	1	mg/kg	<1	<1	<1	<1	<1
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	564	41	201	37	12
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	<1	<1	<1	<1
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	----	----	----	360	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	----	----	----	<0.1	----
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Final pH	----	0.1	pH Unit	9.5	----	----	----	----
EN60Z: ASLP Leachate - ZHE								
Extraction Fluid pH	----	0.1	pH Unit	5.7	5.7	5.7	5.7	5.7

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BD01	----	----	----	----
			Sampling date / time	10-Jun-2023 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2317957-062	--------	--------	--------	--------
				Result	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**9.1**	----	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**5090**	----	----	----	----
Iron	7439-89-6	50	mg/kg	**9710**	----	----	----	----
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.1	mg/kg	**4.5**	----	----	----	----
Selenium	7782-49-2	1	mg/kg	**2**	----	----	----	----
Barium	7440-39-3	0.1	mg/kg	**13.2**	----	----	----	----
Cadmium	7440-43-9	0.1	mg/kg	<0.1	----	----	----	----
Cobalt	7440-48-4	0.1	mg/kg	**19.1**	----	----	----	----
Chromium	7440-47-3	0.1	mg/kg	**13.8**	----	----	----	----
Copper	7440-50-8	0.1	mg/kg	**76.0**	----	----	----	----
Manganese	7439-96-5	0.1	mg/kg	**81.0**	----	----	----	----
Strontium	7440-24-6	0.1	mg/kg	**3.8**	----	----	----	----
Tungsten	7440-33-7	0.1	mg/kg	<0.1	----	----	----	----
Molybdenum	7439-98-7	0.1	mg/kg	**0.6**	----	----	----	----
Nickel	7440-02-0	0.1	mg/kg	**15.8**	----	----	----	----
Lead	7439-92-1	0.1	mg/kg	**4.9**	----	----	----	----
Antimony	7440-36-0	0.1	mg/kg	<0.1	----	----	----	----
Uranium	7440-61-1	0.1	mg/kg	**1.6**	----	----	----	----
Zinc	7440-66-6	0.5	mg/kg	**12.5**	----	----	----	----
Vanadium	7440-62-2	1	mg/kg	**15**	----	----	----	----
Titanium	7440-32-6	1	mg/kg	**145**	----	----	----	----
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	1	mg/kg	<1	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	**58**	----	----	----	----
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	THGW01	THGW02	THGW03	THGW04	THGW05
			Sampling date / time	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-001	EB2317957-002	EB2317957-003	EB2317957-004	EB2317957-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.97	7.88	7.91	8.08	7.83
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	1780	256	1150	1660	1050
ED037P: Alkalinity by PC Titrator								
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	703	181	682	1120	872
Total Alkalinity as CaCO3	----	1	mg/L	703	181	682	1120	872
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	139	20	48	89	30
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	560	16	319	92	96
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	65	20	50	8	28
Magnesium	7439-95-4	1	mg/L	145	20	97	26	67
Sodium	7440-23-5	1	mg/L	397	46	319	636	349
Potassium	7440-09-7	1	mg/L	7	4	4	6	5
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.02	0.02	<0.01	2.10	0.20
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	0.003	<0.001
Barium	7440-39-3	0.001	mg/L	0.156	0.015	0.224	0.078	0.133
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	0.006	<0.001
Cobalt	7440-48-4	0.001	mg/L	0.258	<0.001	0.017	0.002	0.009
Copper	7440-50-8	0.001	mg/L	<0.001	0.005	0.002	0.004	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	0.002	0.014	0.007	0.034	0.032
Molybdenum	7439-98-7	0.001	mg/L	0.001	<0.001	0.002	0.005	0.002
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	0.004	<0.001
Selenium	7782-49-2	0.01	mg/L	0.01	<0.01	<0.01	0.02	<0.01
Strontium	7440-24-6	0.001	mg/L	0.736	0.155	0.424	0.142	0.291
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	<0.01	0.12	<0.01
Uranium	7440-61-1	0.001	mg/L	0.031	0.001	0.033	0.063	0.035
Vanadium	7440-62-2	0.01	mg/L	0.12	0.02	0.07	0.37	0.08
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	0.061	<0.005

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	THGW01	THGW02	THGW03	THGW04	THGW05
			Sampling date / time	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-001	EB2317957-002	EB2317957-003	EB2317957-004	EB2317957-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Iron	7439-89-6	0.05	mg/L	**0.06**	<0.05	<0.05	**1.90**	**0.11**
Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	<0.001	**0.001**	<0.001
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.10**	**0.59**	**0.02**	**16.8**	**2.12**
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	**0.001**	<0.001	<0.001	**0.006**	**0.001**
Barium	7440-39-3	0.001	mg/L	**0.152**	**0.018**	**0.211**	**0.200**	**0.158**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	**0.002**	<0.001	**0.043**	**0.002**
Cobalt	7440-48-4	0.001	mg/L	**0.608**	<0.001	**0.021**	**0.015**	**0.012**
Copper	7440-50-8	0.001	mg/L	<0.001	**0.009**	<0.001	**0.031**	**0.003**
Lead	7439-92-1	0.001	mg/L	<0.001	**0.002**	<0.001	**0.003**	**0.001**
Manganese	7439-96-5	0.001	mg/L	**0.002**	**0.028**	**0.011**	**0.333**	**0.112**
Molybdenum	7439-98-7	0.001	mg/L	**0.001**	<0.001	**0.002**	**0.006**	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	**0.026**	**0.001**
Selenium	7782-49-2	0.01	mg/L	**0.01**	<0.01	<0.01	**0.02**	<0.01
Strontium	7440-24-6	0.001	mg/L	**0.794**	**0.129**	**0.397**	**0.200**	**0.274**
Titanium	7440-32-6	0.01	mg/L	<0.01	**0.03**	<0.01	**2.80**	**0.01**
Uranium	7440-61-1	0.001	mg/L	**0.036**	**0.001**	**0.031**	**0.068**	**0.033**
Vanadium	7440-62-2	0.01	mg/L	**0.11**	**0.02**	**0.07**	**0.51**	**0.10**
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	**0.279**	**0.008**
Iron	7439-89-6	0.05	mg/L	**0.20**	**1.00**	<0.05	**17.8**	**1.42**
Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	<0.001	**0.002**	<0.001
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	0.002	mg/L	**0.007**	<0.002	<0.002	<0.002	<0.002
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.002	mg/L	**0.204**	<0.002	**0.019**	<0.002	**0.009**
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	0.002	mg/L	**0.003**	<0.002	<0.002	<0.002	<0.002
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**2.6**	**0.4**	**2.5**	**5.3**	**3.0**
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.14**	**0.66**	**0.09**	**0.23**	**0.12**
EK057G: Nitrite as N by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	THGW01	THGW02	THGW03	THGW04	THGW05
			Sampling date / time	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-001	EB2317957-002	EB2317957-003	EB2317957-004	EB2317957-005
				Result	Result	Result	Result	Result
EK057G: Nitrite as N by Discrete Analyser - Continued								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	**0.03**	**0.11**
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**14.3**	**0.43**	**3.42**	**29.1**	**2.15**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.02**	**0.58**	**0.01**	**6.52**	**0.05**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	**0.41**	**0.01**	**0.08**	<0.01
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**32.7**	**4.48**	**23.6**	**26.8**	**20.8**
ø Total Cations	----	0.01	meq/L	**32.6**	**4.75**	**24.4**	**30.4**	**22.2**
ø Ionic Balance	----	0.01	%	**0.17**	**2.85**	**1.73**	**6.17**	**3.41**
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	----	2	µg/L	<2	<2	<2	<2	<2

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	THGW01	THGW02	THGW03	THGW04	THGW05
			Sampling date / time	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-001	EB2317957-002	EB2317957-003	EB2317957-004	EB2317957-005
				Result	Result	Result	Result	Result
EP080: BTEXN - Continued								
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP231A: Perfluoroalkyl Sulfonic Acids								
Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
EP231B: Perfluoroalkyl Carboxylic Acids								
Perfluorobutanoic acid (PFBA)	375-22-4	0.01	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.002	µg/L	<0.002	**0.006**	<0.002	**0.003**	<0.002
Perfluorohexanoic acid (PFHxA)	307-24-4	0.002	µg/L	<0.002	**0.002**	<0.002	**0.002**	<0.002
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.002	µg/L	<0.002	**0.002**	<0.002	<0.002	<0.002
Perfluorooctanoic acid (PFOA)	335-67-1	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorononanoic acid (PFNA)	375-95-1	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorodecanoic acid (PFDA)	335-76-2	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorododecanoic acid (PFDoDA)	307-55-1	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EP231C: Perfluoroalkyl Sulfonamides								
Perfluorooctane sulfonamide (FOSA)	754-91-6	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	THGW01	THGW02	THGW03	THGW04	THGW05
			Sampling date / time	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-001	EB2317957-002	EB2317957-003	EB2317957-004	EB2317957-005
				Result	Result	Result	Result	Result
EP231C: Perfluoroalkyl Sulfonamides - Continued								
N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
EP231D: (n:2) Fluorotelomer Sulfonic Acids								
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.005	µg/L	**0.006**	<0.005	**0.006**	**0.040**	**0.010**
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EP231P: PFAS Sums								
Sum of PFAS	----	0.002	µg/L	**0.006**	**0.010**	**0.006**	**0.045**	**0.010**
Sum of PFHxS and PFOS	355-46-4/1763-23-1	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Sum of PFAS (WA DER List)	----	0.002	µg/L	**0.006**	**0.010**	**0.006**	**0.045**	**0.010**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**98.7**	**92.2**	**94.6**	**94.8**	**96.8**
Toluene-D8	2037-26-5	2	%	**108**	**102**	**103**	**104**	**103**
4-Bromofluorobenzene	460-00-4	2	%	**115**	**109**	**107**	**108**	**105**
EP231S: PFAS Surrogate								
13C4-PFOS	----	0.002	%	**100**	**102**	**92.1**	**103**	**105**
13C8-PFOA	----	0.002	%	**105**	**106**	**105**	**106**	**104**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	THGW06	THGW07	THGW08	THGW09	PIT
			Sampling date / time	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-006	EB2317957-007	EB2317957-008	EB2317957-009	EB2317957-010
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.90	8.18	7.59	7.40	8.46
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	1040	1020	3790	697	3780
ED037P: Alkalinity by PC Titrator								
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	876	757	727	604	311
Total Alkalinity as CaCO3	----	1	mg/L	876	757	727	604	334
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	22	33	474	14	488
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	60	75	1260	11	1590
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	22	22	104	52	49
Magnesium	7439-95-4	1	mg/L	70	41	310	86	240
Sodium	7440-23-5	1	mg/L	326	345	717	96	992
Potassium	7440-09-7	1	mg/L	5	6	16	5	24
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.15	0.17	0.16	0.05	<0.01
Antimony	7440-36-0	0.001	mg/L	<0.001	0.005	0.004	0.002	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	0.007	0.001	0.004	0.005
Barium	7440-39-3	0.001	mg/L	0.140	0.062	0.158	0.074	0.079
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	0.0005	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	0.001	<0.001	0.002	<0.001
Cobalt	7440-48-4	0.001	mg/L	0.002	0.004	1.05	0.002	0.018
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.007	0.007	0.002
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	0.007	<0.001
Manganese	7439-96-5	0.001	mg/L	0.009	0.030	0.170	0.014	0.003
Molybdenum	7439-98-7	0.001	mg/L	0.002	0.007	0.003	<0.001	0.033
Nickel	7440-02-0	0.001	mg/L	<0.001	0.001	0.005	0.003	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.01	<0.01	0.04
Strontium	7440-24-6	0.001	mg/L	0.338	0.227	1.36	0.220	0.753
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	7440-61-1	0.001	mg/L	0.024	0.024	0.049	0.005	0.070
Vanadium	7440-62-2	0.01	mg/L	0.18	0.12	0.08	0.04	0.04
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.007	<0.005	<0.005

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	THGW06	THGW07	THGW08	THGW09	PIT
			Sampling date / time	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-006	EB2317957-007	EB2317957-008	EB2317957-009	EB2317957-010
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Iron	7439-89-6	0.05	mg/L	0.16	0.09	0.45	<0.05	<0.05
Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	0.001
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	6.91	24.0	26.8	11.2	0.07
Antimony	7440-36-0	0.001	mg/L	<0.001	0.005	0.005	0.004	<0.001
Arsenic	7440-38-2	0.001	mg/L	0.001	0.009	0.006	0.001	0.006
Barium	7440-39-3	0.001	mg/L	0.170	0.229	0.510	0.223	0.079
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0006	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	0.009	0.044	0.075	0.012	<0.001
Cobalt	7440-48-4	0.001	mg/L	0.006	0.042	1.06	0.010	0.021
Copper	7440-50-8	0.001	mg/L	0.018	0.018	0.054	0.008	0.007
Lead	7439-92-1	0.001	mg/L	<0.001	0.005	0.012	0.025	0.002
Manganese	7439-96-5	0.001	mg/L	0.058	0.330	0.519	0.177	0.006
Molybdenum	7439-98-7	0.001	mg/L	0.002	0.005	0.003	<0.001	0.035
Nickel	7440-02-0	0.001	mg/L	0.006	0.038	0.051	0.010	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.02	<0.01	0.04
Strontium	7440-24-6	0.001	mg/L	0.369	0.296	1.29	0.415	0.801
Titanium	7440-32-6	0.01	mg/L	0.16	0.31	2.58	1.53	<0.01
Uranium	7440-61-1	0.001	mg/L	0.030	0.032	0.049	0.010	0.076
Vanadium	7440-62-2	0.01	mg/L	0.22	0.20	0.22	0.11	0.04
Zinc	7440-66-6	0.005	mg/L	0.046	0.074	0.077	0.012	0.007
Iron	7439-89-6	0.05	mg/L	6.58	27.5	48.9	14.8	0.32
Tungsten	7440-33-7	0.001	mg/L	<0.001	0.001	0.001	0.002	0.002
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	0.002	mg/L	<0.002	<0.002	0.025	<0.002	<0.002
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.002	mg/L	<0.002	0.007	0.881	<0.002	0.003
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	0.002	mg/L	<0.002	<0.002	0.022	<0.002	<0.002
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	3.8	3.6	2.4	1.9	2.4
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.10	1.03	0.49	0.11	0.12
EK057G: Nitrite as N by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	THGW06	THGW07	THGW08	THGW09	PIT
			Sampling date / time	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-006	EB2317957-007	EB2317957-008	EB2317957-009	EB2317957-010
				Result	Result	Result	Result	Result
EK057G: Nitrite as N by Discrete Analyser - Continued								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	**0.26**	**0.86**	**0.01**	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**4.15**	**0.86**	**13.4**	**0.53**	**0.79**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.22**	**7.31**	**1.79**	**1.28**	**0.01**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	**0.02**	**5.10**	**1.28**	**0.16**	<0.01
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**19.6**	**17.9**	**59.9**	**12.7**	**61.7**
ø Total Cations	----	0.01	meq/L	**21.2**	**19.6**	**62.3**	**14.0**	**66.0**
ø Ionic Balance	----	0.01	%	**3.71**	**4.54**	**1.93**	**4.90**	**3.35**
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	**110**	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	**60**	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	**170**	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	**140**	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	**140**	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	----	2	µg/L	<2	<2	<2	<2	<2

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	THGW06	THGW07	THGW08	THGW09	PIT
			Sampling date / time	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-006	EB2317957-007	EB2317957-008	EB2317957-009	EB2317957-010
				Result	Result	Result	Result	Result
EP080: BTEXN - Continued								
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP231A: Perfluoroalkyl Sulfonic Acids								
Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.009
Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.009
Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
EP231B: Perfluoroalkyl Carboxylic Acids								
Perfluorobutanoic acid (PFBA)	375-22-4	0.01	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorohexanoic acid (PFHxA)	307-24-4	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorooctanoic acid (PFOA)	335-67-1	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorononanoic acid (PFNA)	375-95-1	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorodecanoic acid (PFDA)	335-76-2	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorododecanoic acid (PFDoDA)	307-55-1	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EP231C: Perfluoroalkyl Sulfonamides								
Perfluorooctane sulfonamide (FOSA)	754-91-6	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	THGW06	THGW07	THGW08	THGW09	PIT
			Sampling date / time	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2317957-006	EB2317957-007	EB2317957-008	EB2317957-009	EB2317957-010
				Result	Result	Result	Result	Result
EP231C: Perfluoroalkyl Sulfonamides - Continued								
N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.002
EP231D: (n:2) Fluorotelomer Sulfonic Acids								
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.005	µg/L	<0.005	**0.203**	**0.195**	<0.005	<0.005
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EP231P: PFAS Sums								
Sum of PFAS	----	0.002	µg/L	<0.002	**0.203**	**0.195**	<0.002	<0.002
Sum of PFHxS and PFOS	355-46-4/1763-23-1	0.002	µg/L	<0.002	<0.002	<0.002	<0.002	<0.009
Sum of PFAS (WA DER List)	----	0.002	µg/L	<0.002	**0.203**	**0.195**	<0.002	<0.002
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**97.5**	**102**	**103**	**102**	**103**
Toluene-D8	2037-26-5	2	%	**100**	**99.4**	**96.4**	**98.5**	**98.1**
4-Bromofluorobenzene	460-00-4	2	%	**91.5**	**115**	**108**	**105**	**100**
EP231S: PFAS Surrogate								
13C4-PFOS	----	0.002	%	**104**	**90.0**	**100**	**91.5**	**107**
13C8-PFOA	----	0.002	%	**103**	**103**	**101**	**106**	**101**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	Mine Shaft	GWBD01	RB01	RB02	----
			Sampling date / time	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	----
Compound	CAS Number	LOR	Unit	EB2317957-011	EB2317957-012	EB2317957-013	EB2317957-063	--------
				Result	Result	Result	Result	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	8.84	7.91	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	1220	3730	----	----	----
ED037P: Alkalinity by PC Titrator								
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	302	707	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	355	707	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	125	483	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	517	1260	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	6	104	----	----	----
Magnesium	7439-95-4	1	mg/L	80	308	----	----	----
Sodium	7440-23-5	1	mg/L	343	723	----	----	----
Potassium	7440-09-7	1	mg/L	12	16	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	0.18	<0.01	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	0.004	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	0.001	<0.001	----	----
Barium	7440-39-3	0.001	mg/L	0.006	0.160	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	0.001	<0.001	----	----
Cobalt	7440-48-4	0.001	mg/L	0.016	1.09	----	----	----
Copper	7440-50-8	0.001	mg/L	0.001	0.008	<0.001	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L	0.022	0.172	<0.001	----	----
Molybdenum	7439-98-7	0.001	mg/L	0.001	0.003	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	0.005	<0.001	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	0.02	----	----	----
Strontium	7440-24-6	0.001	mg/L	0.053	1.36	----	----	----
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	----	----	----
Uranium	7440-61-1	0.001	mg/L	0.015	0.048	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	0.08	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	0.007	<0.005	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	Mine Shaft	GWBD01	RB01	RB02	----
			Sampling date / time	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	----
Compound	CAS Number	LOR	Unit	EB2317957-011	EB2317957-012	EB2317957-013	EB2317957-063	--------
				Result	Result	Result	Result	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Iron	7439-89-6	0.05	mg/L	**0.85**	**0.47**	<0.05	----	----
Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	----	----	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.03**	**24.4**	----	<0.01	----
Antimony	7440-36-0	0.001	mg/L	<0.001	**0.005**	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	**0.005**	----	<0.001	----
Barium	7440-39-3	0.001	mg/L	**0.005**	**0.441**	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	**0.0006**	----	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	**0.064**	----	<0.001	----
Cobalt	7440-48-4	0.001	mg/L	**0.048**	**1.03**	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	**0.032**	----	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	**0.012**	----	<0.001	----
Manganese	7439-96-5	0.001	mg/L	**0.025**	**0.478**	----	<0.001	----
Molybdenum	7439-98-7	0.001	mg/L	**0.002**	**0.003**	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.043**	----	<0.001	----
Selenium	7782-49-2	0.01	mg/L	<0.01	**0.02**	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.052**	**1.28**	----	----	----
Titanium	7440-32-6	0.01	mg/L	<0.01	**2.18**	----	----	----
Uranium	7440-61-1	0.001	mg/L	**0.016**	**0.050**	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	**0.20**	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.070**	----	<0.005	----
Iron	7439-89-6	0.05	mg/L	**1.40**	**41.8**	----	<0.05	----
Tungsten	7440-33-7	0.001	mg/L	<0.001	**0.001**	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	----	----	<0.0001	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	----	----	----	<0.0001	----
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	0.002	mg/L	<0.002	**0.023**	----	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.002	mg/L	**0.025**	**0.860**	<0.002	----	----
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	0.002	mg/L	<0.002	**0.019**	----	----	----
EK040P: Fluoride by PC Titrator								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	Mine Shaft	GWBD01	RB01	RB02	----
			Sampling date / time	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	----
Compound	CAS Number	LOR	Unit	EB2317957-011	EB2317957-012	EB2317957-013	EB2317957-063	--------
				Result	Result	Result	Result	----
EK040P: Fluoride by PC Titrator - Continued								
Fluoride	16984-48-8	0.1	mg/L	**1.3**	**2.3**	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.02**	**0.63**	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	**0.77**	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	**13.5**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.01**	**2.02**	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	**0.80**	----	----	----
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**24.3**	**59.7**	----	----	----
ø Total Cations	----	0.01	meq/L	**22.1**	**62.4**	----	----	----
ø Ionic Balance	----	0.01	%	**4.68**	**2.19**	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	----	----	----
C10 - C14 Fraction	----	50	µg/L	----	<50	----	----	----
C15 - C28 Fraction	----	100	µg/L	----	<100	----	----	----
C29 - C36 Fraction	----	50	µg/L	----	**60**	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L	----	**60**	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	----	----	----
>C10 - C16 Fraction	----	100	µg/L	----	<100	----	----	----
>C16 - C34 Fraction	----	100	µg/L	----	**120**	----	----	----
>C34 - C40 Fraction	----	100	µg/L	----	<100	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L	----	**120**	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	----	<100	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	Mine Shaft	GWBD01	RB01	RB02	----
			Sampling date / time	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	----
Compound	CAS Number	LOR	Unit	EB2317957-011	EB2317957-012	EB2317957-013	EB2317957-063	--------
				Result	Result	Result	Result	----
EP080: BTEXN - Continued								
Toluene	108-88-3	2	µg/L	<2	<2	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	----	----	----
^ Total Xylenes	----	2	µg/L	<2	<2	----	----	----
^ Sum of BTEX	----	1	µg/L	<1	<1	----	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	----	----	----
EP231A: Perfluoroalkyl Sulfonic Acids								
Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.002	µg/L	<0.002	<0.002	----	----	----
Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.002	µg/L	<0.002	<0.002	----	----	----
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.002	µg/L	<0.002	<0.002	----	----	----
Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.002	µg/L	<0.002	<0.002	----	----	----
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.002	µg/L	**0.014**	<0.002	----	----	----
Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.002	µg/L	<0.002	<0.002	----	----	----
EP231B: Perfluoroalkyl Carboxylic Acids								
Perfluorobutanoic acid (PFBA)	375-22-4	0.01	µg/L	<0.01	<0.01	----	----	----
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.002	µg/L	<0.002	<0.002	----	----	----
Perfluorohexanoic acid (PFHxA)	307-24-4	0.002	µg/L	<0.002	<0.002	----	----	----
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.002	µg/L	<0.002	<0.002	----	----	----
Perfluorooctanoic acid (PFOA)	335-67-1	0.002	µg/L	**0.013**	<0.002	----	----	----
Perfluorononanoic acid (PFNA)	375-95-1	0.002	µg/L	<0.002	<0.002	----	----	----
Perfluorodecanoic acid (PFDA)	335-76-2	0.002	µg/L	<0.002	<0.002	----	----	----
Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.002	µg/L	<0.002	<0.002	----	----	----
Perfluorododecanoic acid (PFDoDA)	307-55-1	0.002	µg/L	<0.002	<0.002	----	----	----
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.002	µg/L	<0.002	<0.002	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	Mine Shaft	GWBD01	RB01	RB02	----
			Sampling date / time	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	----
Compound	CAS Number	LOR	Unit	EB2317957-011	EB2317957-012	EB2317957-013	EB2317957-063	--------
				Result	Result	Result	Result	----
EP231B: Perfluoroalkyl Carboxylic Acids - Continued								
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.005	µg/L	<0.005	<0.005	----	----	----
EP231C: Perfluoroalkyl Sulfonamides								
Perfluorooctane sulfonamide (FOSA)	754-91-6	0.002	µg/L	<0.002	<0.002	----	----	----
N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8	0.005	µg/L	<0.005	<0.005	----	----	----
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.005	µg/L	<0.005	<0.005	----	----	----
N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.005	µg/L	<0.005	<0.005	----	----	----
N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.005	µg/L	<0.005	<0.005	----	----	----
N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9	0.002	µg/L	<0.002	<0.002	----	----	----
N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.002	µg/L	<0.002	<0.002	----	----	----
EP231D: (n:2) Fluorotelomer Sulfonic Acids								
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.005	µg/L	<0.005	<0.005	----	----	----
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.005	µg/L	<0.005	**0.218**	----	----	----
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.005	µg/L	<0.005	<0.005	----	----	----
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.005	µg/L	<0.005	<0.005	----	----	----
EP231P: PFAS Sums								
Sum of PFAS	----	0.002	µg/L	**0.027**	**0.218**	----	----	----
Sum of PFHxS and PFOS	355-46-4/1763-23-1	0.002	µg/L	**0.014**	<0.002	----	----	----
Sum of PFAS (WA DER List)	----	0.002	µg/L	**0.027**	**0.218**	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**102**	**103**	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	Mine Shaft	GWBD01	RB01	RB02	----
			Sampling date / time	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	12-Jun-2023 00:00	----
Compound	CAS Number	LOR	Unit	EB2317957-011	EB2317957-012	EB2317957-013	EB2317957-063	--------
				Result	Result	Result	Result	----
EP080S: TPH(V)/BTEX Surrogates - Continued								
Toluene-D8	2037-26-5	2	%	**97.0**	**95.6**	**----**	**----**	**----**
4-Bromofluorobenzene	460-00-4	2	%	**98.0**	**99.5**	**----**	**----**	**----**
EP231S: PFAS Surrogate								
13C4-PFOS	----	0.002	%	**102**	**100**	**----**	**----**	**----**
13C8-PFOA	----	0.002	%	**105**	**99.3**	**----**	**----**	**----**

Surrogate Control Limits

Sub-Matrix: SOIL		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	16	134
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	10	138
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	23	134
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	53	134
Toluene-D8	2037-26-5	60	131
4-Bromofluorobenzene	460-00-4	59	127
EP231S: PFAS Surrogate			
13C4-PFOS	----	76	136
13C8-PFOA	----	78	131

Sub-Matrix: WATER		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	66	138
Toluene-D8	2037-26-5	79	120
4-Bromofluorobenzene	460-00-4	74	118
EP231S: PFAS Surrogate			
13C4-PFOS	----	65	140
13C8-PFOA	----	71	133

QUALITY CONTROL REPORT

Work Order	: **EB2317957**	Page	: 1 of 45
Amendment	: **1**		
Client	: **ENVIRONMENTAL EARTH SCIENCES**	Laboratory	: Environmental Division Brisbane
Contact	: MS ANNA SHELDON	Contact	: David Wall
Address	: PO BOX 3207 NEWSTEAD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: 07 3852 6666	Telephone	: +61-7-3243 7222
Project	: 722092	Date Samples Received	: 14-Jun-2023
Order number	: ----	Date Analysis Commenced	: 16-Jun-2023
C-O-C number	: COC#3/4/5-AAE-BR	Issue Date	: 07-Jul-2023
Sampler	: AS / SW		
Site	: Tick Hill		
Quote number	: EB23ENVEAR0004		
No. of samples received	: 65		
No. of samples analysed	: 55		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Acid Sulphate Soils, Stafford, QLD
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Inorganics, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Keegan Mullane	Senior Chemist - Organics	Brisbane Organics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
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Matt Frost	Assistant Laboratory Manager	Brisbane Organics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 5119694)									
EB2317957-014	THS01 0-0.1	EG005T: Aluminium	7429-90-5	50	mg/kg	8530	9260	8.3	0% - 20%
		EG005T: Iron	7439-89-6	50	mg/kg	20400	22100	7.6	0% - 20%
EB2317957-051	THT09 2.5 - 3.0	EG005T: Aluminium	7429-90-5	50	mg/kg	5220	5060	3.1	0% - 20%
		EG005T: Iron	7439-89-6	50	mg/kg	11600	11400	2.3	0% - 20%
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 5153649)									
EB2317957-062	BD01	EG005T: Aluminium	7429-90-5	50	mg/kg	5090	5480	7.4	0% - 20%
		EG005T: Iron	7439-89-6	50	mg/kg	9710	10200	5.2	0% - 20%
EA002: pH 1:5 (Soils) (QC Lot: 5119865)									
EB2317957-051	THT09 2.5 - 3.0	EA002: pH Value	----	0.1	pH Unit	9.5	9.5	0.0	0% - 20%
EB2317957-020	THS06 0-0.05	EA002: pH Value	----	0.1	pH Unit	8.9	9.0	1.1	0% - 20%
EA010: Conductivity (1:5) (QC Lot: 5119864)									
EB2317957-051	THT09 2.5 - 3.0	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	274	262	4.4	0% - 20%
EB2317957-020	THS06 0-0.05	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	67	64	4.0	0% - 20%
EA026 : Chromium Reducible Sulfur (QC Lot: 5122461)									
EB2317957-020	THS06 0-0.05	EA026: Chromium Reducible Sulphur	----	0.005	%	0.010	0.009	0.0	No Limit
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 5118436)									
EB2317957-020	THS06 0-0.05	EA055: Moisture Content	----	0.1	%	4.2	4.2	0.0	No Limit
EB2318197-048	Anonymous	EA055: Moisture Content	----	0.1	%	17.6	17.3	1.6	0% - 50%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 5119671)									
EB2317957-025	THS11 0-0.1	EA055: Moisture Content	----	0.1	%	5.6	5.7	0.0	0% - 20%
EB2318359-003	Anonymous	EA055: Moisture Content	----	0.1	%	4.3	4.2	2.5	No Limit
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 5119700)									

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 5119700) - continued									
EB2317957-014	THS01 0-0.1	EA055: Moisture Content	----	0.1	%	1.8	1.8	0.0	0% - 50%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 5119723)									
EB2317957-048	THT07 0.3	EA055: Moisture Content	----	0.1	%	16.7	15.4	8.2	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 5119798)									
EB2317957-015	THS02 0-0.1	EA055: Moisture Content	----	0.1	%	3.3	3.4	0.0	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 5153656)									
EB2317957-062	BD01	EA055: Moisture Content	----	0.1	%	9.1	8.2	11.1	0% - 20%
EG020T: Total Metals by ICP-MS (QC Lot: 5119695)									
EB2317957-014	THS01 0-0.1	EG020X-T: Arsenic	7440-38-2	0.1	mg/kg	1.9	# 2.4	23.3	0% - 20%
		EG020X-T: Barium	7440-39-3	0.1	mg/kg	55.0	61.4	10.9	0% - 20%
		EG020X-T: Cobalt	7440-48-4	0.1	mg/kg	11.3	13.3	16.0	0% - 20%
		EG020X-T: Chromium	7440-47-3	0.1	mg/kg	18.7	21.0	11.6	0% - 20%
		EG020X-T: Copper	7440-50-8	0.1	mg/kg	42.0	50.9	19.2	0% - 20%
		EG020X-T: Manganese	7439-96-5	0.1	mg/kg	175	190	8.2	0% - 20%
		EG020X-T: Molybdenum	7439-98-7	0.1	mg/kg	0.5	0.2	89.7	No Limit
		EG020X-T: Nickel	7440-02-0	0.1	mg/kg	15.3	15.0	2.3	0% - 20%
		EG020X-T: Lead	7439-92-1	0.1	mg/kg	3.2	3.6	9.7	0% - 20%
		EG020X-T: Antimony	7440-36-0	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020X-T: Uranium	7440-61-1	0.1	mg/kg	0.6	0.6	0.0	No Limit
		EG020X-T: Zinc	7440-66-6	0.5	mg/kg	16.6	18.2	9.3	0% - 20%
		EG020X-T: Vanadium	7440-62-2	1	mg/kg	45	49	9.4	0% - 20%
EB2317957-051	THT09 2.5 - 3.0	EG020X-T: Arsenic	7440-38-2	0.1	mg/kg	3.2	3.2	0.0	0% - 20%
		EG020X-T: Barium	7440-39-3	0.1	mg/kg	17.6	17.4	1.1	0% - 20%
		EG020X-T: Cobalt	7440-48-4	0.1	mg/kg	15.0	15.1	0.0	0% - 20%
		EG020X-T: Chromium	7440-47-3	0.1	mg/kg	10.3	10.4	0.0	0% - 20%
		EG020X-T: Copper	7440-50-8	0.1	mg/kg	55.3	54.1	2.2	0% - 20%
		EG020X-T: Manganese	7439-96-5	0.1	mg/kg	83.2	84.1	1.1	0% - 20%
		EG020X-T: Molybdenum	7439-98-7	0.1	mg/kg	0.3	0.4	0.0	No Limit
		EG020X-T: Nickel	7440-02-0	0.1	mg/kg	12.3	12.5	1.3	0% - 20%
		EG020X-T: Lead	7439-92-1	0.1	mg/kg	2.2	2.4	9.6	0% - 20%
		EG020X-T: Antimony	7440-36-0	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020X-T: Uranium	7440-61-1	0.1	mg/kg	1.0	0.9	11.7	No Limit
		EG020X-T: Zinc	7440-66-6	0.5	mg/kg	8.1	8.0	0.0	0% - 50%
		EG020X-T: Vanadium	7440-62-2	1	mg/kg	20	20	0.0	0% - 20%
EG020T: Total Metals by ICP-MS (QC Lot: 5119696)									
EB2317957-014	THS01 0-0.1	EG020Y-T: Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020Y-T: Strontium	7440-24-6	0.1	mg/kg	14.2	15.4	7.9	0% - 20%
		EG020Y-T: Selenium	7782-49-2	1	mg/kg	<1	<1	0.0	No Limit
EB2317957-051	THT09 2.5 - 3.0	EG020Y-T: Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.0	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EG020T: Total Metals by ICP-MS (QC Lot: 5119696) - continued									
EB2317957-051	THT09 2.5 - 3.0	EG020Y-T: Strontium	7440-24-6	0.1	mg/kg	3.2	3.1	0.0	0% - 20%
		EG020Y-T: Selenium	7782-49-2	1	mg/kg	<1	1	0.0	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 5119697)									
EB2317957-014	THS01 0-0.1	EG020R-T: Titanium	7440-32-6	1	mg/kg	201	222	10.1	0% - 20%
EB2317957-051	THT09 2.5 - 3.0	EG020R-T: Titanium	7440-32-6	1	mg/kg	123	115	7.1	0% - 20%
EG020T: Total Metals by ICP-MS (QC Lot: 5119698)									
EB2317957-014	THS01 0-0.1	EG020V-T: Tungsten	7440-33-7	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EB2317957-051	THT09 2.5 - 3.0	EG020V-T: Tungsten	7440-33-7	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 5153650)									
EB2317957-062	BD01	EG020R-T: Titanium	7440-32-6	1	mg/kg	145	157	7.5	0% - 20%
EG020T: Total Metals by ICP-MS (QC Lot: 5153651)									
EB2317957-062	BD01	EG020V-T: Tungsten	7440-33-7	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 5153652)									
EB2317957-062	BD01	EG020X-T: Arsenic	7440-38-2	0.1	mg/kg	4.5	4.2	7.2	0% - 20%
		EG020X-T: Barium	7440-39-3	0.1	mg/kg	13.2	13.8	4.3	0% - 20%
		EG020X-T: Cobalt	7440-48-4	0.1	mg/kg	19.1	19.1	0.0	0% - 20%
		EG020X-T: Chromium	7440-47-3	0.1	mg/kg	13.8	14.6	5.7	0% - 20%
		EG020X-T: Copper	7440-50-8	0.1	mg/kg	76.0	75.2	1.1	0% - 20%
		EG020X-T: Manganese	7439-96-5	0.1	mg/kg	81.0	82.2	1.5	0% - 20%
		EG020X-T: Molybdenum	7439-98-7	0.1	mg/kg	0.6	0.8	21.3	No Limit
		EG020X-T: Nickel	7440-02-0	0.1	mg/kg	15.8	15.9	1.0	0% - 20%
		EG020X-T: Lead	7439-92-1	0.1	mg/kg	4.9	5.3	7.8	0% - 20%
		EG020X-T: Antimony	7440-36-0	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020X-T: Uranium	7440-61-1	0.1	mg/kg	1.6	1.4	14.8	0% - 50%
		EG020X-T: Zinc	7440-66-6	0.5	mg/kg	12.5	13.4	7.0	0% - 20%
		EG020X-T: Vanadium	7440-62-2	1	mg/kg	15	16	0.0	0% - 50%
EG020T: Total Metals by ICP-MS (QC Lot: 5153653)									
EB2317957-062	BD01	EG020Y-T: Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020Y-T: Strontium	7440-24-6	0.1	mg/kg	3.8	3.9	5.0	0% - 20%
		EG020Y-T: Selenium	7782-49-2	1	mg/kg	2	2	0.0	No Limit
EK025SF: Free CN by Segmented Flow Analyser (QC Lot: 5119716)									
EB2317957-014	THS01 0-0.1	EK025SF: Free Cyanide	----	1	mg/kg	<1	<1	0.0	No Limit
EB2317957-030	BD02	EK025SF: Free Cyanide	----	1	mg/kg	<1	<1	0.0	No Limit
EK025SF: Free CN by Segmented Flow Analyser (QC Lot: 5119720)									
EB2317957-048	THT07 0.3	EK025SF: Free Cyanide	----	1	mg/kg	<1	<1	0.0	No Limit
EK025SF: Free CN by Segmented Flow Analyser (QC Lot: 5153286)									
EB2317957-062	BD01	EK025SF: Free Cyanide	----	1	mg/kg	<1	<1	0.0	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 5119714)									

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 5119714) - continued									
EB2317957-014	THS01 0-0.1	EK026SF: Total Cyanide	57-12-5	1	mg/kg	5	5	0.0	No Limit
EB2317957-030	BD02	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.0	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 5119721)									
EB2317957-048	THT07 0.3	EK026SF: Total Cyanide	57-12-5	1	mg/kg	52	51	0.0	0% - 20%
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 5153285)									
EB2317957-062	BD01	EK026SF: Total Cyanide	57-12-5	1	mg/kg	58	56	4.3	No Limit
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QC Lot: 5119715)									
EB2317957-014	THS01 0-0.1	EK028SF: Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	<1	0.0	No Limit
EB2317957-030	BD02	EK028SF: Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	<1	0.0	No Limit
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QC Lot: 5119722)									
EB2317957-048	THT07 0.3	EK028SF: Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	<1	0.0	No Limit
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QC Lot: 5153287)									
EB2317957-062	BD01	EK028SF: Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	<1	0.0	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 5119667)									
EB2318164-001	Anonymous	EK067G: Total Phosphorus as P	----	2	mg/kg	1480	# 836	55.3	0% - 20%
EB2317806-002	Anonymous	EK067G: Total Phosphorus as P	----	2	mg/kg	827	843	1.8	0% - 20%
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 5119866)									
EB2317957-020	THS06 0-0.05	EK071G: Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	1.9	1.9	0.0	0% - 50%
EP066: Polychlorinated Biphenyls (PCB) (QC Lot: 5119914)									
EB2317957-020	THS06 0-0.05	EP066: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EB2318197-049	Anonymous	EP066: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EP068A: Organochlorine Pesticides (OC) (QC Lot: 5119915)									
EB2317957-020	THS06 0-0.05	EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Total Chlordane (sum)	----	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EP068A: Organochlorine Pesticides (OC) (QC Lot: 5119915) - continued									
EB2317957-020	THS06 0-0.05	EP068: Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: 4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
EB2318197-049	Anonymous	EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Total Chlordane (sum)	----	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: 4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 5118435)									
EB2317957-020	THS06 0-0.05	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 5118435) - continued									
EB2318197-048	Anonymous	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 5119913)									
EB2317957-020	THS06 0-0.05	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EB2318197-049	Anonymous	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 5118435)									
EB2317957-020	THS06 0-0.05	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.0	No Limit
EB2318197-048	Anonymous	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 5119913)									
EB2317957-020	THS06 0-0.05	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EB2318197-049	Anonymous	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EP080: BTEXN (QC Lot: 5118435)									
EB2317957-020	THS06 0-0.05	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.0	No Limit
EB2318197-048	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.0	No Limit
EP231A: Perfluoroalkyl Sulfonic Acids (QC Lot: 5119931)									
EB2317957-020	THS06 0-0.05	EP231X: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP231A: Perfluoroalkyl Sulfonic Acids (QC Lot: 5119931) - continued									
EB2317957-020	THS06 0-0.05	EP231X: Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
EB2318197-048	Anonymous	EP231X: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
EP231B: Perfluoroalkyl Carboxylic Acids (QC Lot: 5119931)									
EB2317957-020	THS06 0-0.05	EP231X: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorononanoic acid (PFNA)	375-95-1	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorodecanoic acid (PFDA)	335-76-2	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorododecanoic acid (PFDoDA)	307-55-1	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg	<0.001	<0.001	0.0	No Limit
EB2318197-048	Anonymous	EP231X: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorononanoic acid (PFNA)	375-95-1	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorodecanoic acid (PFDA)	335-76-2	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorododecanoic acid (PFDoDA)	307-55-1	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg	<0.001	<0.001	0.0	No Limit
EP231C: Perfluoroalkyl Sulfonamides (QC Lot: 5119931)									
EB2317957-020	THS06 0-0.05	EP231X: Perfluorooctane sulfonamide (FOSA)	754-91-6	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP231C: Perfluoroalkyl Sulfonamides (QC Lot: 5119931) - continued									
EB2317957-020	THS06 0-0.05	EP231X: N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
EB2318197-048	Anonymous	EP231X: Perfluorooctane sulfonamide (FOSA)	754-91-6	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
EP231D: (n:2) Fluorotelomer Sulfonic Acids (QC Lot: 5119931)									
EB2317957-020	THS06 0-0.05	EP231X: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
EB2318197-048	Anonymous	EP231X: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EA005P: pH by PC Titrator (QC Lot: 5117845)									
EB2318222-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	6.87	6.92	0.7	0% - 20%
EB2318305-006	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	7.74	7.73	0.1	0% - 20%
EA005P: pH by PC Titrator (QC Lot: 5118096)									

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EA005P: pH by PC Titrator (QC Lot: 5118096) - continued									
EB2317957-008	THGW08	EA005-P: pH Value	----	0.01	pH Unit	7.59	7.60	0.1	0% - 20%
EB2318166-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	8.29	8.27	0.2	0% - 20%
EA005P: pH by PC Titrator (QC Lot: 5118101)									
EB2318271-007	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	8.18	8.19	0.1	0% - 20%
EB2317489-009	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	4.25	4.25	0.0	0% - 20%
EA005P: pH by PC Titrator (QC Lot: 5118347)									
EB2318121-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	8.40	8.38	0.2	0% - 20%
EB2317957-012	GWBD01	EA005-P: pH Value	----	0.01	pH Unit	7.91	7.92	0.1	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 5117570)									
EB2317490-001	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	556	549	1.4	0% - 20%
EB2317957-002	THGW02	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	256	240	6.6	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 5117846)									
EB2318222-001	Anonymous	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	10	10	0.0	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	10	10	0.0	No Limit
ED037P: Alkalinity by PC Titrator (QC Lot: 5118092)									
EB2317957-008	THGW08	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	727	727	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	727	727	0.0	0% - 20%
EB2318166-001	Anonymous	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	157	156	0.7	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	157	156	0.7	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 5118102)									
EB2318271-007	Anonymous	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	391	393	0.5	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	391	393	0.5	0% - 20%
EB2317489-009	Anonymous	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	<1	<1	0.0	No Limit
ED037P: Alkalinity by PC Titrator (QC Lot: 5118349)									
EB2317957-012	GWBD01	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	707	709	0.3	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	707	709	0.3	0% - 20%
EB2318254-008	Anonymous	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	5	<1	137	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	5	<1	137	No Limit
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 5117714)									
EB2318282-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	14	14	0.0	0% - 50%
EB2318287-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	245	249	1.4	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 5118159)									
EB2317491-003	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	170	174	2.3	0% - 20%
EB2317489-009	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<5	<5	0.0	No Limit
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 5118160)									
EB2318094-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	0.0	No Limit
EB2317957-008	THGW08	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	474	483	1.8	0% - 20%

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 5122229)									
EB2318409-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	0.0	No Limit
EB2318240-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	0.0	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 5117716)									
EB2318282-002	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	56	56	0.0	0% - 20%
EB2318287-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	157	160	1.7	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 5118156)									
EB2317491-003	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	1020	1030	1.1	0% - 20%
EB2317489-009	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	21	22	6.4	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 5118157)									
EB2318094-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	1180	1180	0.2	0% - 20%
EB2317957-008	THGW08	ED045G: Chloride	16887-00-6	1	mg/L	1260	1270	0.7	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 5122231)									
EB2318409-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	2270	2340	3.3	0% - 20%
EB2318240-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	235	239	1.6	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 5118620)									
EB2318092-002	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	212	210	1.0	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	69	69	0.0	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	387	376	2.7	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	1	1	0.0	No Limit
EB2318289-004	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	72	73	0.0	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	137	139	1.8	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	515	529	2.7	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	32	33	0.0	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 5118621)									
ET2303097-017	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	608	608	0.0	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	724	721	0.5	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	874	876	0.3	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	32	32	0.0	0% - 20%
EB2317957-003	THGW03	ED093F: Calcium	7440-70-2	1	mg/L	50	48	5.0	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	97	93	4.0	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	319	304	4.8	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	4	4	0.0	No Limit
ED093F: Dissolved Major Cations (QC Lot: 5120832)									
EB2317957-001	THGW01	ED093F: Calcium	7440-70-2	1	mg/L	65	63	2.0	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	145	139	3.9	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	397	392	1.1	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	7	6	0.0	No Limit
EB2318232-007	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	<1	<1	0.0	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	<1	<1	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
ED093F: Dissolved Major Cations (QC Lot: 5120832) - continued									
EB2318232-007	Anonymous	ED093F: Sodium	7440-23-5	1	mg/L	6	7	0.0	No Limit
		ED093F: Potassium	7440-09-7	1	mg/L	<1	<1	0.0	No Limit
ED093F: Dissolved Major Cations (QC Lot: 5121653)									
EB2317626-003	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	3	3	0.0	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	2	2	0.0	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	1320	1320	0.2	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	8	8	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 5118618)									
EB2318092-002	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.078	0.078	0.0	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.007	0.007	0.0	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.001	0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.0	No Limit
EB2318289-004	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.001	0.002	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.060	0.060	0.0	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.036	0.036	0.0	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.007	0.007	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	0.01	0.01	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG020F: Dissolved Metals by ICP-MS (QC Lot: 5118619)									
ET2303097-017	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.032	0.032	0.0	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.002	0.001	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.003	0.003	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.166	0.166	0.0	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.071	0.072	0.0	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.003	0.003	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.0	No Limit
EB2317957-003	THGW03	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.224	0.210	6.4	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.017	0.016	0.0	0% - 50%
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.002	<0.001	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.001	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.007	0.006	0.0	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	0.07	0.06	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 5118622)									
EB2318092-002	Anonymous	EG020B-F: Strontium	7440-24-6	0.001	mg/L	0.761	0.751	1.3	0% - 20%
		EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-F: Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 5118623)									
EB2317957-003	THGW03	EG020B-F: Strontium	7440-24-6	0.001	mg/L	0.424	0.409	3.5	0% - 20%
		EG020B-F: Uranium	7440-61-1	0.001	mg/L	0.033	0.028	13.5	0% - 20%
		EG020B-F: Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	0.0	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 5118624)									
EB2318092-002	Anonymous	EG020E-F: Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 5118625)									
EB2317957-003	THGW03	EG020E-F: Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 5120834)									
EB2317957-001	THGW01	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	0.001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.156	0.156	0.0	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.258	0.270	4.7	0% - 20%
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.001	0.001	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.02	0.02	0.0	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	0.01	0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	0.12	0.11	0.0	0% - 50%
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.06	0.06	0.0	No Limit
EB2318232-007	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.014	0.013	0.0	0% - 50%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.092	0.093	0.0	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.07	0.07	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 5120836)									
EB2317957-001	THGW01	EG020B-F: Strontium	7440-24-6	0.001	mg/L	0.736	0.716	2.8	0% - 20%
		EG020B-F: Uranium	7440-61-1	0.001	mg/L	0.031	0.030	0.0	0% - 20%
		EG020B-F: Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG020F: Dissolved Metals by ICP-MS (QC Lot: 5120838)									
EB2317957-001	THGW01	EG020E-F: Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 5121651)									
EB2317626-003	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.606	0.626	3.2	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.002	0.001	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.001	<0.001	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 5121652)									
EB2317626-003	Anonymous	EG020B-F: Strontium	7440-24-6	0.001	mg/L	1.08	1.09	0.2	0% - 20%
		EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-F: Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 5121654)									
EB2317957-011	Mine Shaft	EG020E-F: Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 5118654)									
EB2317957-010	PIT	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	0.006	0.006	0.0	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.079	0.083	5.0	0% - 20%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	0.021	0.021	0.0	0% - 50%
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.007	0.007	0.0	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	0.002	0.001	0.0	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.006	0.006	0.0	No Limit
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	0.035	0.034	0.0	0% - 20%
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.007	0.008	0.0	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.07	0.08	0.0	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	0.04	0.04	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EG020T: Total Metals by ICP-MS (QC Lot: 5118654) - continued									
EB2317957-010	PIT	EG020A-T: Vanadium	7440-62-2	0.01	mg/L	0.04	0.04	0.0	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	0.32	0.30	8.9	No Limit
ET2303093-001	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.092	0.091	1.1	0% - 20%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.153	0.155	1.2	0% - 20%
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	0.003	0.003	0.0	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.0	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 5118656)									
EB2317957-010	PIT	EG020B-T: Strontium	7440-24-6	0.001	mg/L	0.801	0.794	0.8	0% - 20%
		EG020B-T: Uranium	7440-61-1	0.001	mg/L	0.076	0.077	0.0	0% - 20%
		EG020B-T: Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	0.0	No Limit
ET2303093-001	Anonymous	EG020B-T: Strontium	7440-24-6	0.001	mg/L	0.244	0.244	0.0	0% - 20%
		EG020B-T: Uranium	7440-61-1	0.001	mg/L	0.004	0.004	0.0	No Limit
		EG020B-T: Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 5118658)									
EB2317957-010	PIT	EG020E-T: Tungsten	7440-33-7	0.001	mg/L	0.002	0.002	0.0	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 5121697)									
EB2317957-002	THGW02	EG020B-T: Strontium	7440-24-6	0.001	mg/L	0.129	0.131	1.5	0% - 20%
		EG020B-T: Uranium	7440-61-1	0.001	mg/L	0.001	0.001	0.0	No Limit
		EG020B-T: Titanium	7440-32-6	0.01	mg/L	0.03	0.03	0.0	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 5121698)									
EB2317957-002	THGW02	EG020E-T: Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 5121699)									
EB2318055-005	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	0.0001	<0.0001	0.0	No Limit
		EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.145	0.142	2.1	0% - 20%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	0.005	0.005	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG020T: Total Metals by ICP-MS (QC Lot: 5121699) - continued									
EB2318055-005	Anonymous	EG020A-T: Cobalt	7440-48-4	0.001	mg/L	0.072	0.071	0.0	0% - 20%
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.180	0.178	1.4	0% - 20%
		EG020A-T: Lead	7439-92-1	0.001	mg/L	0.032	0.031	0.0	0% - 20%
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	1.10	1.09	0.3	0% - 20%
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	0.179	0.178	0.0	0% - 20%
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.638	0.633	0.8	0% - 20%
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	14.7	14.8	0.6	0% - 20%
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	17.0	17.2	1.1	0% - 20%
EB2317957-002	THGW02	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.018	0.018	0.0	0% - 50%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	0.002	0.001	0.0	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.009	0.008	0.0	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.028	0.029	0.0	0% - 20%
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.59	0.59	0.0	0% - 20%
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	0.02	0.02	0.0	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	1.00	1.00	0.0	0% - 50%
EG020W: Water Leachable Metals by ICP-MS (QC Lot: 5121733)									
EB2317957-055	THT10 2.5 - 3.0	EG020B-W: Strontium	7440-24-6	0.001	mg/L	0.017	0.017	0.0	0% - 50%
		EG020B-W: Uranium	7440-61-1	0.001	mg/L	0.001	0.001	0.0	No Limit
		EG020B-W: Titanium	7440-32-6	0.01	mg/L	0.08	0.06	29.4	No Limit
EG020W: Water Leachable Metals by ICP-MS (QC Lot: 5121734)									
EB2317957-055	THT10 2.5 - 3.0	EG020E-W: Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
EG020W: Water Leachable Metals by ICP-MS (QC Lot: 5121735)									
EB2317957-055	THT10 2.5 - 3.0	EG020A-W: Cadmium	7440-43-9	0.0001	mg/L	0.0001	0.0001	0.0	No Limit
		EG020A-W: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-W: Arsenic	7440-38-2	0.001	mg/L	0.006	0.006	0.0	No Limit
		EG020A-W: Barium	7440-39-3	0.001	mg/L	0.640	0.628	1.8	0% - 20%
		EG020A-W: Chromium	7440-47-3	0.001	mg/L	0.024	0.023	4.7	0% - 20%
		EG020A-W: Cobalt	7440-48-4	0.001	mg/L	0.031	0.032	0.0	0% - 20%

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG020W: Water Leachable Metals by ICP-MS (QC Lot: 5121735) - continued									
EB2317957-055	THT10 2.5 - 3.0	EG020A-W: Copper	7440-50-8	0.001	mg/L	0.096	0.090	6.0	0% - 20%
		EG020A-W: Lead	7439-92-1	0.001	mg/L	0.003	0.003	0.0	No Limit
		EG020A-W: Manganese	7439-96-5	0.001	mg/L	0.062	0.059	5.7	0% - 20%
		EG020A-W: Molybdenum	7439-98-7	0.001	mg/L	0.005	0.005	0.0	No Limit
		EG020A-W: Nickel	7440-02-0	0.001	mg/L	0.006	0.005	0.0	No Limit
		EG020A-W: Zinc	7440-66-6	0.005	mg/L	0.063	0.055	13.4	0% - 50%
		EG020A-W: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-W: Vanadium	7440-62-2	0.01	mg/L	0.02	0.02	0.0	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 5121650)									
EB2317626-003	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 5121709)									
EB2317957-063	RB02	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EK025SF: Free CN by Segmented Flow Analyser (QC Lot: 5119011)									
EB2318191-001	Anonymous	EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	<0.004	0.0	No Limit
EB2317957-006	THGW06	EK025SF: Free Cyanide	----	0.004	mg/L	<0.002	<0.002	0.0	No Limit
EK025SF: Free CN by Segmented Flow Analyser (QC Lot: 5119012)									
EB2317957-001	THGW01	EK025SF: Free Cyanide	----	0.004	mg/L	0.007	0.007	0.0	No Limit
EK025SF: Free CN by Segmented Flow Analyser (QC Lot: 5127889)									
EB2317957-039	THT03 0.5	EK025SF: Free Cyanide	----	0.004	mg/L	<0.002	<0.002	0.0	No Limit
ET2303110-001	Anonymous	EK025SF: Free Cyanide	----	0.004	mg/L	<0.002	<0.002	0.0	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 5119009)									
EB2318191-001	Anonymous	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.0	No Limit
EB2317957-006	THGW06	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.002	<0.002	0.0	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 5119010)									
EB2317957-001	THGW01	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	0.204	0.206	0.8	0% - 20%
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QC Lot: 5119013)									
EB2318191-001	Anonymous	EK028SF: Weak Acid Dissociable Cyanide	----	0.004	mg/L	<0.004	<0.004	0.0	No Limit
EB2317957-006	THGW06	EK028SF: Weak Acid Dissociable Cyanide	----	0.004	mg/L	<0.002	<0.002	0.0	No Limit
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QC Lot: 5119014)									
EB2317957-001	THGW01	EK028SF: Weak Acid Dissociable Cyanide	----	0.004	mg/L	0.003	0.003	0.0	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 5117847)									
EB2318222-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 5118094)									
EB2317957-008	THGW08	EK040P: Fluoride	16984-48-8	0.1	mg/L	2.4	2.4	0.0	0% - 20%
EB2318166-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	4.3	4.3	0.0	0% - 20%
EK040P: Fluoride by PC Titrator (QC Lot: 5118103)									
EB2318271-007	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	1.4	1.4	0.0	0% - 50%

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EK040P: Fluoride by PC Titrator (QC Lot: 5118348)									
EB2317957-012	GWBD01	EK040P: Fluoride	16984-48-8	0.1	mg/L	2.3	2.3	0.0	0% - 20%
EB2318254-008	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 5123888)									
EB2317957-001	THGW01	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.14	0.14	0.0	0% - 50%
EB2317957-011	Mine Shaft	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.02	0.03	59.5	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 5117712)									
EB2318282-002	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EB2318287-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 5118162)									
EB2317491-003	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EB2317489-009	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 5118163)									
EB2318094-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EB2317957-008	THGW08	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	0.86	0.88	2.1	0% - 20%
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 5122230)									
EB2318240-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 5123833)									
EB2317957-001	THGW01	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.02	0.02	0.0	No Limit
EB2318353-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.16	0.17	0.0	0% - 50%
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 5117718)									
EB2318282-002	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EB2318287-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 5118165)									
EB2317491-003	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 5118166)									
EB2318094-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EB2317957-008	THGW08	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	1.28	1.30	1.9	0% - 20%
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 5122228)									
EB2318240-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.02	0.02	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 5120993)									
EB2317957-001	THGW01	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EB2317957-011	Mine Shaft	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 5120993)									
EB2317957-001	THGW01	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit
EB2317957-011	Mine Shaft	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit
EP080: BTEXN (QC Lot: 5120993)									
EB2317957-001	THGW01	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EP080: BTEXN (QC Lot: 5120993) - continued									
EB2317957-001	THGW01	EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit
EB2317957-011	Mine Shaft	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit
EP231A: Perfluoroalkyl Sulfonic Acids (QC Lot: 5117244)									
EB2317957-001	THGW01	EP231X-LL: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.002	µg/L	<0.002	<0.002	0.0	No Limit
EB2317957-011	Mine Shaft	EP231X-LL: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.002	µg/L	0.014	0.014	0.0	No Limit
		EP231X-LL: Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.002	µg/L	<0.002	<0.002	0.0	No Limit
EP231B: Perfluoroalkyl Carboxylic Acids (QC Lot: 5117244)									
EB2317957-001	THGW01	EP231X-LL: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluorohexanoic acid (PFHxA)	307-24-4	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluorooctanoic acid (PFOA)	335-67-1	0.002	µg/L	<0.002	<0.002	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP231B: Perfluoroalkyl Carboxylic Acids (QC Lot: 5117244) - continued									
EB2317957-001	THGW01	EP231X-LL: Perfluorononanoic acid (PFNA)	375-95-1	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluorodecanoic acid (PFDA)	335-76-2	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluorododecanoic acid (PFDoDA)	307-55-1	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.005	µg/L	<0.005	<0.005	0.0	No Limit
		EP231X-LL: Perfluorobutanoic acid (PFBA)	375-22-4	0.01	µg/L	<0.01	<0.01	0.0	No Limit
EB2317957-011	Mine Shaft	EP231X-LL: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluorohexanoic acid (PFHxA)	307-24-4	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluorooctanoic acid (PFOA)	335-67-1	0.002	µg/L	0.013	0.013	0.0	No Limit
		EP231X-LL: Perfluorononanoic acid (PFNA)	375-95-1	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluorodecanoic acid (PFDA)	335-76-2	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluorododecanoic acid (PFDoDA)	307-55-1	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.005	µg/L	<0.005	<0.005	0.0	No Limit
		EP231X-LL: Perfluorobutanoic acid (PFBA)	375-22-4	0.01	µg/L	<0.01	<0.01	0.0	No Limit
EP231C: Perfluoroalkyl Sulfonamides (QC Lot: 5117244)									
EB2317957-001	THGW01	EP231X-LL: Perfluorooctane sulfonamide (FOSA)	754-91-6	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8	0.005	µg/L	<0.005	<0.005	0.0	No Limit
		EP231X-LL: N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.005	µg/L	<0.005	<0.005	0.0	No Limit
		EP231X-LL: N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.005	µg/L	<0.005	<0.005	0.0	No Limit
		EP231X-LL: N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.005	µg/L	<0.005	<0.005	0.0	No Limit
EB2317957-011	Mine Shaft	EP231X-LL: Perfluorooctane sulfonamide (FOSA)	754-91-6	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8	0.005	µg/L	<0.005	<0.005	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EP231C: Perfluoroalkyl Sulfonamides (QC Lot: 5117244) - continued									
EB2317957-011	Mine Shaft	EP231X-LL: N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.005	µg/L	<0.005	<0.005	0.0	No Limit
		EP231X-LL: N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.005	µg/L	<0.005	<0.005	0.0	No Limit
		EP231X-LL: N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.005	µg/L	<0.005	<0.005	0.0	No Limit
EP231D: (n:2) Fluorotelomer Sulfonic Acids (QC Lot: 5117244)									
EB2317957-001	THGW01	EP231X-LL: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.005	µg/L	<0.005	<0.005	0.0	No Limit
		EP231X-LL: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.005	µg/L	0.006	0.006	0.0	No Limit
		EP231X-LL: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.005	µg/L	<0.005	<0.005	0.0	No Limit
		EP231X-LL: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.005	µg/L	<0.005	<0.005	0.0	No Limit
EB2317957-011	Mine Shaft	EP231X-LL: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.005	µg/L	<0.005	<0.005	0.0	No Limit
		EP231X-LL: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.005	µg/L	<0.005	<0.005	0.0	No Limit
		EP231X-LL: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.005	µg/L	<0.005	<0.005	0.0	No Limit
		EP231X-LL: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.005	µg/L	<0.005	<0.005	0.0	No Limit
EP231P: PFAS Sums (QC Lot: 5117244)									
EB2317957-001	THGW01	EP231X-LL: Sum of PFAS	----	0.002	µg/L	0.006	0.006	0.0	No Limit
		EP231X-LL: Sum of PFHxS and PFOS	355-46-4/1763-23-1	0.002	µg/L	<0.002	<0.002	0.0	No Limit
		EP231X-LL: Sum of PFAS (WA DER List)	----	0.002	µg/L	0.006	0.006	0.0	No Limit
EB2317957-011	Mine Shaft	EP231X-LL: Sum of PFAS	----	0.002	µg/L	0.027	0.027	0.0	0% - 50%
		EP231X-LL: Sum of PFHxS and PFOS	355-46-4/1763-23-1	0.002	µg/L	0.014	0.014	0.0	No Limit
		EP231X-LL: Sum of PFAS (WA DER List)	----	0.002	µg/L	0.027	0.027	0.0	0% - 50%

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5119694)								
EG005T: Aluminium	7429-90-5	50	mg/kg	<50	12957 mg/kg	99.6	70.0	130
EG005T: Iron	7439-89-6	50	mg/kg	<50	30690 mg/kg	96.0	70.0	120
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5153649)								
EG005T: Aluminium	7429-90-5	50	mg/kg	<50	12957 mg/kg	88.4	70.0	130
EG005T: Iron	7439-89-6	50	mg/kg	<50	30690 mg/kg	85.2	70.0	120
EA002: pH 1:5 (Soils) (QCLot: 5119865)								
EA002: pH Value	----	----	pH Unit	----	4 pH Unit	101	98.0	102
				----	7 pH Unit	100	98.0	102
EA010: Conductivity (1:5) (QCLot: 5119864)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1412 µS/cm	98.7	97.0	103
EA026 : Chromium Reducible Sulfur (QCLot: 5122461)								
EA026: Chromium Reducible Sulphur	----	0.005	%	<0.005	0.246 %	108	78.7	111
EG020T: Total Metals by ICP-MS (QCLot: 5119695)								
EG020X-T: Arsenic	7440-38-2	0.1	mg/kg	<0.1	68.98449 mg/kg	91.6	87.0	122
EG020X-T: Barium	7440-39-3	0.1	mg/kg	<0.1	80.10339 mg/kg	104	86.0	123
EG020X-T: Cobalt	7440-48-4	0.1	mg/kg	<0.1	9.91145 mg/kg	90.8	88.0	129
EG020X-T: Chromium	7440-47-3	0.1	mg/kg	<0.1	17.46889 mg/kg	86.1	75.0	130
EG020X-T: Copper	7440-50-8	0.1	mg/kg	<0.1	40.39748 mg/kg	96.8	84.0	120
EG020X-T: Manganese	7439-96-5	0.1	mg/kg	<0.1	481.99051 mg/kg	99.0	86.0	130
EG020X-T: Molybdenum	7439-98-7	0.1	mg/kg	<0.1	1.352 mg/kg	89.7	82.0	118
EG020X-T: Nickel	7440-02-0	0.1	mg/kg	<0.1	13.93076 mg/kg	89.8	89.0	127
EG020X-T: Lead	7439-92-1	0.1	mg/kg	<0.1	55.24665 mg/kg	104	85.0	117
EG020X-T: Antimony	7440-36-0	0.1	mg/kg	<0.1	10.20675 mg/kg	91.2	70.0	130
EG020X-T: Uranium	7440-61-1	0.1	mg/kg	<0.1	0.4918 mg/kg	91.6	70.0	130
EG020X-T: Zinc	7440-66-6	0.5	mg/kg	<0.5	177.53551 mg/kg	90.9	71.0	130
EG020X-T: Vanadium	7440-62-2	1	mg/kg	<1	50.71064 mg/kg	94.1	86.0	130
EG020T: Total Metals by ICP-MS (QCLot: 5119696)								
EG020Y-T: Selenium	7782-49-2	1	mg/kg	<1	----	----	----	----
EG020Y-T: Cadmium	7440-43-9	0.1	mg/kg	<0.1	----	----	----	----
EG020Y-T: Strontium	7440-24-6	0.1	mg/kg	<0.1	58.83109 mg/kg	104	70.0	130

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG020T: Total Metals by ICP-MS (QCLot: 5119697)								
EG020R-T: Titanium	7440-32-6	1	mg/kg	<1	695.19498 mg/kg	88.8	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 5119698)								
EG020V-T: Tungsten	7440-33-7	0.1	mg/kg	<0.1	----	----	----	----
EG020T: Total Metals by ICP-MS (QCLot: 5153650)								
EG020R-T: Titanium	7440-32-6	1	mg/kg	<1	417.4 mg/kg	93.0	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 5153651)								
EG020V-T: Tungsten	7440-33-7	0.1	mg/kg	<0.1	----	----	----	----
EG020T: Total Metals by ICP-MS (QCLot: 5153652)								
EG020X-T: Arsenic	7440-38-2	0.1	mg/kg	<0.1	53.23 mg/kg	89.2	87.0	122
EG020X-T: Barium	7440-39-3	0.1	mg/kg	<0.1	70.22 mg/kg	101	86.0	123
EG020X-T: Cobalt	7440-48-4	0.1	mg/kg	<0.1	7.905 mg/kg	91.6	88.0	129
EG020X-T: Chromium	7440-47-3	0.1	mg/kg	<0.1	13.11 mg/kg	86.4	75.0	130
EG020X-T: Copper	7440-50-8	0.1	mg/kg	<0.1	33.44 mg/kg	93.0	84.0	120
EG020X-T: Manganese	7439-96-5	0.1	mg/kg	<0.1	361 mg/kg	95.8	86.0	130
EG020X-T: Molybdenum	7439-98-7	0.1	mg/kg	<0.1	1.053 mg/kg	103	82.0	118
EG020X-T: Nickel	7440-02-0	0.1	mg/kg	<0.1	10.81 mg/kg	91.8	89.0	127
EG020X-T: Lead	7439-92-1	0.1	mg/kg	<0.1	47.89 mg/kg	106	85.0	117
EG020X-T: Antimony	7440-36-0	0.1	mg/kg	<0.1	7.254 mg/kg	79.0	70.0	130
EG020X-T: Uranium	7440-61-1	0.1	mg/kg	<0.1	0.395 mg/kg	107	70.0	130
EG020X-T: Zinc	7440-66-6	0.5	mg/kg	<0.5	147.6 mg/kg	92.6	71.0	130
EG020X-T: Vanadium	7440-62-2	1	mg/kg	<1	35.18 mg/kg	91.4	86.0	130
EG020T: Total Metals by ICP-MS (QCLot: 5153653)								
EG020Y-T: Selenium	7782-49-2	1	mg/kg	<1	----	----	----	----
EG020Y-T: Cadmium	7440-43-9	0.1	mg/kg	<0.1	----	----	----	----
EG020Y-T: Strontium	7440-24-6	0.1	mg/kg	<0.1	47.64 mg/kg	92.1	70.0	130
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5119716)								
EK025SF: Free Cyanide	----	1	mg/kg	<1	40 mg/kg	108	80.0	110
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5119720)								
EK025SF: Free Cyanide	----	1	mg/kg	<1	40 mg/kg	110	80.0	110
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5153286)								
EK025SF: Free Cyanide	----	1	mg/kg	<1	40 mg/kg	106	80.0	110
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 5119714)								
EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	40 mg/kg	84.8	83.0	117
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 5119721)								

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 5119721) - continued								
EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	40 mg/kg	83.5	83.0	117
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 5153285)								
EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	40 mg/kg	117	83.0	117
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QCLot: 5119715)								
EK028SF: Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	40 mg/kg	108	80.0	118
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QCLot: 5119722)								
EK028SF: Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	40 mg/kg	112	80.0	118
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QCLot: 5153287)								
EK028SF: Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	40 mg/kg	102	80.0	118
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 5119667)								
EK067G: Total Phosphorus as P	----	2	mg/kg	<2	142 mg/kg	106	70.0	130
				<2	1200 mg/kg	112	79.0	121
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 5119866)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	<0.1	2.5 mg/kg	102	84.3	112
EN60Z: ASLP Leachate - ZHE (QCLot: 5119617)								
EN60Za: Extraction Fluid pH	----	0.1	pH Unit	5.7	----	----	----	----
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 5119914)								
EP066: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	1 mg/kg	102	71.6	155
EP068A: Organochlorine Pesticides (OC) (QCLot: 5119915)								
EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	0.5 mg/kg	111	72.8	127
EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	0.5 mg/kg	114	71.0	127
EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	0.5 mg/kg	109	67.5	126
EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	0.5 mg/kg	112	72.7	127
EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	0.5 mg/kg	106	70.6	122
EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	0.5 mg/kg	105	64.8	127
EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	0.5 mg/kg	107	72.4	122
EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	0.5 mg/kg	106	67.4	125
EP068: Total Chlordane (sum)	----	0.05	mg/kg	<0.05	----	----	----	----
EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	0.5 mg/kg	106	65.6	124
EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	0.5 mg/kg	101	70.4	122
EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	0.5 mg/kg	106	65.6	125
EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	0.5 mg/kg	103	69.1	124
EP068: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	0.5 mg/kg	106	72.4	125
EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	0.5 mg/kg	105	63.2	127

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EP068A: Organochlorine Pesticides (OC) (QCLot: 5119915) - continued								
EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	0.5 mg/kg	104	69.7	120
EP068: Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	----	----	----	----
EP068: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	0.5 mg/kg	102	61.2	124
EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	0.5 mg/kg	96.9	55.5	125
EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	0.5 mg/kg	99.6	57.1	117
EP068: 4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	0.5 mg/kg	88.4	51.9	125
EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	0.5 mg/kg	90.8	46.5	122
EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	0.5 mg/kg	97.8	34.0	130
EP068: Sum of DDD + DDE + DDT	72-54-8/72-5 5-9/50-2	0.05	mg/kg	<0.05	----	----	----	----
EP068: Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	<0.05	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5118435)								
EP080: C6 - C9 Fraction	----	10	mg/kg	<10	18 mg/kg	106	64.0	120
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5119913)								
EP071: C10 - C14 Fraction	----	50	mg/kg	<50	378 mg/kg	101	79.4	125
EP071: C15 - C28 Fraction	----	100	mg/kg	<100	407 mg/kg	100	78.8	122
EP071: C29 - C36 Fraction	----	100	mg/kg	<100	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5118435)								
EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	22.5 mg/kg	115	58.1	124
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5119913)								
EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	502 mg/kg	99.6	81.0	132
EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	268 mg/kg	103	67.2	130
EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	----	----	----	----
EP080: BTEXN (QCLot: 5118435)								
EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	1 mg/kg	98.8	68.0	107
EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	1 mg/kg	92.1	69.0	108
EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	1 mg/kg	97.5	68.0	109
EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	2 mg/kg	100.0	70.0	114
EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	1 mg/kg	105	74.0	116
EP080: Naphthalene	91-20-3	1	mg/kg	<1	1 mg/kg	84.1	74.0	109
EP231A: Perfluoroalkyl Sulfonic Acids (QCLot: 5119931)								
EP231X: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg	<0.0002	0.0011 mg/kg	111	72.0	128
EP231X: Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.0002	mg/kg	<0.0002	0.00117 mg/kg	122	73.0	123

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EP231A: Perfluoroalkyl Sulfonic Acids (QCLot: 5119931) - continued								
EP231X: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg	<0.0002	0.00118 mg/kg	102	67.0	130
EP231X: Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.0002	mg/kg	<0.0002	0.00119 mg/kg	111	70.0	132
EP231X: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg	<0.0002	0.00116 mg/kg	105	68.0	136
EP231X: Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.0002	mg/kg	<0.0002	0.0012 mg/kg	106	59.0	134
EP231B: Perfluoroalkyl Carboxylic Acids (QCLot: 5119931)								
EP231X: Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg	<0.001	0.00625 mg/kg	103	71.0	135
EP231X: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg	<0.0002	0.00125 mg/kg	100	69.0	132
EP231X: Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg	<0.0002	0.00125 mg/kg	103	70.0	132
EP231X: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg	<0.0002	0.00125 mg/kg	102	71.0	131
EP231X: Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg	<0.0002	0.00125 mg/kg	94.4	69.0	133
EP231X: Perfluorononanoic acid (PFNA)	375-95-1	0.0002	mg/kg	<0.0002	0.00125 mg/kg	114	72.0	129
EP231X: Perfluorodecanoic acid (PFDA)	335-76-2	0.0002	mg/kg	<0.0002	0.00125 mg/kg	115	69.0	133
EP231X: Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.0002	mg/kg	<0.0002	0.00125 mg/kg	114	64.0	136
EP231X: Perfluorododecanoic acid (PFDoDA)	307-55-1	0.0002	mg/kg	<0.0002	0.00125 mg/kg	109	69.0	135
EP231X: Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.0002	mg/kg	<0.0002	0.00125 mg/kg	112	66.0	139
EP231X: Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.0005	mg/kg	<0.0005	0.00312 mg/kg	89.4	69.0	133
EP231C: Perfluoroalkyl Sulfonamides (QCLot: 5119931)								
EP231X: Perfluorooctane sulfonamide (FOSA)	754-91-6	0.0002	mg/kg	<0.0002	0.00125 mg/kg	102	67.0	137
EP231X: N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8	0.0005	mg/kg	<0.0005	0.00312 mg/kg	114	59.6	143
EP231X: N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.0005	mg/kg	<0.0005	0.00312 mg/kg	93.6	62.8	140
EP231X: N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.0005	mg/kg	<0.0005	0.00312 mg/kg	108	61.5	139
EP231X: N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.0005	mg/kg	<0.0005	0.00312 mg/kg	97.8	61.9	137
EP231X: N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9	0.0002	mg/kg	<0.0002	0.00125 mg/kg	104	63.0	144
EP231X: N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.0002	mg/kg	<0.0002	0.00125 mg/kg	106	61.0	139
EP231D: (n:2) Fluorotelomer Sulfonic Acids (QCLot: 5119931)								
EP231X: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg	<0.0005	0.00117 mg/kg	101	62.0	145
EP231X: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg	<0.0005	0.00118 mg/kg	119	64.0	140
EP231X: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg	<0.0005	0.0012 mg/kg	124	65.0	137
EP231X: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg	<0.0005	0.0012 mg/kg	114	54.8	124

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report: Spike	Spike Recovery (%)	Acceptable Limits (%)	

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low	High
EA005P: pH by PC Titrator (QCLot: 5117845)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	100	98.0	102
				----	7 pH Unit	99.7	98.0	102
EA005P: pH by PC Titrator (QCLot: 5118096)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	100	98.0	102
				----	7 pH Unit	99.7	98.0	102
EA005P: pH by PC Titrator (QCLot: 5118101)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	99.5	98.0	102
				----	7 pH Unit	99.7	98.0	102
EA005P: pH by PC Titrator (QCLot: 5118347)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	100	98.0	102
				----	7 pH Unit	100	98.0	102
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 5117570)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	107	88.0	112
				<10	2000 mg/L	96.1	80.9	118
				<10	2410 mg/L	104	81.3	119
ED037P: Alkalinity by PC Titrator (QCLot: 5117846)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	98.8	80.0	120
ED037P: Alkalinity by PC Titrator (QCLot: 5118092)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	99.5	80.0	120
ED037P: Alkalinity by PC Titrator (QCLot: 5118102)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	97.1	80.0	120
ED037P: Alkalinity by PC Titrator (QCLot: 5118349)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	50 mg/L	118	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 5117714)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	95.4	85.0	118
				<1	100 mg/L	93.5	85.0	118
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 5118159)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	95.8	85.0	118
				<1	100 mg/L	95.3	85.0	118
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 5118160)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	92.0	85.0	118
				<1	100 mg/L	94.9	85.0	118
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 5122229)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	93.3	85.0	118
				<1	100 mg/L	95.5	85.0	118

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
ED045G: Chloride by Discrete Analyser (QCLot: 5117716)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	100	90.0	115
				<1	1000 mg/L	103	90.0	115
ED045G: Chloride by Discrete Analyser (QCLot: 5118156)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	103	90.0	115
				<1	1000 mg/L	103	90.0	115
ED045G: Chloride by Discrete Analyser (QCLot: 5118157)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	101	90.0	115
				<1	1000 mg/L	103	90.0	115
ED045G: Chloride by Discrete Analyser (QCLot: 5122231)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	94.7	90.0	115
				<1	1000 mg/L	104	90.0	115
ED093F: Dissolved Major Cations (QCLot: 5118620)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	104	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	103	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	104	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	99.2	70.0	130
ED093F: Dissolved Major Cations (QCLot: 5118621)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	106	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	104	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	103	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	100	70.0	130
ED093F: Dissolved Major Cations (QCLot: 5120832)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	113	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	98.9	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	98.6	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	99.9	70.0	130
ED093F: Dissolved Major Cations (QCLot: 5121653)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	104	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	95.3	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	101	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	95.4	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 5118618)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	100.0	79.0	118
EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	0.1 mg/L	96.1	87.0	113

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low	Acceptable Limits (%) High
EG020F: Dissolved Metals by ICP-MS (QCLot: 5118618) - continued								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	100	88.0	116
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	99.2	70.0	130
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	100	88.0	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	97.7	87.0	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	98.2	86.0	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	92.7	88.0	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	100	89.0	110
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	99.9	89.0	120
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	103	89.0	112
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	97.7	89.0	113
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	97.0	83.0	112
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	99.9	88.0	114
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	98.1	87.0	113
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	105	82.0	114
EG020F: Dissolved Metals by ICP-MS (QCLot: 5118619)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	98.9	79.0	118
EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	0.1 mg/L	96.0	87.0	113
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	98.4	88.0	116
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	99.8	70.0	130
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	99.8	88.0	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	97.7	87.0	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	97.0	86.0	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	93.4	88.0	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	103	89.0	110
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	99.7	89.0	120
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	102	89.0	112
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	97.5	89.0	113
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	95.9	83.0	112
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	98.9	88.0	114
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	97.8	87.0	113
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	103	82.0	114
EG020F: Dissolved Metals by ICP-MS (QCLot: 5118622)								
EG020B-F: Strontium	7440-24-6	0.001	mg/L	<0.001	0.1 mg/L	103	86.0	111
EG020B-F: Titanium	7440-32-6	0.01	mg/L	<0.01	0.1 mg/L	101	89.0	111

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG020F: Dissolved Metals by ICP-MS (QCLot: 5118622) - continued								
EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	105	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 5118623)								
EG020B-F: Strontium	7440-24-6	0.001	mg/L	<0.001	0.1 mg/L	102	86.0	111
EG020B-F: Titanium	7440-32-6	0.01	mg/L	<0.01	0.1 mg/L	98.6	89.0	111
EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	109	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 5118624)								
EG020E-F: Tungsten	7440-33-7	0.001	mg/L	<0.001	0.1 mg/L	91.3	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 5118625)								
EG020E-F: Tungsten	7440-33-7	0.001	mg/L	<0.001	0.1 mg/L	109	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 5120834)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	98.0	79.0	118
EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	0.1 mg/L	102	87.0	113
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	100	88.0	116
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	103	70.0	130
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	99.8	88.0	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	98.1	87.0	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	95.9	86.0	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	94.1	88.0	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	98.0	89.0	110
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	97.9	89.0	120
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	105	89.0	112
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	97.4	89.0	113
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	102	83.0	112
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	98.4	88.0	114
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	98.9	87.0	113
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	98.3	82.0	114
EG020F: Dissolved Metals by ICP-MS (QCLot: 5120836)								
EG020B-F: Strontium	7440-24-6	0.001	mg/L	<0.001	0.1 mg/L	99.2	86.0	111
EG020B-F: Titanium	7440-32-6	0.01	mg/L	<0.01	0.1 mg/L	105	89.0	111
EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	103	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 5120838)								
EG020E-F: Tungsten	7440-33-7	0.001	mg/L	<0.001	0.1 mg/L	109	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 5121651)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	101	79.0	118

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG020F: Dissolved Metals by ICP-MS (QCLot: 5121651) - continued								
EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	0.1 mg/L	112	87.0	113
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	100	88.0	116
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	99.2	70.0	130
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	99.3	88.0	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	97.5	87.0	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	95.4	86.0	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	98.1	88.0	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	94.7	89.0	110
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	101	89.0	120
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	100	89.0	112
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	96.3	89.0	113
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	96.9	83.0	112
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	104	88.0	114
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	101	87.0	113
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	105	82.0	114
EG020F: Dissolved Metals by ICP-MS (QCLot: 5121652)								
EG020B-F: Strontium	7440-24-6	0.001	mg/L	<0.001	0.1 mg/L	96.6	86.0	111
EG020B-F: Titanium	7440-32-6	0.01	mg/L	<0.01	0.1 mg/L	99.5	89.0	111
EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	92.5	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 5121654)								
EG020E-F: Tungsten	7440-33-7	0.001	mg/L	<0.001	0.1 mg/L	98.1	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 5118654)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	111	80.0	114
EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	0.1 mg/L	114	87.0	115
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	106	88.0	112
EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	104	70.0	130
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	102	88.0	111
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	107	89.0	115
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	105	89.0	115
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	106	88.0	116
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	101	89.0	112
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	106	88.0	114
EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	106	90.0	114
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	106	88.0	116

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG020T: Total Metals by ICP-MS (QCLot: 5118654) - continued								
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	99.1	79.0	111
EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	106	87.0	114
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	102	84.0	114
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	110	82.0	118
EG020T: Total Metals by ICP-MS (QCLot: 5118656)								
EG020B-T: Strontium	7440-24-6	0.001	mg/L	<0.001	0.1 mg/L	107	86.0	112
EG020B-T: Titanium	7440-32-6	0.01	mg/L	<0.01	0.1 mg/L	103	88.0	112
EG020B-T: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	102	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 5118658)								
EG020E-T: Tungsten	7440-33-7	0.001	mg/L	<0.001	0.1 mg/L	120	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 5121697)								
EG020B-T: Strontium	7440-24-6	0.001	mg/L	<0.001	0.1 mg/L	98.5	86.0	112
EG020B-T: Titanium	7440-32-6	0.01	mg/L	<0.01	0.1 mg/L	109	88.0	112
EG020B-T: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	95.8	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 5121698)								
EG020E-T: Tungsten	7440-33-7	0.001	mg/L	<0.001	0.1 mg/L	105	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 5121699)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	101	80.0	114
EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	0.1 mg/L	104	87.0	115
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	100	88.0	112
EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	98.7	70.0	130
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	96.7	88.0	111
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	98.6	89.0	115
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	98.8	89.0	115
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	102	88.0	116
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	96.9	89.0	112
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	104	88.0	114
EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	99.0	90.0	114
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	102	88.0	116
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	91.5	79.0	111
EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	107	87.0	114
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	102	84.0	114
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	107	82.0	118
EG020W: Water Leachable Metals by ICP-MS (QCLot: 5121733)								

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG020W: Water Leachable Metals by ICP-MS (QCLot: 5121733) - continued								
EG020B-W: Strontium	7440-24-6	0.001	mg/L	<0.001	0.1 mg/L	94.6	85.0	111
EG020B-W: Titanium	7440-32-6	0.01	mg/L	<0.01	0.1 mg/L	94.5	88.0	108
EG020B-W: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	98.0	70.0	130
EG020W: Water Leachable Metals by ICP-MS (QCLot: 5121734)								
EG020E-W: Tungsten	7440-33-7	0.001	mg/L	<0.001	0.1 mg/L	104	70.0	130
EG020W: Water Leachable Metals by ICP-MS (QCLot: 5121735)								
EG020A-W: Antimony	7440-36-0	0.001	mg/L	<0.001	0.1 mg/L	104	91.0	107
EG020A-W: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	94.7	86.0	111
EG020A-W: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	95.4	70.0	130
EG020A-W: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	95.7	88.0	108
EG020A-W: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	95.7	88.0	112
EG020A-W: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	93.7	90.0	115
EG020A-W: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	95.6	86.0	115
EG020A-W: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	96.2	89.0	113
EG020A-W: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	99.4	90.0	115
EG020A-W: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	95.0	92.0	112
EG020A-W: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	96.1	88.0	112
EG020A-W: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	92.8	80.0	117
EG020A-W: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	101	84.0	113
EG020A-W: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	96.3	86.0	113
EG035F: Dissolved Mercury by FIMS (QCLot: 5121650)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	94.6	84.0	118
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5121709)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	96.5	84.0	118
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5119011)								
EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	0.2 mg/L	118	80.0	120
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5119012)								
EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	0.2 mg/L	113	80.0	120
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5127889)								
EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	0.2 mg/L	115	80.0	120
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 5119009)								
EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	0.2 mg/L	92.1	85.0	119
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 5119010)								
EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	0.2 mg/L	89.1	85.0	119

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QCLot: 5119013)								
EK028SF: Weak Acid Dissociable Cyanide	----	0.004	mg/L	<0.004	0.2 mg/L	116	83.0	120
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QCLot: 5119014)								
EK028SF: Weak Acid Dissociable Cyanide	----	0.004	mg/L	<0.004	0.2 mg/L	113	83.0	120
EK040P: Fluoride by PC Titrator (QCLot: 5117847)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	0.5 mg/L	103	80.0	117
EK040P: Fluoride by PC Titrator (QCLot: 5118094)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	0.5 mg/L	101	80.0	117
EK040P: Fluoride by PC Titrator (QCLot: 5118103)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	0.5 mg/L	106	80.0	117
EK040P: Fluoride by PC Titrator (QCLot: 5118348)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	10 mg/L	102	80.0	117
EK055G: Ammonia as N by Discrete Analyser (QCLot: 5123888)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	98.9	83.5	114
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5117712)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	93.8	90.0	110
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5118162)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	93.7	90.0	110
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5118163)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	93.9	90.0	110
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5122230)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	92.5	90.0	110
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 5123833)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	0.442 mg/L	96.9	84.7	106
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 5117718)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	94.8	81.7	117
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 5118165)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	96.9	81.7	117
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 5118166)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	100	81.7	117
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 5122228)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	99.0	81.7	117
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5117829)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	1192 µg/L	106	51.9	126
EP071: C15 - C28 Fraction	----	100	µg/L	<100	1390 µg/L	90.2	51.4	124

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5117829) - continued								
EP071: C29 - C36 Fraction	----	50	µg/L	<50	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5120993)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	180 µg/L	90.7	77.0	122
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5117829)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	1592 µg/L	101	51.0	133
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	932 µg/L	91.0	49.5	123
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5120993)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	225 µg/L	92.1	76.0	121
EP080: C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	----	----	----	----
EP080: BTEXN (QCLot: 5120993)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	81.8	79.8	115
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	96.0	78.6	116
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	98.4	77.3	115
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	20 µg/L	104	82.0	118
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	104	86.0	119
EP080: Total Xylenes	----	2	µg/L	<2	----	----	----	----
EP080: Sum of BTEX	----	1	µg/L	<1	----	----	----	----
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	87.2	77.8	116
EP231A: Perfluoroalkyl Sulfonic Acids (QCLot: 5117244)								
EP231X-LL: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.002	µg/L	<0.002	0.0222 µg/L	120	72.0	130
EP231X-LL: Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.002	µg/L	<0.002	0.0235 µg/L	126	71.0	127
EP231X-LL: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.002	µg/L	<0.002	0.0237 µg/L	116	68.0	131
EP231X-LL: Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.002	µg/L	<0.002	0.0238 µg/L	126	69.0	134
EP231X-LL: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.002	µg/L	<0.002	0.0232 µg/L	113	65.0	140
EP231X-LL: Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.002	µg/L	<0.002	0.0241 µg/L	122	53.0	142
EP231B: Perfluoroalkyl Carboxylic Acids (QCLot: 5117244)								
EP231X-LL: Perfluorobutanoic acid (PFBA)	375-22-4	0.01	µg/L	<0.01	0.125 µg/L	113	73.0	129
EP231X-LL: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.002	µg/L	<0.002	0.025 µg/L	116	72.0	129
EP231X-LL: Perfluorohexanoic acid (PFHxA)	307-24-4	0.002	µg/L	<0.002	0.025 µg/L	120	72.0	129
EP231X-LL: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.002	µg/L	<0.002	0.025 µg/L	115	72.0	130
EP231X-LL: Perfluorooctanoic acid (PFOA)	335-67-1	0.002	µg/L	<0.002	0.025 µg/L	106	71.0	133
EP231X-LL: Perfluorononanoic acid (PFNA)	375-95-1	0.002	µg/L	<0.002	0.025 µg/L	112	69.0	130

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low	Acceptable Limits (%) High
EP231B: Perfluoroalkyl Carboxylic Acids (QCLot: 5117244) - continued								
EP231X-LL: Perfluorodecanoic acid (PFDA)	335-76-2	0.002	µg/L	<0.002	0.025 µg/L	122	71.0	129
EP231X-LL: Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.002	µg/L	<0.002	0.025 µg/L	120	69.0	133
EP231X-LL: Perfluorododecanoic acid (PFDoDA)	307-55-1	0.002	µg/L	<0.002	0.025 µg/L	125	72.0	134
EP231X-LL: Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.002	µg/L	<0.002	0.025 µg/L	114	65.0	144
EP231X-LL: Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.005	µg/L	<0.005	0.0625 µg/L	116	71.0	132
EP231C: Perfluoroalkyl Sulfonamides (QCLot: 5117244)								
EP231X-LL: Perfluorooctane sulfonamide (FOSA)	754-91-6	0.002	µg/L	<0.002	0.025 µg/L	118	67.0	137
EP231X-LL: N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8	0.005	µg/L	<0.005	0.0625 µg/L	140	68.0	141
EP231X-LL: N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.005	µg/L	<0.005	0.0625 µg/L	116	57.9	141
EP231X-LL: N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.005	µg/L	<0.005	0.0625 µg/L	# 137	63.3	134
EP231X-LL: N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.005	µg/L	<0.005	0.0625 µg/L	116	60.0	136
EP231X-LL: N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9	0.002	µg/L	<0.002	0.025 µg/L	132	65.0	136
EP231X-LL: N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.002	µg/L	<0.002	0.025 µg/L	124	61.0	135
EP231D: (n:2) Fluorotelomer Sulfonic Acids (QCLot: 5117244)								
EP231X-LL: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.005	µg/L	<0.005	0.0234 µg/L	120	63.0	143
EP231X-LL: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.005	µg/L	<0.005	0.0238 µg/L	126	64.0	140
EP231X-LL: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.005	µg/L	<0.005	0.024 µg/L	112	67.0	138
EP231X-LL: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.005	µg/L	<0.005	0.0242 µg/L	107	53.1	133
EP231P: PFAS Sums (QCLot: 5117244)								
EP231X-LL: Sum of PFAS	----	0.002	µg/L	<0.002	----	----	----	----
EP231X-LL: Sum of PFHxS and PFOS	355-46-4/17 63-23-1	0.002	µg/L	<0.002	----	----	----	----
EP231X-LL: Sum of PFAS (WA DER List)	----	0.002	µg/L	<0.002	----	----	----	----

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%) MS	Acceptable Limits (%) Low	Acceptable Limits (%) High
EG020T: Total Metals by ICP-MS (QCLot: 5119695)							

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG020T: Total Metals by ICP-MS (QCLot: 5119695) - continued							
EB2317957-018	THS04 0-0.1	EG020X-T: Arsenic	7440-38-2	50 mg/kg	87.0	70.0	130
		EG020X-T: Chromium	7440-47-3	50 mg/kg	82.2	70.0	130
		EG020X-T: Copper	7440-50-8	250 mg/kg	92.3	70.0	130
		EG020X-T: Nickel	7440-02-0	50 mg/kg	90.3	70.0	130
		EG020X-T: Lead	7439-92-1	250 mg/kg	94.5	70.0	130
		EG020X-T: Zinc	7440-66-6	250 mg/kg	86.5	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 5119696)							
EB2317957-018	THS04 0-0.1	EG020Y-T: Selenium	7782-49-2	50 mg/kg	84.6	70.0	130
		EG020Y-T: Cadmium	7440-43-9	50 mg/kg	96.4	70.0	130
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5119716)							
EB2317957-015	THS02 0-0.1	EK025SF: Free Cyanide	----	40 mg/kg	83.2	70.0	130
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5119720)							
EB2317957-049	THT08 0.1	EK025SF: Free Cyanide	----	40 mg/kg	76.2	70.0	130
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 5119714)							
EB2317957-015	THS02 0-0.1	EK026SF: Total Cyanide	57-12-5	40 mg/kg	85.8	70.0	130
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 5119721)							
EB2317957-049	THT08 0.1	EK026SF: Total Cyanide	57-12-5	80 mg/kg	115	70.0	130
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QCLot: 5119715)							
EB2317957-015	THS02 0-0.1	EK028SF: Weak Acid Dissociable Cyanide	----	40 mg/kg	82.5	70.0	130
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QCLot: 5119722)							
EB2317957-049	THT08 0.1	EK028SF: Weak Acid Dissociable Cyanide	----	40 mg/kg	82.3	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 5119667)							
EB2317806-004	Anonymous	EK067G: Total Phosphorus as P	----	100 mg/kg	# Not Determined	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 5119866)							
EB2317957-022	THS08 0-0.1	EK071G: Reactive Phosphorus as P	14265-44-2	2 mg/kg	104	70.0	130
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 5119914)							
EB2317957-022	THS08 0-0.1	EP066: Total Polychlorinated biphenyls	----	1 mg/kg	110	70.0	130
EP068A: Organochlorine Pesticides (OC) (QCLot: 5119915)							
EB2317957-022	THS08 0-0.1	EP068: gamma-BHC	58-89-9	0.5 mg/kg	101	70.0	136
		EP068: Heptachlor	76-44-8	0.5 mg/kg	96.8	65.0	130
		EP068: Aldrin	309-00-2	0.5 mg/kg	98.0	70.0	130
		EP068: Dieldrin	60-57-1	0.5 mg/kg	92.9	67.0	129
		EP068: Endrin	72-20-8	0.5 mg/kg	95.6	60.0	137
		EP068: 4.4`-DDT	50-29-3	0.5 mg/kg	79.8	70.0	130

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5118435)							
EB2317957-022	THS08 0-0.1	EP080: C6 - C9 Fraction	----	8 mg/kg	83.4	70.0	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5119913)							
EB2317957-022	THS08 0-0.1	EP071: C10 - C14 Fraction	----	379 mg/kg	101	70.0	130
		EP071: C15 - C28 Fraction	----	407 mg/kg	101	70.0	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5118435)							
EB2317957-022	THS08 0-0.1	EP080: C6 - C10 Fraction	C6_C10	8 mg/kg	88.5	70.0	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5119913)							
EB2317957-022	THS08 0-0.1	EP071: >C10 - C16 Fraction	----	502 mg/kg	100	70.0	130
		EP071: >C16 - C34 Fraction	----	268 mg/kg	104	70.0	130
EP080: BTEXN (QCLot: 5118435)							
EB2317957-022	THS08 0-0.1	EP080: Benzene	71-43-2	2 mg/kg	99.2	70.0	130
		EP080: Toluene	108-88-3	2 mg/kg	86.2	70.0	130
EP231A: Perfluoroalkyl Sulfonic Acids (QCLot: 5119931)							
EB2317957-021	THS07 0-0.1	EP231X: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0011 mg/kg	104	72.0	128
		EP231X: Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.00117 mg/kg	122	73.0	123
		EP231X: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.00118 mg/kg	108	67.0	130
		EP231X: Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.00119 mg/kg	112	70.0	132
		EP231X: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.00116 mg/kg	107	68.0	136
		EP231X: Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.0012 mg/kg	108	59.0	134
EP231B: Perfluoroalkyl Carboxylic Acids (QCLot: 5119931)							
EB2317957-021	THS07 0-0.1	EP231X: Perfluorobutanoic acid (PFBA)	375-22-4	0.00625 mg/kg	108	71.0	135
		EP231X: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.00125 mg/kg	110	69.0	132
		EP231X: Perfluorohexanoic acid (PFHxA)	307-24-4	0.00125 mg/kg	108	70.0	132
		EP231X: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.00125 mg/kg	99.2	71.0	131
		EP231X: Perfluorooctanoic acid (PFOA)	335-67-1	0.00125 mg/kg	96.0	69.0	133
		EP231X: Perfluorononanoic acid (PFNA)	375-95-1	0.00125 mg/kg	109	72.0	129
		EP231X: Perfluorodecanoic acid (PFDA)	335-76-2	0.00125 mg/kg	114	69.0	133
		EP231X: Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.00125 mg/kg	122	64.0	136
		EP231X: Perfluorododecanoic acid (PFDoDA)	307-55-1	0.00125 mg/kg	118	69.0	135
		EP231X: Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.00125 mg/kg	134	66.0	139
		EP231X: Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.00312 mg/kg	92.5	69.0	133
EP231C: Perfluoroalkyl Sulfonamides (QCLot: 5119931)							
EB2317957-021	THS07 0-0.1	EP231X: Perfluorooctane sulfonamide (FOSA)	754-91-6	0.00125 mg/kg	106	48.0	128
		EP231X: N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8	0.00312 mg/kg	130	70.0	130
		EP231X: N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.00312 mg/kg	100	70.0	130

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%) MS	Acceptable Limits (%) Low	High
EP231C: Perfluoroalkyl Sulfonamides (QCLot: 5119931) - continued							
EB2317957-021	THS07 0-0.1	EP231X: N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.00312 mg/kg	105	70.0	130
		EP231X: N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.00312 mg/kg	96.2	70.0	130
		EP231X: N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9	0.00125 mg/kg	113	63.0	144
		EP231X: N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.00125 mg/kg	106	61.0	139
EP231D: (n:2) Fluorotelomer Sulfonic Acids (QCLot: 5119931)							
EB2317957-021	THS07 0-0.1	EP231X: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.00117 mg/kg	108	62.0	145
		EP231X: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.00118 mg/kg	119	64.0	140
		EP231X: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0012 mg/kg	121	65.0	137
		EP231X: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0012 mg/kg	93.8	70.0	130

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%) MS	Acceptable Limits (%) Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 5117714)							
EB2318285-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	75.2	70.0	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 5118159)							
EB2317491-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	# Not Determined	70.0	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 5118160)							
EB2317957-009	THGW09	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	100 mg/L	90.8	70.0	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 5122229)							
EB2318240-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	86.9	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 5117716)							
EB2318285-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	111	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 5118156)							
EB2317491-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	# Not Determined	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 5118157)							
EB2317957-009	THGW09	ED045G: Chloride	16887-00-6	2000 mg/L	108	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 5122231)							
EB2318240-001	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	105	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 5118618)							

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%) MS	Acceptable Limits (%) Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 5118618) - continued							
EB2318055-015	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	97.5	70.0	130
		EG020A-F: Barium	7440-39-3	1 mg/L	96.6	70.0	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	96.4	70.0	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	88.1	70.0	130
		EG020A-F: Cobalt	7440-48-4	1 mg/L	91.3	70.0	130
		EG020A-F: Copper	7440-50-8	1 mg/L	90.9	70.0	130
		EG020A-F: Lead	7439-92-1	1 mg/L	104	70.0	130
		EG020A-F: Manganese	7439-96-5	1 mg/L	92.5	70.0	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	93.8	70.0	130
		EG020A-F: Vanadium	7440-62-2	1 mg/L	92.9	70.0	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	96.1	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 5118619)							
EB2317957-009	THGW09	EG020A-F: Arsenic	7440-38-2	1 mg/L	98.0	70.0	130
		EG020A-F: Barium	7440-39-3	1 mg/L	105	70.0	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	99.4	70.0	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	92.4	70.0	130
		EG020A-F: Cobalt	7440-48-4	1 mg/L	93.1	70.0	130
		EG020A-F: Copper	7440-50-8	1 mg/L	89.6	70.0	130
		EG020A-F: Lead	7439-92-1	1 mg/L	97.7	70.0	130
		EG020A-F: Manganese	7439-96-5	1 mg/L	95.4	70.0	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	94.5	70.0	130
		EG020A-F: Vanadium	7440-62-2	1 mg/L	97.0	70.0	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	97.6	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 5120834)							
EB2318232-006	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	102	70.0	130
		EG020A-F: Barium	7440-39-3	1 mg/L	109	70.0	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	106	70.0	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	103	70.0	130
		EG020A-F: Cobalt	7440-48-4	1 mg/L	105	70.0	130
		EG020A-F: Copper	7440-50-8	1 mg/L	105	70.0	130
		EG020A-F: Lead	7439-92-1	1 mg/L	117	70.0	130
		EG020A-F: Manganese	7439-96-5	1 mg/L	110	70.0	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	99.9	70.0	130
		EG020A-F: Vanadium	7440-62-2	1 mg/L	105	70.0	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	102	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 5121651)							
EB2317957-011	Mine Shaft	EG020A-F: Arsenic	7440-38-2	1 mg/L	104	70.0	130
		EG020A-F: Barium	7440-39-3	1 mg/L	106	70.0	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 5121651) - continued							
EB2317957-011	Mine Shaft	EG020A-F: Cadmium	7440-43-9	0.25 mg/L	104	70.0	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	94.3	70.0	130
		EG020A-F: Cobalt	7440-48-4	1 mg/L	96.6	70.0	130
		EG020A-F: Copper	7440-50-8	1 mg/L	97.8	70.0	130
		EG020A-F: Lead	7439-92-1	1 mg/L	95.2	70.0	130
		EG020A-F: Manganese	7439-96-5	1 mg/L	105	70.0	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	99.2	70.0	130
		EG020A-F: Vanadium	7440-62-2	1 mg/L	106	70.0	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	103	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 5118654)							
EB2318289-008	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	106	70.0	130
		EG020A-T: Barium	7440-39-3	1 mg/L	103	70.0	130
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	102	70.0	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	106	70.0	130
		EG020A-T: Cobalt	7440-48-4	1 mg/L	103	70.0	130
		EG020A-T: Copper	7440-50-8	1 mg/L	105	70.0	130
		EG020A-T: Lead	7439-92-1	1 mg/L	102	70.0	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	103	70.0	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	105	70.0	130
		EG020A-T: Vanadium	7440-62-2	1 mg/L	105	70.0	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	103	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 5121699)							
EB2317957-003	THGW03	EG020A-T: Arsenic	7440-38-2	1 mg/L	105	70.0	130
		EG020A-T: Barium	7440-39-3	1 mg/L	106	70.0	130
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	104	70.0	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	95.4	70.0	130
		EG020A-T: Cobalt	7440-48-4	1 mg/L	95.1	70.0	130
		EG020A-T: Copper	7440-50-8	1 mg/L	101	70.0	130
		EG020A-T: Lead	7439-92-1	1 mg/L	97.3	70.0	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	105	70.0	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	101	70.0	130
		EG020A-T: Vanadium	7440-62-2	1 mg/L	104	70.0	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	104	70.0	130
EG020W: Water Leachable Metals by ICP-MS (QCLot: 5121735)							
EB2317957-057	THT10 5.0 - 5.5	EG020A-W: Arsenic	7440-38-2	1 mg/L	95.4	70.0	130
		EG020A-W: Barium	7440-39-3	1 mg/L	101	70.0	130
		EG020A-W: Cadmium	7440-43-9	0.25 mg/L	98.2	70.0	130
		EG020A-W: Chromium	7440-47-3	1 mg/L	90.7	70.0	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG020W: Water Leachable Metals by ICP-MS (QCLot: 5121735) - continued							
EB2317957-057	THT10 5.0 - 5.5	EG020A-W: Cobalt	7440-48-4	1 mg/L	93.0	70.0	130
		EG020A-W: Copper	7440-50-8	1 mg/L	99.7	70.0	130
		EG020A-W: Lead	7439-92-1	1 mg/L	92.3	70.0	130
		EG020A-W: Manganese	7439-96-5	1 mg/L	102	70.0	130
		EG020A-W: Nickel	7440-02-0	1 mg/L	100	70.0	130
		EG020A-W: Vanadium	7440-62-2	1 mg/L	101	70.0	130
		EG020A-W: Zinc	7440-66-6	1 mg/L	102	70.0	130
EG035F: Dissolved Mercury by FIMS (QCLot: 5121650)							
EB2317957-013	RB01	EG035F: Mercury	7439-97-6	0.01 mg/L	87.0	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5121709)							
EB2318055-005	Anonymous	EG035T: Mercury	7439-97-6	0.01 mg/L	76.2	70.0	130
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5119011)							
EB2318302-002	Anonymous	EK025SF: Free Cyanide	----	0.2 mg/L	102	70.0	130
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5119012)							
EB2317957-013	RB01	EK025SF: Free Cyanide	----	0.2 mg/L	91.7	70.0	130
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5127889)							
EB2317957-040	THT03 1.0	EK025SF: Free Cyanide	----	0.2 mg/L	106	70.0	130
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 5119009)							
EB2318302-002	Anonymous	EK026SF: Total Cyanide	57-12-5	0.2 mg/L	102	70.0	130
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 5119010)							
EB2317957-013	RB01	EK026SF: Total Cyanide	57-12-5	0.2 mg/L	99.2	70.0	130
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QCLot: 5119013)							
EB2318302-002	Anonymous	EK028SF: Weak Acid Dissociable Cyanide	----	0.2 mg/L	98.7	70.0	130
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QCLot: 5119014)							
EB2317957-013	RB01	EK028SF: Weak Acid Dissociable Cyanide	----	0.2 mg/L	95.4	70.0	130
EK040P: Fluoride by PC Titrator (QCLot: 5117847)							
EB2317957-001	THGW01	EK040P: Fluoride	16984-48-8	5 mg/L	98.2	70.0	130
EK040P: Fluoride by PC Titrator (QCLot: 5118094)							
EB2317957-009	THGW09	EK040P: Fluoride	16984-48-8	5 mg/L	91.4	70.0	130
EK040P: Fluoride by PC Titrator (QCLot: 5118103)							
EB2317957-011	Mine Shaft	EK040P: Fluoride	16984-48-8	5 mg/L	95.6	70.0	130
EK040P: Fluoride by PC Titrator (QCLot: 5118348)							
EB2318132-001	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	90.2	70.0	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 5123888)							

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK055G: Ammonia as N by Discrete Analyser (QCLot: 5123888) - continued							
EB2317957-002	THGW02	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	85.0	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5117712)							
EB2318285-002	Anonymous	EK057G: Nitrite as N	14797-65-0	0.4 mg/L	103	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5118162)							
EB2317491-002	Anonymous	EK057G: Nitrite as N	14797-65-0	0.4 mg/L	106	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5118163)							
EB2317957-009	THGW09	EK057G: Nitrite as N	14797-65-0	0.4 mg/L	99.8	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5122230)							
EB2318240-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.4 mg/L	98.7	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 5123833)							
EB2317957-002	THGW02	EK067G: Total Phosphorus as P	----	1 mg/L	101	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 5117718)							
EB2318285-002	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.4 mg/L	104	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 5118165)							
EB2317491-002	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.4 mg/L	104	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 5118166)							
EB2317957-009	THGW09	EK071G: Reactive Phosphorus as P	14265-44-2	2 mg/L	104	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 5122228)							
EB2318240-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.4 mg/L	111	70.0	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5120993)							
EB2317957-002	THGW02	EP080: C6 - C9 Fraction	----	40 µg/L	75.7	70.0	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5120993)							
EB2317957-002	THGW02	EP080: C6 - C10 Fraction	C6_C10	40 µg/L	75.2	70.0	130
EP080: BTEXN (QCLot: 5120993)							
EB2317957-002	THGW02	EP080: Benzene	71-43-2	10 µg/L	85.2	70.0	130
		EP080: Toluene	108-88-3	10 µg/L	96.2	70.0	130
EP231A: Perfluoroalkyl Sulfonic Acids (QCLot: 5117244)							
EB2317957-002	THGW02	EP231X-LL: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0222 µg/L	110	72.0	130
		EP231X-LL: Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.0235 µg/L	120	71.0	127
		EP231X-LL: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0237 µg/L	109	68.0	131
		EP231X-LL: Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.0238 µg/L	118	69.0	134
		EP231X-LL: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0232 µg/L	131	65.0	140
		EP231X-LL: Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.0241 µg/L	134	53.0	142
EP231B: Perfluoroalkyl Carboxylic Acids (QCLot: 5117244)							

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%) MS	Acceptable Limits (%) Low	High
EP231B: Perfluoroalkyl Carboxylic Acids (QCLot: 5117244) - continued							
EB2317957-002	THGW02	EP231X-LL: Perfluorobutanoic acid (PFBA)	375-22-4	0.125 µg/L	112	73.0	129
		EP231X-LL: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.025 µg/L	117	72.0	129
		EP231X-LL: Perfluorohexanoic acid (PFHxA)	307-24-4	0.025 µg/L	112	72.0	129
		EP231X-LL: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.025 µg/L	113	72.0	130
		EP231X-LL: Perfluorooctanoic acid (PFOA)	335-67-1	0.025 µg/L	104	71.0	133
		EP231X-LL: Perfluorononanoic acid (PFNA)	375-95-1	0.025 µg/L	115	69.0	130
		EP231X-LL: Perfluorodecanoic acid (PFDA)	335-76-2	0.025 µg/L	126	71.0	129
		EP231X-LL: Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.025 µg/L	116	69.0	133
		EP231X-LL: Perfluorododecanoic acid (PFDoDA)	307-55-1	0.025 µg/L	122	72.0	134
		EP231X-LL: Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.025 µg/L	113	65.0	144
		EP231X-LL: Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.0625 µg/L	121	71.0	132
EP231C: Perfluoroalkyl Sulfonamides (QCLot: 5117244)							
EB2317957-002	THGW02	EP231X-LL: Perfluorooctane sulfonamide (FOSA)	754-91-6	0.025 µg/L	130	67.0	137
		EP231X-LL: N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8	0.0625 µg/L	123	68.0	141
		EP231X-LL: N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.0625 µg/L	113	40.0	130
		EP231X-LL: N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.0625 µg/L	124	50.0	130
		EP231X-LL: N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.0625 µg/L	112	40.0	130
		EP231X-LL: N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9	0.025 µg/L	114	65.0	136
		EP231X-LL: N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.025 µg/L	125	61.0	135
EP231D: (n:2) Fluorotelomer Sulfonic Acids (QCLot: 5117244)							
EB2317957-002	THGW02	EP231X-LL: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0234 µg/L	106	63.0	143
		EP231X-LL: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0238 µg/L	124	64.0	140
		EP231X-LL: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.024 µg/L	113	67.0	138
		EP231X-LL: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0242 µg/L	117	50.0	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2317957**	Page	: 1 of 32
Amendment	: **1**		
Client	: **ENVIRONMENTAL EARTH SCIENCES**	Laboratory	: Environmental Division Brisbane
Contact	: MS ANNA SHELDON	Telephone	: +61-7-3243 7222
Project	: 722092	Date Samples Received	: 14-Jun-2023
Site	: Tick Hill	Issue Date	: 07-Jul-2023
Sampler	: AS / SW	No. of samples received	: 65
Order number	: ----	No. of samples analysed	: 55

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **Duplicate outliers exist - please see following pages for full details.**
- **Laboratory Control outliers exist - please see following pages for full details.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Duplicate (DUP) RPDs							
EG020T: Total Metals by ICP-MS	EB2317957--014	THS01 0-0.1	**Arsenic**	7440-38-2	23.3 %	0% - 20%	**RPD exceeds LOR based limits**
EK067G: Total Phosphorus as P by Discrete Analyser	EB2318164--001	Anonymous	**Total Phosphorus as P**	----	55.3 %	0% - 20%	**RPD exceeds LOR based limits**
Matrix Spike (MS) Recoveries							
EK067G: Total Phosphorus as P by Discrete Analyser	EB2317806--004	Anonymous	**Total Phosphorus as P**	----	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Laboratory Control Spike (LCS) Recoveries							
EP231C: Perfluoroalkyl Sulfonamides	QC-5117244-002	----	**N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)**	24448-09-7	137 %	63.3-134%	**Recovery greater than upper control limit**
Matrix Spike (MS) Recoveries							
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	EB2317491--002	Anonymous	**Sulfate as SO4 - Turbidimetric**	14808-79-8	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
ED045G: Chloride by Discrete Analyser	EB2317491--002	Anonymous	**Chloride**	16887-00-6	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Outliers : Analysis Holding Time Compliance

Matrix: **SOIL**

Method		*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)		*Date extracted*	*Due for extraction*	***Days overdue***	*Date analysed*	*Due for analysis*	***Days overdue***
EA002: pH 1:5 (Soils)							
Soil Glass Jar - Unpreserved							
THT01 0.5, THT06 0.5,	THT01 1.0, THT06 1.0	20-Jun-2023	16-Jun-2023	**4**	----	----	----
Soil Glass Jar - Unpreserved							
THS01 0-0.1, THS06 0-0.05	THS03 0.3-0.35,	20-Jun-2023	17-Jun-2023	**3**	----	----	----
Soil Glass Jar - Unpreserved							
THS13 0.4-0.5, THT09 1.0 - 1.5, THT09 4.2 - 4.5,	THS15 0-0.1, THT09 2.5 - 3.0, THT09 5.0 - 5.5	20-Jun-2023	18-Jun-2023	**2**	----	----	----
EA010: Conductivity (1:5)							

Matrix: **SOIL**

Method / Container / Client Sample ID(s)	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EA010: Conductivity (1:5) - Analysis Holding Time Compliance						
Soil Glass Jar - Unpreserved THT01 0.5, THT01 1.0, THT06 0.5, THT06 1.0	20-Jun-2023	16-Jun-2023	**4**	----	----	----
Soil Glass Jar - Unpreserved THS01 0-0.1, THS03 0.3-0.35, THS06 0-0.05	20-Jun-2023	17-Jun-2023	**3**	----	----	----
Soil Glass Jar - Unpreserved THS13 0.4-0.5, THS15 0-0.1, THT09 1.0 - 1.5, THT09 2.5 - 3.0, THT09 4.2 - 4.5, THT09 5.0 - 5.5	20-Jun-2023	18-Jun-2023	**2**	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)						
Soil Glass Jar - Unpreserved BD01	----	----	----	05-Jul-2023	24-Jun-2023	**11**
EK025SF: Free CN by Segmented Flow Analyser						
Soil Glass Jar - Unpreserved BD01	05-Jul-2023	24-Jun-2023	**11**	----	----	----
EK026SF: Total CN by Segmented Flow Analyser						
Soil Glass Jar - Unpreserved BD01	05-Jul-2023	24-Jun-2023	**11**	----	----	----
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser						
Soil Glass Jar - Unpreserved BD01	05-Jul-2023	24-Jun-2023	**11**	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser						
HDPE Soil Jar THT11 4.0 - 4.4	20-Jun-2023	18-Jun-2023	**2**	----	----	----
Soil Glass Jar - Unpreserved THGW08 2.9	20-Jun-2023	15-Jun-2023	**5**	----	----	----
Soil Glass Jar - Unpreserved THT02 1.0	20-Jun-2023	16-Jun-2023	**4**	----	----	----
Soil Glass Jar - Unpreserved THS06 0-0.05	20-Jun-2023	17-Jun-2023	**3**	----	----	----
Soil Glass Jar - Unpreserved THS08 0-0.1, THS11 0-0.1, THS13 0.4-0.5, THT09 4.2 - 4.5	20-Jun-2023	18-Jun-2023	**2**	----	----	----

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EA005P: pH by PC Titrator						

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EA005P: pH by PC Titrator - Analysis Holding Time Compliance						
Clear Plastic Bottle - Natural THGW01, THGW02, THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, Mine Shaft, GWBD01	----	----	----	19-Jun-2023	12-Jun-2023	**7**
EA015: Total Dissolved Solids dried at 180 ± 5 °C						
Clear Plastic Bottle - Natural THGW01, THGW02, THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, Mine Shaft, GWBD01	----	----	----	20-Jun-2023	19-Jun-2023	**1**
EK057G: Nitrite as N by Discrete Analyser						
Clear Plastic Bottle - Natural THGW01, THGW02, THGW03, THGW04, THGW05, THGW06	----	----	----	16-Jun-2023	14-Jun-2023	**2**
Clear Plastic Bottle - Natural THGW07, THGW08, THGW09, PIT, Mine Shaft	----	----	----	17-Jun-2023	14-Jun-2023	**3**
Clear Plastic Bottle - Natural GWBD01	----	----	----	21-Jun-2023	14-Jun-2023	**7**
EK071G: Reactive Phosphorus as P by discrete analyser						
Clear Plastic Bottle - Natural THGW01, THGW02, THGW03, THGW04, THGW05, THGW06	----	----	----	16-Jun-2023	14-Jun-2023	**2**
Clear Plastic Bottle - Natural THGW07, THGW08, THGW09, PIT, Mine Shaft	----	----	----	17-Jun-2023	14-Jun-2023	**3**
Clear Plastic Bottle - Natural GWBD01	----	----	----	21-Jun-2023	14-Jun-2023	**7**

Outliers : Frequency of Quality Control Samples

Matrix: **SOIL**

Matrix: **SOIL**

Quality Control Sample Type / Method	Count QC	Count Regular	Rate (%) Actual	Rate (%) Expected	Quality Control Specification
	0				
Laboratory Control Samples (LCS)					
Total Metals by ICP-MS - Suite V	0	15	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
Total Metals by ICP-AES	0	15	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Quality Control Sample Type / Method	Count QC	Count Regular	Rate (%) Actual	Rate (%) Expected	Quality Control Specification
	0				
Laboratory Duplicates (DUP)					
TRH - Semivolatile Fraction	0	18	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
TRH - Semivolatile Fraction	0	18	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / *Container / Client Sample ID(s)*	*Sample Date*	*Extraction / Preparation* Date extracted	Due for extraction	Evaluation	*Analysis* Date analysed	Due for analysis	Evaluation
EA002: pH 1:5 (Soils)							
Soil Glass Jar - Unpreserved (EA002) THT01 0.5, THT01 1.0, THT06 0.5, THT06 1.0	**09-Jun-2023**	**20-Jun-2023**	16-Jun-2023	×	**20-Jun-2023**	20-Jun-2023	✓
Soil Glass Jar - Unpreserved (EA002) THS01 0-0.1, THS03 0.3-0.35, THS06 0-0.05	**10-Jun-2023**	**20-Jun-2023**	17-Jun-2023	×	**20-Jun-2023**	20-Jun-2023	✓
Soil Glass Jar - Unpreserved (EA002) THS13 0.4-0.5, THS15 0-0.1, THT09 1.0 - 1.5, THT09 2.5 - 3.0, THT09 4.2 - 4.5, THT09 5.0 - 5.5	**11-Jun-2023**	**20-Jun-2023**	18-Jun-2023	×	**20-Jun-2023**	20-Jun-2023	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA010: Conductivity (1:5)								
Soil Glass Jar - Unpreserved (EA010)								
THT01 0.5,	THT01 1.0,	**09-Jun-2023**	**20-Jun-2023**	16-Jun-2023	×	**20-Jun-2023**	18-Jul-2023	✓
THT06 0.5,	THT06 1.0							
Soil Glass Jar - Unpreserved (EA010)								
THS01 0-0.1,	THS03 0.3-0.35,	**10-Jun-2023**	**20-Jun-2023**	17-Jun-2023	×	**20-Jun-2023**	18-Jul-2023	✓
THS06 0-0.05								
Soil Glass Jar - Unpreserved (EA010)								
THS13 0.4-0.5,	THS15 0-0.1,	**11-Jun-2023**	**20-Jun-2023**	18-Jun-2023	×	**20-Jun-2023**	18-Jul-2023	✓
THT09 1.0 - 1.5,	THT09 2.5 - 3.0,							
THT09 4.2 - 4.5,	THT09 5.0 - 5.5							
EA026 : Chromium Reducible Sulfur								
Pulp Bag (EA026)								
THT01 1.0,	THT06 1.0	**09-Jun-2023**	**22-Jun-2023**	04-Mar-2026	✓	**22-Jun-2023**	20-Sep-2023	✓
Pulp Bag (EA026)								
THS06 0-0.05		**10-Jun-2023**	**22-Jun-2023**	05-Mar-2026	✓	**22-Jun-2023**	20-Sep-2023	✓
Pulp Bag (EA026)								
THS13 0.4-0.5,	THS15 0-0.1,	**11-Jun-2023**	**22-Jun-2023**	06-Mar-2026	✓	**22-Jun-2023**	20-Sep-2023	✓
THT09 2.5 - 3.0,	THT09 5.0 - 5.5							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content (Dried @ 105-110°C)							
HDPE Soil Jar (EA055) THT11 1.2 - 1.5, THT11 2.5 - 3.0, THT11 4.0 - 4.4, THT11 5.0 - 5.5	**11-Jun-2023**	**----**	----	----	**19-Jun-2023**	25-Jun-2023	✓
Soil Glass Jar - Unpreserved (EA055) THGW08 2.9	**08-Jun-2023**	**----**	----	----	**19-Jun-2023**	22-Jun-2023	✓
Soil Glass Jar - Unpreserved (EA055) THT02 1.0, THT03 0.5, THT03 1.0, THT05 0.5, THT05 1.0, THT06 0.5, THT07 0.2, THT07 0.3, THT08 0.1	**09-Jun-2023**	**----**	----	----	**19-Jun-2023**	23-Jun-2023	✓
Soil Glass Jar - Unpreserved (EA055) THS01 0-0.1, THS02 0-0.1, THS03 0.3-0.35, THS04 0-0.1, THS06 0-0.05, THS07 0-0.1	**10-Jun-2023**	**----**	----	----	**19-Jun-2023**	24-Jun-2023	✓
Soil Glass Jar - Unpreserved (EA055) BD01	**10-Jun-2023**	**----**	----	----	**05-Jul-2023**	24-Jun-2023	✗
Soil Glass Jar - Unpreserved (EA055) THS08 0-0.1, THS09 0-0.1, THS10 0-0.1, THS11 0-0.1, THS12 0-0.1, THS13 0.4-0.5, THS14 0-0.1, THS15 0-0.1, BD02, THT09 1.0 - 1.5, THT09 2.5 - 3.0, THT09 4.2 - 4.5, THT09 5.0 - 5.5, THT10 1.0 - 1.5, THT10 2.5 - 3.0, THT10 4.0 - 4.5, THT10 5.0 - 5.5	**11-Jun-2023**	**----**	----	----	**19-Jun-2023**	25-Jun-2023	✓
EG005(ED093)T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T) THT06 0.5	**09-Jun-2023**	**19-Jun-2023**	06-Dec-2023	✓	**21-Jun-2023**	06-Dec-2023	✓
Soil Glass Jar - Unpreserved (EG005T) BD01	**10-Jun-2023**	**05-Jul-2023**	07-Dec-2023	✓	**06-Jul-2023**	07-Dec-2023	✓
Soil Glass Jar - Unpreserved (EG005T) THS01 0-0.1, THS04 0-0.1, THS06 0-0.05	**10-Jun-2023**	**19-Jun-2023**	07-Dec-2023	✓	**21-Jun-2023**	07-Dec-2023	✓
Soil Glass Jar - Unpreserved (EG005T) THS12 0-0.1, THS13 0.4-0.5, THS14 0-0.1, THS15 0-0.1, BD02, THT09 1.0 - 1.5, THT09 2.5 - 3.0, THT09 4.2 - 4.5, THT09 5.0 - 5.5	**11-Jun-2023**	**19-Jun-2023**	08-Dec-2023	✓	**21-Jun-2023**	08-Dec-2023	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG020T: Total Metals by ICP-MS							
Soil Glass Jar - Unpreserved (EG020Y-T) THT06 0.5	**09-Jun-2023**	**19-Jun-2023**	06-Dec-2023	✓	**21-Jun-2023**	06-Dec-2023	✓
Soil Glass Jar - Unpreserved (EG020Y-T) BD01	**10-Jun-2023**	**05-Jul-2023**	07-Dec-2023	✓	**06-Jul-2023**	07-Dec-2023	✓
Soil Glass Jar - Unpreserved (EG020Y-T) THS01 0-0.1, THS04 0-0.1, THS06 0-0.05	**10-Jun-2023**	**19-Jun-2023**	07-Dec-2023	✓	**21-Jun-2023**	07-Dec-2023	✓
Soil Glass Jar - Unpreserved (EG020Y-T) THS12 0-0.1, THS13 0.4-0.5, THS14 0-0.1, THS15 0-0.1, BD02, THT09 1.0 - 1.5, THT09 2.5 - 3.0, THT09 4.2 - 4.5, THT09 5.0 - 5.5	**11-Jun-2023**	**19-Jun-2023**	08-Dec-2023	✓	**21-Jun-2023**	08-Dec-2023	✓
EK025SF: Free CN by Segmented Flow Analyser							
HDPE Soil Jar (EK025SF) THT11 1.2 - 1.5, THT11 2.5 - 3.0, THT11 4.0 - 4.4, THT11 5.0 - 5.5	**11-Jun-2023**	**19-Jun-2023**	25-Jun-2023	✓	**23-Jun-2023**	03-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK025SF) THGW08 2.9	**08-Jun-2023**	**19-Jun-2023**	22-Jun-2023	✓	**23-Jun-2023**	03-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK025SF) THT03 0.5, THT03 1.0, THT05 0.5, THT05 1.0, THT06 0.5, THT07 0.2, THT07 0.3, THT08 0.1	**09-Jun-2023**	**19-Jun-2023**	23-Jun-2023	✓	**23-Jun-2023**	03-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK025SF) BD01	**10-Jun-2023**	**05-Jul-2023**	24-Jun-2023	×	**06-Jul-2023**	19-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK025SF) THS01 0-0.1, THS02 0-0.1, THS06 0-0.05	**10-Jun-2023**	**19-Jun-2023**	24-Jun-2023	✓	**22-Jun-2023**	03-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK025SF) THS03 0.3-0.35	**10-Jun-2023**	**19-Jun-2023**	24-Jun-2023	✓	**23-Jun-2023**	03-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK025SF) THS13 0.4-0.5, BD02	**11-Jun-2023**	**19-Jun-2023**	25-Jun-2023	✓	**22-Jun-2023**	03-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK025SF) THS08 0-0.1, THS09 0-0.1, THS11 0-0.1, THS12 0-0.1, THS15 0-0.1, THT10 1.0 - 1.5, THT10 2.5 - 3.0, THT10 4.0 - 4.5, THT10 5.0 - 5.5	**11-Jun-2023**	**19-Jun-2023**	25-Jun-2023	✓	**23-Jun-2023**	03-Jul-2023	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK026SF: Total CN by Segmented Flow Analyser								
HDPE Soil Jar (EK026SF)								
THT11 1.2 - 1.5,	THT11 2.5 - 3.0,	**11-Jun-2023**	**19-Jun-2023**	25-Jun-2023	✓	**23-Jun-2023**	03-Jul-2023	✓
THT11 4.0 - 4.4,	THT11 5.0 - 5.5							
Soil Glass Jar - Unpreserved (EK026SF)								
THGW08 2.9		**08-Jun-2023**	**19-Jun-2023**	22-Jun-2023	✓	**23-Jun-2023**	03-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK026SF)								
THT03 0.5,	THT03 1.0,	**09-Jun-2023**	**19-Jun-2023**	23-Jun-2023	✓	**23-Jun-2023**	03-Jul-2023	✓
THT05 0.5,	THT05 1.0,							
THT06 0.5,	THT07 0.2,							
THT07 0.3,	THT08 0.1							
Soil Glass Jar - Unpreserved (EK026SF)								
BD01		**10-Jun-2023**	**05-Jul-2023**	24-Jun-2023	×	**06-Jul-2023**	19-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK026SF)								
THS01 0-0.1,	THS02 0-0.1,	**10-Jun-2023**	**19-Jun-2023**	24-Jun-2023	✓	**22-Jun-2023**	03-Jul-2023	✓
THS06 0-0.05								
Soil Glass Jar - Unpreserved (EK026SF)								
THS03 0.3-0.35		**10-Jun-2023**	**19-Jun-2023**	24-Jun-2023	✓	**23-Jun-2023**	03-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK026SF)								
BD02		**11-Jun-2023**	**19-Jun-2023**	25-Jun-2023	✓	**22-Jun-2023**	03-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK026SF)								
THS08 0-0.1,	THS09 0-0.1,	**11-Jun-2023**	**19-Jun-2023**	25-Jun-2023	✓	**23-Jun-2023**	03-Jul-2023	✓
THS11 0-0.1,	THS12 0-0.1,							
THS13 0.4-0.5,	THS15 0-0.1,							
THT10 1.0 - 1.5,	THT10 2.5 - 3.0,							
THT10 4.0 - 4.5,	THT10 5.0 - 5.5							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser							
HDPE Soil Jar (EK028SF) THT11 1.2 - 1.5, THT11 2.5 - 3.0, THT11 4.0 - 4.4, THT11 5.0 - 5.5	**11-Jun-2023**	**19-Jun-2023**	25-Jun-2023	✓	**23-Jun-2023**	03-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK028SF) THGW08 2.9	**08-Jun-2023**	**19-Jun-2023**	22-Jun-2023	✓	**23-Jun-2023**	03-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK028SF) THT03 0.5, THT03 1.0, THT05 0.5, THT05 1.0, THT06 0.5, THT07 0.2, THT07 0.3, THT08 0.1	**09-Jun-2023**	**19-Jun-2023**	23-Jun-2023	✓	**23-Jun-2023**	03-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK028SF) BD01	**10-Jun-2023**	**05-Jul-2023**	24-Jun-2023	×	**06-Jul-2023**	19-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK028SF) THS01 0-0.1, THS02 0-0.1	**10-Jun-2023**	**19-Jun-2023**	24-Jun-2023	✓	**22-Jun-2023**	03-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK028SF) THS03 0.3-0.35, THS06 0-0.05	**10-Jun-2023**	**19-Jun-2023**	24-Jun-2023	✓	**23-Jun-2023**	03-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK028SF) BD02, THT10 1.0 - 1.5	**11-Jun-2023**	**19-Jun-2023**	25-Jun-2023	✓	**22-Jun-2023**	03-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK028SF) THS08 0-0.1, THS09 0-0.1, THS11 0-0.1, THS12 0-0.1, THS13 0.4-0.5, THS15 0-0.1, THT10 2.5 - 3.0, THT10 4.0 - 4.5, THT10 5.0 - 5.5	**11-Jun-2023**	**19-Jun-2023**	25-Jun-2023	✓	**23-Jun-2023**	03-Jul-2023	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
HDPE Soil Jar (EK067G) THT11 4.0 - 4.4	**11-Jun-2023**	**20-Jun-2023**	09-Jul-2023	✓	**20-Jun-2023**	18-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK067G) THGW08 2.9	**08-Jun-2023**	**20-Jun-2023**	06-Jul-2023	✓	**20-Jun-2023**	18-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK067G) THT02 1.0	**09-Jun-2023**	**20-Jun-2023**	07-Jul-2023	✓	**20-Jun-2023**	18-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK067G) THS06 0-0.05	**10-Jun-2023**	**20-Jun-2023**	08-Jul-2023	✓	**20-Jun-2023**	18-Jul-2023	✓
Soil Glass Jar - Unpreserved (EK067G) THS08 0-0.1, THS11 0-0.1, THS13 0.4-0.5, THT09 4.2 - 4.5	**11-Jun-2023**	**20-Jun-2023**	09-Jul-2023	✓	**20-Jun-2023**	18-Jul-2023	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK071G: Reactive Phosphorus as P by discrete analyser							
HDPE Soil Jar (EK071G) THT11 4.0 - 4.4	**11-Jun-2023**	**20-Jun-2023**	18-Jun-2023	×	**21-Jun-2023**	22-Jun-2023	✓
Soil Glass Jar - Unpreserved (EK071G) THGW08 2.9	**08-Jun-2023**	**20-Jun-2023**	15-Jun-2023	×	**21-Jun-2023**	22-Jun-2023	✓
Soil Glass Jar - Unpreserved (EK071G) THT02 1.0	**09-Jun-2023**	**20-Jun-2023**	16-Jun-2023	×	**21-Jun-2023**	22-Jun-2023	✓
Soil Glass Jar - Unpreserved (EK071G) THS06 0-0.05	**10-Jun-2023**	**20-Jun-2023**	17-Jun-2023	×	**21-Jun-2023**	22-Jun-2023	✓
Soil Glass Jar - Unpreserved (EK071G) THS08 0-0.1, THS11 0-0.1, THS13 0.4-0.5, THT09 4.2 - 4.5	**11-Jun-2023**	**20-Jun-2023**	18-Jun-2023	×	**21-Jun-2023**	22-Jun-2023	✓
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)							
Non-Volatile Leach: 180 day HT (e.g. PFAS, metals ex.Hg) (EN60a-G) THT10 2.5 - 3.0, THT10 5.0 - 5.5	**11-Jun-2023**	**19-Jun-2023**	08-Dec-2023	✓	**----**	----	----
EN60Z: ASLP Leachate - ZHE							
ZHE Leach: 14 day HT(e.g. CN, BTEX) (EN60Za) THT03 0.5, THT03 1.0, THT05 0.5, THT05 1.0	**09-Jun-2023**	**19-Jun-2023**	23-Jun-2023	✓	**----**	----	----
ZHE Leach: 14 day HT(e.g. CN, BTEX) (EN60Za) THT10 1.0 - 1.5, THT10 2.5 - 3.0, THT10 4.0 - 4.5, THT10 5.0 - 5.5, THT11 1.2 - 1.5, THT11 2.5 - 3.0, THT11 4.0 - 4.4, THT11 5.0 - 5.5	**11-Jun-2023**	**19-Jun-2023**	25-Jun-2023	✓	**----**	----	----
EP066: Polychlorinated Biphenyls (PCB)							
Soil Glass Jar - Unpreserved (EP066) THS06 0-0.05	**10-Jun-2023**	**19-Jun-2023**	24-Jun-2023	✓	**20-Jun-2023**	29-Jul-2023	✓
Soil Glass Jar - Unpreserved (EP066) THS08 0-0.1, THS09 0-0.1, THS10 0-0.1	**11-Jun-2023**	**19-Jun-2023**	25-Jun-2023	✓	**20-Jun-2023**	29-Jul-2023	✓
EP068A: Organochlorine Pesticides (OC)							
Soil Glass Jar - Unpreserved (EP068) THS06 0-0.05	**10-Jun-2023**	**19-Jun-2023**	24-Jun-2023	✓	**20-Jun-2023**	29-Jul-2023	✓
Soil Glass Jar - Unpreserved (EP068) THS08 0-0.1, THS09 0-0.1, THS10 0-0.1	**11-Jun-2023**	**19-Jun-2023**	25-Jun-2023	✓	**20-Jun-2023**	29-Jul-2023	✓
EP080/071: Total Petroleum Hydrocarbons							
Soil Glass Jar - Unpreserved (EP080) THS06 0-0.05	**10-Jun-2023**	**19-Jun-2023**	24-Jun-2023	✓	**20-Jun-2023**	24-Jun-2023	✓
Soil Glass Jar - Unpreserved (EP080) THS08 0-0.1, THS09 0-0.1, THS10 0-0.1, THS14 0-0.1	**11-Jun-2023**	**19-Jun-2023**	25-Jun-2023	✓	**20-Jun-2023**	25-Jun-2023	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Soil Glass Jar - Unpreserved (EP080) THS06 0-0.05	**10-Jun-2023**	**19-Jun-2023**	24-Jun-2023	✓	**20-Jun-2023**	24-Jun-2023	✓
Soil Glass Jar - Unpreserved (EP080) THS08 0-0.1, THS09 0-0.1, THS10 0-0.1, THS14 0-0.1	**11-Jun-2023**	**19-Jun-2023**	25-Jun-2023	✓	**20-Jun-2023**	25-Jun-2023	✓
EP080: BTEXN							
Soil Glass Jar - Unpreserved (EP080) THS06 0-0.05	**10-Jun-2023**	**19-Jun-2023**	24-Jun-2023	✓	**20-Jun-2023**	24-Jun-2023	✓
Soil Glass Jar - Unpreserved (EP080) THS08 0-0.1, THS09 0-0.1, THS10 0-0.1, THS14 0-0.1	**11-Jun-2023**	**19-Jun-2023**	25-Jun-2023	✓	**20-Jun-2023**	25-Jun-2023	✓
EP231A: Perfluoroalkyl Sulfonic Acids							
HDPE Soil Jar (EP231X) THT05 1.0	**09-Jun-2023**	**19-Jun-2023**	06-Dec-2023	✓	**23-Jun-2023**	29-Jul-2023	✓
HDPE Soil Jar (EP231X) THS06 0-0.05	**10-Jun-2023**	**19-Jun-2023**	07-Dec-2023	✓	**23-Jun-2023**	29-Jul-2023	✓
HDPE Soil Jar (EP231X) THS08 0-0.1, THT09 1.0 - 1.5	**11-Jun-2023**	**19-Jun-2023**	08-Dec-2023	✓	**23-Jun-2023**	29-Jul-2023	✓
Soil Glass Jar - Unpreserved (EP231X) THS07 0-0.1	**10-Jun-2023**	**19-Jun-2023**	07-Dec-2023	✓	**23-Jun-2023**	29-Jul-2023	✓
EP231B: Perfluoroalkyl Carboxylic Acids							
HDPE Soil Jar (EP231X) THT05 1.0	**09-Jun-2023**	**19-Jun-2023**	06-Dec-2023	✓	**23-Jun-2023**	29-Jul-2023	✓
HDPE Soil Jar (EP231X) THS06 0-0.05	**10-Jun-2023**	**19-Jun-2023**	07-Dec-2023	✓	**23-Jun-2023**	29-Jul-2023	✓
HDPE Soil Jar (EP231X) THS08 0-0.1, THT09 1.0 - 1.5	**11-Jun-2023**	**19-Jun-2023**	08-Dec-2023	✓	**23-Jun-2023**	29-Jul-2023	✓
Soil Glass Jar - Unpreserved (EP231X) THS07 0-0.1	**10-Jun-2023**	**19-Jun-2023**	07-Dec-2023	✓	**23-Jun-2023**	29-Jul-2023	✓
EP231C: Perfluoroalkyl Sulfonamides							
HDPE Soil Jar (EP231X) THT05 1.0	**09-Jun-2023**	**19-Jun-2023**	06-Dec-2023	✓	**23-Jun-2023**	29-Jul-2023	✓
HDPE Soil Jar (EP231X) THS06 0-0.05	**10-Jun-2023**	**19-Jun-2023**	07-Dec-2023	✓	**23-Jun-2023**	29-Jul-2023	✓
HDPE Soil Jar (EP231X) THS08 0-0.1, THT09 1.0 - 1.5	**11-Jun-2023**	**19-Jun-2023**	08-Dec-2023	✓	**23-Jun-2023**	29-Jul-2023	✓
Soil Glass Jar - Unpreserved (EP231X) THS07 0-0.1	**10-Jun-2023**	**19-Jun-2023**	07-Dec-2023	✓	**23-Jun-2023**	29-Jul-2023	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP231D: (n:2) Fluorotelomer Sulfonic Acids							
HDPE Soil Jar (EP231X) THT05 1.0	09-Jun-2023	19-Jun-2023	06-Dec-2023	✓	23-Jun-2023	29-Jul-2023	✓
HDPE Soil Jar (EP231X) THS06 0-0.05	10-Jun-2023	19-Jun-2023	07-Dec-2023	✓	23-Jun-2023	29-Jul-2023	✓
HDPE Soil Jar (EP231X) THS08 0-0.1, THT09 1.0 - 1.5	11-Jun-2023	19-Jun-2023	08-Dec-2023	✓	23-Jun-2023	29-Jul-2023	✓
Soil Glass Jar - Unpreserved (EP231X) THS07 0-0.1	10-Jun-2023	19-Jun-2023	07-Dec-2023	✓	23-Jun-2023	29-Jul-2023	✓
EP231P: PFAS Sums							
HDPE Soil Jar (EP231X) THT05 1.0	09-Jun-2023	19-Jun-2023	06-Dec-2023	✓	23-Jun-2023	29-Jul-2023	✓
HDPE Soil Jar (EP231X) THS06 0-0.05	10-Jun-2023	19-Jun-2023	07-Dec-2023	✓	23-Jun-2023	29-Jul-2023	✓
HDPE Soil Jar (EP231X) THS08 0-0.1, THT09 1.0 - 1.5	11-Jun-2023	19-Jun-2023	08-Dec-2023	✓	23-Jun-2023	29-Jul-2023	✓
Soil Glass Jar - Unpreserved (EP231X) THS07 0-0.1	10-Jun-2023	19-Jun-2023	07-Dec-2023	✓	23-Jun-2023	29-Jul-2023	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P) THGW01, THGW02, THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, Mine Shaft, GWBD01	12-Jun-2023	----	----	----	19-Jun-2023	12-Jun-2023	✗
EA015: Total Dissolved Solids dried at 180 ± 5 °C							
Clear Plastic Bottle - Natural (EA015H) THGW01, THGW02, THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, Mine Shaft, GWBD01	12-Jun-2023	----	----	----	20-Jun-2023	19-Jun-2023	✗

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P) THGW01, THGW02, THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, Mine Shaft, GWBD01	**12-Jun-2023**	**----**	----	----	**19-Jun-2023**	26-Jun-2023	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G) THGW01, THGW02, THGW03, THGW04, THGW05, THGW06	**12-Jun-2023**	**----**	----	----	**16-Jun-2023**	10-Jul-2023	✓
Clear Plastic Bottle - Natural (ED041G) THGW07, THGW08, THGW09, PIT, Mine Shaft	**12-Jun-2023**	**----**	----	----	**17-Jun-2023**	10-Jul-2023	✓
Clear Plastic Bottle - Natural (ED041G) GWBD01	**12-Jun-2023**	**----**	----	----	**21-Jun-2023**	10-Jul-2023	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G) THGW01, THGW02, THGW03, THGW04, THGW05, THGW06	**12-Jun-2023**	**----**	----	----	**16-Jun-2023**	10-Jul-2023	✓
Clear Plastic Bottle - Natural (ED045G) THGW07, THGW08, THGW09, PIT, Mine Shaft	**12-Jun-2023**	**----**	----	----	**17-Jun-2023**	10-Jul-2023	✓
Clear Plastic Bottle - Natural (ED045G) GWBD01	**12-Jun-2023**	**----**	----	----	**21-Jun-2023**	10-Jul-2023	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) THGW02, THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, GWBD01	**12-Jun-2023**	**----**	----	----	**19-Jun-2023**	10-Jul-2023	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) THGW01	**12-Jun-2023**	**----**	----	----	**20-Jun-2023**	10-Jul-2023	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Mine Shaft	**12-Jun-2023**	**----**	----	----	**22-Jun-2023**	10-Jul-2023	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG020E-F) THGW02, THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, GWBD01	**12-Jun-2023**	**----**	----	----	**19-Jun-2023**	09-Dec-2023	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG020E-F) THGW01	**12-Jun-2023**	**----**	----	----	**20-Jun-2023**	09-Dec-2023	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020E-F) Mine Shaft	**12-Jun-2023**	**----**	----	----	**22-Jun-2023**	09-Dec-2023	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020A-F) RB01	**12-Jun-2023**	**----**	----	----	**22-Jun-2023**	09-Dec-2023	✓
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T) THGW02, THGW03, THGW05, THGW08, THGW09, Mine Shaft, GWBD01, RB02	**12-Jun-2023**	**21-Jun-2023**	09-Dec-2023	✓	**22-Jun-2023**	09-Dec-2023	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020E-T) THGW01, THGW04, THGW06, THGW07, PIT	**12-Jun-2023**	**19-Jun-2023**	09-Dec-2023	✓	**19-Jun-2023**	09-Dec-2023	✓
EG020W: Water Leachable Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020E-W) THT10 2.5 - 3.0, THT10 5.0 - 5.5	**19-Jun-2023**	**21-Jun-2023**	16-Dec-2023	✓	**22-Jun-2023**	16-Dec-2023	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035F) RB01	**12-Jun-2023**	**----**	----	----	**21-Jun-2023**	26-Jun-2023	✓
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035T) RB02	**12-Jun-2023**	**----**	----	----	**21-Jun-2023**	10-Jul-2023	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK025SF: Free CN by Segmented Flow Analyser								
Black Opaque Plastic Bottle - NaOH (EK025SF)								
THT03 0.5,	THT03 1.0,	**19-Jun-2023**	**----**	----	----	**23-Jun-2023**	03-Jul-2023	✓
THT05 0.5,	THT05 1.0,							
THT10 1.0 - 1.5,	THT10 2.5 - 3.0,							
THT10 4.0 - 4.5,	THT10 5.0 - 5.5,							
THT11 1.2 - 1.5,	THT11 2.5 - 3.0,							
THT11 4.0 - 4.4,	THT11 5.0 - 5.5							
Opaque plastic bottle - NaOH - Pb Acetate (EK025SF)								
THGW01,	THGW02,	**12-Jun-2023**	**----**	----	----	**20-Jun-2023**	26-Jun-2023	✓
THGW03,	THGW04,							
THGW05,	THGW06,							
THGW07,	THGW08,							
THGW09,	PIT,							
Mine Shaft,	GWBD01							
EK026SF: Total CN by Segmented Flow Analyser								
Opaque plastic bottle - NaOH - Pb Acetate (EK026SF)								
THGW06,	THGW09	**12-Jun-2023**	**----**	----	----	**19-Jun-2023**	26-Jun-2023	✓
Opaque plastic bottle - NaOH - Pb Acetate (EK026SF)								
THGW01,	THGW02,	**12-Jun-2023**	**----**	----	----	**20-Jun-2023**	26-Jun-2023	✓
THGW03,	THGW04,							
THGW05,	THGW07,							
THGW08,	PIT,							
Mine Shaft,	GWBD01,							
RB01								
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Opaque plastic bottle - NaOH - Pb Acetate (EK028SF)								
THGW01,	THGW02,	**12-Jun-2023**	**----**	----	----	**20-Jun-2023**	26-Jun-2023	✓
THGW03,	THGW04,							
THGW05,	THGW06,							
THGW07,	THGW08,							
THGW09,	PIT,							
Mine Shaft,	GWBD01							
EK040P: Fluoride by PC Titrator								
Clear Plastic Bottle - Natural (EK040P)								
THGW01,	THGW02,	**12-Jun-2023**	**----**	----	----	**19-Jun-2023**	10-Jul-2023	✓
THGW03,	THGW04,							
THGW05,	THGW06,							
THGW07,	THGW08,							
THGW09,	PIT,							
Mine Shaft,	GWBD01							

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G) THGW01, THGW02, THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, Mine Shaft, GWBD01	**12-Jun-2023**	**----**	----	----	**21-Jun-2023**	10-Jul-2023	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G) THGW01, THGW02, THGW03, THGW04, THGW05, THGW06	**12-Jun-2023**	**----**	----	----	**16-Jun-2023**	14-Jun-2023	✗
Clear Plastic Bottle - Natural (EK057G) THGW07, THGW08, THGW09, PIT, Mine Shaft	**12-Jun-2023**	**----**	----	----	**17-Jun-2023**	14-Jun-2023	✗
Clear Plastic Bottle - Natural (EK057G) GWBD01	**12-Jun-2023**	**----**	----	----	**21-Jun-2023**	14-Jun-2023	✗
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G) THGW01, THGW02, THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, Mine Shaft, GWBD01	**12-Jun-2023**	**21-Jun-2023**	10-Jul-2023	✓	**21-Jun-2023**	10-Jul-2023	✓
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G) THGW01, THGW02, THGW03, THGW04, THGW05, THGW06	**12-Jun-2023**	**----**	----	----	**16-Jun-2023**	14-Jun-2023	✗
Clear Plastic Bottle - Natural (EK071G) THGW07, THGW08, THGW09, PIT, Mine Shaft	**12-Jun-2023**	**----**	----	----	**17-Jun-2023**	14-Jun-2023	✗
Clear Plastic Bottle - Natural (EK071G) GWBD01	**12-Jun-2023**	**----**	----	----	**21-Jun-2023**	14-Jun-2023	✗

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP071) THGW01, THGW02, THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, GWBD01	**12-Jun-2023**	**17-Jun-2023**	19-Jun-2023	✓	**19-Jun-2023**	27-Jul-2023	✓
Amber VOC Vial - Sulfuric Acid (EP080) THGW01, THGW02, THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, Mine Shaft, GWBD01	**12-Jun-2023**	**20-Jun-2023**	26-Jun-2023	✓	**20-Jun-2023**	26-Jun-2023	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber Glass Bottle - Unpreserved (EP071) THGW01, THGW02, THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, GWBD01	**12-Jun-2023**	**17-Jun-2023**	19-Jun-2023	✓	**19-Jun-2023**	27-Jul-2023	✓
Amber VOC Vial - Sulfuric Acid (EP080) THGW01, THGW02, THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, Mine Shaft, GWBD01	**12-Jun-2023**	**20-Jun-2023**	26-Jun-2023	✓	**20-Jun-2023**	26-Jun-2023	✓
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid (EP080) THGW01, THGW02, THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, Mine Shaft, GWBD01	**12-Jun-2023**	**20-Jun-2023**	26-Jun-2023	✓	**20-Jun-2023**	26-Jun-2023	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP231A: Perfluoroalkyl Sulfonic Acids							
HDPE (no PTFE) (EP231X-LL) THGW01, THGW02, Mine Shaft	**12-Jun-2023**	**21-Jun-2023**	09-Dec-2023	✓	**22-Jun-2023**	09-Dec-2023	✓
HDPE (no PTFE) (EP231X-LL) THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, GWBD01	**12-Jun-2023**	**21-Jun-2023**	09-Dec-2023	✓	**23-Jun-2023**	09-Dec-2023	✓
EP231B: Perfluoroalkyl Carboxylic Acids							
HDPE (no PTFE) (EP231X-LL) THGW01, THGW02, Mine Shaft	**12-Jun-2023**	**21-Jun-2023**	09-Dec-2023	✓	**22-Jun-2023**	09-Dec-2023	✓
HDPE (no PTFE) (EP231X-LL) THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, GWBD01	**12-Jun-2023**	**21-Jun-2023**	09-Dec-2023	✓	**23-Jun-2023**	09-Dec-2023	✓
EP231C: Perfluoroalkyl Sulfonamides							
HDPE (no PTFE) (EP231X-LL) THGW01, THGW02, Mine Shaft	**12-Jun-2023**	**21-Jun-2023**	09-Dec-2023	✓	**22-Jun-2023**	09-Dec-2023	✓
HDPE (no PTFE) (EP231X-LL) THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, GWBD01	**12-Jun-2023**	**21-Jun-2023**	09-Dec-2023	✓	**23-Jun-2023**	09-Dec-2023	✓
EP231D: (n:2) Fluorotelomer Sulfonic Acids							
HDPE (no PTFE) (EP231X-LL) THGW01, THGW02, Mine Shaft	**12-Jun-2023**	**21-Jun-2023**	09-Dec-2023	✓	**22-Jun-2023**	09-Dec-2023	✓
HDPE (no PTFE) (EP231X-LL) THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, GWBD01	**12-Jun-2023**	**21-Jun-2023**	09-Dec-2023	✓	**23-Jun-2023**	09-Dec-2023	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP231P: PFAS Sums							
HDPE (no PTFE) (EP231X-LL) THGW01, THGW02, Mine Shaft	**12-Jun-2023**	**21-Jun-2023**	09-Dec-2023	✓	**22-Jun-2023**	09-Dec-2023	✓
HDPE (no PTFE) (EP231X-LL) THGW03, THGW04, THGW05, THGW06, THGW07, THGW08, THGW09, PIT, GWBD01	**12-Jun-2023**	**21-Jun-2023**	09-Dec-2023	✓	**23-Jun-2023**	09-Dec-2023	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Chromium Reducible Sulphur	EA026	1	7	14.29	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	2	16	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Free Cyanide by Segmented Flow Analyser	EK025SF	4	29	13.79	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	8	59	13.56	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	2	15	13.33	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	2	13	15.38	10.00	✓	NEPM 2013 B3 & ALS QC Standard
pH (1:5)	EA002	2	16	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	2	13	15.38	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	1	8	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	4	31	12.90	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	3	15	20.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite R	EG020R-T	3	14	21.43	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite V	EG020V-T	3	15	20.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite X	EG020X-T	3	15	20.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite Y	EG020Y-T	3	14	21.43	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus By Discrete Analyser	EK067G	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	2	16	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	13	15.38	10.00	✓	NEPM 2013 B3 & ALS QC Standard
WAD Cyanide by Segmented Flow Analyser	EK028SF	4	29	13.79	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Chromium Reducible Sulphur	EA026	1	7	14.29	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Free Cyanide by Segmented Flow Analyser	EK025SF	3	29	10.34	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	13	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
pH (1:5)	EA002	2	16	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	13	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	1	8	12.50	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	3	31	9.68	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	15	13.33	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite R	EG020R-T	2	14	14.29	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite V	EG020V-T	0	15	0.00	5.00	✗	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite X	EG020X-T	2	15	13.33	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite Y	EG020Y-T	2	14	14.29	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus By Discrete Analyser	EK067G	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Control Samples (LCS) - Continued							
TRH Volatiles/BTEX	EP080	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
WAD Cyanide by Segmented Flow Analyser	EK028SF	3	29	**10.34**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
ASLP for Volatile Analytes (Zero Headspace Extraction)	EN60Za	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chromium Reducible Sulphur	EA026	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free Cyanide by Segmented Flow Analyser	EK025SF	3	29	**10.34**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	3	31	**9.68**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	15	**13.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite R	EG020R-T	2	14	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite V	EG020V-T	2	15	**13.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite X	EG020X-T	2	15	**13.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite Y	EG020Y-T	2	14	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus By Discrete Analyser	EK067G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
WAD Cyanide by Segmented Flow Analyser	EK028SF	3	29	**10.34**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Free Cyanide by Segmented Flow Analyser	EK025SF	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	31	**6.45**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	0	15	**0.00**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite X	EG020X-T	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite Y	EG020Y-T	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus By Discrete Analyser	EK067G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
WAD Cyanide by Segmented Flow Analyser	EK028SF	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP) - Continued							
Alkalinity by Auto Titrator	ED037-P	7	63	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	8	71	**11.27**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	7	54	**12.96**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	4	24	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite E	EG020E-F	4	12	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	6	51	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	5	33	**15.15**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	7	52	**13.46**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	7	52	**13.46**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS by LCMSMS	EP231X-LL	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by Auto Titrator	EA005-P	8	64	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	6	35	**17.14**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	8	73	**10.96**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	3	23	**13.04**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	4	29	**13.79**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	3	23	**13.04**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite E	EG020E-T	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	18	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite A	EG020A-W	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite B	EG020B-W	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite E	EG020E-W	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Weak Acid Dissociable Cyanide by Segmented Flow Analyser	EK028SF	3	20	**15.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by Auto Titrator	ED037-P	4	63	**6.35**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	8	71	**11.27**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	4	54	**7.41**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	4	24	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite E	EG020E-F	4	12	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	4	51	**7.84**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	3	33	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	4	52	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Control Samples (LCS) - Continued							
Nitrite as N by Discrete Analyser	EK057G	4	52	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS by LCMSMS	EP231X-LL	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by Auto Titrator	EA005-P	8	64	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	4	35	**11.43**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	8	73	**10.96**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	23	**8.70**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	3	20	**15.00**	**15.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	2	23	**8.70**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite E	EG020E-T	2	12	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite A	EG020A-W	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite B	EG020B-W	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite E	EG020E-W	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Weak Acid Dissociable Cyanide by Segmented Flow Analyser	EK028SF	2	20	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	4	71	**5.63**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	4	54	**7.41**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	4	24	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite E	EG020E-F	4	12	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	4	51	**7.84**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	3	33	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	4	52	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	4	52	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS by LCMSMS	EP231X-LL	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	4	35	**11.43**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	4	73	**5.48**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	23	**8.70**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	2	23	**8.70**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite E	EG020E-T	2	12	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
TRH - Semivolatile Fraction	EP071	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite A	EG020A-W	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite B	EG020B-W	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite E	EG020E-W	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Weak Acid Dissociable Cyanide by Segmented Flow Analyser	EK028SF	2	20	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	4	71	**5.63**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	4	54	**7.41**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	4	51	**7.84**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	3	33	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	4	52	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS by LCMSMS	EP231X-LL	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	4	35	**11.43**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	4	73	**5.48**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	23	**8.70**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	18	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite A	EG020A-W	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Weak Acid Dissociable Cyanide by Segmented Flow Analyser	EK028SF	2	20	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH (1:5)	EA002	SOIL	In house: Referenced to Rayment and Lyons 4A1 and APHA 4500H+. pH is determined on soil samples after a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
Electrical Conductivity (1:5)	EA010	SOIL	In house: Referenced to Rayment and Lyons 3A1 and APHA 2510. Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
Chromium Reducible Sulphur	EA026	SOIL	In house: Referenced to Sullivan et al (1998) The CRS method converts reduced inorganic sulfur to H2S by CrCl2 solution ; the evolved H2S is trapped in a zinc acetate solution as ZnS which is quantified by iodometric titration.
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM Schedule B(3).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3)
Water Leachable Metals by ICP-MS - Suite A	EG020A-W	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, AS 4439.3, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Water Leachable Metals by ICP-MS - Suite B	EG020B-W	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Water Leachable Metals by ICP-MS - Suite E	EG020E-W	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite R	EG020R-T	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020. Metals in solids are determined following an appropriate acid digestion. The ICPMS technique ionizes selected elements. Ions are passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass / charge ratios prior to measurement by a discrete dynode ion detector. This method is compliant with NEPM Schedule B(3)
Total Metals by ICP-MS - Suite V	EG020V-T	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Metals in solids are determined following an appropriate acid digestion. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Analytical Methods	Method	Matrix	Method Descriptions
Total Metals by ICP-MS - Suite X	EG020X-T	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite Y	EG020Y-T	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Free Cyanide by Segmented Flow Analyser	EK025SF	SOIL	In house: Referenced to ASTM D7237, APHA 4500-CN-C&O and ISO 14403: Using an automated segmented flow analyser, a sample at high pH (caustic leach of a soil) is buffered to pH 6.0. The hydrogen cyanide present passes across a gas dialysis membrane into an acceptor stream consisting of 0.01 M sodium hydroxide. The acceptor stream mixes with a buffer at pH 5.2 and reacts with chloramine-T to form cyanogen chloride. Cyanogen chloride reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour. This is measured at 600nm. This method is compliant with NEPM Schedule B(3).
Total Cyanide by Segmented Flow Analyser	EK026SF	SOIL	In house: Referenced to APHA 4500-CN C / ASTM D7511 / ISO 14403. Caustic leachates of soil samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM Schedule B(3).
WAD Cyanide by Segmented Flow Analyser	EK028SF	SOIL	In house: Referenced to APHA 4500-CN C&O / ISO 14403. Caustic leachates of soil samples are introduced into an automated segmented flow analyser. Hydrogen cyanide is liberated from a slightly acidified (pH 4.5) and is dialysed. Tight cyanide complexes that would not be amenable to oxidation by chlorine are not converted. Iron cyanide complexes are precipitated with zinc acetate. Liberated HCN diffuses through a membrane into a stream of sodium hydroxide where it is carried as CN- The cyanide in caustic solution is buffered to pH 5.2 and further converted to cyanogen chloride by reaction with chloramine-T. Cyanogen chloride subsequently reacts with 4-pyridine carboxylic and 1,3-dimethylbarbituric acids to give a red colour complex. This colour is measured at 600 nm. This method is compliant with NEPM Schedule B(3).
Total Phosphorus By Discrete Analyser	EK067G	SOIL	In house: Referenced to APHA 4500 P-B&F This procedure involves sulfuric acid digestion and quantification using Discrete Analyser.
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	SOIL	In house: Referenced to APHA 4500 P-F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM Schedule B(3).
Polychlorinated Biphenyls (PCB)	EP066	SOIL	In house: Referenced to USEPA SW 846 - 8270 Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3).

Analytical Methods	Method	Matrix	Method Descriptions
Pesticides by GCMS	EP068	SOIL	In house: Referenced to USEPA SW 846 - 8270 Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM Schedule B(3).
TRH - Semivolatile Fraction	EP071	SOIL	In house: Referenced to USEPA SW 846 - 8015 Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C40. Compliant with NEPM Schedule B(3).
TRH Volatiles/BTEX	EP080	SOIL	In house: Referenced to USEPA SW 846 - 8260. Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve. Compliant with NEPM Schedule B(3) amended.
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	SOIL	In-house: Analysis of soils by solvent extraction followed by LC-Electrospray-MS-MS, Negative Mode using MRM using internal standard quantitation. Isotopically labelled analogues of target analytes used as internal standards and surrogates are added to a portion of soil which is then extracted with MTBE and an ion pairing reagent. A portion of extract is exchanged into the analytical solvent mixture, combined with an equal volume reagent water and filtered for analysis. Method procedures and data quality objectives conform to US DoD QSM 5.3, table B-15 requirements.
pH by Auto Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM Schedule B(3)
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM Schedule B(3)
Alkalinity by Auto Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm.
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Analytical Methods	Method	Matrix	Method Descriptions
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite B	EG020B-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite E	EG020E-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite E	EG020E-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Free CN by Segmented Flow Analyser	EK025SF	WATER	In house: Referenced to ASTM D7237, APHA 4500-CN-C&O and ISO 14403: Using an automated segmented flow analyser, a sample at high pH (sodium hydroxide preserved) is buffered to pH 6.0. The hydrogen cyanide present passes across a gas dialysis membrane into an acceptor stream consisting of 0.01 M sodium hydroxide. The acceptor stream mixes with a buffer at pH 5.2 and reacts with chloramine-T to form cyanogen chloride. Cyanogen chloride reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour, measured at 600nm. This method is compliant with NEPM Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Total Cyanide by Segmented Flow Analyser	EK026SF	WATER	In house: Referenced to APHA 4500-CN C&O / ASTM D7511 / ISO 14403. Sodium hydroxide preserved samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM Schedule B(3)
Weak Acid Dissociable Cyanide by Segmented Flow Analyser	EK028SF	WATER	In house: Referenced to APHA 4500-CN C&O / ISO 14403. Samples preserved with sodium hydroxide are introduced into an automated segmented flow analyser. Hydrogen cyanide is liberated from a slightly acidified (pH 4.5) and is dialysed. Tight cyanide complexes that would not be amenable to oxidation by chlorine are not converted. Iron cyanide complexes are precipitated with zinc acetate. Liberated HCN diffuses through a membrane into a stream of sodium hydroxide where it is carried as CN- The cyanide in caustic solution is buffered to pH 5.2 and further converted to cyanogen chloride by reaction with chloramine-T. Cyanogen chloride subsequently reacts with 4-pyridine carboxylic and 1,3-dimethylbarbituric acids to give a red colour complex. This colour is measured at 600 nm. This method is compliant with NEPM Schedule B(3)
Fluoride by Auto Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al, Zhang et al. This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015 The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260 Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM Schedule B(3)
Per- and Polyfluoroalkyl Substances (PFAS by LCMSMS	EP231X-LL	WATER	In-house: Analysis of fresh and saline waters by Solid Phase Extraction (SPE) followed by LC-Electrospray-MS-MS, Negative Mode using MRM and internal standard quantitation. Isotopically labelled analogues of target analytes used as internal standards and surrogates are added to the sample container. The entire contents are transferred to a solid phase extraction (SPE) cartridge. The sample container is successively rinsed with aliquots of the elution solvent. The eluted extract is concentrated, combined with an equal volume of reagent water and filtered for analysis. Method procedures and data quality objectives conform to US DoD QSM 5.3, table B-15 requirements.

Preparation Methods	Method	Matrix	Method Descriptions
NaOH leach for CN in Soils	CN-PR	SOIL	In house: APHA 4500 CN. Samples are extracted by end-over-end tumbling with NaOH.
TKN/TP Digestion	EK061/EK067	SOIL	In house: Referenced to APHA 4500 Norg- D; APHA 4500 P - H. Macro Kjeldahl digestion.
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house
Digestion for Total Recoverable Metals in DI Water Leachate	EN25W	SOIL	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
ASLP for Non & Semivolatile Analytes - Glass Leaching Vessel	EN60a-G	SOIL	In house QWI-EN/60 referenced to AS4439.3 Preparation of Leachates
ASLP for Volatile Analytes (Zero Headspace Extraction)	EN60Za	SOIL	In house QWI-EN/60 referenced to AS4439.2 Preparation of Leachates
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM Schedule B(3).
Methanolic Extraction of Soils for Purge and Trap	ORG16	SOIL	In house: Referenced to USEPA SW 846 - 5030A. 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids	ORG17	SOIL	In house: Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.
QuECheRS Extraction of Solids	ORG71	SOIL	In house: Sequential extractions with Acetonitrile/Methanol by shaking. Extraction efficiency aided by the addition of salts under acidic conditions. Where relevant, interferences from co-extracted organics are removed with dispersive clean-up media (dSPE). The extract is either diluted or concentrated and exchanged into the analytical solvent.
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM Schedule B(3)

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for purging.
Solid Phase Extraction (SPE) for PFAS in water	ORG72	WATER	In-house: Isotopically labelled analogues of target analytes used as internal standards and surrogates are added to the sample container. The entire contents are transferred to a solid phase extraction (SPE) cartridge. The sample container is successively rinsed with aliquots of the elution solvent. The eluted extract is combined with an equal volume of reagent water and a portion is filtered for analysis. Method procedures conform to US DoD QSM 5.3, table B-15 requirements.

CHAIN OF CUSTODY - ANALYSIS REQUEST FORM

Job No: 722092 Laboratory: ALS | EB2317957

Project Manager: Anna Sheldon Sampler: AS/SW Site Location: Tick Hill **Sheet:** 1 **of** 4

Environmental Division Brisbane
Work Order Reference
EB2317957

Telephone : +61-7-3243 7222

No. of samples	Sample ID/ Depth	Anticipated Result (PID)/EC reading	Date sampled	Time sampled	Sample Matrix: Soil	Water	Sediment	Analysis Required: EES Ionic Balance	CN-FWT-LL	Total Metals extended - see below	Dissolved Metals extended - see below	PFAS EP231XLL	Total P - EK067	EES Metals (total)	EK02LL6 - total CN	W-4 TRH BTEXN					Sample-specific instructions/ notes
1	THGW001		12/06/2023			x		x	x	x	x	x	x			x					
2	THGW002		12/06/2023			x		x	x	x	x	x	x			x					
3	THGW003		12/06/2023			x		x	x	x	x	x	x			x					
4	THGW004		12/06/2023			x		x	x	x	x	x	x			x					
5	THGW005		12/06/2023			x		x	x	x	x	x	x			x					
6	THGW006		12/06/2023			x		x	x	x	x	x	x			x					
7	THGW007		12/06/2023			x		x	x	x	x	x	x			x					
8	THGW008		12/06/2023			x		x	x	x	x	x	x			x					
9	THGW009		12/06/2023			x		x	x	x	x	x	x			x					
10	Pit		12/06/2023			x		x	x	x	x	x	x			x					
11	Mine Shaft		12/06/2023			x		x	x	x	x	x	x			x					
12	GWBD01		12/06/2023			x		x	x	x	x	x	x			x					
13	RB01		12/06/2023			x								x	x						
63	RB02		12/06/2023			x								x							
64	THGW07 - 1.0		9.6.23					No	analysis	assigned											
65	THT08 - 0.5		10.6.23																		16.6.23
	Added by ALS																				
	TOTAL																				

Turn Around *(circle)*: **NORMAL / 3 DAYS / 48 HRS / 24 HRS** *(confirm with lab in advance if quick turn-around is required)*

Lab Quotation No. *(if applicable)* : EB23ENVEAR0004

Comments/ Instructions: Total and Dissolved metals Suite -

Al, Sb, As, Ba, Cd, Cr, Co, Cu, Pb, Fe, Mn, Mo, Ni, Se, Sr, Ti, W, U, V, Zn

Send report to sampler *(email address)* : sweiss@eesigroup.com

Cc: report to PM/PD *(email address)* : Asheldon@eesigroup.com

Cc: invoice to *(email address)*: accounts@eesigroup.com

	Name	Signature	PD Initial	Date	Time
Sent off Site/Office by:	A Sheldon			13/06/2023	
Receiving Lab:					
Receiving Lab:					

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Phone: (07) 3852 6666
PO Box: 3207, Newstead QLD 4006

Email: qldlab@eesigroup.com

CHAIN OF CUSTODY - ANALYSIS REQUEST FORM

Job No: 722092 Laboratory: ALS | EB2317957

Project Manager: Anna Sheldon Sampler: AS/SW Site Location: Tick Hill **Sheet:** 2 **of** 4

No. of samples	Sample ID/ Depth		Anticipated Result (PID)/EC reading	Date sampled	Time sampled	Sample Matrix: Soil	Water	Sediment	Analysis Required: Extended metals	Metals Al, Fe	CN Free, total & WAD	pH EC 1:5	CRS - EA026	PFAS EP231X	Total P and Reactive P	S- 04 TRH BTEXN	S-11 OCP / PCB				HOLD	Sample-specific instructions/ notes
14	THS01	0-0.1		10/06/2023		X			X	X	X	X										
15	THS02	0-0.1		10/06/2023		X					X											
16	THS03	0-0.1		10/06/2023		X															X	
17	THS03	0.3-0.35		10/06/2023		X					X	X										
18	THS04	0-0.1		10/06/2023		X			X	X												
19	THS05	0-0.1		10/06/2023		X															X	
20	THS06	0-0.05		10/06/2023		X			X	X	X	X	X	X	X	X	X					
21	THS07	0-0.1		10/06/2023		X								X								
22	THS08	0-0.1		11/06/2023		X					X			X	X	X	X					
23	THS09	0-0.1		11/06/2023		X					X					X	X					
24	THS10	0-0.1		11/06/2023		X										X	X					
25	THS11	0-0.1		11/06/2023		X					X				X							
26	THS12	0-0.1		11/06/2023		X			X	X	X											
27	THS13	0.4-0.5		11/06/2023		X			x	x	X	X	X		X							
28	THS14	0-0.1		11/06/2023		X			x	x						X						
29	THS15	0-0.1		11/06/2023		X			x	x	X	X	X									
31	THGW08	0-0.1		8/06/2023		X															X	
32	THGW08	1		8/06/2023		X															X	
33	THGW08	2		8/06/2023		X															X	
34	THGW08	2.9		8/06/2023		X					X				X							
	TOTAL																					

Turn Around *(circle)*: **NORMAL / 3 DAYS / 48 HRS / 24 HRS** *(confirm with lab in advance if quick turn-around is required)*

Lab Quotation No. *(if applicable)* : EB23ENVEAR0004

Comments/ Instructions: Metals suite

Sb, As, Ba, Cd, Cr, Co, Cu, Pb, Mn, Mo, Ni, Se, Sr, Ti, W, U, V, Zn

Send report to sampler *(email address)* : sweiss@eesigroup.com

Cc: report to PM/PD *(email address)* : Asheldon@eesigroup.com

Cc: invoice to *(email address)*: accounts@eesigroup.com

	Name	Signature	PD Initial	Date	Time
Sent off Site/Office by:	A Sheldon			13/06/2023	
Receiving Lab:					
Receiving Lab:					

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED
Phone: (07) 3852 6666
PO Box: 3207, Newstead QLD 4006
Email: qldlab@eesigroup.com

CHAIN OF CUSTODY - ANALYSIS REQUEST FORM

Job No: 722092 Laboratory: ALS | EB2317957

Project Manager: Anna Sheldon Sampler: AS/SW Site Location: Tick Hill **Sheet:** 3 **of** 4

No. of samples	Sample ID/ Depth		Anticipated Result (PID)/EC reading	Date sampled	Time sampled	Sample Matrix: Soil	Water	Sediment	Analysis Required: Extended metals	Metals Al, Fe	CN Free, total & WAD	pH EC 1:5	CRS - EA026	PFAS EP231X	Total P and Reactive P		ASLP leach	CN Free (on leach)			HOLD	Sample-specific instructions/ notes
35	THT01	0.5		9/06/2023		X						X										
36	THT01	1		9/06/2023		X						X	X									
37	THT02	0.5		9/06/2023		X															X	
38	THT02	1		9/06/2023		X									X							
39	THT03	0.5		9/06/2023		X					X						X	X				
40	THT03	1		9/06/2023		X					X						X	X				
41	THT04	0.5		9/06/2023		X															X	
42	THT04	1		9/06/2023		X															X	
43	THT05	0.5		9/06/2023		X					X						X	X				
44	THT05	1		9/06/2023		X					X			X			X	X				
45	THT06	0.5		9/06/2023		X			X	X	X	X										
46	THT06	1		9/06/2023		X						X	X									
47	THT07	0.2		9/06/2023		X					X											
48	THT07	0.3		9/06/2023		X					X											
49	THT08	0.1		9/06/2023		X					X											
50	THT09	1.0-1.5		11/06/2023		X			X	X		X		X								
51	THT09	2.5-3.0		11/06/2023		X			X	X		X	X									
52	THT09	4.2-4.5		11/06/2023		X			X	X		X			X							
53	THT09	5.0-5.5		11/06/2023		X			X	X		X	X									
54	THT10	1.0-1.5		11/06/2023		X					X						X	X				
	TOTAL																					

Turn Around *(circle)*: **NORMAL / 3 DAYS / 48 HRS / 24 HRS** *(confirm with lab in advance if quick turn-around is required)*

Lab Quotation No. *(if applicable)*: EB23ENVEAR0004

Comments/ Instructions: Metals suite

Sb, As, Ba, Cd, Cr, Co, Cu, Pb, Mn, Mo, Ni, Se, Sr, Ti, W, U, V, Zn

Send report to sampler *(email address)*: sweiss@eesigroup.com

Cc: report to PM/PD *(email address)*: Asheldon@eesigroup.com

Cc: invoice to *(email address)*: accounts@eesigroup.com

	Name	Signature	PD Initial	Date	Time
Sent off Site/Office by:	A Sheldon			13/06/2023	
Receiving Lab:					
Receiving Lab:					

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED
Phone: (07) 3852 6666
PO Box: 3207, Newstead QLD 4006
Email: qldlab@eesigroup.com

CHAIN OF CUSTODY - ANALYSIS REQUEST FORM

Job No: 722092

Laboratory: ALS | EB2317957

Project Manager: Anna Sheldon

Sampler: AS/SW

Site Location: Tick Hill

Sheet: 4 **of** 4

No. of samples	Sample ID/ Depth		Anticipated Result (PID)/EC reading	Date sampled	Time sampled	Sample Matrix: Soil	Water	Sediment	Analysis Required: Extended metals	Metals Al, Fe	CN Free, total & WAD	pH EC 1:5	CRS - EA026	PFAS EP231X	Total P and Reactive P				ASLP leach	CN Free (on leach)	Extended metals on leach	Sample-specific instructions/ notes
55	THT10	2.5-3.0		11/06/2023		X					X								X	X	X	
56	THT10	4.0-4.5		11/06/2023		X					X								X	X		
57	THT10	5.0-5.5		11/06/2023		X					X								X	X	X	
58	THT11	1.2-1.5		11/06/2023		X					X								X	X		Use PFAS jar for CN and leach analysis
59	THT11	2.5-3.0		11/06/2023		X					X								X	X		Use PFAS jar for CN and leach analysis
60	THT11	4.0-4.4		11/06/2023		X					X				X				X	X		Use PFAS jar for CN and leach analysis
61	THT11	5.0-5.5		11/06/2023		X					X								X	X		Use PFAS jar for CN and leach analysis
62	BD01			10/06/2023		X			X	X	X											
30	BD02			11/06/2023		X			X	X	X											
	TOTAL																					

Turn Around *(circle)*: **NORMAL / 3 DAYS / 48 HRS / 24 HRS** *(confirm with lab in advance if quick turn-around is required)*

Lab Quotation No. *(if applicable)*: EB23ENVEAR0004

Comments/ Instructions: Metals suite

Sb, As, Ba, Cd, Cr, Co, Cu, Pb, Mn, Mo, Ni, Se, Sr, Ti, W, U, V, Zn

Send report to sampler *(email address)*: sweiss@eesigroup.com

Cc: report to PM/PD *(email address)*: Asheldon@eesigroup.com

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	Name	Signature	PD Initial	Date	Time
Sent off Site/Office by:	A Sheldon			13/06/2023	
Receiving Lab:					
Receiving Lab:					

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Phone: (07) 3852 6666
PO Box: 3207, Newstead QLD 4006

Email: qldlab@eesigroup.com

CERTIFICATE OF ANALYSIS

Work Order	: **EB2318849**	Page	: 1 of 18
Client	: **ENVIRONMENTAL EARTH SCIENCES**	Laboratory	: Environmental Division Brisbane
Contact	: MS ANNA SHELDON	Contact	: David Wall
Address	: UNIT 3/1 ROSS STREET NEWSTEAD QLD, AUSTRALIA 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: 07 3852 6666	Telephone	: +61-7-3243 7222
Project	: 722092	Date Samples Received	: 22-Jun-2023 14:00
Order number	: ----	Date Analysis Commenced	: 23-Jun-2023
C-O-C number	: ----	Issue Date	: 04-Jul-2023 16:23
Sampler	: PAUL TAN		
Site	: Tick Hill		
Quote number	: EB23ENVEAR0004		
No. of samples received	: 19		
No. of samples analysed	: 19		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Inorganics, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Timothy Creagh	Senior Chemist - Organics	Brisbane Inorganics, Stafford, QLD
Timothy Creagh	Senior Chemist - Organics	Brisbane Organics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Particular samples have been crushed prior to preparation and analysis as per client request on the Chain of Custody. Please refer to SRN for further details.
- EG020X-T (Total Metals by ICP-MS): Sample 'THTSF_DEC_02_600_900' (EB2318849-011) shows poor duplicate results due to sample heterogeneity. Confirmed by re-extraction and re-analysis.

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)			Sample ID	THTSF_DEC_01_0_300	THTSF_DEC_01_300_600	THTSF_DEC_01_600_900	THTSF_DEC_01_900_1200	THTSF_DEC_01_1200_1500
			Sampling date / time	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2318849-001	EB2318849-002	EB2318849-003	EB2318849-004	EB2318849-005
				Result	Result	Result	Result	Result
EG020W: Water Leachable Metals by ICP-MS								
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	**0.001**	**0.002**
Barium	7440-39-3	0.001	mg/L	**0.428**	**0.391**	**0.484**	**0.902**	**0.952**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	**0.002**	**0.011**	**0.002**	**0.004**	**0.005**
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	**0.002**	**0.001**	**0.018**
Copper	7440-50-8	0.001	mg/L	**0.003**	**0.002**	**0.002**	**0.003**	**0.013**
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	**0.001**
Manganese	7439-96-5	0.001	mg/L	**0.014**	**0.010**	**0.011**	**0.024**	**0.026**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	**0.003**
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	**0.001**	**0.003**
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	7440-24-6	0.001	mg/L	**0.031**	**0.020**	**0.019**	**0.025**	**0.026**
Titanium	7440-32-6	0.01	mg/L	**0.02**	<0.01	**0.03**	**0.05**	**0.07**
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	7440-62-2	0.01	mg/L	**0.02**	**0.02**	**0.02**	**0.04**	**0.05**
Zinc	7440-66-6	0.005	mg/L	**0.114**	**0.039**	**0.037**	**0.071**	**0.090**
Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)			Sample ID	THTSF_DEC_01_1500_1800	THTSF_DEC_01_1800_2100	THTSF_DEC_01_2100_2400	THTSF_DEC_02_0_300	THTSF_DEC_02_300_600
			Sampling date / time	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2318849-006	EB2318849-007	EB2318849-008	EB2318849-009	EB2318849-010
				Result	Result	Result	Result	Result
EG020W: Water Leachable Metals by ICP-MS								
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	**0.002**	**0.002**	**0.008**	**0.001**	**0.002**
Barium	7440-39-3	0.001	mg/L	**1.15**	**0.740**	**3.41**	**1.57**	**0.819**
Cadmium	7440-43-9	0.0001	mg/L	**0.0001**	**0.0002**	**0.0008**	**0.0003**	**0.0001**
Chromium	7440-47-3	0.001	mg/L	**0.006**	**0.002**	**0.044**	**0.012**	**0.003**
Cobalt	7440-48-4	0.001	mg/L	**0.044**	**0.010**	**0.053**	**0.004**	**0.003**
Copper	7440-50-8	0.001	mg/L	**0.038**	**0.003**	**0.364**	**0.011**	**0.038**
Lead	7439-92-1	0.001	mg/L	**0.002**	<0.001	**0.021**	**0.003**	**0.002**
Manganese	7439-96-5	0.001	mg/L	**0.023**	**0.012**	**0.191**	**0.063**	**0.021**
Molybdenum	7439-98-7	0.001	mg/L	**0.004**	**0.001**	**0.006**	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	**0.003**	**0.002**	**0.028**	**0.006**	**0.003**
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	**0.01**	<0.01	<0.01
Strontium	7440-24-6	0.001	mg/L	**0.031**	**0.029**	**0.077**	**0.032**	**0.018**
Titanium	7440-32-6	0.01	mg/L	**0.08**	**0.04**	**0.26**	**0.10**	**0.03**
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	**0.003**	<0.001	<0.001
Vanadium	7440-62-2	0.01	mg/L	**0.05**	**0.04**	**0.14**	**0.09**	**0.03**
Zinc	7440-66-6	0.005	mg/L	**0.098**	**0.060**	**0.512**	**0.224**	**0.068**
Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)			Sample ID	THTSF_DEC_02_600_900	THTSF_DEC_02_900_1200	THTSF_DEC_02_1200_1500	THTSF_DEC_02_1500_1800	THTSF_DEC_02_1800_2100
			Sampling date / time	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2318849-011	EB2318849-012	EB2318849-013	EB2318849-014	EB2318849-015
				Result	Result	Result	Result	Result
EG020W: Water Leachable Metals by ICP-MS								
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	**0.006**	**0.003**	**0.001**	**0.002**
Barium	7440-39-3	0.001	mg/L	**0.486**	**0.790**	**0.811**	**0.520**	**0.669**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	**0.004**	**0.004**	**0.002**	**0.004**
Cobalt	7440-48-4	0.001	mg/L	<0.001	**0.015**	**0.011**	**0.003**	**0.005**
Copper	7440-50-8	0.001	mg/L	**0.002**	**0.072**	**0.058**	**0.010**	**0.025**
Lead	7439-92-1	0.001	mg/L	<0.001	**0.003**	**0.002**	<0.001	**0.002**
Manganese	7439-96-5	0.001	mg/L	**0.006**	**0.020**	**0.021**	**0.010**	**0.023**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	**0.003**	**0.002**	**0.002**	**0.001**
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.004**	**0.004**	**0.001**	**0.003**
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	7440-24-6	0.001	mg/L	**0.019**	**0.020**	**0.022**	**0.016**	**0.020**
Titanium	7440-32-6	0.01	mg/L	<0.01	**0.03**	**0.03**	**0.02**	**0.04**
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	7440-62-2	0.01	mg/L	**0.02**	**0.03**	**0.03**	**0.03**	**0.03**
Zinc	7440-66-6	0.005	mg/L	**0.040**	**0.072**	**0.070**	**0.036**	**0.059**
Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)			Sample ID	THTSF_DEC_02_2100_2400	THTSF_DEC_01_2400_2700	THTSF_DEC_01_2700_3000	THTSF_03	----
			Sampling date / time	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	----
Compound	CAS Number	LOR	Unit	EB2318849-016	EB2318849-017	EB2318849-018	EB2318849-019	--------
				Result	Result	Result	Result	----
EG020W: Water Leachable Metals by ICP-MS								
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Arsenic	7440-38-2	0.001	mg/L	**0.005**	**0.014**	**0.022**	**0.002**	----
Barium	7440-39-3	0.001	mg/L	**1.69**	**1.41**	**1.19**	**0.513**	----
Cadmium	7440-43-9	0.0001	mg/L	**0.0003**	**0.0002**	**0.0002**	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	**0.022**	**0.041**	**0.011**	**0.002**	----
Cobalt	7440-48-4	0.001	mg/L	**0.020**	**0.039**	**0.047**	**0.001**	----
Copper	7440-50-8	0.001	mg/L	**0.183**	**0.141**	**0.132**	**0.008**	----
Lead	7439-92-1	0.001	mg/L	**0.006**	**0.009**	**0.008**	<0.001	----
Manganese	7439-96-5	0.001	mg/L	**0.097**	**0.096**	**0.039**	**0.012**	----
Molybdenum	7439-98-7	0.001	mg/L	**0.002**	**0.011**	**0.014**	**0.001**	----
Nickel	7440-02-0	0.001	mg/L	**0.012**	**0.016**	**0.009**	<0.001	----
Selenium	7782-49-2	0.01	mg/L	<0.01	**0.05**	**0.08**	<0.01	----
Strontium	7440-24-6	0.001	mg/L	**0.033**	**0.033**	**0.026**	**0.028**	----
Titanium	7440-32-6	0.01	mg/L	**0.12**	**0.13**	**0.08**	**0.02**	----
Uranium	7440-61-1	0.001	mg/L	**0.002**	**0.005**	**0.003**	<0.001	----
Vanadium	7440-62-2	0.01	mg/L	**0.06**	**0.06**	**0.04**	**0.02**	----
Zinc	7440-66-6	0.005	mg/L	**0.264**	**0.170**	**0.142**	**0.024**	----
Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----

Analytical Results

Sub-Matrix: ASLP ZHE LEACHATE (Matrix: WATER)			Sample ID	THTSF_DEC_01_0_300	THTSF_DEC_01_300_600	THTSF_DEC_01_600_900	THTSF_DEC_01_900_1200	THTSF_DEC_01_1200_1500
			Sampling date / time	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2318849-001	EB2318849-002	EB2318849-003	EB2318849-004	EB2318849-005
				Result	Result	Result	Result	Result
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	0.004	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004

Analytical Results

Sub-Matrix: ASLP ZHE LEACHATE (Matrix: WATER)			Sample ID	THTSF_DEC_01_1500_1800	THTSF_DEC_01_1800_2100	THTSF_DEC_01_2100_2400	THTSF_DEC_02_0_300	THTSF_DEC_02_300_600
			Sampling date / time	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2318849-006	EB2318849-007	EB2318849-008	EB2318849-009	EB2318849-010
				Result	Result	Result	Result	Result
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	0.004	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004

Analytical Results

Sub-Matrix: ASLP ZHE LEACHATE (Matrix: WATER)			Sample ID	THTSF_DEC_02_600_900	THTSF_DEC_02_900_1200	THTSF_DEC_02_1200_1500	THTSF_DEC_02_1500_1800	THTSF_DEC_02_1800_2100
			Sampling date / time	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2318849-011	EB2318849-012	EB2318849-013	EB2318849-014	EB2318849-015
				Result	Result	Result	Result	Result
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	0.004	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004

Analytical Results

Sub-Matrix: ASLP ZHE LEACHATE (Matrix: WATER)			Sample ID	THTSF_DEC_02_2100_2400	THTSF_DEC_01_2400_2700	THTSF_DEC_01_2700_3000	THTSF_03	----
			Sampling date / time	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	----
Compound	CAS Number	LOR	Unit	EB2318849-016	EB2318849-017	EB2318849-018	EB2318849-019	--------
				Result	Result	Result	Result	----
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	0.004	mg/L	<0.004	<0.004	<0.004	<0.004	**----**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THTSF_DEC_01_0_300	THTSF_DEC_01_300_600	THTSF_DEC_01_600_900	THTSF_DEC_01_900_1200	THTSF_DEC_01_1200_1500
			Sampling date / time	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2318849-001	EB2318849-002	EB2318849-003	EB2318849-004	EB2318849-005
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.6	9.5	9.8	9.9	9.4
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	53	84	220	158	436
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	0.009	0.017	0.042	0.007	0.092
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	12400	12500	12600	12500	11500
Iron	7439-89-6	50	mg/kg	28000	26000	27900	26000	24300
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.1	mg/kg	1.2	0.9	1.2	0.9	1.5
Selenium	7782-49-2	1	mg/kg	<1	<1	<1	<1	<1
Barium	7440-39-3	0.1	mg/kg	89.2	63.5	66.7	79.4	52.9
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	7440-48-4	0.1	mg/kg	14.4	14.3	13.3	12.5	14.5
Chromium	7440-47-3	0.1	mg/kg	19.4	19.3	26.0	24.5	23.4
Copper	7440-50-8	0.1	mg/kg	26.8	26.8	11.0	11.0	35.1
Manganese	7439-96-5	0.1	mg/kg	204	174	187	171	187
Strontium	7440-24-6	0.1	mg/kg	19.7	18.8	20.1	20.6	19.1
Tungsten	7440-33-7	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	7439-98-7	0.1	mg/kg	<0.1	<0.1	0.1	<0.1	0.2
Nickel	7440-02-0	0.1	mg/kg	15.4	15.8	17.3	15.3	20.3
Lead	7439-92-1	0.1	mg/kg	2.7	1.7	2.0	1.4	3.3
Antimony	7440-36-0	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Uranium	7440-61-1	0.1	mg/kg	0.6	0.6	0.7	0.7	0.9
Zinc	7440-66-6	0.5	mg/kg	19.9	17.3	13.9	13.3	14.6
Vanadium	7440-62-2	1	mg/kg	48	44	49	46	49
Titanium	7440-32-6	1	mg/kg	338	199	357	305	262
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	1	mg/kg	<1	<1	<1	<1	<1
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	<1	<1	<1	7
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THTSF_DEC_01_0_300	THTSF_DEC_01_300_600	THTSF_DEC_01_600_900	THTSF_DEC_01_900_1200	THTSF_DEC_01_1200_1500
			Sampling date / time	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2318849-001	EB2318849-002	EB2318849-003	EB2318849-004	EB2318849-005
				Result	Result	Result	Result	Result
EN60-DI: Bottle Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Final pH	----	0.1	pH Unit	**7.2**	**8.6**	**9.0**	**9.0**	**9.0**
EN60Z-DI: Deionised Water Leach (Zero Headspace Extraction)								
Final pH	----	0.1	pH Unit	**6.5**	**6.5**	**6.5**	**6.5**	**6.5**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THTSF_DEC_01_1500_1800	THTSF_DEC_01_1800_2100	THTSF_DEC_01_2100_2400	THTSF_DEC_02_0_300	THTSF_DEC_02_300_600
			Sampling date / time	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2318849-006	EB2318849-007	EB2318849-008	EB2318849-009	EB2318849-010
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.4	9.4	9.7	9.8	10.0
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	475	373	916	106	249
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	0.012	0.018	0.009	<0.005	<0.005
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	13700	13000	14100	14400	10400
Iron	7439-89-6	50	mg/kg	27800	25300	29600	30000	22500
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.1	mg/kg	1.7	1.4	3.1	1.1	1.5
Selenium	7782-49-2	1	mg/kg	<1	<1	1	<1	<1
Barium	7440-39-3	0.1	mg/kg	142	58.2	81.4	91.2	87.2
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	7440-48-4	0.1	mg/kg	15.2	15.2	27.1	15.0	17.0
Chromium	7440-47-3	0.1	mg/kg	27.8	25.3	29.2	27.1	19.8
Copper	7440-50-8	0.1	mg/kg	43.9	26.6	193	6.2	93.5
Manganese	7439-96-5	0.1	mg/kg	182	164	182	192	131
Strontium	7440-24-6	0.1	mg/kg	26.2	19.4	23.6	27.9	25.2
Tungsten	7440-33-7	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	7439-98-7	0.1	mg/kg	0.3	0.1	0.6	<0.1	0.2
Nickel	7440-02-0	0.1	mg/kg	18.9	18.1	25.8	20.7	20.1
Lead	7439-92-1	0.1	mg/kg	3.3	2.9	6.6	1.6	3.7
Antimony	7440-36-0	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Uranium	7440-61-1	0.1	mg/kg	0.9	1.0	1.4	0.5	0.8
Zinc	7440-66-6	0.5	mg/kg	16.0	16.1	23.6	26.1	18.7
Vanadium	7440-62-2	1	mg/kg	54	44	54	47	40
Titanium	7440-32-6	1	mg/kg	349	310	234	178	240
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	1	mg/kg	<1	<1	<1	<1	<1
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	20	1	192	1	22
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THTSF_DEC_01_1500_1800	THTSF_DEC_01_1800_2100	THTSF_DEC_01_2100_2400	THTSF_DEC_02_0_300	THTSF_DEC_02_300_600
			Sampling date / time	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2318849-006	EB2318849-007	EB2318849-008	EB2318849-009	EB2318849-010
				Result	Result	Result	Result	Result
EN60-DI: Bottle Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Final pH	----	0.1	pH Unit	**9.0**	**9.0**	**9.5**	**9.6**	**9.3**
EN60Z-DI: Deionised Water Leach (Zero Headspace Extraction)								
Final pH	----	0.1	pH Unit	**6.5**	**6.5**	**6.5**	**6.5**	**6.5**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THTSF_DEC_02_600_900	THTSF_DEC_02_900_1200	THTSF_DEC_02_1200_1500	THTSF_DEC_02_1500_1800	THTSF_DEC_02_1800_2100
			Sampling date / time	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2318849-011	EB2318849-012	EB2318849-013	EB2318849-014	EB2318849-015
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.9	9.7	9.8	9.8	10.0
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	201	361	272	283	216
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	0.010	0.007	0.010	0.006	0.016
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	10300	13200	9460	10800	10300
Iron	7439-89-6	50	mg/kg	22900	26700	19900	20400	19300
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.1	mg/kg	1.5	1.8	1.5	1.4	1.4
Selenium	7782-49-2	1	mg/kg	<1	<1	<1	<1	<1
Barium	7440-39-3	0.1	mg/kg	77.9	77.3	61.8	52.6	34.0
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	7440-48-4	0.1	mg/kg	19.5	19.4	14.8	15.5	16.3
Chromium	7440-47-3	0.1	mg/kg	17.7	24.7	18.9	18.8	16.8
Copper	7440-50-8	0.1	mg/kg	48.5	77.7	62.3	43.4	40.0
Manganese	7439-96-5	0.1	mg/kg	175	175	120	124	141
Strontium	7440-24-6	0.1	mg/kg	24.8	22.2	19.8	13.5	10.1
Tungsten	7440-33-7	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	7439-98-7	0.1	mg/kg	0.2	0.3	0.3	0.2	0.2
Nickel	7440-02-0	0.1	mg/kg	17.7	20.6	17.0	17.2	15.1
Lead	7439-92-1	0.1	mg/kg	2.0	3.8	2.8	2.5	2.6
Antimony	7440-36-0	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Uranium	7440-61-1	0.1	mg/kg	0.8	1.0	0.8	0.9	0.8
Zinc	7440-66-6	0.5	mg/kg	17.2	22.0	15.8	15.3	13.8
Vanadium	7440-62-2	1	mg/kg	36	46	37	34	31
Titanium	7440-32-6	1	mg/kg	112	205	200	199	187
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	1	mg/kg	<1	<1	<1	<1	<1
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	47	24	18	12
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THTSF_DEC_02_600_900	THTSF_DEC_02_900_1200	THTSF_DEC_02_1200_1500	THTSF_DEC_02_1500_1800	THTSF_DEC_02_1800_2100
			Sampling date / time	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00
Compound	CAS Number	LOR	Unit	EB2318849-011	EB2318849-012	EB2318849-013	EB2318849-014	EB2318849-015
				Result	Result	Result	Result	Result
EN60-DI: Bottle Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Final pH	----	0.1	pH Unit	**9.2**	**9.3**	**9.2**	**9.3**	**9.2**
EN60Z-DI: Deionised Water Leach (Zero Headspace Extraction)								
Final pH	----	0.1	pH Unit	**6.5**	**6.5**	**6.5**	**6.6**	**6.6**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THTSF_DEC_02_2100_2400	THTSF_DEC_01_2400_2700	THTSF_DEC_01_2700_3000	THTSF_03	----
			Sampling date / time	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	----
Compound	CAS Number	LOR	Unit	EB2318849-016	EB2318849-017	EB2318849-018	EB2318849-019	--------
				Result	Result	Result	Result	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.9	9.8	9.3	8.5	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	464	680	1310	294	----
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	0.008	0.008	0.013	0.024	----
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	11400	14400	19200	9480	----
Iron	7439-89-6	50	mg/kg	24400	30600	37100	23700	----
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.1	mg/kg	2.4	4.9	7.2	4.0	----
Selenium	7782-49-2	1	mg/kg	1	2	3	1	----
Barium	7440-39-3	0.1	mg/kg	50.4	65.2	63.3	43.4	----
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.4	<0.1	----
Cobalt	7440-48-4	0.1	mg/kg	21.0	29.7	47.4	17.2	----
Chromium	7440-47-3	0.1	mg/kg	26.9	35.9	35.6	26.2	----
Copper	7440-50-8	0.1	mg/kg	132	216	357	83.1	----
Manganese	7439-96-5	0.1	mg/kg	163	171	204	124	----
Strontium	7440-24-6	0.1	mg/kg	13.0	22.1	25.0	13.5	----
Tungsten	7440-33-7	0.1	mg/kg	<0.1	<0.1	0.1	<0.1	----
Molybdenum	7439-98-7	0.1	mg/kg	0.3	0.7	1.4	0.6	----
Nickel	7440-02-0	0.1	mg/kg	20.4	26.3	37.5	16.0	----
Lead	7439-92-1	0.1	mg/kg	3.5	5.8	14.4	4.3	----
Antimony	7440-36-0	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	----
Uranium	7440-61-1	0.1	mg/kg	1.3	2.0	3.1	1.5	----
Zinc	7440-66-6	0.5	mg/kg	19.0	25.8	46.7	16.1	----
Vanadium	7440-62-2	1	mg/kg	38	53	62	37	----
Titanium	7440-32-6	1	mg/kg	156	192	205	152	----
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	1	mg/kg	<1	<1	<1	<1	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	224	459	336	58	----
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	<1	<1	<1	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	THTSF_DEC_02_2100_2400	THTSF_DEC_01_2400_2700	THTSF_DEC_01_2700_3000	THTSF_03	----
			Sampling date / time	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	22-Jun-2023 00:00	----
Compound	CAS Number	LOR	Unit	EB2318849-016	EB2318849-017	EB2318849-018	EB2318849-019	--------
				Result	Result	Result	Result	----
EN60-DI: Bottle Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Final pH	----	0.1	pH Unit	**9.5**	**9.3**	**9.3**	**8.9**	**----**
EN60Z-DI: Deionised Water Leach (Zero Headspace Extraction)								
Final pH	----	0.1	pH Unit	**6.6**	**6.6**	**6.6**	**6.6**	**----**

QUALITY CONTROL REPORT

Work Order	: **EB2318849**	Page	: 1 of 9
Client	: **ENVIRONMENTAL EARTH SCIENCES**	Laboratory	: Environmental Division Brisbane
Contact	: MS ANNA SHELDON	Contact	: David Wall
Address	: UNIT 3/1 ROSS STREET NEWSTEAD QLD, AUSTRALIA 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: 07 3852 6666	Telephone	: +61-7-3243 7222
Project	: 722092	Date Samples Received	: 22-Jun-2023
Order number	: ----	Date Analysis Commenced	: 23-Jun-2023
C-O-C number	: ----	Issue Date	: 04-Jul-2023
Sampler	: PAUL TAN		
Site	: Tick Hill		
Quote number	: EB23ENVEAR0004		
No. of samples received	: 19		
No. of samples analysed	: 19		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Inorganics, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Timothy Creagh	Senior Chemist - Organics	Brisbane Inorganics, Stafford, QLD
Timothy Creagh	Senior Chemist - Organics	Brisbane Organics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 5129695)									
EB2318849-001	THTSF_DEC_01_0_300	EG005T: Aluminium	7429-90-5	50	mg/kg	12400	12500	0.5	0% - 20%
		EG005T: Iron	7439-89-6	50	mg/kg	28000	29300	4.6	0% - 20%
EB2318849-011	THTSF_DEC_02_600_900	EG005T: Aluminium	7429-90-5	50	mg/kg	10300	8840	15.5	0% - 20%
		EG005T: Iron	7439-89-6	50	mg/kg	22900	19700	14.9	0% - 20%
EA002: pH 1:5 (Soils) (QC Lot: 5129704)									
EB2318849-001	THTSF_DEC_01_0_300	EA002: pH Value	----	0.1	pH Unit	8.6	8.7	0.0	0% - 20%
EB2318849-011	THTSF_DEC_02_600_900	EA002: pH Value	----	0.1	pH Unit	9.9	9.9	0.0	0% - 20%
EA010: Conductivity (1:5) (QC Lot: 5129703)									
EB2318849-001	THTSF_DEC_01_0_300	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	53	53	0.0	0% - 20%
EB2318849-011	THTSF_DEC_02_600_900	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	201	185	8.3	0% - 20%
EA026 : Chromium Reducible Sulfur (QC Lot: 5142434)									
EB2318849-001	THTSF_DEC_01_0_300	EA026: Chromium Reducible Sulphur	----	0.005	%	0.009	0.007	28.4	No Limit
EB2318849-011	THTSF_DEC_02_600_900	EA026: Chromium Reducible Sulphur	----	0.005	%	0.010	0.008	26.1	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 5129696)									
EB2318849-011	THTSF_DEC_02_600_900	EG020X-T: Barium	7440-39-3	0.1	mg/kg	77.9	# 63.4	20.6	0% - 20%
		EG020X-T: Chromium	7440-47-3	0.1	mg/kg	17.7	# 13.6	26.5	0% - 20%
		EG020X-T: Copper	7440-50-8	0.1	mg/kg	48.5	49.4	1.8	0% - 20%
EB2318849-001	THTSF_DEC_01_0_300	EG020X-T: Arsenic	7440-38-2	0.1	mg/kg	1.2	1.2	0.0	0% - 50%
		EG020X-T: Barium	7440-39-3	0.1	mg/kg	89.2	83.3	6.9	0% - 20%
		EG020X-T: Cobalt	7440-48-4	0.1	mg/kg	14.4	13.3	7.6	0% - 20%
		EG020X-T: Chromium	7440-47-3	0.1	mg/kg	19.4	20.0	2.7	0% - 20%
		EG020X-T: Copper	7440-50-8	0.1	mg/kg	26.8	26.3	1.9	0% - 20%
		EG020X-T: Manganese	7439-96-5	0.1	mg/kg	204	197	3.6	0% - 20%

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EG020T: Total Metals by ICP-MS (QC Lot: 5129696) - continued									
EB2318849-001	THTSF_DEC_01_0_300	EG020X-T: Molybdenum	7439-98-7	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020X-T: Nickel	7440-02-0	0.1	mg/kg	15.4	15.1	2.4	0% - 20%
		EG020X-T: Lead	7439-92-1	0.1	mg/kg	2.7	2.8	0.0	0% - 20%
		EG020X-T: Antimony	7440-36-0	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020X-T: Uranium	7440-61-1	0.1	mg/kg	0.6	0.6	0.0	No Limit
		EG020X-T: Zinc	7440-66-6	0.5	mg/kg	19.9	19.2	3.7	0% - 20%
		EG020X-T: Vanadium	7440-62-2	1	mg/kg	48	48	0.0	0% - 20%
EB2318849-011	THTSF_DEC_02_600_900	EG020X-T: Arsenic	7440-38-2	0.1	mg/kg	1.5	1.3	11.9	0% - 50%
		EG020X-T: Cobalt	7440-48-4	0.1	mg/kg	19.5	17.2	12.8	0% - 20%
		EG020X-T: Manganese	7439-96-5	0.1	mg/kg	175	177	1.0	0% - 20%
		EG020X-T: Molybdenum	7439-98-7	0.1	mg/kg	0.2	0.2	0.0	No Limit
		EG020X-T: Nickel	7440-02-0	0.1	mg/kg	17.7	14.7	18.8	0% - 20%
		EG020X-T: Lead	7439-92-1	0.1	mg/kg	2.0	1.7	18.4	0% - 20%
		EG020X-T: Antimony	7440-36-0	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020X-T: Uranium	7440-61-1	0.1	mg/kg	0.8	0.8	0.0	No Limit
		EG020X-T: Zinc	7440-66-6	0.5	mg/kg	17.2	16.2	6.2	0% - 20%
		EG020X-T: Vanadium	7440-62-2	1	mg/kg	36	31	14.8	0% - 20%
EG020T: Total Metals by ICP-MS (QC Lot: 5129697)									
EB2318849-011	THTSF_DEC_02_600_900	EG020Y-T: Strontium	7440-24-6	0.1	mg/kg	24.8	24.0	3.3	0% - 20%
EB2318849-001	THTSF_DEC_01_0_300	EG020Y-T: Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020Y-T: Strontium	7440-24-6	0.1	mg/kg	19.7	18.8	5.0	0% - 20%
		EG020Y-T: Selenium	7782-49-2	1	mg/kg	<1	<1	0.0	No Limit
EB2318849-011	THTSF_DEC_02_600_900	EG020Y-T: Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020Y-T: Selenium	7782-49-2	1	mg/kg	<1	<1	0.0	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 5129698)									
EB2318849-011	THTSF_DEC_02_600_900	EG020R-T: Titanium	7440-32-6	1	mg/kg	112	94	16.7	0% - 20%
EB2318849-001	THTSF_DEC_01_0_300	EG020R-T: Titanium	7440-32-6	1	mg/kg	338	338	0.0	0% - 20%
EG020T: Total Metals by ICP-MS (QC Lot: 5129699)									
EB2318849-001	THTSF_DEC_01_0_300	EG020V-T: Tungsten	7440-33-7	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EB2318849-011	THTSF_DEC_02_600_900	EG020V-T: Tungsten	7440-33-7	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EK025SF: Free CN by Segmented Flow Analyser (QC Lot: 5129702)									
EB2318849-001	THTSF_DEC_01_0_300	EK025SF: Free Cyanide	----	1	mg/kg	<1	<1	0.0	No Limit
EB2318849-011	THTSF_DEC_02_600_900	EK025SF: Free Cyanide	----	1	mg/kg	<1	<1	0.0	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 5129700)									
EB2318849-001	THTSF_DEC_01_0_300	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.0	No Limit
EB2318849-011	THTSF_DEC_02_600_900	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.0	No Limit
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QC Lot: 5129701)									
EB2318849-001	THTSF_DEC_01_0_300	EK028SF: Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	<1	0.0	No Limit
EB2318849-011	THTSF_DEC_02_600_900	EK028SF: Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	<1	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EG020W: Water Leachable Metals by ICP-MS (QC Lot: 5141426)									
EB2318849-001	THTSF_DEC_01_0_300	EG020B-W: Strontium	7440-24-6	0.001	mg/L	0.031	0.031	0.0	0% - 20%
		EG020B-W: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-W: Titanium	7440-32-6	0.01	mg/L	0.02	0.03	0.0	No Limit
EB2318849-012	THTSF_DEC_02_900_1200	EG020B-W: Strontium	7440-24-6	0.001	mg/L	0.020	0.020	0.0	0% - 50%
		EG020B-W: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-W: Titanium	7440-32-6	0.01	mg/L	0.03	0.03	0.0	No Limit
EG020W: Water Leachable Metals by ICP-MS (QC Lot: 5141427)									
EB2318849-001	THTSF_DEC_01_0_300	EG020E-W: Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
EB2318849-012	THTSF_DEC_02_900_1200	EG020E-W: Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
EG020W: Water Leachable Metals by ICP-MS (QC Lot: 5141428)									
EB2318849-001	THTSF_DEC_01_0_300	EG020A-W: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-W: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-W: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-W: Barium	7440-39-3	0.001	mg/L	0.428	0.437	2.1	0% - 20%
		EG020A-W: Chromium	7440-47-3	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020A-W: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-W: Copper	7440-50-8	0.001	mg/L	0.003	0.003	0.0	No Limit
		EG020A-W: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-W: Manganese	7439-96-5	0.001	mg/L	0.014	0.015	7.2	0% - 50%
		EG020A-W: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-W: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-W: Zinc	7440-66-6	0.005	mg/L	0.114	0.123	7.8	0% - 20%
		EG020A-W: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-W: Vanadium	7440-62-2	0.01	mg/L	0.02	0.02	0.0	No Limit
EB2318849-012	THTSF_DEC_02_900_1200	EG020A-W: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-W: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-W: Arsenic	7440-38-2	0.001	mg/L	0.006	0.005	0.0	No Limit
		EG020A-W: Barium	7440-39-3	0.001	mg/L	0.790	0.791	0.0	0% - 20%
		EG020A-W: Chromium	7440-47-3	0.001	mg/L	0.004	0.004	0.0	No Limit
		EG020A-W: Cobalt	7440-48-4	0.001	mg/L	0.015	0.014	0.0	0% - 50%
		EG020A-W: Copper	7440-50-8	0.001	mg/L	0.072	0.072	0.0	0% - 20%
		EG020A-W: Lead	7439-92-1	0.001	mg/L	0.003	0.003	0.0	No Limit
		EG020A-W: Manganese	7439-96-5	0.001	mg/L	0.020	0.020	0.0	0% - 50%
		EG020A-W: Molybdenum	7439-98-7	0.001	mg/L	0.003	0.003	0.0	No Limit
		EG020A-W: Nickel	7440-02-0	0.001	mg/L	0.004	0.004	0.0	No Limit
		EG020A-W: Zinc	7440-66-6	0.005	mg/L	0.072	0.072	0.0	0% - 50%
		EG020A-W: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-W: Vanadium	7440-62-2	0.01	mg/L	0.03	0.03	0.0	No Limit
EK025SF: Free CN by Segmented Flow Analyser (QC Lot: 5140233)									
ET2303262-010	Anonymous	EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	<0.004	0.0	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EK025SF: Free CN by Segmented Flow Analyser (QC Lot: 5140233) - continued									
EB2318849-005	THTSF_DEC_01_1200_1500	EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	<0.004	0.0	No Limit
EK025SF: Free CN by Segmented Flow Analyser (QC Lot: 5140234)									
ET2303261-020	Anonymous	EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	<0.004	0.0	No Limit
ET2303261-002	Anonymous	EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	<0.004	0.0	No Limit
EK025SF: Free CN by Segmented Flow Analyser (QC Lot: 5145184)									
EB2319682-005	Anonymous	EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	<0.004	0.0	No Limit
EB2319682-001	Anonymous	EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	<0.004	0.0	No Limit

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5129695)								
EG005T: Aluminium	7429-90-5	50	mg/kg	<50	12957 mg/kg	108	70.0	130
EG005T: Iron	7439-89-6	50	mg/kg	<50	30690 mg/kg	104	70.0	120
EA002: pH 1:5 (Soils) (QCLot: 5129704)								
EA002: pH Value	----	----	pH Unit	----	4 pH Unit	101	98.0	102
				----	7 pH Unit	100	98.0	102
EA010: Conductivity (1:5) (QCLot: 5129703)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1412 µS/cm	100	97.0	103
EA026 : Chromium Reducible Sulfur (QCLot: 5142434)								
EA026: Chromium Reducible Sulphur	----	0.005	%	<0.005	0.246 %	103	78.7	111
EG020T: Total Metals by ICP-MS (QCLot: 5129696)								
EG020X-T: Arsenic	7440-38-2	0.1	mg/kg	<0.1	70.38918 mg/kg	88.0	87.0	122
EG020X-T: Barium	7440-39-3	0.1	mg/kg	<0.1	83.06098 mg/kg	91.6	86.0	123
EG020X-T: Cobalt	7440-48-4	0.1	mg/kg	<0.1	10.19594 mg/kg	90.9	88.0	129
EG020X-T: Chromium	7440-47-3	0.1	mg/kg	<0.1	16.93221 mg/kg	92.2	75.0	130
EG020X-T: Copper	7440-50-8	0.1	mg/kg	<0.1	33.4382 mg/kg	106	84.0	120
EG020X-T: Manganese	7439-96-5	0.1	mg/kg	<0.1	481.99051 mg/kg	90.3	86.0	130
EG020X-T: Molybdenum	7439-98-7	0.1	mg/kg	<0.1	1.31126 mg/kg	96.7	82.0	118
EG020X-T: Nickel	7440-02-0	0.1	mg/kg	<0.1	14.07494 mg/kg	90.2	89.0	127
EG020X-T: Lead	7439-92-1	0.1	mg/kg	<0.1	57.76519 mg/kg	86.0	85.0	117
EG020X-T: Antimony	7440-36-0	0.1	mg/kg	<0.1	10.20675 mg/kg	77.7	70.0	130
EG020X-T: Uranium	7440-61-1	0.1	mg/kg	<0.1	0.48453 mg/kg	96.5	70.0	130
EG020X-T: Zinc	7440-66-6	0.5	mg/kg	<0.5	181.3805 mg/kg	94.9	71.0	130
EG020X-T: Vanadium	7440-62-2	1	mg/kg	<1	49.9847 mg/kg	89.6	86.0	130
EG020T: Total Metals by ICP-MS (QCLot: 5129697)								
EG020Y-T: Selenium	7782-49-2	1	mg/kg	<1	----	----	----	----
EG020Y-T: Cadmium	7440-43-9	0.1	mg/kg	<0.1	----	----	----	----
EG020Y-T: Strontium	7440-24-6	0.1	mg/kg	<0.1	63.14034 mg/kg	89.2	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 5129698)								
EG020R-T: Titanium	7440-32-6	1	mg/kg	<1	730 mg/kg	76.6	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 5129699)								

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG020T: Total Metals by ICP-MS (QCLot: 5129699) - continued								
EG020V-T: Tungsten	7440-33-7	0.1	mg/kg	<0.1	----	----	----	----
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5129702)								
EK025SF: Free Cyanide	----	1	mg/kg	<1	40 mg/kg	108	80.0	110
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 5129700)								
EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	40 mg/kg	90.6	83.0	117
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QCLot: 5129701)								
EK028SF: Weak Acid Dissociable Cyanide	----	1	mg/kg	<1	40 mg/kg	110	80.0	118
EN60Z-DI: Deionised Water Leach (Zero Headspace Extraction) (QCLot: 5136609)								
EN60Z-DIa: Final pH	----	0.1	pH Unit	6.5	----	----	----	----
EN60Z-DI: Deionised Water Leach (Zero Headspace Extraction) (QCLot: 5139525)								
EN60Z-DIa: Final pH	----	0.1	pH Unit	6.6	----	----	----	----

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG020W: Water Leachable Metals by ICP-MS (QCLot: 5141426)								
EG020B-W: Strontium	7440-24-6	0.001	mg/L	<0.001	0.1 mg/L	98.6	85.0	111
EG020B-W: Titanium	7440-32-6	0.01	mg/L	<0.01	0.1 mg/L	101	88.0	108
EG020B-W: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	98.1	70.0	130
EG020W: Water Leachable Metals by ICP-MS (QCLot: 5141427)								
EG020E-W: Tungsten	7440-33-7	0.001	mg/L	<0.001	0.1 mg/L	98.0	70.0	130
EG020W: Water Leachable Metals by ICP-MS (QCLot: 5141428)								
EG020A-W: Antimony	7440-36-0	0.001	mg/L	<0.001	0.1 mg/L	100	91.0	107
EG020A-W: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	103	86.0	111
EG020A-W: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	104	70.0	130
EG020A-W: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	102	88.0	108
EG020A-W: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	108	88.0	112
EG020A-W: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	97.5	90.0	115
EG020A-W: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	102	86.0	115
EG020A-W: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	98.4	89.0	113
EG020A-W: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	99.2	90.0	115
EG020A-W: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	101	92.0	112
EG020A-W: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	98.3	88.0	112
EG020A-W: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	96.4	80.0	117
EG020A-W: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	100	84.0	113

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG020W: Water Leachable Metals by ICP-MS (QCLot: 5141428) - continued								
EG020A-W: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	96.3	86.0	113
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5140233)								
EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	0.2 mg/L	106	80.0	120
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5140234)								
EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	0.2 mg/L	105	80.0	120
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5145184)								
EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	0.2 mg/L	110	80.0	120

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG020T: Total Metals by ICP-MS (QCLot: 5129696)							
EB2318849-002	THTSF_DEC_01_300_600	EG020X-T: Arsenic	7440-38-2	50 mg/kg	86.3	70.0	130
		EG020X-T: Chromium	7440-47-3	50 mg/kg	88.1	70.0	130
		EG020X-T: Copper	7440-50-8	250 mg/kg	88.1	70.0	130
		EG020X-T: Nickel	7440-02-0	50 mg/kg	90.3	70.0	130
		EG020X-T: Lead	7439-92-1	250 mg/kg	88.2	70.0	130
		EG020X-T: Zinc	7440-66-6	250 mg/kg	89.4	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 5129697)							
EB2318849-002	THTSF_DEC_01_300_600	EG020Y-T: Selenium	7782-49-2	50 mg/kg	73.3	70.0	130
		EG020Y-T: Cadmium	7440-43-9	50 mg/kg	86.1	70.0	130
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5129702)							
EB2318849-002	THTSF_DEC_01_300_600	EK025SF: Free Cyanide	----	40 mg/kg	108	70.0	130
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 5129700)							
EB2318849-002	THTSF_DEC_01_300_600	EK026SF: Total Cyanide	57-12-5	40 mg/kg	106	70.0	130
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QCLot: 5129701)							
EB2318849-002	THTSF_DEC_01_300_600	EK028SF: Weak Acid Dissociable Cyanide	----	40 mg/kg	105	70.0	130

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG020W: Water Leachable Metals by ICP-MS (QCLot: 5141428)							
EB2318849-002	THTSF_DEC_01_300_600	EG020A-W: Arsenic	7440-38-2	1 mg/L	104	70.0	130

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%) MS	Acceptable Limits (%) Low	High
EG020W: Water Leachable Metals by ICP-MS (QCLot: 5141428) - continued							
EB2318849-002	THTSF_DEC_01_300_600	EG020A-W: Barium	7440-39-3	1 mg/L	102	70.0	130
		EG020A-W: Cadmium	7440-43-9	0.25 mg/L	101	70.0	130
		EG020A-W: Chromium	7440-47-3	1 mg/L	101	70.0	130
		EG020A-W: Cobalt	7440-48-4	1 mg/L	98.3	70.0	130
		EG020A-W: Copper	7440-50-8	1 mg/L	104	70.0	130
		EG020A-W: Lead	7439-92-1	1 mg/L	105	70.0	130
		EG020A-W: Manganese	7439-96-5	1 mg/L	101	70.0	130
		EG020A-W: Nickel	7440-02-0	1 mg/L	99.6	70.0	130
		EG020A-W: Vanadium	7440-62-2	1 mg/L	94.7	70.0	130
		EG020A-W: Zinc	7440-66-6	1 mg/L	99.8	70.0	130
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5140233)							
ET2303262-014	Anonymous	EK025SF: Free Cyanide	----	0.2 mg/L	105	70.0	130
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5140234)							
ET2303261-018	Anonymous	EK025SF: Free Cyanide	----	0.2 mg/L	101	70.0	130
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 5145184)							
EB2319682-002	Anonymous	EK025SF: Free Cyanide	----	0.8 mg/L	118	70.0	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2318849**	Page	: 1 of 11
Client	: **ENVIRONMENTAL EARTH SCIENCES**	Laboratory	: Environmental Division Brisbane
Contact	: MS ANNA SHELDON	Telephone	: +61-7-3243 7222
Project	: 722092	Date Samples Received	: 22-Jun-2023
Site	: Tick Hill	Issue Date	: 04-Jul-2023
Sampler	: PAUL TAN	No. of samples received	: 19
Order number	: ----	No. of samples analysed	: 19

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **Duplicate outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Duplicate (DUP) RPDs							
EG020T: Total Metals by ICP-MS	EB2318849--011	THTSF_DEC_02_600_900	**Barium**	7440-39-3	20.6 %	0% - 20%	**RPD exceeds LOR based limits**
EG020T: Total Metals by ICP-MS	EB2318849--011	THTSF_DEC_02_600_900	**Chromium**	7440-47-3	26.5 %	0% - 20%	**RPD exceeds LOR based limits**

Outliers : Analysis Holding Time Compliance

Matrix: **SOIL**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EA026 : Chromium Reducible Sulfur							
Snap Lock Bag							
THTSF_DEC_01_0_300,	THTSF_DEC_01_300_600,	30-Jun-2023	23-Jun-2023	**7**	----	----	----
THTSF_DEC_01_600_900,	THTSF_DEC_01_900_1200,						
THTSF_DEC_01_1200_1500,	THTSF_DEC_01_1500_1800,						
THTSF_DEC_01_1800_2100,	THTSF_DEC_01_2100_2400,						
THTSF_DEC_02_0_300,	THTSF_DEC_02_300_600,						
THTSF_DEC_02_600_900,	THTSF_DEC_02_900_1200,						
THTSF_DEC_02_1200_1500,	THTSF_DEC_02_1500_1800,						
THTSF_DEC_02_1800_2100,	THTSF_DEC_02_2100_2400,						
THTSF_DEC_01_2400_2700,	THTSF_DEC_01_2700_3000,						
THTSF_03							

Outliers : Frequency of Quality Control Samples

Matrix: **SOIL**

Quality Control Sample Type / Method	Count: QC	Count: Regular	Rate (%): Actual	Rate (%): Expected	Quality Control Specification
	0				
Laboratory Control Samples (LCS)					
Total Metals by ICP-MS - Suite V	0	19	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
Total Metals by ICP-AES	0	19	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA002: pH 1:5 (Soils)								
Snap Lock Bag (EA002)								
THTSF_DEC_01_0_300,	THTSF_DEC_01_300_600,	**22-Jun-2023**	**28-Jun-2023**	29-Jun-2023	✓	**28-Jun-2023**	28-Jun-2023	✓
THTSF_DEC_01_600_900,	THTSF_DEC_01_900_1200,							
THTSF_DEC_01_1200_1500,	THTSF_DEC_01_1500_1800,							
THTSF_DEC_01_1800_2100,	THTSF_DEC_01_2100_2400,							
THTSF_DEC_02_0_300,	THTSF_DEC_02_300_600,							
THTSF_DEC_02_600_900,	THTSF_DEC_02_900_1200,							
THTSF_DEC_02_1200_1500,	THTSF_DEC_02_1500_1800,							
THTSF_DEC_02_1800_2100,	THTSF_DEC_02_2100_2400,							
THTSF_DEC_01_2400_2700,	THTSF_DEC_01_2700_3000,							
THTSF_03								
EA010: Conductivity (1:5)								
Snap Lock Bag (EA010)								
THTSF_DEC_01_0_300,	THTSF_DEC_01_300_600,	**22-Jun-2023**	**28-Jun-2023**	29-Jun-2023	✓	**28-Jun-2023**	26-Jul-2023	✓
THTSF_DEC_01_600_900,	THTSF_DEC_01_900_1200,							
THTSF_DEC_01_1200_1500,	THTSF_DEC_01_1500_1800,							
THTSF_DEC_01_1800_2100,	THTSF_DEC_01_2100_2400,							
THTSF_DEC_02_0_300,	THTSF_DEC_02_300_600,							
THTSF_DEC_02_600_900,	THTSF_DEC_02_900_1200,							
THTSF_DEC_02_1200_1500,	THTSF_DEC_02_1500_1800,							
THTSF_DEC_02_1800_2100,	THTSF_DEC_02_2100_2400,							
THTSF_DEC_01_2400_2700,	THTSF_DEC_01_2700_3000,							
THTSF_03								
EA026 : Chromium Reducible Sulfur								
Snap Lock Bag (EA026)								
THTSF_DEC_01_0_300,	THTSF_DEC_01_300_600,	**22-Jun-2023**	**30-Jun-2023**	23-Jun-2023	×	**30-Jun-2023**	28-Sep-2023	✓
THTSF_DEC_01_600_900,	THTSF_DEC_01_900_1200,							
THTSF_DEC_01_1200_1500,	THTSF_DEC_01_1500_1800,							
THTSF_DEC_01_1800_2100,	THTSF_DEC_01_2100_2400,							
THTSF_DEC_02_0_300,	THTSF_DEC_02_300_600,							
THTSF_DEC_02_600_900,	THTSF_DEC_02_900_1200,							
THTSF_DEC_02_1200_1500,	THTSF_DEC_02_1500_1800,							
THTSF_DEC_02_1800_2100,	THTSF_DEC_02_2100_2400,							
THTSF_DEC_01_2400_2700,	THTSF_DEC_01_2700_3000,							
THTSF_03								

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG005(ED093)T: Total Metals by ICP-AES								
Snap Lock Bag (EG005T)								
THTSF_DEC_01_0_300,	THTSF_DEC_01_300_600,	**22-Jun-2023**	**28-Jun-2023**	19-Dec-2023	✓	**30-Jun-2023**	19-Dec-2023	✓
THTSF_DEC_01_600_900,	THTSF_DEC_01_900_1200,							
THTSF_DEC_01_1200_1500,	THTSF_DEC_01_1500_1800,							
THTSF_DEC_01_1800_2100,	THTSF_DEC_01_2100_2400,							
THTSF_DEC_02_0_300,	THTSF_DEC_02_300_600,							
THTSF_DEC_02_600_900,	THTSF_DEC_02_900_1200,							
THTSF_DEC_02_1200_1500,	THTSF_DEC_02_1500_1800,							
THTSF_DEC_02_1800_2100,	THTSF_DEC_02_2100_2400,							
THTSF_DEC_01_2400_2700,	THTSF_DEC_01_2700_3000,							
THTSF_03								
EG020T: Total Metals by ICP-MS								
Snap Lock Bag (EG020Y-T)								
THTSF_DEC_01_0_300,	THTSF_DEC_01_300_600,	**22-Jun-2023**	**28-Jun-2023**	19-Dec-2023	✓	**01-Jul-2023**	19-Dec-2023	✓
THTSF_DEC_01_600_900,	THTSF_DEC_01_900_1200,							
THTSF_DEC_01_1200_1500,	THTSF_DEC_01_1500_1800,							
THTSF_DEC_01_1800_2100,	THTSF_DEC_01_2100_2400,							
THTSF_DEC_02_0_300,	THTSF_DEC_02_300_600,							
THTSF_DEC_02_600_900,	THTSF_DEC_02_900_1200,							
THTSF_DEC_02_1200_1500,	THTSF_DEC_02_1500_1800,							
THTSF_DEC_02_1800_2100,	THTSF_DEC_02_2100_2400,							
THTSF_DEC_01_2400_2700,	THTSF_DEC_01_2700_3000,							
THTSF_03								
EK025SF: Free CN by Segmented Flow Analyser								
Snap Lock Bag (EK025SF)								
THTSF_DEC_01_0_300,	THTSF_DEC_01_300_600,	**22-Jun-2023**	**28-Jun-2023**	06-Jul-2023	✓	**29-Jun-2023**	12-Jul-2023	✓
THTSF_DEC_01_600_900,	THTSF_DEC_01_900_1200,							
THTSF_DEC_01_1200_1500,	THTSF_DEC_01_1500_1800,							
THTSF_DEC_01_1800_2100,	THTSF_DEC_01_2100_2400,							
THTSF_DEC_02_0_300,	THTSF_DEC_02_300_600,							
THTSF_DEC_02_600_900,	THTSF_DEC_02_900_1200,							
THTSF_DEC_02_1200_1500,	THTSF_DEC_02_1500_1800,							
THTSF_DEC_02_1800_2100,	THTSF_DEC_02_2100_2400,							
THTSF_DEC_01_2400_2700,	THTSF_DEC_01_2700_3000,							
THTSF_03								

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK026SF: Total CN by Segmented Flow Analyser							
Snap Lock Bag (EK026SF)							
THTSF_DEC_01_0_300, THTSF_DEC_01_300_600, THTSF_DEC_01_600_900, THTSF_DEC_01_900_1200, THTSF_DEC_01_1200_1500, THTSF_DEC_01_1500_1800, THTSF_DEC_01_1800_2100, THTSF_DEC_01_2100_2400, THTSF_DEC_02_0_300, THTSF_DEC_02_300_600, THTSF_DEC_02_600_900, THTSF_DEC_02_900_1200, THTSF_DEC_02_1200_1500, THTSF_DEC_02_1500_1800, THTSF_DEC_02_1800_2100, THTSF_DEC_02_2100_2400, THTSF_DEC_01_2400_2700, THTSF_DEC_01_2700_3000, THTSF_03	**22-Jun-2023**	**28-Jun-2023**	06-Jul-2023	✓	**29-Jun-2023**	12-Jul-2023	✓
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser							
Snap Lock Bag (EK028SF)							
THTSF_DEC_01_0_300, THTSF_DEC_01_300_600, THTSF_DEC_01_600_900, THTSF_DEC_01_900_1200, THTSF_DEC_01_1200_1500, THTSF_DEC_01_1500_1800, THTSF_DEC_01_1800_2100, THTSF_DEC_01_2100_2400, THTSF_DEC_02_0_300, THTSF_DEC_02_300_600, THTSF_DEC_02_600_900, THTSF_DEC_02_900_1200, THTSF_DEC_02_1200_1500, THTSF_DEC_02_1500_1800, THTSF_DEC_02_1800_2100, THTSF_DEC_02_2100_2400, THTSF_DEC_01_2400_2700, THTSF_DEC_01_2700_3000, THTSF_03	**22-Jun-2023**	**28-Jun-2023**	06-Jul-2023	✓	**29-Jun-2023**	12-Jul-2023	✓
EN60-DI: Bottle Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)							
Non-Volatile Leach: 180 day HT (e.g. PFAS, metals ex.Hg) (EN60-DIa-G)							
THTSF_DEC_01_0_300, THTSF_DEC_01_300_600, THTSF_DEC_01_600_900, THTSF_DEC_01_900_1200, THTSF_DEC_01_1200_1500, THTSF_DEC_01_1500_1800, THTSF_DEC_01_1800_2100, THTSF_DEC_01_2100_2400, THTSF_DEC_02_0_300, THTSF_DEC_02_300_600, THTSF_DEC_02_600_900, THTSF_DEC_02_900_1200, THTSF_DEC_02_1200_1500, THTSF_DEC_02_1500_1800, THTSF_DEC_02_1800_2100, THTSF_DEC_02_2100_2400, THTSF_DEC_01_2400_2700, THTSF_DEC_01_2700_3000, THTSF_03	**22-Jun-2023**	**23-Jun-2023**	19-Dec-2023	✓	**----**	----	----

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EN60Z-DI: Deionised Water Leach (Zero Headspace Extraction)							
ZHE Leach: 14 day HT(e.g. CN, BTEX) (EN60Z-DIa) THTSF_DEC_01_0_300, THTSF_DEC_01_300_600, THTSF_DEC_01_600_900, THTSF_DEC_01_900_1200, THTSF_DEC_01_1200_1500, THTSF_DEC_01_1500_1800, THTSF_DEC_01_1800_2100, THTSF_DEC_01_2100_2400, THTSF_DEC_02_0_300, THTSF_DEC_02_300_600, THTSF_DEC_02_600_900, THTSF_DEC_02_900_1200, THTSF_DEC_02_1200_1500	22-Jun-2023	27-Jun-2023	06-Jul-2023	✓	----	----	----
ZHE Leach: 14 day HT(e.g. CN, BTEX) (EN60Z-DIa) THTSF_DEC_02_1500_1800, THTSF_DEC_02_1800_2100, THTSF_DEC_02_2100_2400, THTSF_DEC_01_2400_2700, THTSF_DEC_01_2700_3000, THTSF_03	22-Jun-2023	28-Jun-2023	06-Jul-2023	✓	----	----	----

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG020W: Water Leachable Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020E-W) THTSF_DEC_01_0_300, THTSF_DEC_01_300_600, THTSF_DEC_01_600_900, THTSF_DEC_01_900_1200, THTSF_DEC_01_1200_1500, THTSF_DEC_01_1500_1800, THTSF_DEC_01_1800_2100, THTSF_DEC_01_2100_2400, THTSF_DEC_02_0_300, THTSF_DEC_02_300_600, THTSF_DEC_02_600_900, THTSF_DEC_02_900_1200, THTSF_DEC_02_1200_1500, THTSF_DEC_02_1500_1800, THTSF_DEC_02_1800_2100, THTSF_DEC_02_2100_2400, THTSF_DEC_01_2400_2700, THTSF_DEC_01_2700_3000, THTSF_03	23-Jun-2023	29-Jun-2023	20-Dec-2023	✓	30-Jun-2023	20-Dec-2023	✓
EK025SF: Free CN by Segmented Flow Analyser							
Black Opaque Plastic Bottle - NaOH (EK025SF) THTSF_DEC_01_0_300, THTSF_DEC_01_300_600, THTSF_DEC_01_600_900, THTSF_DEC_01_900_1200, THTSF_DEC_01_1200_1500, THTSF_DEC_01_1500_1800, THTSF_DEC_01_1800_2100, THTSF_DEC_01_2100_2400, THTSF_DEC_02_0_300, THTSF_DEC_02_300_600, THTSF_DEC_02_600_900, THTSF_DEC_02_900_1200, THTSF_DEC_02_1200_1500	27-Jun-2023	----	----	----	29-Jun-2023	11-Jul-2023	✓
Black Opaque Plastic Bottle - NaOH (EK025SF) THTSF_DEC_02_1500_1800, THTSF_DEC_02_1800_2100, THTSF_DEC_01_2700_3000, THTSF_03	28-Jun-2023	----	----	----	01-Jul-2023	12-Jul-2023	✓
Black Opaque Plastic Bottle - NaOH (EK025SF) THTSF_DEC_02_2100_2400, THTSF_DEC_01_2400_2700	28-Jun-2023	----	----	----	30-Jun-2023	12-Jul-2023	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Chromium Reducible Sulphur	EA026	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free Cyanide by Segmented Flow Analyser	EK025SF	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH (1:5)	EA002	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite R	EG020R-T	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite V	EG020V-T	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite X	EG020X-T	3	19	**15.79**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite Y	EG020Y-T	3	19	**15.79**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
WAD Cyanide by Segmented Flow Analyser	EK028SF	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Chromium Reducible Sulphur	EA026	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free Cyanide by Segmented Flow Analyser	EK025SF	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH (1:5)	EA002	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite R	EG020R-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite V	EG020V-T	0	19	**0.00**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite X	EG020X-T	2	19	**10.53**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite Y	EG020Y-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
WAD Cyanide by Segmented Flow Analyser	EK028SF	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chromium Reducible Sulphur	EA026	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Deionised Water Leach - Zero Headspace Extraction	EN60Z-DIa	2	19	**10.53**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free Cyanide by Segmented Flow Analyser	EK025SF	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite R	EG020R-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite V	EG020V-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite X	EG020X-T	2	19	**10.53**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite Y	EG020Y-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
WAD Cyanide by Segmented Flow Analyser	EK028SF	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Matrix Spikes (MS) - Continued							
Free Cyanide by Segmented Flow Analyser	EK025SF	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	0	19	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite X	EG020X-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite Y	EG020Y-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
WAD Cyanide by Segmented Flow Analyser	EK028SF	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Free CN by Segmented Flow Analyser	EK025SF	6	47	**12.77**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite A	EG020A-W	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite B	EG020B-W	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite E	EG020E-W	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Free CN by Segmented Flow Analyser	EK025SF	3	47	**6.38**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite A	EG020A-W	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite B	EG020B-W	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite E	EG020E-W	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Free CN by Segmented Flow Analyser	EK025SF	3	47	**6.38**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite A	EG020A-W	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite B	EG020B-W	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite E	EG020E-W	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Free CN by Segmented Flow Analyser	EK025SF	3	47	**6.38**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICP-MS - Suite A	EG020A-W	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH (1:5)	EA002	SOIL	In house: Referenced to Rayment and Lyons 4A1 and APHA 4500H+. pH is determined on soil samples after a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
Electrical Conductivity (1:5)	EA010	SOIL	In house: Referenced to Rayment and Lyons 3A1 and APHA 2510. Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
Chromium Reducible Sulphur	EA026	SOIL	In house: Referenced to Sullivan et al (1998) The CRS method converts reduced inorganic sulfur to H2S by CrCl2 solution ; the evolved H2S is trapped in a zinc acetate solution as ZnS which is quantified by iodometric titration.
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3)
Water Leachable Metals by ICP-MS - Suite A	EG020A-W	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, AS 4439.3, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Water Leachable Metals by ICP-MS - Suite B	EG020B-W	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Water Leachable Metals by ICP-MS - Suite E	EG020E-W	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite R	EG020R-T	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020. Metals in solids are determined following an appropriate acid digestion. The ICPMS technique ionizes selected elements. Ions are passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass / charge ratios prior to measurement by a discrete dynode ion detector. This method is compliant with NEPM Schedule B(3)
Total Metals by ICP-MS - Suite V	EG020V-T	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Metals in solids are determined following an appropriate acid digestion. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite X	EG020X-T	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Analytical Methods	Method	Matrix	Method Descriptions
Total Metals by ICP-MS - Suite Y	EG020Y-T	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Free Cyanide by Segmented Flow Analyser	EK025SF	SOIL	In house: Referenced to ASTM D7237, APHA 4500-CN-C&O and ISO 14403: Using an automated segmented flow analyser, a sample at high pH (caustic leach of a soil) is buffered to pH 6.0. The hydrogen cyanide present passes across a gas dialysis membrane into an acceptor stream consisting of 0.01 M sodium hydroxide. The acceptor stream mixes with a buffer at pH 5.2 and reacts with chloramine-T to form cyanogen chloride. Cyanogen chloride reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour. This is measured at 600nm. This method is compliant with NEPM Schedule B(3).
Total Cyanide by Segmented Flow Analyser	EK026SF	SOIL	In house: Referenced to APHA 4500-CN C / ASTM D7511 / ISO 14403. Caustic leachates of soil samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM Schedule B(3).
WAD Cyanide by Segmented Flow Analyser	EK028SF	SOIL	In house: Referenced to APHA 4500-CN C&O / ISO 14403. Caustic leachates of soil samples are introduced into an automated segmented flow analyser. Hydrogen cyanide is liberated from a slightly acidified (pH 4.5) and is dialysed. Tight cyanide complexes that would not be amenable to oxidation by chlorine are not converted. Iron cyanide complexes are precipitated with zinc acetate. Liberated HCN diffuses through a membrane into a stream of sodium hydroxide where it is carried as CN- The cyanide in caustic solution is buffered to pH 5.2 and further converted to cyanogen chloride by reaction with chloramine-T. Cyanogen chloride subsequently reacts with 4-pyridine carboxylic and 1,3-dimethylbarbituric acids to give a red colour complex. This colour is measured at 600 nm. This method is compliant with NEPM Schedule B(3).

Preparation Methods	Method	Matrix	Method Descriptions
NaOH leach for CN in Soils	CN-PR	SOIL	In house: APHA 4500 CN. Samples are extracted by end-over-end tumbling with NaOH.
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house
Digestion for Total Recoverable Metals in DI Water Leachate	EN25W	SOIL	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
Deionised Water Leach - Glass Leaching Vessel	EN60-DIa-G	SOIL	In house QWI-EN/60 referenced to AS4439.3 Preparation of Leachates
Deionised Water Leach - Zero Headspace Extraction	EN60Z-DIa	SOIL	In house QWI-EN/60 referenced to AS4439.2 Preparation of Leachates

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM Schedule B(3).
Dry and Crush	EN84	SOIL	In house

CHAIN OF CUSTODY - ANALYSIS REQUEST FORM

Job No: 722092 Laboratory: ALS

Project Manager: Anna Sheldon Sampler: Paul Tan Site Location: Tick Hill **Sheet:** 1 **of** 1

No. of samples	Sample ID/ Depth	Anticipated Result (PID)/EC reading	Date sampled	Time sampled	Sample Matrix: Soil	Sample Matrix: Water	Sample Matrix: Sediment	Analysis Required: Extended metals	Metals Al, Fe	CN Free, total & WAD	pH EC 1:5	CRS - EA026						ASLP leach	CN Free (on leach)	Extended metals on leach	Sample-specific instructions/ notes
1	THTSF_DEC_01_0_300				X			X	X	X	X	X						X	X	X	
2	THTSF_DEC_01_300_600				X			X	X	X	X	X						X	X	X	
3	THTSF_DEC_01_600_900				X			X	X	X	X	X						X	X	X	
4	THTSF_DEC_01_900_1200				X			X	X	X	X	X						X	X	X	
5	THTSF_DEC_01_1200_1500				X			X	X	X	X	X						X	X	X	
6	THTSF_DEC_01_1500_1800				X			X	X	X	X	X						X	X	X	
7	THTSF_DEC_01_1800_2100				X			X	X	X	X	X						X	X	X	
8	THTSF_DEC_01_2100_2400				X			X	X	X	X	X						X	X	X	
9	THTSF_DEC_02_0_300				X			X	X	X	X	X						X	X	X	
10	THTSF_DEC_02_300_600				X			X	X	X	X	X						X	X	X	
11	THTSF_DEC_02_600_900				X			X	X	X	X	X						X	X	X	
12	THTSF_DEC_02_900_1200				X			X	X	X	X	X						X	X	X	
13	THTSF_DEC_02_1200_1500				X			X	X	X	X	X						X	X	X	
14	THTSF_DEC_02_1500_1800				X			X	X	X	X	X						X	X	X	
15	THTSF_DEC_02_1800_2100				X			X	X	X	X	X						X	X	X	
16	THTSF_DEC_02_2100_2400				X			X	X	X	X	X						X	X	X	
17	THTSF_DEC_01_2400_2700				X			X	X	X	X	X						X	X	X	
18	THTSF_DEC_01_2700_3000				X			X	X	X	X	X						X	X	X	
19	THTSF_03				X			X	X	X	X	X						X	X	X	
	TOTAL 19																				

Environmental Division Brisbane
Work Order Reference
EB2318849

Telephone : + 61-7-3243 7222

Turn Around *(circle)*: **NORMAL / 3 DAYS / 48 HRS / 24 HRS** *(confirm with lab in advance if quick turn-around is required)*

Lab Quotation No. *(if applicable)* : EB23ENVEAR0004

Comments/ Instructions: Metals suite

Sb, As, Ba, Cd, Cr, Co, Cu, Pb, Mn, Mo, Ni, Se, Sr, Ti, W, U, V, Zn

Send report to sampler *(email address)* : sweiss@eesigroup.com

Cc: report to PM/PD *(email address)* : Asheldon@eesigroup.com

Cc: invoice to *(email address)*: accounts@eesigroup.com

	Name	Signature	PD Initial	Date	Time
Sent off Site/Office by:					
Receiving Lab:	SW	SW		22/6/23	14:00
Receiving Lab:					

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED
Phone: (07) 3852 6666
PO Box: 3207, Newstead QLD 4006
Email: qldlab@eesigroup.com

SAMPLE RECEIPT INFORMATION & BOTTLE TYPE

105

WORKORDER No: EB2312849

To be completed by Sample Receipt 22/06/23 @1400

Sorting Times (Only record for BP, Mobil & URS)	Temperature Details (record if NOT on COC)	Packaging			Courier Details (Mandatory for Quarantine)	Samples checked, labelled and put in trays by:
Time Sorting Commenced:	Sample Temp 17.6 °C	Security Seal Intact? *Circle below* YES (Security seal intact) NO (Security seal broken) NA (No security seal used)	Packaging Type	No.	Con Note: TNT 156808771	Initial:
Time Placed in Fridge:	Chilling Method - Circle		Hard Esky			
Sorting to Fridge Target Time <1 Hour	Ice / Ice Bricks / No Chilling		Foam Esky		*Cells shaded grey don't need to be completed on this form if they are entered directly into LIMS/ANGEL by Sample Receipt staff.*	
			Other	1x Pallet		

Sample Receipt Advice Comments - To be completed by Sorting Staff

VOC analysis may be compromised as sample containers contained **headspace** *(list)*:

Details of any samples damaged during transit:

Other Information (eg. Were bottles received that weren't completely filled) (eg. If sample temperature is above 6'C add further detail here - *Internal use only - Not for SRN*): Brown dot

Metals Bottles: F = Field filtered. T = Total. N/S = Not Specified.
Cyanide Bottles: Tr = Treated, meaning the client has ticked the pre-treated box on the bottle. Un = Untreated, meaning the box is not ticked.
Ferrous Iron, Hexavalent Chromium & Geosmin and MIB: F = Field filtered. N/S = Not Specified.
Soil Bags: S = Small. M = Medium (~500mL asbestos or PSD bag). L = Large (~6kg FMT bag)

Lab No.	-S		-G						-O		-P				-RF				-RGF				-B		-M				-TOC		-VOC					
	Soil Jar 125mL 250mL	Bag Plastic White Green	Nat Green			Nat White 500mL	UT Nutrients		Green Vial (Geos & MIB)	Glass Orange		Glass Purp (O&G) 250ML	Plastic Purp 250mL	Plastic Grey (PFOS / PFOA) 60ml	Bacto Black / Thio Grey 250mL	-RT 60mL Nitric Red				-RGT 60mL Lab Acidified				NaOH Hexa Chrome Blue 60mL		NaOH CN Blue 60mL	0.5L Glass Brown CIRCLE Lab Preserved Or Pre-preserved	Fluoro Yellow (Sulfide) 250mL		Fluoro Orange 125mL (Sulfite)	HCl Fe^{2+} Maroon 60mL		-DOC Vial H_2SO_4 Purple 40mL		Vial H_2SO_4 Purple 40mL (VOC)	H.S Y/N	EDA Vial 40mL	Endo-Toxin Tube	DUST CuSO4 UnPres 2.5L 4L	Other
	Frozen Wet Dry		1L	500mL	250mL	1L	Light Green (T)	Turquoise (F)		100 mL	500 mL	1L	60mL	250ml	500mL	STD F	STD T	ORC F	ORC T	STD F	STD T	ORC F	ORC T	F	T			UHS F	UHS T		F	T	TOC	DOC						
	This line allows for an initial indication of bottle types received without specifying the exact number for each sample. When using this function tick the boxes matching the containers received for this work order.																																						
1																																							
2																																							
3																																							
4																																							
5																																							
6																																							
7																																							
8																																							
9																																							
10																																							

ENVIRO PREP WORK REQUEST SHEET

TO: **Prep Lab**	FROM: **Environmental**
RECEIVED: date.	BATCH NO: EB2318849
DATE SENT: click >	TYPE OF SAMPLE: Soil
DUE DATE: click >	CLIENT NAME: **ENVEAR**

☒ **WHOLE SAMPLE**	☐ **SPLIT**	☐ **URGENT**

SAMPLE RECEIPT TO SEND NO MORE THAN 250 g. PLACE EXCESS SAMPLE IN BULK.

SAMPLES	ANALYSIS
1<->19	Please dry and crush (homogenise) entire sample
	at 40°C
	Choose an item.
	Take a split to be pulped and return the remainder to SR
	for traying up.
	Do not dry at 80°C

COPY

PREP INSTRUCTIONS	
☐ SIEVES TO Choose an item.µm	Other: Click here to enter text. µm
☐ CRUSHING	
☐ PULVERISE	
☐ OTHER: Click here to enter text.	
☐ RETURN TO SR FOR FORWARDING TO: Choose an item. Click here to enter other location.	

ALL SAMPLES TO BE DRIED AT 80°C MAXIMUM

SIGNED: _____

1000953

CHAIN OF CUSTODY - ANALYSIS REQUEST FORM

Job No: 722092

Laboratory: Eurofins

Sheet: 1 of 1

Site Location: Tick Hill

Project Manager: Anna Sheldon

Sampler: AS/SW

No. of samples	Sample ID/ Depth	Anticipated Result (PID)/EC reading	Date sampled	Time sampled	Sample Matrix: Soil	Sample Matrix: Water	Sample Matrix: Sediment	Extended metals See below	CN Free, total & WAD	EES Ionic Balance	CN-Total, Free and WAD	Total Metals extended - see below	Dissolved Metals extended - see below	PFAS Extended Trace	B1 - TRH BTEXN	Sample-specific instructions/ notes
	GWSD01		12/06/2023			x				x	x	x	x	x	x	
	SD01		10/06/2023		x			x	x							
	TOTAL															

Analysis Required

14/06 2-35PM

9.6

Turn Around *(circle)*: **NORMAL / 3 DAYS / 48 HRS / 24 HRS** *(confirm with lab in advance if quick turn-around is required)*

Comments/ Instructions: Metals suite

Al, Sb, As, Ba, Cd, Cr, Co, Cu, Fe, Pb, Mn, Mo, Ni, Se, Sr, Ti, W, U, V, Zn

Lab Quotation No. *(if applicable)*:

Send report to sampler *(email address)*: sweiss@eesigroup.com

Cc: report to PM/PD *(email address)*: Asheldon@eesigroup.com

Cc: invoice to *(email address)*: accounts@eesigroup.com

	Name	Signature	PD Initial	Date	Time
Sent off Site/Office by:	A Sheldon			13/06/2023	
Receiving Lab:					
Receiving Lab:					

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Phone: (07) 3852 6666
PO Box: 3207, Newstead QLD 4006

Email: qldlab@eesigroup.com

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www.eurofins.com.au EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

Melbourne	Geelong	Sydney	Canberra	Brisbane	Newcastle
6 Monterey Road	19/8 Lewalan Street	179 Magowar Road	Unit 1,2 Dacre Street	1/21 Smallwood Place	1/2 Frost Drive
Dandenong South	Grovedale	Girraween	Mitchell	Murarrie	Mayfield West NSW 2304
VIC 3175	VIC 3216	NSW 2145	ACT 2911	QLD 4172	Tel: +61 2 4968 8448
Tel: +61 3 8564 5000	Tel: +61 3 8564 5000	Tel: +61 2 9900 8400	Tel: +61 2 6113 8091	Tel: +61 7 3902 4600	NATA# 1261
NATA# 1261 Site# 1254	NATA# 1261 Site# 25403	NATA# 1261 Site# 18217	NATA# 1261 Site# 25466	NATA# 1261 Site# 20794	Site# 25079 & 25289

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NATA# 2377 Site# 2370

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NZBN: 9429046024954

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Penrose,	Rolleston,
Auckland 1061	Christchurch 7675
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IANZ# 1327	IANZ# 1290

Sample Receipt Advice

Company name:	Environmental Earth Sciences QLD
Contact name:	Anna Sheldon
Project name:	TICK HILL
Project ID:	722092
Turnaround time:	5 Day
Date/Time received	Jun 19, 2023 2:35 PM
Eurofins reference	1000953

Sample Information

- ✓ A detailed list of analytes logged into our LIMS, is included in the attached summary table.
- ✓ All samples have been received as described on the above COC.
- ✓ COC has been completed correctly.
- ✓ Attempt to chill was evident.
- ✓ Appropriately preserved sample containers have been used.
- ✓ All samples were received in good condition.
- ✓ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.
- ✓ Appropriate sample containers have been used.
- ✓ Sample containers for volatile analysis received with zero headspace.
- ✗ Split sample sent to requested external lab.
- ✗ Some samples have been subcontracted.
- N/A Custody Seals intact (if used).

Notes

Contact

If you have any questions with respect to these samples, please contact your Analytical Services Manager:

Peter Brand on phone : 0436 360 123 or by email: PeterBrand@eurofins.com

Results will be delivered electronically via email to Anna Sheldon - asheldon@environmentalearthsciences.com.

Note: A copy of these results will also be delivered to the general Environmental Earth Sciences QLD email address.

Global Leader - Results you can trust

eurofins

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

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Christchurch
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Rolleston,
Christchurch 7675
Tel: +64 3 343 5201
IANZ# 1290

Company Name: Environmental Earth Sciences QLD
Address: Unit 3, 1 Ross Street
Newstead
QLD 4006

Project Name: TICK HILL
Project ID: 722092

Order No.:
Report #: 1000953
Phone: 07 3852 6666
Fax: 07 3852 5666

Received: Jun 19, 2023 2:35 PM
Due: Jun 26, 2023
Priority: 5 Day
Contact Name: Anna Sheldon

Eurofins Analytical Services Manager : Peter Brand

Sample Detail						Aluminium	Aluminium (filtered)	Antimony	Antimony (filtered)	Barium	Barium (filtered)	Cobalt	Cobalt (filtered)	Cyanide (free)	Cyanide (total)	Cyanide (weak acid dissoc.)	Iron	Iron (filtered)	Manganese	Manganese (filtered)	Molybdenum	Molybdenum (filtered)	Selenium	Selenium (filtered)	Strontium	Strontium (filtered)	Titanium	Titanium (filtered)	Uranium	Uranium (filtered)	Vanadium	Vanadium (filtered)	Metals M7	Metals M7 filtered	EES Ionic Balance Suite	Moisture Set	Eurofins Suite B1	Per- and Polyfluoroalkyl Substances (PFASs)
Melbourne Laboratory - NATA # 1261 Site # 1254														X	X	X																			X			
Brisbane Laboratory - NATA # 1261 Site # 20794						X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
External Laboratory																																						
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																																	
1	GWSD01	Jun 12, 2023		Water	B23-Jn0047459	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
2	SD01	Jun 10, 2023		Soil	B23-Jn0047460	X		X		X		X		X	X	X	X		X		X		X		X		X		X		X		X			X			
Test Counts						2	1	2	1	2	1	2	1	2	2	2	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	1	1	1	1

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Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 20794

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Environmental Earth Sciences QLD
Unit 3, 1 Ross Street
Newstead
QLD 4006

Attention: **Anna Sheldon**

Report **1000953-S-V2**
Project name TICK HILL
Project ID 722092
Received Date Jun 19, 2023

Client Sample ID			**SD01**
Sample Matrix			**Soil**
Eurofins Sample No.			**B23-Jn0047460**
Date Sampled			**Jun 10, 2023**
Test/Reference	LOR	Unit	
Cyanide (free)	5	mg/kg	< 5
Cyanide (total)	5	mg/kg	69
Cyanide (weak acid dissoc.)	5	mg/kg	< 5
Heavy Metals			
Aluminium	20	mg/kg	9800
Antimony	10	mg/kg	< 10
Arsenic	2	mg/kg	8.7
Barium	5	mg/kg	19
Cadmium	0.5	mg/kg	< 0.5
Chromium	5	mg/kg	28
Cobalt	5	mg/kg	36
Copper	5	mg/kg	140
Iron	20	mg/kg	25000
Lead	5	mg/kg	8.7
Manganese	5	mg/kg	150
Molybdenum	5	mg/kg	< 5
Nickel	5	mg/kg	28
Selenium	2	mg/kg	3.7
Strontium	10	mg/kg	< 10
Titanium	10	mg/kg	460
Uranium	10	mg/kg	< 10
Vanadium	10	mg/kg	47
Zinc	5	mg/kg	20
Sample Properties			
% Moisture	1	%	9.9

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Cyanide (free)	Melbourne	Jun 23, 2023	14 Days
- Method: LTM-INO-4020 Total Free WAD Cyanide by CFA			
Cyanide (total)	Melbourne	Jun 23, 2023	14 Days
- Method: LTM-INO-4020 Total Free WAD Cyanide by CFA			
Cyanide (weak acid dissoc.)	Melbourne	Jun 23, 2023	14 Days
- Method: LTM-INO-4020 Total Free WAD Cyanide by CFA			
Heavy Metals	Brisbane	Jun 26, 2023	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Metals M7	Brisbane	Jun 26, 2023	180 Days
- Method: USEPA 6010/6020 Heavy Metals			
% Moisture	Brisbane	Jun 21, 2023	14 Days
- Method: LTM-GEN-7080 Moisture			

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web: www.eurofins.com.au
email: EnviroSales@eurofins.com

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Project Name: TICK HILL
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Received: Jun 19, 2023 2:35 PM
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Priority: 5 Day
Contact Name: Anna Sheldon

Eurofins Analytical Services Manager : Peter Brand

Sample Detail						Aluminium	Aluminium (filtered)	Antimony	Antimony (filtered)	Barium	Barium (filtered)	Cobalt	Cobalt (filtered)	Cyanide (free)	Cyanide (total)	Cyanide (weak acid dissoc.)	Iron	Iron (filtered)	Manganese	Manganese (filtered)	Molybdenum	Molybdenum (filtered)	Selenium	Selenium (filtered)	Strontium	Strontium (filtered)	Titanium	Titanium (filtered)	Uranium	Uranium (filtered)	Vanadium	Vanadium (filtered)	Metals M7	Metals M7 filtered	EES Ionic Balance Suite	Moisture Set	Eurofins Suite B1	Per- and Polyfluoroalkyl Substances (PFASs)
Melbourne Laboratory - NATA # 1261 Site # 1254														X	X	X																			X			
Brisbane Laboratory - NATA # 1261 Site # 20794						X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
External Laboratory																																						
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																																	
1	GWSD01	Jun 12, 2023		Water	B23-Jn0047459	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
2	SD01	Jun 10, 2023		Soil	B23-Jn0047460	X		X		X		X		X	X	X	X		X		X		X		X		X		X		X		X			X			
Test Counts						2	1	2	1	2	1	2	1	2	2	2	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	1	1	1	1

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Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
µg/L: micrograms per litre
ppm: parts per million
ppb: parts per billion
%: Percentage
org/100 mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100 mL: Most Probable Number of organisms per 100 millilitres
CFU: Colony forming unit

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR: RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS. SVOCs recoveries 20 – 150%

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Cyanide (free)	mg/kg	< 5			5	Pass	
Cyanide (total)	mg/kg	< 5			5	Pass	
Cyanide (weak acid dissoc.)	mg/kg	< 5			5	Pass	
Method Blank							
Heavy Metals							
Aluminium	mg/kg	< 20			20	Pass	
Antimony	mg/kg	< 10			10	Pass	
Arsenic	mg/kg	< 2			2	Pass	
Barium	mg/kg	< 5			5	Pass	
Cadmium	mg/kg	< 0.5			0.5	Pass	
Chromium	mg/kg	< 5			5	Pass	
Cobalt	mg/kg	< 5			5	Pass	
Copper	mg/kg	< 5			5	Pass	
Iron	mg/kg	< 20			20	Pass	
Lead	mg/kg	< 5			5	Pass	
Manganese	mg/kg	< 5			5	Pass	
Molybdenum	mg/kg	< 5			5	Pass	
Nickel	mg/kg	< 5			5	Pass	
Selenium	mg/kg	< 2			2	Pass	
Strontium	mg/kg	< 10			10	Pass	
Titanium	mg/kg	< 10			10	Pass	
Uranium	mg/kg	< 10			10	Pass	
Vanadium	mg/kg	< 10			10	Pass	
Zinc	mg/kg	< 5			5	Pass	
LCS - % Recovery							
Cyanide (free)	%	103			70-130	Pass	
Cyanide (total)	%	112			70-130	Pass	
Cyanide (weak acid dissoc.)	%	103			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Aluminium	%	96			80-120	Pass	
Antimony	%	95			80-120	Pass	
Arsenic	%	116			80-120	Pass	
Barium	%	94			80-120	Pass	
Cadmium	%	113			80-120	Pass	
Chromium	%	113			80-120	Pass	
Cobalt	%	95			80-120	Pass	
Copper	%	111			80-120	Pass	
Iron	%	95			80-120	Pass	
Lead	%	113			80-120	Pass	
Manganese	%	94			80-120	Pass	
Molybdenum	%	95			80-120	Pass	
Nickel	%	110			80-120	Pass	
Selenium	%	93			80-120	Pass	
Strontium	%	95			80-120	Pass	
Titanium	%	92			80-120	Pass	
Uranium	%	97			80-120	Pass	
Vanadium	%	93			80-120	Pass	
Zinc	%	111			80-120	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic	B23-Jn0045178	NCP	%	78			75-125	Pass	
Cadmium	B23-Jn0045178	NCP	%	86			75-125	Pass	
Chromium	B23-Jn0045178	NCP	%	77			75-125	Pass	
Cobalt	B23-Jn0045178	NCP	%	77			75-125	Pass	
Copper	B23-Jn0045178	NCP	%	77			75-125	Pass	
Iron	B23-Jn0045178	NCP	%	109			75-125	Pass	
Lead	B23-Jn0045178	NCP	%	84			75-125	Pass	
Molybdenum	B23-Jn0045178	NCP	%	82			75-125	Pass	
Nickel	B23-Jn0045178	NCP	%	77			75-125	Pass	
Strontium	B23-Jn0045178	NCP	%	83			75-125	Pass	
Titanium	B23-Jn0047217	NCP	%	107			75-125	Pass	
Uranium	B23-Jn0045178	NCP	%	85			75-125	Pass	
Vanadium	B23-Jn0045178	NCP	%	80			75-125	Pass	
Zinc	B23-Jn0058616	NCP	%	99			75-125	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Aluminium	B23-Jn0045200	NCP	mg/kg	53000	51000	3.8	30%	Pass	
Antimony	B23-Jn0045200	NCP	mg/kg	< 10	< 10	<1	30%	Pass	
Arsenic	B23-Jn0045200	NCP	mg/kg	5.3	4.9	6.8	30%	Pass	
Barium	B23-Jn0045200	NCP	mg/kg	180	200	11	30%	Pass	
Cadmium	B23-Jn0045200	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Chromium	B23-Jn0045200	NCP	mg/kg	110	110	<1	30%	Pass	
Cobalt	B23-Jn0045200	NCP	mg/kg	48	57	16	30%	Pass	
Copper	B23-Jn0045200	NCP	mg/kg	27	28	1.1	30%	Pass	
Iron	B23-Jn0045200	NCP	mg/kg	73000	74000	1.0	30%	Pass	
Lead	B23-Jn0045200	NCP	mg/kg	5.6	5.6	<1	30%	Pass	
Manganese	B23-Jn0045200	NCP	mg/kg	2600	3200	21	30%	Pass	
Molybdenum	B23-Jn0045200	NCP	mg/kg	< 5	< 5	<1	30%	Pass	
Nickel	B23-Jn0045200	NCP	mg/kg	61	63	2.9	30%	Pass	
Selenium	B23-Jn0045200	NCP	mg/kg	< 2	< 2	<1	30%	Pass	
Strontium	B23-Jn0045200	NCP	mg/kg	63	65	2.6	30%	Pass	
Titanium	B23-Jn0045200	NCP	mg/kg	3100	2900	6.0	30%	Pass	
Uranium	B23-Jn0045200	NCP	mg/kg	< 10	< 10	<1	30%	Pass	
Vanadium	B23-Jn0045200	NCP	mg/kg	140	130	<1	30%	Pass	
Zinc	B23-Jn0045200	NCP	mg/kg	110	110	<1	30%	Pass	
Duplicate									
Sample Properties				Result 1	Result 2	RPD			
% Moisture	B23-Jn0045213	NCP	%	7.2	9.5	28	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised by:

Peter Brand	Analytical Services Manager
Mary Makarios	Senior Analyst-Inorganic
Jonathon Angell	Senior Analyst-Sample Properties
Jonathon Angell	Senior Analyst-Metal

Glenn Jackson
Managing Director

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

Eurofins shall not be liable for loss, cost, damages or expenses incurred by the client, or any other person or company, resulting from the use of any information or interpretation given in this report. In no case shall Eurofins be liable for consequential damages including, but not limited to, lost profits, damages for failure to meet deadlines and lost production arising from this report. This document shall not be reproduced except in full and relates only to the items tested. Unless indicated otherwise, the tests were performed on the samples as received.

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Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 20794

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Environmental Earth Sciences QLD
Unit 3, 1 Ross Street
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QLD 4006

Attention: **Anna Sheldon**

Report **1000953-W-V2**
Project name TICK HILL
Project ID 722092
Received Date Jun 19, 2023

Client Sample ID			**GWSD01**
Sample Matrix			**Water**
Eurofins Sample No.			**B23-Jn0047459**
Date Sampled			**Jun 12, 2023**
Test/Reference	LOR	Unit	
Total Recoverable Hydrocarbons - 1999 NEPM Fractions			
TRH C6-C9	0.02	mg/L	< 0.02
TRH C10-C14	0.05	mg/L	< 0.05
TRH C15-C28	0.1	mg/L	< 0.1
TRH C29-C36	0.1	mg/L	< 0.1
TRH C10-C36 (Total)	0.1	mg/L	< 0.1
BTEX			
Benzene	0.001	mg/L	< 0.001
Toluene	0.001	mg/L	< 0.001
Ethylbenzene	0.001	mg/L	< 0.001
m&p-Xylenes	0.002	mg/L	< 0.002
o-Xylene	0.001	mg/L	< 0.001
Xylenes - Total*	0.003	mg/L	< 0.003
4-Bromofluorobenzene (surr.)	1	%	118
Total Recoverable Hydrocarbons - 2013 NEPM Fractions			
Naphthalene[N02]	0.01	mg/L	< 0.01
TRH >C10-C16 less Naphthalene (F2)[N01]	0.05	mg/L	< 0.05
TRH C6-C10	0.02	mg/L	< 0.02
TRH C6-C10 less BTEX (F1)[N04]	0.02	mg/L	< 0.02
Total Recoverable Hydrocarbons - 2013 NEPM Fractions			
TRH >C10-C16	0.05	mg/L	< 0.05
TRH >C16-C34	0.1	mg/L	< 0.1
TRH >C34-C40	0.1	mg/L	< 0.1
TRH >C10-C40 (total)*	0.1	mg/L	< 0.1
Ammonia (as N)	0.01	mg/L	0.41
Chloride	1	mg/L	1300
Conductivity (at 25 °C)	10	uS/cm	2500
Cyanide (free)	0.005	mg/L	0.11
Cyanide (total)	0.005	mg/L	0.89
Cyanide (weak acid dissoc.)	0.005	mg/L	0.23
Fluoride	0.5	mg/L	2.2
Nitrate (as N)	0.02	mg/L	12
Nitrite (as N)	0.02	mg/L	0.75
pH (at 25 °C)	0.1	pH Units	8.7
Phosphorus reactive (as P)	0.01	mg/L	0.81

Client Sample ID			GWSD01
Sample Matrix			Water
Eurofins Sample No.			B23-Jn0047459
Date Sampled			Jun 12, 2023
Test/Reference	LOR	Unit	
Sulphate (as S)	5	mg/L	150
Total Dissolved Solids Dried at 180 °C ± 2 °C	10	mg/L	2500
Alkalinity (speciated)			
Bicarbonate Alkalinity (as CaCO3)	20	mg/L	920
Carbonate Alkalinity (as CaCO3)	10	mg/L	280
Total Alkalinity (as CaCO3)	20	mg/L	1200
Heavy Metals			
Aluminium	0.05	mg/L	24
Aluminium (filtered)	0.05	mg/L	< 0.05
Antimony	0.005	mg/L	< 0.005
Antimony (filtered)	0.005	mg/L	< 0.005
Arsenic	0.001	mg/L	0.005
Arsenic (filtered)	0.001	mg/L	0.001
Barium	0.005	mg/L	0.40
Barium (filtered)	0.005	mg/L	0.16
Cadmium	0.0002	mg/L	0.0005
Cadmium (filtered)	0.0002	mg/L	< 0.0002
Chromium	0.001	mg/L	0.057
Chromium (filtered)	0.001	mg/L	< 0.001
Cobalt	0.001	mg/L	[R05]1.0
Cobalt (filtered)	0.001	mg/L	[R05]1.1
Copper	0.001	mg/L	0.025
Copper (filtered)	0.001	mg/L	0.006
Iron	0.05	mg/L	44
Iron (filtered)	0.05	mg/L	0.22
Lead	0.001	mg/L	0.011
Lead (filtered)	0.001	mg/L	< 0.001
Manganese	0.005	mg/L	0.43
Manganese (filtered)	0.005	mg/L	0.15
Molybdenum	0.005	mg/L	< 0.005
Molybdenum (filtered)	0.005	mg/L	< 0.005
Nickel	0.001	mg/L	0.037
Nickel (filtered)	0.001	mg/L	0.005
Selenium	0.001	mg/L	[R05]0.013
Selenium (filtered)	0.001	mg/L	[R05]0.017
Strontium	0.005	mg/L	1.6
Strontium (filtered)	0.005	mg/L	1.6
Titanium	0.005	mg/L	1.9
Titanium (filtered)	0.005	mg/L	< 0.005
Uranium	0.005	mg/L	0.043
Uranium (filtered)	0.005	mg/L	0.041
Vanadium	0.005	mg/L	0.17
Vanadium (filtered)	0.005	mg/L	0.069
Zinc	0.005	mg/L	0.066
Zinc (filtered)	0.005	mg/L	< 0.005
Alkali Metals			
Calcium	0.5	mg/L	100
Magnesium	0.5	mg/L	290
Potassium	0.5	mg/L	14
Sodium	0.5	mg/L	640

Client Sample ID			GWSD01
Sample Matrix			Water
Eurofins Sample No.			B23-Jn0047459
Date Sampled			Jun 12, 2023
Test/Reference	LOR	Unit	
Perfluoroalkyl carboxylic acids (PFCAs)			
Perfluorobutanoic acid (PFBA)[N11]	0.05	ug/L	< 0.05
Perfluoropentanoic acid (PFPeA)[N11]	0.01	ug/L	< 0.01
Perfluorohexanoic acid (PFHxA)[N11]	0.01	ug/L	< 0.01
Perfluoroheptanoic acid (PFHpA)[N11]	0.01	ug/L	< 0.01
Perfluorooctanoic acid (PFOA)[N11]	0.01	ug/L	< 0.01
Perfluorononanoic acid (PFNA)[N11]	0.01	ug/L	< 0.01
Perfluorodecanoic acid (PFDA)[N11]	0.01	ug/L	< 0.01
Perfluoroundecanoic acid (PFUnDA)[N11]	0.01	ug/L	< 0.01
Perfluorododecanoic acid (PFDoDA)[N11]	0.01	ug/L	< 0.01
Perfluorotridecanoic acid (PFTrDA)[N15]	0.01	ug/L	< 0.01
Perfluorotetradecanoic acid (PFTeDA)[N11]	0.01	ug/L	< 0.01
13C4-PFBA (surr.)	1	%	83
13C5-PFPeA (surr.)	1	%	81
13C5-PFHxA (surr.)	1	%	97
13C4-PFHpA (surr.)	1	%	100
13C8-PFOA (surr.)	1	%	88
13C5-PFNA (surr.)	1	%	85
13C6-PFDA (surr.)	1	%	86
13C2-PFUnDA (surr.)	1	%	75
13C2-PFDoDA (surr.)	1	%	45
13C2-PFTeDA (surr.)	1	%	43
Perfluoroalkyl sulfonamido substances			
Perfluorooctane sulfonamide (FOSA)[N11]	0.05	ug/L	< 0.05
N-methylperfluoro-1-octane sulfonamide (N-MeFOSA)[N11]	0.05	ug/L	< 0.05
N-ethylperfluoro-1-octane sulfonamide (N-EtFOSA)[N11]	0.05	ug/L	< 0.05
2-(N-methylperfluoro-1-octane sulfonamido)-ethanol(N-MeFOSE)[N11]	0.05	ug/L	< 0.05
2-(N-ethylperfluoro-1-octane sulfonamido)-ethanol(N-EtFOSE)[N11]	0.05	ug/L	< 0.05
N-ethyl-perfluorooctanesulfonamidoacetic acid (N-EtFOSAA)[N11]	0.05	ug/L	< 0.05
N-methyl-perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)[N11]	0.05	ug/L	< 0.05
13C8-FOSA (surr.)	1	%	62
D3-N-MeFOSA (surr.)	1	%	45
D5-N-EtFOSA (surr.)	1	%	32
D7-N-MeFOSE (surr.)	1	%	41
D9-N-EtFOSE (surr.)	1	%	40
D5-N-EtFOSAA (surr.)	1	%	74
D3-N-MeFOSAA (surr.)	1	%	62
Perfluoroalkyl sulfonic acids (PFSAs)			
Perfluorobutanesulfonic acid (PFBS)[N11]	0.01	ug/L	< 0.01
Perfluorononanesulfonic acid (PFNS)[N15]	0.01	ug/L	< 0.01
Perfluoropropanesulfonic acid (PFPrS)[N15]	0.01	ug/L	< 0.01
Perfluoropentanesulfonic acid (PFPeS)[N15]	0.01	ug/L	< 0.01
Perfluorohexanesulfonic acid (PFHxS)[N11]	0.01	ug/L	< 0.01
Perfluoroheptanesulfonic acid (PFHpS)[N15]	0.01	ug/L	< 0.01
Perfluorooctanesulfonic acid (PFOS)[N11]	0.01	ug/L	< 0.01
Perfluorodecanesulfonic acid (PFDS)[N15]	0.01	ug/L	< 0.01
13C3-PFBS (surr.)	1	%	117

Client Sample ID			GWSD01
Sample Matrix			Water
Eurofins Sample No.			B23-Jn0047459
Date Sampled			Jun 12, 2023
Test/Reference	LOR	Unit	
Perfluoroalkyl sulfonic acids (PFSAs)			
18O2-PFHxS (surr.)	1	%	97
13C8-PFOS (surr.)	1	%	72
n:2 Fluorotelomer sulfonic acids (n:2 FTSAs)			
1H.1H.2H.2H-perfluorohexanesulfonic acid (4:2 FTSA)[N11]	0.01	ug/L	< 0.01
1H.1H.2H.2H-perfluorooctanesulfonic acid(6:2 FTSA)[N11]	0.05	ug/L	0.26
1H.1H.2H.2H-perfluorodecanesulfonic acid (8:2 FTSA)[N11]	0.01	ug/L	< 0.01
1H.1H.2H.2H-perfluorododecanesulfonic acid (10:2 FTSA)[N11]	0.01	ug/L	< 0.01
13C2-4:2 FTSA (surr.)	1	%	87
13C2-6:2 FTSA (surr.)	1	%	87
13C2-8:2 FTSA (surr.)	1	%	64
13C2-10:2 FTSA (surr.)	1	%	103
PFASs Summations			
Sum (PFHxS + PFOS)*	0.01	ug/L	< 0.01
Sum of US EPA PFAS (PFOS + PFOA)*	0.01	ug/L	< 0.01
Sum of enHealth PFAS (PFHxS + PFOS + PFOA)*	0.01	ug/L	< 0.01
Sum of WA DWER PFAS (n=10)*	0.05	ug/L	0.26
Sum of PFASs (n=30)*	0.1	ug/L	0.26

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Total Recoverable Hydrocarbons - 1999 NEPM Fractions	Brisbane	Jun 26, 2023	7 Days
- Method: LTM-ORG-2010 TRH C6-C40			
BTEX	Brisbane	Jun 26, 2023	14 Days
- Method: USEPA SW846 8260			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Brisbane	Jun 26, 2023	7 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Brisbane	Jun 26, 2023	7 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Ammonia (as N)	Melbourne	Jun 22, 2023	28 Days
- Method: LTM-INO-4450 Determination of Nitrogen Species by Discrete Analyser			
Chloride	Melbourne	Jun 22, 2023	28 Days
- Method: LTM-INO-4090 Chloride by Discrete Analyser			
Conductivity (at 25 °C)	Melbourne	Jun 22, 2023	28 Days
- Method: LTM-INO-4030 Conductivity			
Fluoride	Melbourne	Jun 22, 2023	28 Days
- Method: Ion selective electrode (ISE) by APHA 4500-F B, C and in-house method LTM-INO-4150			
Nitrate (as N)	Melbourne	Jun 22, 2023	28 Days
- Method: LTM-INO-4450 Determination of Nitrogen Species by Discrete Analyser			
Nitrite (as N)	Melbourne	Jun 22, 2023	2 Days
- Method: LTM-INO-4450 Determination of Nitrogen Species by Discrete Analyser			
pH (at 25 °C)	Melbourne	Jun 22, 2023	0 Hours
- Method: LTM-GEN-7090 pH in water by ISE			
Phosphorus reactive (as P)	Melbourne	Jun 22, 2023	2 Days
- Method: APHA 4500-P			
Sulphate (as S)	Melbourne	Jun 22, 2023	28 Days
- Method: LTM-INO-4110 Sulfate by Discrete Analyser			
Total Dissolved Solids Dried at 180 °C ± 2 °C	Melbourne	Jul 05, 2023	28 Days
- Method: LTM-INO-4170 Total Dissolved Solids in Water			
Alkalinity (speciated)	Melbourne	Jun 22, 2023	14 Days
- Method: LTM-INO-4250 Alkalinity by Electrometric Titration			
Alkali Metals	Melbourne	Jun 22, 2023	180 Days
- Method: LTM-MET-3010 Alkali Metals Sulfur Silicon Phosphorus by ICP-AES			
Cyanide (free)	Melbourne	Jun 22, 2023	14 Days
- Method: LTM-INO-4020 Total Free WAD Cyanide by CFA			
Cyanide (total)	Melbourne	Jun 22, 2023	14 Days
- Method: LTM-INO-4020 Total Free WAD Cyanide by CFA			
Cyanide (weak acid dissoc.)	Melbourne	Jun 22, 2023	14 Days
- Method: LTM-INO-4020 Total Free WAD Cyanide by CFA			
Heavy Metals	Brisbane	Jun 26, 2023	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Heavy Metals (filtered)	Brisbane	Jun 26, 2023	180 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Metals M7	Brisbane	Jun 21, 2023	180 Days
- Method: USEPA 6010/6020 Heavy Metals			
Metals M7 filtered	Brisbane	Jun 21, 2023	180 Days
- Method: USEPA 6010/6020 Heavy Metals			
Per- and Polyfluoroalkyl Substances (PFASs)			
Perfluoroalkyl carboxylic acids (PFCAs)	Brisbane	Jun 26, 2023	28 Days
- Method: LTM-ORG-2100 Per- and Polyfluoroalkyl Substances (PFAS)			
Perfluoroalkyl sulfonamido substances	Brisbane	Jun 26, 2023	28 Days
- Method: LTM-ORG-2100 Per- and Polyfluoroalkyl Substances (PFAS)			

Description	Testing Site	Extracted	Holding Time
Perfluoroalkyl sulfonic acids (PFSAs)	Brisbane	Jun 26, 2023	28 Days
- Method: LTM-ORG-2100 Per- and Polyfluoroalkyl Substances (PFAS)			
n:2 Fluorotelomer sulfonic acids (n:2 FTSAs)	Brisbane	Jun 26, 2023	28 Days
- Method: LTM-ORG-2100 Per- and Polyfluoroalkyl Substances (PFAS)			

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Company Name: Environmental Earth Sciences QLD
Address: Unit 3, 1 Ross Street
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Project Name: TICK HILL
Project ID: 722092

Order No.:
Report #: 1000953
Phone: 07 3852 6666
Fax: 07 3852 5666

Received: Jun 19, 2023 2:35 PM
Due: Jun 26, 2023
Priority: 5 Day
Contact Name: Anna Sheldon

Eurofins Analytical Services Manager : Peter Brand

Sample Detail						Aluminium	Aluminium (filtered)	Antimony	Antimony (filtered)	Barium	Barium (filtered)	Cobalt	Cobalt (filtered)	Cyanide (free)	Cyanide (total)	Cyanide (weak acid dissoc.)	Iron	Iron (filtered)	Manganese	Manganese (filtered)	Molybdenum	Molybdenum (filtered)	Selenium	Selenium (filtered)	Strontium	Strontium (filtered)	Titanium	Titanium (filtered)	Uranium	Uranium (filtered)	Vanadium	Vanadium (filtered)	Metals M7	Metals M7 filtered	EES Ionic Balance Suite	Moisture Set	Eurofins Suite B1	Per- and Polyfluoroalkyl Substances (PFASs)
Melbourne Laboratory - NATA # 1261 Site # 1254														X	X	X																			X			
Brisbane Laboratory - NATA # 1261 Site # 20794						X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
External Laboratory																																						
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																																	
1	GWSD01	Jun 12, 2023		Water	B23-Jn0047459	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
2	SD01	Jun 10, 2023		Soil	B23-Jn0047460	X		X		X		X		X	X	X	X		X		X		X		X		X		X		X		X			X			
Test Counts						2	1	2	1	2	1	2	1	2	2	2	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	1	1	1	1

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Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
µg/L: micrograms per litre
ppm: parts per million
ppb: parts per billion
%: Percentage
org/100 mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100 mL: Most Probable Number of organisms per 100 millilitres
CFU: Colony forming unit

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR: RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS. SVOCs recoveries 20 – 150%

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	mg/L	< 0.02			0.02	Pass	
TRH C10-C14	mg/L	< 0.05			0.05	Pass	
TRH C15-C28	mg/L	< 0.1			0.1	Pass	
TRH C29-C36	mg/L	< 0.1			0.1	Pass	
Method Blank							
BTEX							
Benzene	mg/L	< 0.001			0.001	Pass	
Toluene	mg/L	< 0.001			0.001	Pass	
Ethylbenzene	mg/L	< 0.001			0.001	Pass	
m&p-Xylenes	mg/L	< 0.002			0.002	Pass	
o-Xylene	mg/L	< 0.001			0.001	Pass	
Xylenes - Total*	mg/L	< 0.003			0.003	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/L	< 0.01			0.01	Pass	
TRH C6-C10	mg/L	< 0.02			0.02	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
TRH >C10-C16	mg/L	< 0.05			0.05	Pass	
TRH >C16-C34	mg/L	< 0.1			0.1	Pass	
TRH >C34-C40	mg/L	< 0.1			0.1	Pass	
Method Blank							
Ammonia (as N)	mg/L	< 0.01			0.01	Pass	
Chloride	mg/L	< 1			1	Pass	
Conductivity (at 25 °C)	uS/cm	< 10			10	Pass	
Fluoride	mg/L	< 0.5			0.5	Pass	
Nitrate (as N)	mg/L	< 0.02			0.02	Pass	
Nitrite (as N)	mg/L	< 0.02			0.02	Pass	
Phosphorus reactive (as P)	mg/L	< 0.01			0.01	Pass	
Sulphate (as S)	mg/L	< 5			5	Pass	
Total Dissolved Solids Dried at 180 °C ± 2 °C	mg/L	< 10			10	Pass	
Method Blank							
Alkalinity (speciated)							
Bicarbonate Alkalinity (as CaCO3)	mg/L	< 20			20	Pass	
Carbonate Alkalinity (as CaCO3)	mg/L	< 10			10	Pass	
Total Alkalinity (as CaCO3)	mg/L	< 20			20	Pass	
Method Blank							
Heavy Metals							
Aluminium	mg/L	< 0.05			0.05	Pass	
Aluminium (filtered)	mg/L	< 0.05			0.05	Pass	
Antimony	mg/L	< 0.005			0.005	Pass	
Antimony (filtered)	mg/L	< 0.005			0.005	Pass	
Arsenic	mg/L	< 0.001			0.001	Pass	
Arsenic (filtered)	mg/L	< 0.001			0.001	Pass	
Barium	mg/L	< 0.005			0.005	Pass	
Barium (filtered)	mg/L	< 0.005			0.005	Pass	
Cadmium	mg/L	< 0.0002			0.0002	Pass	
Cadmium (filtered)	mg/L	< 0.0002			0.0002	Pass	
Chromium	mg/L	< 0.001			0.001	Pass	
Chromium (filtered)	mg/L	< 0.001			0.001	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Cobalt	mg/L	< 0.001			0.001	Pass	
Cobalt (filtered)	mg/L	< 0.001			0.001	Pass	
Copper	mg/L	< 0.001			0.001	Pass	
Copper (filtered)	mg/L	< 0.001			0.001	Pass	
Iron	mg/L	< 0.05			0.05	Pass	
Iron (filtered)	mg/L	< 0.05			0.05	Pass	
Lead	mg/L	< 0.001			0.001	Pass	
Lead (filtered)	mg/L	< 0.001			0.001	Pass	
Manganese	mg/L	< 0.005			0.005	Pass	
Manganese (filtered)	mg/L	< 0.005			0.005	Pass	
Molybdenum	mg/L	< 0.005			0.005	Pass	
Molybdenum (filtered)	mg/L	< 0.005			0.005	Pass	
Nickel	mg/L	< 0.001			0.001	Pass	
Nickel (filtered)	mg/L	< 0.001			0.001	Pass	
Selenium	mg/L	< 0.001			0.001	Pass	
Selenium (filtered)	mg/L	< 0.001			0.001	Pass	
Strontium	mg/L	< 0.005			0.005	Pass	
Strontium (filtered)	mg/L	< 0.005			0.005	Pass	
Titanium	mg/L	< 0.005			0.005	Pass	
Titanium (filtered)	mg/L	< 0.005			0.005	Pass	
Uranium	mg/L	< 0.005			0.005	Pass	
Uranium (filtered)	mg/L	< 0.005			0.005	Pass	
Vanadium	mg/L	< 0.005			0.005	Pass	
Vanadium (filtered)	mg/L	< 0.005			0.005	Pass	
Zinc	mg/L	< 0.005			0.005	Pass	
Zinc (filtered)	mg/L	< 0.005			0.005	Pass	
Method Blank							
Alkali Metals							
Calcium	mg/L	< 0.5			0.5	Pass	
Magnesium	mg/L	< 0.5			0.5	Pass	
Potassium	mg/L	< 0.5			0.5	Pass	
Sodium	mg/L	< 0.5			0.5	Pass	
Method Blank							
Perfluoroalkyl carboxylic acids (PFCAs)							
Perfluorobutanoic acid (PFBA)	ug/L	< 0.05			0.05	Pass	
Perfluoropentanoic acid (PFPeA)	ug/L	< 0.01			0.01	Pass	
Perfluorohexanoic acid (PFHxA)	ug/L	< 0.01			0.01	Pass	
Perfluoroheptanoic acid (PFHpA)	ug/L	< 0.01			0.01	Pass	
Perfluorooctanoic acid (PFOA)	ug/L	< 0.01			0.01	Pass	
Perfluorononanoic acid (PFNA)	ug/L	< 0.01			0.01	Pass	
Perfluorodecanoic acid (PFDA)	ug/L	< 0.01			0.01	Pass	
Perfluoroundecanoic acid (PFUnDA)	ug/L	< 0.01			0.01	Pass	
Perfluorododecanoic acid (PFDoDA)	ug/L	< 0.01			0.01	Pass	
Perfluorotridecanoic acid (PFTrDA)	ug/L	< 0.01			0.01	Pass	
Perfluorotetradecanoic acid (PFTeDA)	ug/L	< 0.01			0.01	Pass	
Method Blank							
Perfluoroalkyl sulfonamido substances							
Perfluorooctane sulfonamide (FOSA)	ug/L	< 0.05			0.05	Pass	
N-methylperfluoro-1-octane sulfonamide (N-MeFOSA)	ug/L	< 0.05			0.05	Pass	
N-ethylperfluoro-1-octane sulfonamide (N-EtFOSA)	ug/L	< 0.05			0.05	Pass	
2-(N-methylperfluoro-1-octane sulfonamido)-ethanol(N-MeFOSE)	ug/L	< 0.05			0.05	Pass	
2-(N-ethylperfluoro-1-octane sulfonamido)-ethanol(N-EtFOSE)	ug/L	< 0.05			0.05	Pass	
N-ethyl-perfluorooctanesulfonamidoacetic acid (N-EtFOSAA)	ug/L	< 0.05			0.05	Pass	
N-methyl-perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)	ug/L	< 0.05			0.05	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Perfluoroalkyl sulfonic acids (PFSAs)							
Perfluorobutanesulfonic acid (PFBS)	ug/L	< 0.01			0.01	Pass	
Perfluorononanesulfonic acid (PFNS)	ug/L	< 0.01			0.01	Pass	
Perfluoropropanesulfonic acid (PFPrS)	ug/L	< 0.01			0.01	Pass	
Perfluoropentanesulfonic acid (PFPeS)	ug/L	< 0.01			0.01	Pass	
Perfluorohexanesulfonic acid (PFHxS)	ug/L	< 0.01			0.01	Pass	
Perfluoroheptanesulfonic acid (PFHpS)	ug/L	< 0.01			0.01	Pass	
Perfluorooctanesulfonic acid (PFOS)	ug/L	< 0.01			0.01	Pass	
Perfluorodecanesulfonic acid (PFDS)	ug/L	< 0.01			0.01	Pass	
Method Blank							
n:2 Fluorotelomer sulfonic acids (n:2 FTSAs)							
1H.1H.2H.2H-perfluorohexanesulfonic acid (4:2 FTSA)	ug/L	< 0.01			0.01	Pass	
1H.1H.2H.2H-perfluorooctanesulfonic acid(6:2 FTSA)	ug/L	< 0.05			0.05	Pass	
1H.1H.2H.2H-perfluorodecanesulfonic acid (8:2 FTSA)	ug/L	< 0.01			0.01	Pass	
1H.1H.2H.2H-perfluorododecanesulfonic acid (10:2 FTSA)	ug/L	< 0.01			0.01	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	%	116			70-130	Pass	
TRH C10-C14	%	78			70-130	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	100			70-130	Pass	
Toluene	%	127			70-130	Pass	
Ethylbenzene	%	129			70-130	Pass	
m&p-Xylenes	%	128			70-130	Pass	
Xylenes - Total*	%	126			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
TRH C6-C10	%	115			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
TRH >C10-C16	%	78			70-130	Pass	
LCS - % Recovery							
Ammonia (as N)	%	128			70-130	Pass	
Chloride	%	126			70-130	Pass	
Conductivity (at 25 °C)	%	100			70-130	Pass	
Fluoride	%	96			70-130	Pass	
Nitrite (as N)	%	89			70-130	Pass	
Phosphorus reactive (as P)	%	109			70-130	Pass	
Sulphate (as S)	%	101			70-130	Pass	
Total Dissolved Solids Dried at 180 °C ± 2 °C	%	115			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Aluminium	%	103			80-120	Pass	
Aluminium (filtered)	%	103			80-120	Pass	
Antimony	%	98			80-120	Pass	
Arsenic	%	95			80-120	Pass	
Arsenic (filtered)	%	95			80-120	Pass	
Barium	%	93			80-120	Pass	
Cadmium	%	94			80-120	Pass	
Cadmium (filtered)	%	94			80-120	Pass	
Chromium	%	99			80-120	Pass	
Chromium (filtered)	%	99			80-120	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Cobalt	%	99			80-120	Pass	
Cobalt (filtered)	%	99			80-120	Pass	
Copper	%	98			80-120	Pass	
Copper (filtered)	%	98			80-120	Pass	
Iron	%	107			80-120	Pass	
Iron (filtered)	%	107			80-120	Pass	
Lead	%	105			80-120	Pass	
Lead (filtered)	%	105			80-120	Pass	
Manganese	%	98			80-120	Pass	
Manganese (filtered)	%	98			80-120	Pass	
Molybdenum	%	96			80-120	Pass	
Molybdenum (filtered)	%	96			80-120	Pass	
Nickel	%	100			80-120	Pass	
Nickel (filtered)	%	100			80-120	Pass	
Selenium	%	101			80-120	Pass	
Selenium (filtered)	%	101			80-120	Pass	
Strontium	%	96			80-120	Pass	
Strontium (filtered)	%	96			80-120	Pass	
Titanium	%	100			80-120	Pass	
Titanium (filtered)	%	100			80-120	Pass	
Uranium	%	111			80-120	Pass	
Uranium (filtered)	%	111			80-120	Pass	
Vanadium	%	101			80-120	Pass	
Zinc	%	99			80-120	Pass	
Zinc (filtered)	%	99			80-120	Pass	
LCS - % Recovery							
Alkali Metals							
Calcium	%	96			80-120	Pass	
Magnesium	%	104			80-120	Pass	
Potassium	%	94			80-120	Pass	
Sodium	%	95			80-120	Pass	
LCS - % Recovery							
Perfluoroalkyl carboxylic acids (PFCAs)							
Perfluorobutanoic acid (PFBA)	%	75			50-150	Pass	
Perfluoropentanoic acid (PFPeA)	%	80			50-150	Pass	
Perfluorohexanoic acid (PFHxA)	%	81			50-150	Pass	
Perfluoroheptanoic acid (PFHpA)	%	82			50-150	Pass	
Perfluorooctanoic acid (PFOA)	%	89			50-150	Pass	
Perfluorononanoic acid (PFNA)	%	85			50-150	Pass	
Perfluorodecanoic acid (PFDA)	%	70			50-150	Pass	
Perfluoroundecanoic acid (PFUnDA)	%	65			50-150	Pass	
Perfluorododecanoic acid (PFDoDA)	%	79			50-150	Pass	
Perfluorotridecanoic acid (PFTrDA)	%	99			50-150	Pass	
Perfluorotetradecanoic acid (PFTeDA)	%	74			50-150	Pass	
LCS - % Recovery							
Perfluoroalkyl sulfonamido substances							
Perfluorooctane sulfonamide (FOSA)	%	72			50-150	Pass	
N-methylperfluoro-1-octane sulfonamide (N-MeFOSA)	%	72			50-150	Pass	
N-ethylperfluoro-1-octane sulfonamide (N-EtFOSA)	%	87			50-150	Pass	
2-(N-methylperfluoro-1-octane sulfonamido)-ethanol(N-MeFOSE)	%	84			50-150	Pass	
2-(N-ethylperfluoro-1-octane sulfonamido)-ethanol(N-EtFOSE)	%	62			50-150	Pass	
N-ethyl-perfluorooctanesulfonamidoacetic acid (N-EtFOSAA)	%	90			50-150	Pass	
N-methyl-perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)	%	90			50-150	Pass	
LCS - % Recovery							

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Perfluoroalkyl sulfonic acids (PFSAs)									
Perfluorobutanesulfonic acid (PFBS)			%	74			50-150	Pass	
Perfluorononanesulfonic acid (PFNS)			%	79			50-150	Pass	
Perfluoropropanesulfonic acid (PFPrS)			%	55			50-150	Pass	
Perfluoropentanesulfonic acid (PFPeS)			%	107			50-150	Pass	
Perfluorohexanesulfonic acid (PFHxS)			%	81			50-150	Pass	
Perfluoroheptanesulfonic acid (PFHpS)			%	84			50-150	Pass	
Perfluorooctanesulfonic acid (PFOS)			%	100			50-150	Pass	
Perfluorodecanesulfonic acid (PFDS)			%	63			50-150	Pass	
LCS - % Recovery									
n:2 Fluorotelomer sulfonic acids (n:2 FTSAs)									
1H.1H.2H.2H-perfluorohexanesulfonic acid (4:2 FTSA)			%	97			50-150	Pass	
1H.1H.2H.2H-perfluorooctanesulfonic acid(6:2 FTSA)			%	82			50-150	Pass	
1H.1H.2H.2H-perfluorodecanesulfonic acid (8:2 FTSA)			%	97			50-150	Pass	
1H.1H.2H.2H-perfluorododecanesulfonic acid (10:2 FTSA)			%	63			50-150	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C6-C9	B23-Jn0064374	NCP	%	104			70-130	Pass	
TRH C10-C14	B23-Jn0058539	NCP	%	128			70-130	Pass	
Spike - % Recovery									
BTEX				Result 1					
Benzene	B23-Jn0064374	NCP	%	93			70-130	Pass	
Toluene	B23-Jn0064374	NCP	%	128			70-130	Pass	
Ethylbenzene	B23-Jn0064374	NCP	%	126			70-130	Pass	
m&p-Xylenes	B23-Jn0064374	NCP	%	105			70-130	Pass	
o-Xylene	B23-Jn0064374	NCP	%	102			70-130	Pass	
Xylenes - Total*	B23-Jn0064374	NCP	%	104			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
TRH C6-C10	B23-Jn0064374	NCP	%	107			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
TRH >C10-C16	B23-Jn0058539	NCP	%	127			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Aluminium	B23-Jn0042806	NCP	%	106			75-125	Pass	
Aluminium (filtered)	B23-Jn0048062	NCP	%	110			75-125	Pass	
Antimony (filtered)	B23-Jn0047507	NCP	%	94			75-125	Pass	
Arsenic	B23-Jn0042806	NCP	%	104			75-125	Pass	
Arsenic (filtered)	B23-Jn0047507	NCP	%	93			75-125	Pass	
Barium (filtered)	B23-Jn0048062	NCP	%	123			75-125	Pass	
Cadmium	B23-Jn0042806	NCP	%	102			75-125	Pass	
Cadmium (filtered)	B23-Jn0048062	NCP	%	106			75-125	Pass	
Chromium	B23-Jn0042806	NCP	%	98			75-125	Pass	
Chromium (filtered)	B23-Jn0048062	NCP	%	85			75-125	Pass	
Cobalt	B23-Jn0042806	NCP	%	97			75-125	Pass	
Cobalt (filtered)	B23-Jn0048062	NCP	%	75			75-125	Pass	
Copper	B23-Jn0042806	NCP	%	95			75-125	Pass	
Iron	B23-Jn0042806	NCP	%	105			75-125	Pass	
Iron (filtered)	B23-Jn0048062	NCP	%	91			75-125	Pass	
Lead	B23-Jn0042806	NCP	%	101			75-125	Pass	
Manganese	B23-Jn0042806	NCP	%	99			75-125	Pass	
Manganese (filtered)	B23-Jn0048062	NCP	%	92			75-125	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Molybdenum (filtered)	B23-Jn0048062	NCP	%	121			75-125	Pass	
Nickel	B23-Jn0042806	NCP	%	98			75-125	Pass	
Selenium (filtered)	B23-Jn0048062	NCP	%	82			75-125	Pass	
Strontium	B23-Jn0042806	NCP	%	107			75-125	Pass	
Strontium (filtered)	B23-Jn0047507	NCP	%	99			75-125	Pass	
Titanium (filtered)	B23-Jn0048062	NCP	%	105			75-125	Pass	
Uranium	B23-Jn0042806	NCP	%	106			75-125	Pass	
Uranium (filtered)	B23-Jn0048062	NCP	%	79			75-125	Pass	
Vanadium (filtered)	B23-Jn0048062	NCP	%	94			75-125	Pass	
Zinc	B23-Jn0042806	NCP	%	101			75-125	Pass	
Spike - % Recovery									
Alkali Metals				Result 1					
Calcium	M23-Jn0049736	NCP	%	95			75-125	Pass	
Magnesium	M23-Jn0049736	NCP	%	101			75-125	Pass	
Potassium	M23-Jn0049736	NCP	%	94			75-125	Pass	
Sodium	M23-Jn0049736	NCP	%	95			75-125	Pass	
Spike - % Recovery									
Perfluoroalkyl carboxylic acids (PFCAs)				Result 1					
Perfluorobutanoic acid (PFBA)	B23-Jn0047459	CP	%	61			50-150	Pass	
Perfluoropentanoic acid (PFPeA)	B23-Jn0047459	CP	%	69			50-150	Pass	
Perfluorohexanoic acid (PFHxA)	B23-Jn0047459	CP	%	68			50-150	Pass	
Perfluoroheptanoic acid (PFHpA)	B23-Jn0047459	CP	%	68			50-150	Pass	
Perfluorooctanoic acid (PFOA)	B23-Jn0047459	CP	%	96			50-150	Pass	
Perfluorononanoic acid (PFNA)	B23-Jn0047459	CP	%	79			50-150	Pass	
Perfluorodecanoic acid (PFDA)	B23-Jn0047459	CP	%	65			50-150	Pass	
Perfluoroundecanoic acid (PFUnDA)	B23-Jn0047459	CP	%	59			50-150	Pass	
Perfluorododecanoic acid (PFDoDA)	B23-Jn0047459	CP	%	80			50-150	Pass	
Perfluorotridecanoic acid (PFTrDA)	B23-Jn0047459	CP	%	79			50-150	Pass	
Perfluorotetradecanoic acid (PFTeDA)	B23-Jn0047459	CP	%	67			50-150	Pass	
Spike - % Recovery									
Perfluoroalkyl sulfonamido substances				Result 1					
Perfluorooctane sulfonamide (FOSA)	B23-Jn0047459	CP	%	90			50-150	Pass	
N-methylperfluoro-1-octane sulfonamide (N-MeFOSA)	B23-Jn0047459	CP	%	84			50-150	Pass	
N-ethylperfluoro-1-octane sulfonamide (N-EtFOSA)	B23-Jn0047459	CP	%	101			50-150	Pass	
2-(N-methylperfluoro-1-octane sulfonamido)-ethanol(N-MeFOSE)	B23-Jn0047459	CP	%	76			50-150	Pass	
2-(N-ethylperfluoro-1-octane sulfonamido)-ethanol(N-EtFOSE)	B23-Jn0047459	CP	%	59			50-150	Pass	
N-ethyl-perfluorooctanesulfonamidoacetic acid (N-EtFOSAA)	B23-Jn0047459	CP	%	82			50-150	Pass	
N-methyl-perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)	B23-Jn0047459	CP	%	88			50-150	Pass	
Spike - % Recovery									
Perfluoroalkyl sulfonic acids (PFSAs)				Result 1					
Perfluorobutanesulfonic acid (PFBS)	B23-Jn0047459	CP	%	101			50-150	Pass	
Perfluorononanesulfonic acid (PFNS)	B23-Jn0047459	CP	%	61			50-150	Pass	
Perfluoropropanesulfonic acid (PFPrS)	B23-Jn0047459	CP	%	51			50-150	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Perfluoropentanesulfonic acid (PFPeS)	B23-Jn0047459	CP	%	112			50-150	Pass	
Perfluorohexanesulfonic acid (PFHxS)	B23-Jn0047459	CP	%	69			50-150	Pass	
Perfluoroheptanesulfonic acid (PFHpS)	B23-Jn0047459	CP	%	73			50-150	Pass	
Perfluorooctanesulfonic acid (PFOS)	B23-Jn0047459	CP	%	78			50-150	Pass	
Perfluorodecanesulfonic acid (PFDS)	B23-Jn0047459	CP	%	58			50-150	Pass	
Spike - % Recovery									
n:2 Fluorotelomer sulfonic acids (n:2 FTSAs)				Result 1					
1H.1H.2H.2H-perfluorohexanesulfonic acid (4:2 FTSA)	B23-Jn0047459	CP	%	74			50-150	Pass	
1H.1H.2H.2H-perfluorooctanesulfonic acid(6:2 FTSA)	B23-Jn0047459	CP	%	107			50-150	Pass	
1H.1H.2H.2H-perfluorodecanesulfonic acid (8:2 FTSA)	B23-Jn0047459	CP	%	89			50-150	Pass	
1H.1H.2H.2H-perfluorododecanesulfonic acid (10:2 FTSA)	B23-Jn0047459	CP	%	75			50-150	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	B23-Jn0048894	NCP	mg/L	0.28	0.30	9.6	30%	Pass	
TRH C10-C14	B23-Jn0047459	CP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
TRH C15-C28	B23-Jn0047459	CP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
TRH C29-C36	B23-Jn0047459	CP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	B23-Jn0048894	NCP	mg/L	0.009	0.008	1.4	30%	Pass	
Toluene	B23-Jn0048894	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Ethylbenzene	B23-Jn0048894	NCP	mg/L	< 0.001	0.001	12	30%	Pass	
m&p-Xylenes	B23-Jn0048894	NCP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
o-Xylene	B23-Jn0048894	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Xylenes - Total*	B23-Jn0048894	NCP	mg/L	< 0.003	< 0.003	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	B23-Jn0048894	NCP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
TRH C6-C10	B23-Jn0048894	NCP	mg/L	0.28	0.31	9.8	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
TRH >C10-C16	B23-Jn0047459	CP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
TRH >C16-C34	B23-Jn0047459	CP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
TRH >C34-C40	B23-Jn0047459	CP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Ammonia (as N)	M23-Jn0047060	NCP	mg/L	0.02	0.05	100	30%	Fail	Q15
Chloride	M23-Jn0049860	NCP	mg/L	17	17	<1	30%	Pass	
Conductivity (at 25 °C)	M23-Jn0055699	NCP	uS/cm	190	190	1.6	30%	Pass	
Cyanide (total)	M23-Jn0057635	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Fluoride	N23-Jn0032556	NCP	mg/L	5.1	5.6	8.0	30%	Pass	
Nitrate (as N)	M23-Jn0041610	NCP	mg/L	1.1	1.1	1.2	30%	Pass	
Nitrite (as N)	M23-Jn0041610	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	Q15
pH (at 25 °C)	M23-Jn0052031	NCP	pH Units	7.6	7.6	pass	30%	Pass	

Duplicate									
				Result 1	Result 2	RPD			
Sulphate (as S)	M23-Jn0049860	NCP	mg/L	< 5	< 5	<1	30%	Pass	
Total Dissolved Solids Dried at 180 °C ± 2 °C	M23-Jn0054410	NCP	mg/L	200	180	6.3	30%	Pass	
Duplicate									
Alkalinity (speciated)				Result 1	Result 2	RPD			
Bicarbonate Alkalinity (as CaCO3)	M23-Jn0055699	NCP	mg/L	55	65	16	30%	Pass	
Carbonate Alkalinity (as CaCO3)	M23-Jn0055699	NCP	mg/L	< 10	< 10	<1	30%	Pass	
Total Alkalinity (as CaCO3)	M23-Jn0055699	NCP	mg/L	55	65	16	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Aluminium	B23-Jn0048062	NCP	mg/L	0.06	0.06	6.3	30%	Pass	
Aluminium (filtered)	B23-Jn0048061	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Arsenic (filtered)	B23-Jn0048061	NCP	mg/L	0.001	< 0.001	2.9	30%	Pass	
Barium (filtered)	B23-Jn0048061	NCP	mg/L	0.016	0.018	10	30%	Pass	
Cadmium (filtered)	B23-Jn0048061	NCP	mg/L	< 0.0002	< 0.0002	<1	30%	Pass	
Chromium (filtered)	B23-Jn0047506	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Cobalt (filtered)	B23-Jn0048061	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Copper (filtered)	B23-Jn0048061	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Iron	B23-Jn0048062	NCP	mg/L	0.07	0.07	1.2	30%	Pass	
Iron (filtered)	B23-Jn0048061	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Lead (filtered)	B23-Jn0047506	NCP	mg/L	0.006	0.006	<1	30%	Pass	
Manganese (filtered)	B23-Jn0048061	NCP	mg/L	0.024	0.024	<1	30%	Pass	
Molybdenum (filtered)	B23-Jn0048061	NCP	mg/L	0.011	0.011	1.7	30%	Pass	
Nickel (filtered)	B23-Jn0047506	NCP	mg/L	0.023	0.023	<1	30%	Pass	
Selenium (filtered)	B23-Jn0048061	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Strontium (filtered)	B23-Jn0047506	NCP	mg/L	0.027	0.028	4.9	30%	Pass	
Uranium (filtered)	B23-Jn0048061	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Vanadium (filtered)	B23-Jn0048061	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Zinc (filtered)	B23-Jn0047506	NCP	mg/L	0.13	0.13	<1	30%	Pass	
Duplicate									
Alkali Metals				Result 1	Result 2	RPD			
Calcium	M23-Jn0049736	NCP	mg/L	110	110	<1	30%	Pass	
Magnesium	M23-Jn0049736	NCP	mg/L	110	110	<1	30%	Pass	
Potassium	M23-Jn0049736	NCP	mg/L	7.1	7.1	<1	30%	Pass	
Sodium	M23-Jn0049736	NCP	mg/L	310	310	<1	30%	Pass	
Duplicate									
Perfluoroalkyl carboxylic acids (PFCAs)				Result 1	Result 2	RPD			
Perfluorobutanoic acid (PFBA)	S23-Jn0040484	NCP	ug/L	2.5	2.6	2.0	30%	Pass	
Perfluoropentanoic acid (PFPeA)	B23-Jn0047480	NCP	ug/L	0.04	0.05	24	30%	Pass	
Perfluorohexanoic acid (PFHxA)	S23-Jn0040484	NCP	ug/L	0.83	0.80	3.1	30%	Pass	
Perfluoroheptanoic acid (PFHpA)	S23-Jn0040484	NCP	ug/L	0.11	0.11	2.4	30%	Pass	
Perfluorooctanoic acid (PFOA)	S23-Jn0040484	NCP	ug/L	0.53	0.50	5.6	30%	Pass	
Perfluorononanoic acid (PFNA)	S23-Jn0040484	NCP	ug/L	< 0.1	< 0.1	<1	30%	Pass	
Perfluorodecanoic acid (PFDA)	S23-Jn0040484	NCP	ug/L	< 0.1	< 0.1	<1	30%	Pass	
Perfluoroundecanoic acid (PFUnDA)	S23-Jn0040484	NCP	ug/L	< 0.1	< 0.1	<1	30%	Pass	
Perfluorododecanoic acid (PFDoDA)	S23-Jn0040484	NCP	ug/L	< 0.1	< 0.1	<1	30%	Pass	
Perfluorotridecanoic acid (PFTrDA)	S23-Jn0040484	NCP	ug/L	< 0.1	< 0.1	<1	30%	Pass	
Perfluorotetradecanoic acid (PFTeDA)	S23-Jn0040484	NCP	ug/L	< 0.1	< 0.1	<1	30%	Pass	

Duplicate									
Perfluoroalkyl sulfonamido substances				Result 1	Result 2	RPD			
Perfluorooctane sulfonamide (FOSA)	S23-Jn0040484	NCP	ug/L	< 0.5	< 0.5	<1	30%	Pass	
N-methylperfluoro-1-octane sulfonamide (N-MeFOSA)	S23-Jn0040484	NCP	ug/L	< 0.5	< 0.5	<1	30%	Pass	
N-ethylperfluoro-1-octane sulfonamide (N-EtFOSA)	S23-Jn0040484	NCP	ug/L	< 0.5	< 0.5	<1	30%	Pass	
2-(N-methylperfluoro-1-octane sulfonamido)-ethanol(N-MeFOSE)	S23-Jn0040484	NCP	ug/L	< 0.5	< 0.5	<1	30%	Pass	
2-(N-ethylperfluoro-1-octane sulfonamido)-ethanol(N-EtFOSE)	S23-Jn0040484	NCP	ug/L	< 0.5	< 0.5	<1	30%	Pass	
N-ethyl-perfluorooctanesulfonamidoacetic acid (N-EtFOSAA)	S23-Jn0040484	NCP	ug/L	< 0.5	< 0.5	<1	30%	Pass	
N-methyl-perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)	S23-Jn0040484	NCP	ug/L	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
Perfluoroalkyl sulfonic acids (PFSAs)				Result 1	Result 2	RPD			
Perfluorobutanesulfonic acid (PFBS)	S23-Jn0040484	NCP	ug/L	0.79	0.82	4.6	30%	Pass	
Perfluorononanesulfonic acid (PFNS)	B23-Jn0047480	NCP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluoropropanesulfonic acid (PFPrS)	B23-Jn0047480	NCP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluoropentanesulfonic acid (PFPeS)	S23-Jn0040484	NCP	ug/L	< 0.1	< 0.1	<1	30%	Pass	
Perfluorohexanesulfonic acid (PFHxS)	S23-Jn0040484	NCP	ug/L	4.1	4.5	9.2	30%	Pass	
Perfluoroheptanesulfonic acid (PFHpS)	S23-Jn0040484	NCP	ug/L	< 0.1	< 0.1	<1	30%	Pass	
Perfluorooctanesulfonic acid (PFOS)	S23-Jn0040484	NCP	ug/L	1.8	2.1	14	30%	Pass	
Perfluorodecanesulfonic acid (PFDS)	B23-Jn0047480	NCP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Duplicate									
n:2 Fluorotelomer sulfonic acids (n:2 FTSAs)				Result 1	Result 2	RPD			
1H.1H.2H.2H-perfluorohexanesulfonic acid (4:2 FTSA)	S23-Jn0040484	NCP	ug/L	< 0.1	< 0.1	<1	30%	Pass	
1H.1H.2H.2H-perfluorooctanesulfonic acid(6:2 FTSA)	B23-Jn0047480	NCP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
1H.1H.2H.2H-perfluorodecanesulfonic acid (8:2 FTSA)	S23-Jn0040484	NCP	ug/L	< 0.1	< 0.1	<1	30%	Pass	
1H.1H.2H.2H-perfluorododecanesulfonic acid (10:2 FTSA)	S23-Jn0040484	NCP	ug/L	< 0.1	< 0.1	<1	30%	Pass	

Comments

V2 issued to include repeat results for TDS

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N11	Isotope dilution is used for calibration of each native compound for which an exact labelled analogue is available (Isotope Dilution Quantitation). The isotopically labelled analogues allow identification and recovery correction of the concentration of the associated native PFAS compounds.
N15	Where the native PFAS compound does not have labelled analogue then the quantification is made using the Extracted Internal Standard Analyte with the closest retention time to the analyte and no recovery correction has been made (Internal Standard Quantitation).
Q15	The RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.
R05	Theoretically the total result should be greater or equal to the dissolved concentration. However the difference reported is within the uncertainty of the individual tests

Authorised by:

Peter Brand	Analytical Services Manager
Angelique Lang-Frey	Senior Analyst-Metal
Caitlin Breeze	Senior Analyst-Inorganic
Emily Rosenberg	Senior Analyst-Metal
Jonathon Angell	Senior Analyst-Organic
Jonathon Angell	Senior Analyst-PFAS
Jonathon Angell	Senior Analyst-Volatile
Mary Makarios	Senior Analyst-Inorganic

Glenn Jackson
Managing Director

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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CHAIN OF CUSTODY - ANALYSIS REQUEST FORM

Job No: 722092 Laboratory: SAL

Project Manager: Anna Sheldon Sampler: AS/SW Site Location: Tick Hill **Sheet:** 1 **of** 1

No. of samples	Sample ID/ Depth	Anticipated Result (PID)/EC reading	Date sampled	Time sampled	Sample Matrix: Soil	Sample Matrix: Water	Sample Matrix: Sediment	Analysis Required: pH EC	CEC	Total Fe	Extended metals - see below	TOC									Sample-specific instructions/ notes
	THS14 0-0.1		11/06/2023		x			x	x	x	x	x									
	THGW08		9/06/2023		x			x	x	x	x										
	THGW09		9/06/2023		x			x	x	x											
	TOTAL																				

Turn Around *(circle):* **NORMAL / 3 DAYS / 48 HRS / 24 HRS** *(confirm with lab in advance if quick turn-around is required)*

Lab Quotation No. *(if applicable)* :

Comments/ Instructions: Metals suite

Al Sb, As, Ba, Cd, Cr, Co, Cu, Pb, Mn, Mo, Ni, Se, Sr, Ti, W, U, V, Zn

Send report to sampler *(email address)* : sweiss@eesigroup.com

Cc: report to PM/PD *(email address)* : Asheldon@eesigroup.com

Cc: invoice to *(email address)*: accounts@eesigroup.com

	Name	Signature	PD Initial	Date	Time
Sent off Site/Office by:	A Sheldon			15/06/2023	1300
Receiving Lab:					
Receiving Lab:					

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED
Phone: (07) 3852 6666
PO Box: 3207, Newstead QLD 4006
Email: qldlab@eesigroup.com

SYDNEY ANALYTICAL LABORATORIES

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ERMINGTON NSW 2115

Laboratory:
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SEVEN HILLS NSW 2147
Telephone: (02) 9838 8903
Fax: (02) 9838 8919
A.C.N. 003 614 695
A.B.N. 81 829 182 852
NATA No: 1884

ANALYTICAL REPORT for:

ENVIRONMENTAL & EARTH SCIENCES

PO BOX 380
NORTH SYDNEY 2059

ATTN: SAM WEISS

JOB NO: SAL28618

CLIENT ORDER: 722092

DATE RECEIVED: 19/06/23

DATE COMPLETED: 05/07/23

TYPE OF SAMPLES: SOILS

NO OF SAMPLES: 3

NATA Accredited for compliance with ISO/IEC 17025 Testing

.....
Issued on 05/07/23
Lance Smith
(Chief Chemist)

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL28618
CLIENT ORDER: 722092

	SAMPLES	pH 1:5	COND. uS/cm	TOC %	CEC MEQ%	Ex.Na MEQ%	Ex.K MEQ%
1	THS14_0-0.1	7.9	180	<0.1	16.3	0.05	1.30
2	THGW08	9.0	90		3.2	0.15	0.21
3	THGW09	8.7	90		7.6	0.15	0.04
MDL		0.1	5	0.1	0.1	0.01	0.01
Method Code		WA1	WA2	C48	S7	S7	S7
Preparation		P3	P3	P3	P3	P3	P3

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL28618
CLIENT ORDER: 722092

	SAMPLES	Ex.Ca MEQ%	Ex.Mg MEQ%	Ex.Mn MEQ%	Ex.Al MEQ%	Sol.Na MEQ%	Sol.K MEQ%
1	THS14_0-0.1	12.9	3.40	<0.01	<0.1	0.01	0.20
2	THGW08	2.50	0.54	<0.01	<0.1	0.23	0.02
3	THGW09	6.3	1.60	<0.01	<0.1	0.06	0.01
MDL		0.01	0.01	0.01	0.1	0.01	0.01
Method Code		S7	S7	S7	S7	S7	S7
Preparation		P3	P3	P3	P3	P3	P3

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL28618
CLIENT ORDER: 722092

	SAMPLES	Sol.Ca MEQ%	Sol.Mg MEQ%	Sol.Mn MEQ%	Sol.Al MEQ%	Al %	Sb mg/kg
1	THS14_0-0.1	0.32	0.41	<0.01	<0.01	1.4	<0.5
2	THGW08	0.15	0.22	<0.01	<0.01	1.5	<0.5
3	THGW09	0.19	0.21	<0.01	<0.01		
	AGAL-10					1.0	7.0
MDL		0.01	0.01	0.01	0.01	0.01	0.5
Method Code		S7	S7	S7	S7	M4	M7
Preparation		P3	P3	P3	P3	P3	P3

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL28618
CLIENT ORDER: 722092

	SAMPLES	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Co mg/kg	Cu mg/kg
1	THS14_0-0.1	4.0	83	<0.5	18	6.0	15
2	THGW08	3.5	64	<0.5	14	7.5	3.5
	AGAL-10	16	23	8.5	69	9.0	22
MDL		0.5	1	0.5	0.5	0.5	0.5
Method Code		M7	M4	M1	M1	M1	M1
Preparation		P3	P3	P3	P3	P3	P3

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL28618
CLIENT ORDER: 722092

	SAMPLES	Pb mg/kg	Mn mg/kg	Mo mg/kg	Ni mg/kg	Se mg/kg	Sr mg/kg
1	THS14_0-0.1	7.5	195	1.0	6.5	<0.5	15
2	THGW08	5.5	210	<0.5	6.5	<0.5	12
	AGAL-10	38	230	7.5	16	8.5	
MDL		0.5	0.5	0.5	0.5	0.5	0.5
Method Code		M1	M1	M4	M1	M7	M9
Preparation		P3	P3	P3	P3	P3	P3

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL28618
CLIENT ORDER: 722092

	SAMPLES	Ti mg/kg	V mg/kg	Zn mg/kg	Tot.Fe %
1	THS14_0-0.1	<10	20	23	3.0
2	THGW08	<10	23	10	2.7
3	THGW09				2.0
	AGAL-10		21	61	2.1
MDL		10	1	0.5	0.01
Method Code		M4	M4	M1	M1
Preparation		P3	P3	P3	P3

RESULTS ON DRY BASIS
SITE: TICK HILL
DATE OF COLLECTION: 09/06/23 - 11/06/23

SYDNEY ANALYTICAL LABORATORIES

CERTIFIED REFERENCE MATERIAL

JOB NO: SAL28618
CLIENT ORDER: 722092

CRM Number	Analyte	Units	CRM Result	Certified Value	%Recovery	Acceptance Criteria %
AGAL-10	Aluminium	%	1.0	0.93	108	80-120
AGAL-10	Antimony	mg/kg	7.0	7.3	96	70-110
AGAL-10	Arsenic	mg/kg	16	17.2	93	80-125
AGAL-10	Barium	mg/kg	23	28.4	81	80-120
AGAL-10	Cadmium	mg/kg	8.5	9.3	91	80-120
AGAL-10	Chromium	mg/kg	69	82.0	84	80-120
AGAL-10	Cobalt	mg/kg	9.0	9.2	98	80-120
AGAL-10	Copper	mg/kg	22	23.2	95	85-115
AGAL-10	Lead	mg/kg	38	40.4	94	85-115
AGAL-10	Manganese	mg/kg	230	241	95	85-110
AGAL-10	Molybdenum	mg/kg	7.5	8.6	87	70-130
AGAL-10	Nickel	mg/kg	16	17.8	90	80-125
AGAL-10	Selenium	mg/kg	8.5	11.0	77	70-130
AGAL-10	Vanadium	mg/kg	21	25.3	83	70-130
AGAL-10	Zinc	mg/kg	61	57.0	107	85-115
AGAL-10	Total Fe	%	2.1		-	-

All results are within the acceptance criteria

Note: The hot acid digest does not always determine 'total' metals. Refractory elements such as Iron and Aluminium and some base metals (particularly Chromium) show lower recoveries depending on their form within the sample matrix. Silicates and oxides are normally less soluble than elements in metallic or salt forms. The acceptance criteria for this reference material is based on histories of analyte recoveries using the nitric acid based digestion procedures.

ANALYTICAL REPORT

JOB NO: SAL28618
CLIENT ORDER: 722092

METHODS OF PREPARATION AND ANALYSIS

The tests contained in this report have been carried out on the samples as received by the laboratory. In the case where an analyte or group of analytes are received outside of recommended holding times, the analysis will proceed and the report annotated. Analysis is carried out within analyte holding times where possible.

P3	Sample dried, jaw crushed and sieved at 1mm
WA1	pH - In House Method A8.40 (1:5 soil/water extract) Determined by APHA 4500B
WA2	Conductivity-In House Method A8.25 (1:5 soil/water extract) Determined by APHA 2510B
C48	Total Organic Carbon - AS1289.4.1.1
S7	Cation Exchange Capacity & Exchangeable/Soluble Cations Determined by Silver Thiourea Method CEC-1
M4	Refractory Element - Digestion Method 3050 (HNO_3/H_2O_2) Element determined by APHA 3111D (Flame AAS)
M7	Hydride Element - Digestion Method 7061 (HNO_3/H_2SO_4) Element determined by APHA 3114B (Hydride Generation AAS)
M1	Base Metal - Digestion Method 3050 (HNO_3/H_2O_2) Element determined by APHA 3111B (Flame AAS)
M9	Alkali Metal - Digestion Method 3050 (HNO_3/H_2O_2) Element determined by APHA 3500B/3111B (Flame AAS)

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ET2206834**	Page	: 1 of 8
Client	: **ENVIRONMENTAL EARTH SCIENCES**	Laboratory	: Environmental Division Townsville
Contact	: MS ANNA SHELDON	Contact	: David Wall
Address	: 2 BYTH STREET BRISBANE QLD 4053	Address	: 13 Carlton Street, Kirwan Townsville QLD Australia 4815
Telephone	: 07 3852 6666	Telephone	: +61 7 4773 0000
Project	: 722092	Date Samples Received	: 23-Dec-2022 08:35
Order number	: ----	Date Analysis Commenced	: 23-Dec-2022
C-O-C number	: ----	Issue Date	: 09-Jan-2023 15:06
Sampler	: A.S		
Site	: Tick Hill		
Quote number	: EN/010/21		
No. of samples received	: 10		
No. of samples analysed	: 10		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe		Townsville Inorganics, Townsville, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD
Narelle Drummond	Laboratory Manager	Townsville Inorganics, Townsville, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- As per QWI – EN55-3 Data Interpreting Procedures, Ionic balances are typically calculated using Major Anions - Chloride, Alkalinity and Sulfate; and Major Cations - Calcium, Magnesium, Potassium and Sodium. Where applicable and dependent upon sample matrix, the Ionic Balance may also include the additional contribution of Ammonia, Dissolved Metals by ICPMS and H+ to the Cations and Nitrate, SiO2 and Fluoride to the Anions.
- It has been noted that EK025SF (Free Cyanide by SFA) is greater than EK028SF (WAD Cyanide by SFA) for some samples, however this difference is within the limits of experimental variation.
- EK058G, EA005-P, EA015H, ED037-P, ED041G, ED045G, EK040P, EK055G, EK057G, EK059G, EK071G conducted by ALS Townsville, NATA accreditation no. 825, (Site no. 23472 for Chemical Testing and Site no. 23313 for Biological Testing)
- All remaining analysis will be conducted by ALS Environmental, Brisbane, NATA accreditation no. 825, Site No. 818.
- It is recognised that EG020T (Total Metals by ICP-MS) is less than EG020F (Dissolved Metals by ICP-MS) for some samples. However, the difference is within experimental variation of the methods.
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	THGW01	THGW02	THGW03	THGW04	THGW05
			Sampling date / time	20-Dec-2022 00:00	20-Dec-2022 00:00	20-Dec-2022 00:00	19-Dec-2022 00:00	20-Dec-2022 00:00
Compound	CAS Number	LOR	Unit	ET2206834-001	ET2206834-002	ET2206834-003	ET2206834-004	ET2206834-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.79	7.81	7.58	8.04	7.60
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	2090	421	1170	1720	1030
ED037P: Alkalinity by PC Titrator								
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	742	257	673	1170	897
Total Alkalinity as CaCO3	----	1	mg/L	742	257	673	1170	897
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	142	22	49	80	27
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	589	54	296	96	82
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	71	21	54	5	30
Magnesium	7439-95-4	1	mg/L	152	26	89	21	65
Sodium	7440-23-5	1	mg/L	419	88	304	653	332
Potassium	7440-09-7	1	mg/L	8	5	4	5	5
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony	7440-36-0	0.001	mg/L	<0.001	0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	0.001	<0.001	0.004	<0.001
Barium	7440-39-3	0.001	mg/L	0.144	0.020	0.192	0.050	0.110
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	0.603	<0.001	0.015	<0.001	0.003
Copper	7440-50-8	0.001	mg/L	0.002	0.004	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	0.002	0.005	<0.001	0.002	0.007
Molybdenum	7439-98-7	0.001	mg/L	0.002	0.001	0.002	0.006	0.002
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	0.02	<0.01
Strontium	7440-24-6	0.001	mg/L	0.728	0.190	0.387	0.132	0.247
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	7440-61-1	0.001	mg/L	0.029	0.006	0.022	0.050	0.026
Vanadium	7440-62-2	0.01	mg/L	0.08	0.02	0.04	0.34	0.07
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	THGW01	THGW02	THGW03	THGW04	THGW05
			Sampling date / time	20-Dec-2022 00:00	20-Dec-2022 00:00	20-Dec-2022 00:00	19-Dec-2022 00:00	20-Dec-2022 00:00
Compound	CAS Number	LOR	Unit	ET2206834-001	ET2206834-002	ET2206834-003	ET2206834-004	ET2206834-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Iron	7439-89-6	0.05	mg/L	**0.08**	<0.05	<0.05	<0.05	<0.05
Tungsten	7440-33-7	0.001	mg/L	**0.002**	<0.001	<0.001	<0.001	<0.001
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.06**	**0.05**	**0.02**	**0.96**	**0.02**
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	**0.002**	**0.002**	<0.001	**0.004**	<0.001
Barium	7440-39-3	0.001	mg/L	**0.183**	**0.034**	**0.236**	**0.086**	**0.145**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	**0.003**	<0.001
Cobalt	7440-48-4	0.001	mg/L	**0.721**	<0.001	**0.023**	<0.001	**0.004**
Copper	7440-50-8	0.001	mg/L	**0.003**	**0.008**	<0.001	**0.001**	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	**0.001**	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	**0.002**	**0.039**	**0.004**	**0.014**	**0.010**
Molybdenum	7439-98-7	0.001	mg/L	**0.001**	<0.001	**0.002**	**0.006**	**0.002**
Nickel	7440-02-0	0.001	mg/L	**0.002**	<0.001	<0.001	**0.001**	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	**0.02**	<0.01
Strontium	7440-24-6	0.001	mg/L	**0.848**	**0.236**	**0.417**	**0.148**	**0.262**
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	<0.01	**0.24**	<0.01
Uranium	7440-61-1	0.001	mg/L	**0.037**	**0.006**	**0.032**	**0.072**	**0.036**
Vanadium	7440-62-2	0.01	mg/L	**0.12**	**0.03**	**0.07**	**0.44**	**0.10**
Zinc	7440-66-6	0.005	mg/L	**0.007**	**0.006**	<0.005	**0.006**	<0.005
Iron	7439-89-6	0.05	mg/L	**0.18**	**0.08**	<0.05	**1.09**	<0.05
Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	0.002	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.002	mg/L	**0.446**	<0.002	**0.023**	<0.002	**0.003**
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	0.002	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**2.4**	**0.8**	**2.6**	**5.4**	**3.3**
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.02**	**1.27**	**0.09**	**0.23**	**0.23**
EK057G: Nitrite as N by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	THGW01	THGW02	THGW03	THGW04	THGW05
			Sampling date / time	20-Dec-2022 00:00	20-Dec-2022 00:00	20-Dec-2022 00:00	19-Dec-2022 00:00	20-Dec-2022 00:00
Compound	CAS Number	LOR	Unit	ET2206834-001	ET2206834-002	ET2206834-003	ET2206834-004	ET2206834-005
				Result	Result	Result	Result	Result
EK057G: Nitrite as N by Discrete Analyser - Continued								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	0.03
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	10.1	0.77	3.40	23.2	2.49
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.02	0.77	0.01	0.08	<0.01
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	34.4	7.12	22.8	27.8	20.8
ø Total Cations	----	0.01	meq/L	34.5	7.14	23.3	30.5	21.4
ø Ionic Balance	----	0.01	%	0.12	0.19	1.14	4.74	1.46
ED009: Anions								
Bromide	24959-67-9	0.02	mg/L	1.96	0.24	1.11	0.61	0.44

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	THGW06	PIT	Mine Shaft	TSF	BD01
			Sampling date / time	19-Dec-2022 00:00	19-Dec-2022 00:00	20-Dec-2022 00:00	20-Dec-2022 00:00	20-Dec-2022 00:00
Compound	CAS Number	LOR	Unit	ET2206834-006	ET2206834-007	ET2206834-008	ET2206834-009	ET2206834-010
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.67	8.68	8.87	8.66	7.77
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	1020	3550	1290	5510	1060
ED037P: Alkalinity by PC Titrator								
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	918	319	337	237	871
Total Alkalinity as CaCO3	----	1	mg/L	918	374	400	283	871
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	30	496	118	879	27
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	60	1650	471	2250	83
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	24	56	7	107	30
Magnesium	7439-95-4	1	mg/L	67	230	85	276	65
Sodium	7440-23-5	1	mg/L	316	979	348	1390	335
Potassium	7440-09-7	1	mg/L	4	24	15	34	5
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	0.005	<0.001	0.116	<0.001
Barium	7440-39-3	0.001	mg/L	0.114	0.107	0.003	0.152	0.108
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	0.001	0.007	0.032	0.009	0.003
Copper	7440-50-8	0.001	mg/L	<0.001	0.004	<0.001	0.022	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	0.005	<0.001	0.002	0.147	0.007
Molybdenum	7439-98-7	0.001	mg/L	0.002	0.034	0.002	0.059	0.003
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	0.002	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	0.05	<0.01	0.04	<0.01
Strontium	7440-24-6	0.001	mg/L	0.332	0.769	0.048	0.519	0.246
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	7440-61-1	0.001	mg/L	0.021	0.069	0.018	0.022	0.027
Vanadium	7440-62-2	0.01	mg/L	0.14	0.02	<0.01	0.01	0.07
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	THGW06	PIT	Mine Shaft	TSF	BD01
			Sampling date / time	19-Dec-2022 00:00	19-Dec-2022 00:00	20-Dec-2022 00:00	20-Dec-2022 00:00	20-Dec-2022 00:00
Compound	CAS Number	LOR	Unit	ET2206834-006	ET2206834-007	ET2206834-008	ET2206834-009	ET2206834-010
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Tungsten	7440-33-7	0.001	mg/L	<0.001	**0.001**	<0.001	<0.001	<0.001
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.22**	**0.03**	<0.01	**0.27**	**0.02**
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	**0.001**	**0.006**	<0.001	**0.124**	<0.001
Barium	7440-39-3	0.001	mg/L	**0.158**	**0.129**	**0.006**	**0.177**	**0.149**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	**0.002**	**0.010**	**0.057**	**0.011**	**0.004**
Copper	7440-50-8	0.001	mg/L	<0.001	**0.007**	<0.001	**0.036**	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	**0.008**	**0.006**	**0.020**	**0.208**	**0.010**
Molybdenum	7439-98-7	0.001	mg/L	**0.002**	**0.038**	**0.002**	**0.066**	**0.002**
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	**0.002**	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	**0.05**	<0.01	**0.04**	<0.01
Strontium	7440-24-6	0.001	mg/L	**0.359**	**0.868**	**0.076**	**0.564**	**0.271**
Titanium	7440-32-6	0.01	mg/L	**0.01**	<0.01	<0.01	<0.01	<0.01
Uranium	7440-61-1	0.001	mg/L	**0.029**	**0.087**	**0.023**	**0.025**	**0.037**
Vanadium	7440-62-2	0.01	mg/L	**0.20**	**0.04**	<0.01	**0.02**	**0.10**
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.011**	<0.005	**0.016**	<0.005
Iron	7439-89-6	0.05	mg/L	**0.17**	**0.10**	**0.33**	**0.21**	<0.05
Tungsten	7440-33-7	0.001	mg/L	<0.001	**0.002**	<0.001	<0.001	<0.001
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	0.002	mg/L	<0.002	<0.002	<0.002	**0.023**	<0.002
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.002	mg/L	<0.002	<0.002	**0.033**	**0.028**	**0.004**
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	0.002	mg/L	<0.002	<0.002	<0.002	**0.022**	<0.002
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**3.8**	**2.6**	**1.4**	**2.0**	**3.6**
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.17**	**0.12**	**0.12**	**0.24**	**0.02**
EK057G: Nitrite as N by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	THGW06	PIT	Mine Shaft	TSF	BD01
			Sampling date / time	19-Dec-2022 00:00	19-Dec-2022 00:00	20-Dec-2022 00:00	20-Dec-2022 00:00	20-Dec-2022 00:00
Compound	CAS Number	LOR	Unit	ET2206834-006	ET2206834-007	ET2206834-008	ET2206834-009	ET2206834-010
				Result	Result	Result	Result	Result
EK057G: Nitrite as N by Discrete Analyser - Continued								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.01	<0.01	<0.01	0.03
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	3.69	0.52	0.01	<0.01	2.40
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.02	<0.01	<0.01	0.02	<0.01
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	20.6	64.3	23.7	87.4	20.3
ø Total Cations	----	0.01	meq/L	20.6	64.9	22.9	89.4	21.5
ø Ionic Balance	----	0.01	%	0.24	0.45	1.86	1.11	2.96
ED009: Anions								
Bromide	24959-67-9	0.02	mg/L	0.33	6.15	1.61	7.95	0.44

Inter-Laboratory Testing

Analysis conducted by ALS Brisbane, NATA accreditation no. 825, site no. 818 (Chemistry) 18958 (Biology).

(WATER) ED093F: Dissolved Major Cations

(WATER) EN055: Ionic Balance

(WATER) EG020F: Dissolved Metals by ICP-MS

(WATER) EG020T: Total Metals by ICP-MS

(WATER) ED009: Anions

(WATER) EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser

(WATER) EK025SF: Free CN by Segmented Flow Analyser

(WATER) EK026SF: Total CN by Segmented Flow Analyser

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **ET2206834**	Page	: 1 of 9
Client	: **ENVIRONMENTAL EARTH SCIENCES**	Laboratory	: Environmental Division Townsville
Contact	: MS ANNA SHELDON	Contact	: David Wall
Address	: 2 BYTH STREET BRISBANE QLD 4053	Address	: 13 Carlton Street, Kirwan Townsville QLD Australia 4815
Telephone	: 07 3852 6666	Telephone	: +61 7 4773 0000
Project	: 722092	Date Samples Received	: 23-Dec-2022
Order number	: ----	Date Analysis Commenced	: 23-Dec-2022
C-O-C number	: ----	Issue Date	: 09-Jan-2023
Sampler	: A.S		
Site	: Tick Hill		
Quote number	: EN/010/21		
No. of samples received	: 10		
No. of samples analysed	: 10		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe		Townsville Inorganics, Townsville, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD
Narelle Drummond	Laboratory Manager	Townsville Inorganics, Townsville, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
ED009: Anions (QC Lot: 4796970)									
ET2206834-001	THGW01	ED009: Bromide	24959-67-9	0.02	mg/L	1.96	2.00	2.0	No Limit
EA005P: pH by PC Titrator (QC Lot: 4790620)									
ET2206834-001	THGW01	EA005-P: pH Value	----	0.01	pH Unit	7.79	7.79	0.0	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 4790710)									
ET2205692-005	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	224	210	6.5	0% - 20%
ET2206834-001	THGW01	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	2090	1790	15.5	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 4790621)									
ET2206834-001	THGW01	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	742	709	4.6	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	742	709	4.6	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 4790637)									
ET2206695-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1770	1740	1.4	0% - 20%
ET2206810-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	2810	2850	1.4	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 4790640)									
ET2206834-008	Mine Shaft	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	118	120	1.8	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 4790638)									
ET2206810-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	130	130	0.0	0% - 20%
ET2206834-007	PIT	ED045G: Chloride	16887-00-6	1	mg/L	1650	1670	1.1	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 4800904)									
ET2206834-005	THGW05	ED093F: Calcium	7440-70-2	1	mg/L	30	29	3.7	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	65	64	0.0	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	332	329	0.8	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	5	5	0.0	No Limit
EB2238323-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	3	3	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
ED093F: Dissolved Major Cations (QC Lot: 4800904) - continued									
EB2238323-001	Anonymous	ED093F: Magnesium	7439-95-4	1	mg/L	<1	<1	0.0	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	425	421	0.9	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	1	1	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 4800901)									
ET2206834-005	THGW05	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.110	0.104	5.5	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.003	0.003	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.007	0.007	0.0	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	0.07	0.06	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.0	No Limit
EB2238323-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.076	0.076	0.0	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.010	0.010	0.0	0% - 50%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.003	0.003	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.008	0.007	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 4800902)									
ET2206834-005	THGW05	EG020B-F: Strontium	7440-24-6	0.001	mg/L	0.247	0.246	0.0	0% - 20%
		EG020B-F: Uranium	7440-61-1	0.001	mg/L	0.026	0.026	0.0	0% - 20%
		EG020B-F: Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG020F: Dissolved Metals by ICP-MS (QC Lot: 4800902) - continued									
EB2238323-001	Anonymous	EG020B-F: Strontium	7440-24-6	0.001	mg/L	0.076	0.077	2.0	0% - 20%
		EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-F: Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 4800905)									
ET2206834-005	THGW05	EG020E-F: Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 4801065)									
ET2206834-003	THGW03	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	0.001	0.0	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.236	0.232	1.9	0% - 20%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	0.023	0.022	5.8	0% - 20%
		EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.004	0.003	0.0	No Limit
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.02	0.03	49.9	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	0.07	0.07	0.0	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.0	No Limit
ET2206834-007	PIT	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	0.006	0.006	0.0	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.129	0.132	2.5	0% - 20%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	0.010	0.010	0.0	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.007	0.007	0.0	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.006	0.006	0.0	No Limit
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	0.038	0.040	5.1	0% - 20%
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.011	0.011	0.0	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.03	0.03	0.0	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	0.05	0.05	0.0	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	0.04	0.04	0.0	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	0.10	0.10	0.0	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 4801067)									
ET2206834-003	THGW03	EG020B-T: Strontium	7440-24-6	0.001	mg/L	0.417	0.404	3.1	0% - 20%

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG020T: Total Metals by ICP-MS (QC Lot: 4801067) - continued									
ET2206834-003	THGW03	EG020B-T: Uranium	7440-61-1	0.001	mg/L	0.032	0.031	3.6	0% - 20%
		EG020B-T: Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	0.0	No Limit
ET2206834-007	PIT	EG020B-T: Strontium	7440-24-6	0.001	mg/L	0.868	0.888	2.3	0% - 20%
		EG020B-T: Uranium	7440-61-1	0.001	mg/L	0.087	0.088	0.0	0% - 20%
		EG020B-T: Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 4801069)									
ET2206834-003	THGW03	EG020E-T: Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
EK025SF: Free CN by Segmented Flow Analyser (QC Lot: 4796598)									
ET2206834-006	THGW06	EK025SF: Free Cyanide	----	0.004	mg/L	<0.002	<0.002	0.0	No Limit
ET2206834-001	THGW01	EK025SF: Free Cyanide	----	0.004	mg/L	<0.002	<0.002	0.0	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 4796597)									
ET2206834-006	THGW06	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.002	<0.002	0.0	No Limit
ET2206834-001	THGW01	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	0.446	0.418	6.5	0% - 20%
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QC Lot: 4796599)									
ET2206834-006	THGW06	EK028SF: Weak Acid Dissociable Cyanide	----	0.004	mg/L	<0.002	<0.002	0.0	No Limit
ET2206834-001	THGW01	EK028SF: Weak Acid Dissociable Cyanide	----	0.004	mg/L	<0.002	<0.002	0.0	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 4790619)									
ET2206834-001	THGW01	EK040P: Fluoride	16984-48-8	0.1	mg/L	2.4	2.6	11.6	0% - 20%
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 4790948)									
ET2206818-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	1.19	1.17	1.7	0% - 20%
ET2206834-008	Mine Shaft	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.12	0.12	0.0	0% - 50%
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 4790636)									
ET2205123-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	1.55	1.34	14.9	0% - 20%
ET2206834-001	THGW01	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 4790639)									
ET2206834-001	THGW01	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.02	0.01	0.0	No Limit

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
ED009: Anions (QCLot: 4796970)								
ED009: Bromide	24959-67-9	0.02	mg/L	<0.02	2 mg/L	99.2	77.0	117
EA005P: pH by PC Titrator (QCLot: 4790620)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	101	98.0	102
				----	7 pH Unit	99.7	98.0	102
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 4790710)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	98.3	88.0	112
				<10	2000 mg/L	100	88.0	112
ED037P: Alkalinity by PC Titrator (QCLot: 4790621)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	110	90.0	110
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 4790637)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	100 mg/L	93.1	85.0	115
				<1	25 mg/L	101	85.0	115
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 4790640)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	100 mg/L	91.8	85.0	115
				<1	25 mg/L	103	85.0	115
ED045G: Chloride by Discrete Analyser (QCLot: 4790638)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	1000 mg/L	100	85.0	115
				<1	10 mg/L	103	85.0	115
ED093F: Dissolved Major Cations (QCLot: 4800904)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	110	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	100	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	98.9	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	98.2	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 4800901)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	99.3	79.0	118
EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	0.1 mg/L	101	87.0	113
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	99.9	88.0	116
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	100	70.0	130
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	101	88.0	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	105	87.0	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	98.7	86.0	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	99.0	88.0	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	98.7	89.0	110

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
				Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 4800901) - continued								
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	100	89.0	120
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	98.6	89.0	112
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	97.6	89.0	113
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	98.8	83.0	112
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	101	88.0	114
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	99.7	87.0	113
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	101	82.0	114
EG020F: Dissolved Metals by ICP-MS (QCLot: 4800902)								
EG020B-F: Strontium	7440-24-6	0.001	mg/L	<0.001	0.1 mg/L	98.3	86.0	111
EG020B-F: Titanium	7440-32-6	0.01	mg/L	<0.01	0.1 mg/L	98.4	89.0	111
EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	89.8	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 4800905)								
EG020E-F: Tungsten	7440-33-7	0.001	mg/L	<0.001	0.1 mg/L	102	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 4801065)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	105	80.0	114
EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	0.1 mg/L	105	87.0	115
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	105	88.0	112
EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	105	70.0	130
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	102	88.0	111
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	104	89.0	115
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	104	89.0	115
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	102	88.0	116
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	106	89.0	112
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	102	88.0	114
EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	107	90.0	114
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	101	88.0	116
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	102	79.0	111
EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	105	87.0	114
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	102	84.0	114
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	105	82.0	118
EG020T: Total Metals by ICP-MS (QCLot: 4801067)								
EG020B-T: Strontium	7440-24-6	0.001	mg/L	<0.001	0.1 mg/L	105	86.0	112
EG020B-T: Titanium	7440-32-6	0.01	mg/L	<0.01	0.1 mg/L	107	88.0	112
EG020B-T: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	115	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 4801069)								
EG020E-T: Tungsten	7440-33-7	0.001	mg/L	<0.001	0.1 mg/L	112	70.0	130
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 4796598)								
EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	0.2 mg/L	109	80.0	120

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 4796597)								
EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	0.2 mg/L	100	85.0	119
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QCLot: 4796599)								
EK028SF: Weak Acid Dissociable Cyanide	----	0.004	mg/L	<0.004	0.2 mg/L	109	83.0	120
EK040P: Fluoride by PC Titrator (QCLot: 4790619)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	103	90.0	110
EK055G: Ammonia as N by Discrete Analyser (QCLot: 4790948)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	117	80.0	120
EK057G: Nitrite as N by Discrete Analyser (QCLot: 4790636)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	99.4	80.0	120
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 4790639)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	98.6	85.0	115

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Acceptable Limits (%): Low	Acceptable Limits (%): High
ED009: Anions (QCLot: 4796970)							
ET2206834-002	THGW02	ED009: Bromide	24959-67-9	2.5 mg/L	95.4	70.0	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 4790637)							
ET2206696-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	# Not Determined	70.0	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 4790640)							
ET2206834-009	TSF	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	# Not Determined	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 4790638)							
ET2206810-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	98.7	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 4800901)							
EB2238260-002	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	99.7	70.0	130
		EG020A-F: Barium	7440-39-3	1 mg/L	102	70.0	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	101	70.0	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	99.5	70.0	130
		EG020A-F: Cobalt	7440-48-4	1 mg/L	94.5	70.0	130
		EG020A-F: Copper	7440-50-8	1 mg/L	98.3	70.0	130
		EG020A-F: Lead	7439-92-1	1 mg/L	97.0	70.0	130

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%) MS	Acceptable Limits (%) Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 4800901) - continued							
EB2238260-002	Anonymous	EG020A-F: Manganese	7439-96-5	1 mg/L	97.6	70.0	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	96.9	70.0	130
		EG020A-F: Vanadium	7440-62-2	1 mg/L	95.0	70.0	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	98.8	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 4801065)							
ET2206834-009	TSF	EG020A-T: Arsenic	7440-38-2	2 mg/L	110	70.0	130
		EG020A-T: Barium	7440-39-3	2 mg/L	122	70.0	130
		EG020A-T: Cadmium	7440-43-9	0.5 mg/L	111	70.0	130
		EG020A-T: Chromium	7440-47-3	2 mg/L	107	70.0	130
		EG020A-T: Cobalt	7440-48-4	2 mg/L	106	70.0	130
		EG020A-T: Copper	7440-50-8	2 mg/L	102	70.0	130
		EG020A-T: Lead	7439-92-1	2 mg/L	109	70.0	130
		EG020A-T: Manganese	7439-96-5	2 mg/L	110	70.0	130
		EG020A-T: Nickel	7440-02-0	2 mg/L	104	70.0	130
		EG020A-T: Vanadium	7440-62-2	2 mg/L	112	70.0	130
		EG020A-T: Zinc	7440-66-6	2 mg/L	99.5	70.0	130
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 4796598)							
ET2206834-002	THGW02	EK025SF: Free Cyanide	----	0.2 mg/L	128	70.0	130
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 4796597)							
ET2206834-002	THGW02	EK026SF: Total Cyanide	57-12-5	0.2 mg/L	128	70.0	130
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser (QCLot: 4796599)							
ET2206834-002	THGW02	EK028SF: Weak Acid Dissociable Cyanide	----	0.2 mg/L	116	70.0	130
EK040P: Fluoride by PC Titrator (QCLot: 4790619)							
ET2206834-002	THGW02	EK040P: Fluoride	16984-48-8	1.92 mg/L	117	80.0	120
EK055G: Ammonia as N by Discrete Analyser (QCLot: 4790948)							
ET2206818-004	Anonymous	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	77.5	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 4790636)							
ET2205123-005	Anonymous	EK057G: Nitrite as N	14797-65-0	0.4 mg/L	100	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 4790639)							
ET2206834-002	THGW02	EK071G: Reactive Phosphorus as P	14265-44-2	0.4 mg/L	80.6	70.0	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **ET2206834**	Page	: 1 of 14
Client	: **ENVIRONMENTAL EARTH SCIENCES**	Laboratory	: Environmental Division Townsville
Contact	: MS ANNA SHELDON	Telephone	: +61 7 4773 0000
Project	: 722092	Date Samples Received	: 23-Dec-2022
Site	: Tick Hill	Issue Date	: 09-Jan-2023
Sampler	: A.S	No. of samples received	: 10
Order number	: ----	No. of samples analysed	: 10

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	ET2206696--001	Anonymous	**Sulfate as SO4 - Turbidimetric**	14808-79-8	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	ET2206834--009	TSF	**Sulfate as SO4 - Turbidimetric**	14808-79-8	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA005P: pH by PC Titrator						
Clear Plastic Bottle - Natural THGW04, THGW06, PIT	----	----	----	23-Dec-2022	19-Dec-2022	**4**
Clear Plastic Bottle - Natural THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	----	----	----	23-Dec-2022	20-Dec-2022	**3**
EA015: Total Dissolved Solids dried at 180 ± 5 °C						
Clear Plastic Bottle - Natural THGW04, THGW06, PIT	----	----	----	29-Dec-2022	26-Dec-2022	**3**
Clear Plastic Bottle - Natural THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	----	----	----	29-Dec-2022	27-Dec-2022	**2**
ED093F: Dissolved Major Cations						
Clear Plastic Bottle - Natural THGW04, THGW06, PIT	----	----	----	06-Jan-2023	26-Dec-2022	**11**
Clear Plastic Bottle - Natural THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	----	----	----	06-Jan-2023	27-Dec-2022	**10**
EK025SF: Free CN by Segmented Flow Analyser						

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EK025SF: Free CN by Segmented Flow Analyser - Analysis Holding Time Compliance						
Opaque plastic bottle - NaOH THGW04, THGW06, PIT	----	----	----	06-Jan-2023	02-Jan-2023	**4**
Opaque plastic bottle - NaOH THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	----	----	----	06-Jan-2023	03-Jan-2023	**3**
EK026SF: Total CN by Segmented Flow Analyser						
Opaque plastic bottle - NaOH THGW04, THGW06, PIT	----	----	----	06-Jan-2023	02-Jan-2023	**4**
Opaque plastic bottle - NaOH THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	----	----	----	06-Jan-2023	03-Jan-2023	**3**
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser						
Opaque plastic bottle - NaOH THGW04, THGW06, PIT	----	----	----	06-Jan-2023	02-Jan-2023	**4**
Opaque plastic bottle - NaOH THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	----	----	----	06-Jan-2023	03-Jan-2023	**3**
EK057G: Nitrite as N by Discrete Analyser						
Clear Plastic Bottle - Natural THGW04, THGW06, PIT	----	----	----	23-Dec-2022	21-Dec-2022	**2**
Clear Plastic Bottle - Natural THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	----	----	----	23-Dec-2022	22-Dec-2022	**1**
EK071G: Reactive Phosphorus as P by discrete analyser						
Clear Plastic Bottle - Natural THGW04, THGW06, PIT	----	----	----	23-Dec-2022	21-Dec-2022	**2**

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EK071G: Reactive Phosphorus as P by discrete analyser - Analysis Holding Time Compliance						
Clear Plastic Bottle - Natural THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	----	----	----	23-Dec-2022	22-Dec-2022	**1**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Evaluation	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Evaluation
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P) THGW04, THGW06, PIT	**19-Dec-2022**	**----**	----	----	**23-Dec-2022**	19-Dec-2022	×
Clear Plastic Bottle - Natural (EA005-P) THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	**20-Dec-2022**	**----**	----	----	**23-Dec-2022**	20-Dec-2022	×
EA015: Total Dissolved Solids dried at 180 ± 5 °C							
Clear Plastic Bottle - Natural (EA015H) THGW04, THGW06, PIT	**19-Dec-2022**	**----**	----	----	**29-Dec-2022**	26-Dec-2022	×
Clear Plastic Bottle - Natural (EA015H) THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	**20-Dec-2022**	**----**	----	----	**29-Dec-2022**	27-Dec-2022	×

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED009: Anions							
Clear Plastic Bottle - Natural (ED009) THGW04, THGW06, PIT	**19-Dec-2022**	**----**	----	----	**03-Jan-2023**	16-Jan-2023	✓
Clear Plastic Bottle - Natural (ED009) THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	**20-Dec-2022**	**----**	----	----	**03-Jan-2023**	17-Jan-2023	✓
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P) THGW04, THGW06, PIT	**19-Dec-2022**	**----**	----	----	**23-Dec-2022**	02-Jan-2023	✓
Clear Plastic Bottle - Natural (ED037-P) THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	**20-Dec-2022**	**----**	----	----	**23-Dec-2022**	03-Jan-2023	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G) THGW04, THGW06, PIT	**19-Dec-2022**	**----**	----	----	**23-Dec-2022**	16-Jan-2023	✓
Clear Plastic Bottle - Natural (ED041G) THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	**20-Dec-2022**	**----**	----	----	**23-Dec-2022**	17-Jan-2023	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G) THGW04, THGW06, PIT	**19-Dec-2022**	**----**	----	----	**23-Dec-2022**	16-Jan-2023	✓
Clear Plastic Bottle - Natural (ED045G) THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	**20-Dec-2022**	**----**	----	----	**23-Dec-2022**	17-Jan-2023	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Natural (ED093F) THGW04, THGW06, PIT	**19-Dec-2022**	**----**	----	----	**06-Jan-2023**	26-Dec-2022	×
Clear Plastic Bottle - Natural (ED093F) THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	**20-Dec-2022**	**----**	----	----	**06-Jan-2023**	27-Dec-2022	×
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Natural (EG020E-F) THGW04, THGW06, PIT	**19-Dec-2022**	**----**	----	----	**06-Jan-2023**	17-Jun-2023	✓
Clear Plastic Bottle - Natural (EG020E-F) THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	**20-Dec-2022**	**----**	----	----	**06-Jan-2023**	18-Jun-2023	✓
EG020T: Total Metals by ICP-MS							
Clear HDPE (U-T ORC) - Unfiltered; Lab-acidified (EG020E-T) THGW04, THGW06, PIT	**19-Dec-2022**	**04-Jan-2023**	17-Jun-2023	✓	**04-Jan-2023**	17-Jun-2023	✓
Clear HDPE (U-T ORC) - Unfiltered; Lab-acidified (EG020E-T) THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	**20-Dec-2022**	**04-Jan-2023**	18-Jun-2023	✓	**04-Jan-2023**	18-Jun-2023	✓
EK025SF: Free CN by Segmented Flow Analyser							
Opaque plastic bottle - NaOH (EK025SF) THGW04, THGW06, PIT	**19-Dec-2022**	**----**	----	----	**06-Jan-2023**	02-Jan-2023	×
Opaque plastic bottle - NaOH (EK025SF) THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	**20-Dec-2022**	**----**	----	----	**06-Jan-2023**	03-Jan-2023	×

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK026SF: Total CN by Segmented Flow Analyser							
Opaque plastic bottle - NaOH (EK026SF) THGW04, THGW06, PIT	**19-Dec-2022**	**----**	----	----	**06-Jan-2023**	02-Jan-2023	×
Opaque plastic bottle - NaOH (EK026SF) THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	**20-Dec-2022**	**----**	----	----	**06-Jan-2023**	03-Jan-2023	×
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser							
Opaque plastic bottle - NaOH (EK028SF) THGW04, THGW06, PIT	**19-Dec-2022**	**----**	----	----	**06-Jan-2023**	02-Jan-2023	×
Opaque plastic bottle - NaOH (EK028SF) THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	**20-Dec-2022**	**----**	----	----	**06-Jan-2023**	03-Jan-2023	×
EK040P: Fluoride by PC Titrator							
Clear Plastic Bottle - Natural (EK040P) THGW04, THGW06, PIT	**19-Dec-2022**	**----**	----	----	**23-Dec-2022**	16-Jan-2023	✓
Clear Plastic Bottle - Natural (EK040P) THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	**20-Dec-2022**	**----**	----	----	**23-Dec-2022**	17-Jan-2023	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G) THGW04, THGW06, PIT	**19-Dec-2022**	**----**	----	----	**29-Dec-2022**	16-Jan-2023	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G) THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	**20-Dec-2022**	**----**	----	----	**29-Dec-2022**	17-Jan-2023	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G) THGW04, THGW06, PIT	**19-Dec-2022**	**----**	----	----	**23-Dec-2022**	21-Dec-2022	✘
Clear Plastic Bottle - Natural (EK057G) THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	**20-Dec-2022**	**----**	----	----	**23-Dec-2022**	22-Dec-2022	✘
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G) THGW04, THGW06, PIT	**19-Dec-2022**	**----**	----	----	**23-Dec-2022**	21-Dec-2022	✘
Clear Plastic Bottle - Natural (EK071G) THGW01, THGW02, THGW03, THGW05, Mine Shaft, TSF, BD01	**20-Dec-2022**	**----**	----	----	**23-Dec-2022**	22-Dec-2022	✘

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Alkalinity by Auto Titrator	ED037-P	1	10	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite E	EG020E-F	1	10	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	1	10	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by Auto Titrator	EA005-P	1	10	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	10	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions - by IC	ED009	1	10	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	3	23	**13.04**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite E	EG020E-T	1	10	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Weak Acid Dissociable Cyanide by Segmented Flow Analyser	EK028SF	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by Auto Titrator	ED037-P	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite E	EG020E-F	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by Auto Titrator	EA005-P	2	10	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions - by IC	ED009	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	4	23	**17.39**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Control Samples (LCS) - Continued							
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite E	EG020E-T	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Weak Acid Dissociable Cyanide by Segmented Flow Analyser	EK028SF	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite E	EG020E-F	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions - by IC	ED009	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	23	**8.70**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite E	EG020E-T	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Weak Acid Dissociable Cyanide by Segmented Flow Analyser	EK028SF	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions - by IC	ED009	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	23	**8.70**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Matrix Spikes (MS) - Continued							
Weak Acid Dissociable Cyanide by Segmented Flow Analyser	EK028SF	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH by Auto Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM Schedule B(3)
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM Schedule B(3)
Standard Anions - by IC	ED009	WATER	In house: Referenced to APHA 4110. This method is compliant with NEPM Schedule B(3)
Alkalinity by Auto Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm.
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Analytical Methods	Method	Matrix	Method Descriptions
Total Metals by ICP-MS - Suite B	EG020B-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite E	EG020E-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite E	EG020E-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Free CN by Segmented Flow Analyser	EK025SF	WATER	In house: Referenced to ASTM D7237, APHA 4500-CN-C&O and ISO 14403: Using an automated segmented flow analyser, a sample at high pH (sodium hydroxide preserved) is buffered to pH 6.0. The hydrogen cyanide present passes across a gas dialysis membrane into an acceptor stream consisting of 0.01 M sodium hydroxide. The acceptor stream mixes with a buffer at pH 5.2 and reacts with chloramine-T to form cyanogen chloride. Cyanogen chloride reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour, measured at 600nm. This method is compliant with NEPM Schedule B(3)
Total Cyanide by Segmented Flow Analyser	EK026SF	WATER	In house: Referenced to APHA 4500-CN C&O / ASTM D7511 / ISO 14403. Sodium hydroxide preserved samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM Schedule B(3)
Weak Acid Dissociable Cyanide by Segmented Flow Analyser	EK028SF	WATER	In house: Referenced to APHA 4500-CN C&O / ISO 14403. Samples preserved with sodium hydroxide are introduced into an automated segmented flow analyser. Hydrogen cyanide is liberated from a slightly acidified (pH 4.5) and is dialysed. Tight cyanide complexes that would not be amenable to oxidation by chlorine are not converted. Iron cyanide complexes are precipitated with zinc acetate. Liberated HCN diffuses through a membrane into a stream of sodium hydroxide where it is carried as CN- The cyanide in caustic solution is buffered to pH 5.2 and further converted to cyanogen chloride by reaction with chloramine-T. Cyanogen chloride subsequently reacts with 4 ¿pyridine carboxylic and 1,3 - dimethylbarbituric acids to give a red colour complex. This colour is measured at 600 nm. This method is compliant with NEPM Schedule B(3)
Fluoride by Auto Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)

ALS Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **ET2206834**

Client	: **ENVIRONMENTAL EARTH SCIENCES**	Laboratory	: Environmental Division Townsville
Contact	: MS ANNA SHELDON	Contact	: David Wall
Address	: 2 BYTH STREET BRISBANE QLD 4053	Address	: 13 Carlton Street, Kirwan Townsville QLD Australia 4815
E-mail	: asheldon@eesigroup.com	E-mail	: david.wall@alsglobal.com
Telephone	: 07 3852 6666	Telephone	: +61 7 4773 0000
Facsimile	: 07 3852 5666	Facsimile	:
Project	: 722092	Page	: 1 of 3
Order number	: ----	Quote number	: ES2021ENVEAR0011 (EN/010/21)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: Tick Hill		
Sampler	: A.S		

Dates

Date Samples Received	: 23-Dec-2022 08:35	Issue Date	: 23-Dec-2022
Client Requested Due Date	: 09-Jan-2023	Scheduled Reporting Date	: **09-Jan-2023**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 1	Temperature	: 16.7°C - Ice Bricks present
Receipt Detail	: Large Esky	No. of samples received / analysed	: 10 / 10

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- Please be advised, fluro yellow bottles were provided, however there is no analysis requested for the bottles. Bottles have been put on hold in Townsville. If this is incorrect please contact Client Services at alsenviroTownsville@alsglobal.com.
- **23/12/2022: SRN has been resent to acknowledge that that low level CN has been added and Bromide. For any further information regarding these adjustments please contact client services at ALSEnviro.Brisbane@alsglobal.com.**
- Discounted Package Prices apply only when specific ALS Group Codes ('W', 'S', 'NT' suites) are referenced on COCs.
- EK058G, EA005-P, EA015H, ED037-P, ED041G, ED045G, EK040P, EK055G, EK057G, EK059G, EK071G conducted by ALS Townsville, NATA accreditation no. 825, (Site no. 23472 for Chemical Testing and Site no. 23313 for Biological Testing)
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months ± 1 week) from receipt of samples.
- All remaining analysis will be conducted by ALS Environmental, Brisbane, NATA accreditation no. 825, Site No. 818.
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The laboratory will process these samples unless instructions are received from you indicating you do not wish to proceed. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

Method / Sample ID	Sample Container Received	Preferred Sample Container for Analysis
Dissolved Metals by ICP-MS - Suite A : EG020A-F		
THGW01	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
THGW02	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
THGW03	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
THGW04	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
THGW05	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
THGW06	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
PIT	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
Mine Shaft	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
TSF	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
BD01	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
Dissolved Metals by ICP-MS - Suite B : EG020B-F		
THGW01	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
THGW02	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
THGW03	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
THGW04	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
THGW05	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
THGW06	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
PIT	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
Mine Shaft	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
TSF	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
BD01	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
Dissolved Metals by ICP-MS - Suite E : EG020E-F		
THGW01	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
THGW02	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
THGW03	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
THGW04	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
THGW05	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
THGW06	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
PIT	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
Mine Shaft	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
TSF	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered
BD01	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - Nitric Acid; Filtered

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **WATER**

Laboratory sample ID	Sampling date / time	Sample ID	WATER - CN-FWT-LL Cyanide -Free, WAD & Total Low Level	WATER - ED009 Standard Anions	WATER - EES Ionic Balance EES Ionic Balance	WATER - EG020F Dissolved Metals by ICP/MS	WATER - EG020T Total Metals by ICP/MS (including digestion)
ET2206834-001	20-Dec-2022 00:00	THGW01	✓	✓	✓	✓	✓
ET2206834-002	20-Dec-2022 00:00	THGW02	✓	✓	✓	✓	✓
ET2206834-003	20-Dec-2022 00:00	THGW03	✓	✓	✓	✓	✓
ET2206834-004	19-Dec-2022 00:00	THGW04	✓	✓	✓	✓	✓
ET2206834-005	20-Dec-2022 00:00	THGW05	✓	✓	✓	✓	✓
ET2206834-006	19-Dec-2022 00:00	THGW06	✓	✓	✓	✓	✓
ET2206834-007	19-Dec-2022 00:00	PIT	✓	✓	✓	✓	✓
ET2206834-008	20-Dec-2022 00:00	Mine Shaft	✓	✓	✓	✓	✓

			WATER - CN-FWT-LL Cyanide -Free, WAD & Total Low Level	WATER - ED009 Standard Anions	WATER - EES Ionic Balance EES Ionic Balance	WATER - EG020F Dissolved Metals by ICP/MS	WATER - EG020T Total Metals by ICP/MS (including digestion)
ET2206834-009	20-Dec-2022 00:00	TSF	✓	✓	✓	✓	✓
ET2206834-010	20-Dec-2022 00:00	BD01	✓	✓	✓	✓	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

ACCOUNTS PAYABLE (EESI GROUP)

- A4 - AU Tax Invoice (INV)	Email	accounts@eesigroup.com

ANNA SHELDON

- *AU Certificate of Analysis - NATA (COA)	Email	asheldon@eesigroup.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	asheldon@eesigroup.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	asheldon@eesigroup.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	asheldon@eesigroup.com
- Chain of Custody (CoC) (COC)	Email	asheldon@eesigroup.com
- EDI Format - ENMRG (ENMRG)	Email	asheldon@eesigroup.com
- EDI Format - ESDAT (ESDAT)	Email	asheldon@eesigroup.com

RESULTS ADDRESS QLD

- *AU Certificate of Analysis - NATA (COA)	Email	qldlab@eesigroup.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	qldlab@eesigroup.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	qldlab@eesigroup.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	qldlab@eesigroup.com
- Chain of Custody (CoC) (COC)	Email	qldlab@eesigroup.com
- EDI Format - ENMRG (ENMRG)	Email	qldlab@eesigroup.com
- EDI Format - ESDAT (ESDAT)	Email	qldlab@eesigroup.com

CHAIN OF CUSTODY - ANALYSIS REQUEST FORM

Job No: 722092 Laboratory: ALS

Project Manager: A Sheldon Sampler: AS Site Location: Tick Hill Sheet: 1 of 1

No. of samples	Sample ID/ Depth	Anticipated Result (PID)EC reading	Date sampled	Time sampled	Sample Matrix: Soil	Water	Sediment	+ Bromide EES Ionic balance	Metals - total	Metals - dissolved	Cyanide total WAD CN - FWT-LL + free	EES Ionic Balance	Sample-specific instructions/ notes
1	THGW01		20/12/22			x		x	x	x	x		Samples not field filtered for dissolved metals. Please filter prior to analysis.
2	THGW02		20/12/22			x		x	x	x	x		
3	THGW03		20/12/22			x		x	x	x	x		
4	TH GW04		19/12/22			x		x	x	x	x		
5	TH GW05		20/12/22			x		x	x	x	x		
6	TH GW06		19/12/22			x		x	x	x	x		Metals suite - total & dissolved Al Sb As Ba Cd Cr Co Cu Pb Fe Mn Mo Ni Se Sr Ti W U V Zn
7	PIT		19/12/22			x		x	x	x	x		
8	Mine shaft		20/12/22			x		VAN	x	x	x	x	
9	TSF		20/12/22			x		VAN	x	x	x	x	
10	BD01		20/12/22.			x		x	x	x	x		
	TOTAL					10		8	10	10	10	2	

Metals bottle provided. Please filter

Environmental Division Townsville
Work Order Reference
ET2206834

Telephone : +61 7 4729 9000

17 #

Turn Around (circle): NORMALY 3 DAYS / 48 HRS / 24 HRS (confirm with lab in advance if quick turn-around is required)

Comments/ Instructions:

Lab Quotation No. (if applicable): EN/010/21

Send report to (email address): asheldon@eesigroup.com

Cc: report to (email address): qldlab@eesigroup.com

Cc: invoice to (email address): accounts@eesigroup.com

	Name	Signature	Date	Time
Sent off Site/Office by:	Anna Sheldon		21/12/22	1500
Receiving Lab:	Niamh F MT		21.12.22	1509
Receiving Lab:	Elke Mairu		23/12/22	0835

Phone: (07) 3852 6666
Fax: (07) 3852 5666
PO Box 3207 Newstead, QLD
Email: eesqld@environmentalearthsciences.com

ENVIRONMENTAL EARTH SCIENCES

Please forward Samples + COC to Eurofins. Bri's to forward.

CHAIN OF CUSTODY - ANALYSIS REQUEST FORM

Job No: 722092 Laboratory: Eurofins.

Project Manager: A Sheldon Sampler: AS Site Location: Tick Hill Sheet: 1 of 1

No. of samples	Sample ID/ Depth	Anticipated Result (PID)/EC reading	Date sampled	Time sampled	Sample Matrix: Soil	Sample Matrix: Water	Sample Matrix: Sediment	Analysis Required: CN Free	CN WAD	CN Total		Metals - Total	Metals - Dissolved	pH & EC	BIIC Ca Mg K	BIIF Cl SO4 alk F	BIGC Nutrients	NO3 NO2 NH4 PO4			Sample-specific instructions/ notes
	SD01		20/12/22			x		x	x	x		x	x	x	x	x	x				1 bottle provided for total metals No sample filtered for dissolved metals Please filter sample prior to analysis
																					Metals suite - Total & Dissolved Al Sb As Ba Cd Cr Co Cu Pb Fe Mn Mo Ni Se Sr Ti W U V Zn
	TOTAL					1		1	1	1		1	1	1	1	1	1				

Date/Time: 29/12/22 1:05 pm
Chilled: Yes / No
Temp: 2.8
Correction: +0.2
Final Temp: 2.6 AT

Turn Around (circle): NORMAL / 3 DAYS / 48 HRS / 24 HRS (confirm with lab in advance if quick turn-around is required)

Comments/ Instructions: CN - ~~AWRA~~ APHA 4500-CN

Lab Quotation No. (if applicable):

Send report to (email address): asheldon@eesigroup.com

Cc: report to (email address): qldlabe eesigroup.com

Cc: invoice to (email address): accounts@eesigroup.com

	Name	Signature	Date	Time
Sent off Site/Office by:	Anna Sheldon		21/12/22	1500
Receiving Lab:	Nimesh F.			
Receiving Lab:				

Phone: (07) 3852 6666
Fax: (07) 3852 5666
PO Box 3207 Newstead, QLD
Email: eesqld@environmentalearthsciences.com

953272

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www.eurofins.com.au EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

Melbourne	Geelong	Sydney	Canberra	Brisbane	Newcastle
6 Monterey Road	19/8 Lewalan Street	179 Magowar Road	Unit 1,2 Dacre Street	1/21 Smallwood Place	4/52 Industrial Drive
Dandenong South	Grovedale	Girraween	Mitchell	Murarrie	Mayfield East NSW 2304
VIC 3175	VIC 3216	NSW 2145	ACT 2911	QLD 4172	PO Box 60 Wickham 2293
Tel: +61 3 8564 5000	Tel: +61 3 8564 5000	Tel: +61 2 9900 8400	Tel: +61 2 6113 8091	Tel: +61 7 3902 4600	Tel: +61 2 4968 8448
NATA# 1261 Site# 1254	NATA# 1261 Site# 1254	NATA# 1261 Site# 18217		NATA# 1261 Site# 20794	NATA# 1261 Site# 25079

Eurofins ARL Pty Ltd
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Perth
46-48 Banksia Road
Welshpool
WA 6106
Tel: +61 8 6253 4444
NATA# 2377 Site# 2370

Eurofins Environment Testing NZ Ltd
NZBN: 9429046024954

Auckland	Christchurch
35 O'Rorke Road	43 Detroit Drive
Penrose,	Rolleston,
Auckland 1061	Christchurch 7675
Tel: +64 9 526 45 51	Tel: 0800 856 450
IANZ# 1327	IANZ# 1290

Sample Receipt Advice

Company name:	Environmental Earth Sciences QLD
Contact name:	Anna Sheldon
Project name:	TICK HILL
Project ID:	722092
Turnaround time:	10 Day
Date/Time received	Dec 29, 2022 1:05 PM
Eurofins reference	953272

Sample Information

- ✓ A detailed list of analytes logged into our LIMS, is included in the attached summary table.
- ✓ All samples have been received as described on the above COC.
- ✓ COC has been completed correctly.
- ✓ Attempt to chill was evident.
- ✓ Appropriately preserved sample containers have been used.
- ✓ All samples were received in good condition.
- ✓ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.
- ✓ Appropriate sample containers have been used.
- ✓ Sample containers for volatile analysis received with zero headspace.
- ✗ Split sample sent to requested external lab.
- ✗ Some samples have been subcontracted.
- N/A Custody Seals intact (if used).

Notes

As these samples were received after the 15th, a 10 day TAT has been applied due to the holiday period. Tungsten (W) analysis is not able to be performed.

Contact

If you have any questions with respect to these samples, please contact your Analytical Services Manager:

Peter Brand on phone : 0436 360 123 or by email: PeterBrand@eurofins.com

Results will be delivered electronically via email to Anna Sheldon - asheldon@environmentalearthsciences.com.

Note: A copy of these results will also be delivered to the general Environmental Earth Sciences QLD email address.

Global Leader - Results you can trust

eurofins

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

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NATA# 1261 Site# 1254

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Tel: +61 2 9900 8400
NATA# 1261 Site# 18217

Canberra
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Mitchell
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NATA# 1261 Site# 20794

Newcastle
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Tel: +61 2 4968 8448
NATA# 1261 Site# 25079

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IANZ# 1327

Christchurch
43 Detroit Drive
Rolleston,
Christchurch 7675
Tel: 0800 856 450
IANZ# 1290

Company Name: Environmental Earth Sciences QLD
Address: Unit 3, 1 Ross Street
Newstead
QLD 4006

Project Name: TICK HILL
Project ID: 722092

Order No.:
Report #: 953272
Phone: 07 3852 6666
Fax: 07 3852 5666

Received: Dec 29, 2022 1:05 PM
Due: Jan 13, 2023
Priority: 10 Day
Contact Name: Anna Sheldon

Eurofins Analytical Services Manager : Peter Brand

Sample Detail						Aluminium	Aluminium (filtered)	Antimony	Antimony (filtered)	Arsenic	Arsenic (filtered)	Barium	Barium (filtered)	Cadmium	Cadmium (filtered)	Chromium	Chromium (filtered)	Cobalt	Cobalt (filtered)	Conductivity (at 25 °C)	Copper	Copper (filtered)	Cyanide (free)	Cyanide (total)	Cyanide (weak acid dissoc.)	Iron	Iron (filtered)	Lead	Lead (filtered)	Manganese	Manganese (filtered)	Molybdenum	Molybdenum (filtered)	Nickel	Nickel (filtered)	pH (at 25 °C)	Selenium	Selenium (filtered)	Strontium	Strontium (filtered)	Titanium	Titanium (filtered)	Uranium	Uranium (filtered)	Vanadium	Vanadium (filtered)	Zinc	Zinc (filtered)	Eurofins Suite B19C:	Eurofins Suite B11F: Cl/SO4/Alkalinity/Total	Eurofins Suite B11C: Na/K/Ca/Mg
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
External Laboratory																																																		
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																																												
1	SD01	Dec 20, 2022		Water	B22-De0057723	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Test Counts						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

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Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Environmental Earth Sciences QLD
Unit 3, 1 Ross Street
Newstead
QLD 4006

Attention: **Anna Sheldon**

Report **953272-W**
Project name TICK HILL
Project ID 722092
Received Date Dec 29, 2022

Client Sample ID			**SD01**
Sample Matrix			**Water**
Eurofins Sample No.			**B22-De0057723**
Date Sampled			**Dec 20, 2022**
Test/Reference	LOR	Unit	
Ammonia (as N)	0.01	mg/L	< 0.01
Chloride	1	mg/L	91
Conductivity (at 25 °C)	10	uS/cm	1500
Cyanide (free)	0.005	mg/L	< 0.005
Cyanide (total)	0.005	mg/L	< 0.005
Cyanide (weak acid dissoc.)	0.005	mg/L	< 0.005
Fluoride	0.5	mg/L	1.9
Nitrate & Nitrite (as N)	0.05	mg/L	3.1
Nitrate (as N)	0.02	mg/L	3.0
Nitrite (as N)	0.02	mg/L	0.04
pH (at 25 °C)	0.1	pH Units	7.6
Phosphorus reactive (as P)	0.01	mg/L	0.10
Sulphate (as SO4)	5	mg/L	28
Alkalinity (speciated)			
Bicarbonate Alkalinity (as CaCO3)	20	mg/L	1800
Carbonate Alkalinity (as CaCO3)	10	mg/L	< 10
Hydroxide Alkalinity (as CaCO3)	20	mg/L	< 20
Total Alkalinity (as CaCO3)	20	mg/L	1800
Heavy Metals			
Aluminium	0.05	mg/L	< 0.05
Aluminium (filtered)	0.05	mg/L	< 0.05
Antimony	0.005	mg/L	< 0.005
Antimony (filtered)	0.005	mg/L	< 0.005
Arsenic	0.001	mg/L	< 0.001
Arsenic (filtered)	0.001	mg/L	< 0.001
Barium	0.02	mg/L	0.13
Barium (filtered)	0.02	mg/L	0.13
Cadmium	0.0002	mg/L	< 0.0002
Cadmium (filtered)	0.0002	mg/L	< 0.0002
Chromium	0.001	mg/L	< 0.001
Chromium (filtered)	0.001	mg/L	< 0.001
Cobalt	0.001	mg/L	0.004
Cobalt (filtered)	0.001	mg/L	0.004
Copper	0.001	mg/L	< 0.001
Copper (filtered)	0.001	mg/L	< 0.001

Client Sample ID			SD01
Sample Matrix			Water
Eurofins Sample No.			B22-De0057723
Date Sampled			Dec 20, 2022
Test/Reference	LOR	Unit	
Heavy Metals			
Iron	0.05	mg/L	< 0.05
Iron (filtered)	0.05	mg/L	< 0.05
Lead	0.001	mg/L	< 0.001
Lead (filtered)	0.001	mg/L	< 0.001
Manganese	0.005	mg/L	0.009
Manganese (filtered)	0.005	mg/L	0.008
Molybdenum	0.005	mg/L	< 0.005
Molybdenum (filtered)	0.005	mg/L	< 0.005
Nickel	0.001	mg/L	< 0.001
Nickel (filtered)	0.001	mg/L	< 0.001
Selenium	0.001	mg/L	0.002
Selenium (filtered)	0.001	mg/L	0.001
Strontium	0.005	mg/L	0.26
Strontium (filtered)	0.005	mg/L	0.22
Titanium	0.005	mg/L	< 0.005
Titanium (filtered)	0.005	mg/L	< 0.005
Uranium	0.005	mg/L	0.033
Uranium (filtered)	0.005	mg/L	0.012
Vanadium	0.005	mg/L	0.091
Vanadium (filtered)	0.005	mg/L	0.091
Zinc	0.005	mg/L	0.006
Zinc (filtered)	0.005	mg/L	< 0.005
Eurofins Suite B11C: Na/K/Ca/Mg			
Calcium	0.5	mg/L	19
Magnesium	0.5	mg/L	53
Potassium	0.5	mg/L	4.3
Sodium	0.5	mg/L	280

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Eurofins Suite B19C: NO3/NO2/NOx/Reactive P/NH3			
Ammonia (as N)	Melbourne	Jan 03, 2023	28 Days
- Method: APHA 4500-NH3 Ammonia Nitrogen by FIA			
Nitrate & Nitrite (as N)	Melbourne	Jan 03, 2023	28 Days
- Method: LTM-INO-4120 Analysis of NOx NO2 NH3 by FIA			
Nitrate (as N)	Melbourne	Jan 03, 2023	28 Days
- Method: LTM-INO-4120 Analysis of NOx NO2 NH3 by FIA			
Nitrite (as N)	Melbourne	Jan 03, 2023	2 Days
- Method: LTM-INO-4120 Analysis of NOx NO2 NH3 by FIA			
Phosphorus reactive (as P)	Melbourne	Jan 03, 2023	2 Days
- Method: APHA 4500-P			
Eurofins Suite B11F: Cl/SO4/Alkalinity/Total F			
Chloride	Melbourne	Jan 03, 2023	28 Days
- Method: LTM-INO-4090 Chloride by Discrete Analyser			
Fluoride	Melbourne	Jan 03, 2023	28 Days
- Method: in-house method LTM-INO-4390 Fluoride by Discrete Analyser			
Sulphate (as SO4)	Melbourne	Jan 03, 2023	28 Days
- Method: LTM-INO-4110 Sulfate by Discrete Analyser			
Alkalinity (speciated)	Melbourne	Jan 03, 2023	14 Days
- Method: LTM-INO-4250 Alkalinity by Electrometric Titration			
Conductivity (at 25 °C)	Melbourne	Jan 03, 2023	28 Days
- Method: LTM-INO-4030 Conductivity			
Cyanide (free)	Melbourne	Jan 03, 2023	14 Days
- Method: LTM-INO-4020 Total Free WAD Cyanide by CFA			
Cyanide (total)	Melbourne	Jan 03, 2023	14 Days
- Method: LTM-INO-4020 Total Free WAD Cyanide by CFA			
Cyanide (weak acid dissoc.)	Melbourne	Jan 03, 2023	14 Days
- Method: LTM-INO-4020 Total Free WAD Cyanide by CFA			
pH (at 25 °C)	Melbourne	Jan 03, 2023	0 Hours
- Method: LTM-GEN-7090 pH in water by ISE			
Heavy Metals	Melbourne	Jan 03, 2023	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Heavy Metals (filtered)	Melbourne	Jan 03, 2023	180 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Eurofins Suite B11C: Na/K/Ca/Mg	Melbourne	Jan 03, 2023	180 Days
- Method: LTM-MET-3010 Alkali Metals by ICP-AES			

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Project Name: TICK HILL
Project ID: 722092

Order No.:
Report #: 953272
Phone: 07 3852 6666
Fax: 07 3852 5666

Received: Dec 29, 2022 1:05 PM
Due: Jan 13, 2023
Priority: 10 Day
Contact Name: Anna Sheldon

Eurofins Analytical Services Manager : Peter Brand

Sample Detail						Aluminium	Aluminium (filtered)	Antimony	Antimony (filtered)	Arsenic	Arsenic (filtered)	Barium	Barium (filtered)	Cadmium	Cadmium (filtered)	Chromium	Chromium (filtered)	Cobalt	Cobalt (filtered)	Conductivity (at 25 °C)	Copper	Copper (filtered)	Cyanide (free)	Cyanide (total)	Cyanide (weak acid dissoc.)	Iron	Iron (filtered)	Lead	Lead (filtered)	Manganese	Manganese (filtered)	Molybdenum	Molybdenum (filtered)	Nickel	Nickel (filtered)	pH (at 25 °C)	Selenium	Selenium (filtered)	Strontium	Strontium (filtered)	Titanium	Titanium (filtered)	Uranium	Uranium (filtered)	Vanadium	Vanadium (filtered)	Zinc	Zinc (filtered)	Eurofins Suite B19C:	Eurofins Suite B11F: Cl/SO4/Alkalinity/Total	Eurofins Suite B11C: Na/K/Ca/Mg
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
External Laboratory																																																		
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																																													
1	SD01	Dec 20, 2022		Water	B22-De0057723	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Test Counts						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
µg/L: micrograms per litre
ppm: parts per million
ppb: parts per billion
%: Percentage
org/100 mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100 mL: Most Probable Number of organisms per 100 millilitres
CFU: Colony forming unit

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Ammonia (as N)	mg/L	< 0.01			0.01	Pass	
Chloride	mg/L	< 1			1	Pass	
Cyanide (total)	mg/L	< 0.005			0.005	Pass	
Fluoride	mg/L	< 0.5			0.5	Pass	
Nitrate & Nitrite (as N)	mg/L	< 0.05			0.05	Pass	
Nitrate (as N)	mg/L	< 0.02			0.02	Pass	
Nitrite (as N)	mg/L	< 0.02			0.02	Pass	
Phosphorus reactive (as P)	mg/L	< 0.01			0.01	Pass	
Sulphate (as SO4)	mg/L	< 5			5	Pass	
Method Blank							
Alkalinity (speciated)							
Carbonate Alkalinity (as CaCO3)	mg/L	< 10			10	Pass	
Hydroxide Alkalinity (as CaCO3)	mg/L	< 20			20	Pass	
Method Blank							
Heavy Metals							
Aluminium	mg/L	< 0.05			0.05	Pass	
Aluminium (filtered)	mg/L	< 0.05			0.05	Pass	
Antimony	mg/L	< 0.005			0.005	Pass	
Antimony (filtered)	mg/L	< 0.005			0.005	Pass	
Arsenic	mg/L	< 0.001			0.001	Pass	
Arsenic (filtered)	mg/L	< 0.001			0.001	Pass	
Barium	mg/L	< 0.02			0.02	Pass	
Barium (filtered)	mg/L	< 0.02			0.02	Pass	
Cadmium	mg/L	< 0.0002			0.0002	Pass	
Cadmium (filtered)	mg/L	< 0.0002			0.0002	Pass	
Chromium	mg/L	< 0.001			0.001	Pass	
Chromium (filtered)	mg/L	< 0.001			0.001	Pass	
Cobalt	mg/L	< 0.001			0.001	Pass	
Cobalt (filtered)	mg/L	< 0.001			0.001	Pass	
Copper	mg/L	< 0.001			0.001	Pass	
Copper (filtered)	mg/L	< 0.001			0.001	Pass	
Iron	mg/L	< 0.05			0.05	Pass	
Iron (filtered)	mg/L	< 0.05			0.05	Pass	
Lead	mg/L	< 0.001			0.001	Pass	
Lead (filtered)	mg/L	< 0.001			0.001	Pass	
Manganese	mg/L	< 0.005			0.005	Pass	
Manganese (filtered)	mg/L	< 0.005			0.005	Pass	
Molybdenum	mg/L	< 0.005			0.005	Pass	
Molybdenum (filtered)	mg/L	< 0.005			0.005	Pass	
Nickel	mg/L	< 0.001			0.001	Pass	
Nickel (filtered)	mg/L	< 0.001			0.001	Pass	
Selenium	mg/L	< 0.001			0.001	Pass	
Selenium (filtered)	mg/L	< 0.001			0.001	Pass	
Strontium	mg/L	< 0.005			0.005	Pass	
Strontium (filtered)	mg/L	< 0.005			0.005	Pass	
Titanium	mg/L	< 0.005			0.005	Pass	
Titanium (filtered)	mg/L	< 0.005			0.005	Pass	
Uranium	mg/L	< 0.005			0.005	Pass	
Uranium (filtered)	mg/L	< 0.005			0.005	Pass	
Vanadium	mg/L	< 0.005			0.005	Pass	
Vanadium (filtered)	mg/L	< 0.005			0.005	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Zinc	mg/L	< 0.005			0.005	Pass	
Zinc (filtered)	mg/L	< 0.005			0.005	Pass	
Method Blank							
Eurofins Suite B11C: Na/K/Ca/Mg							
Calcium	mg/L	< 0.5			0.5	Pass	
Magnesium	mg/L	< 0.5			0.5	Pass	
Potassium	mg/L	< 0.5			0.5	Pass	
Sodium	mg/L	< 0.5			0.5	Pass	
LCS - % Recovery							
Ammonia (as N)	%	102			70-130	Pass	
Chloride	%	107			70-130	Pass	
Conductivity (at 25 °C)	%	116			70-130	Pass	
Cyanide (total)	%	85			70-130	Pass	
Fluoride	%	76			70-130	Pass	
Nitrate & Nitrite (as N)	%	103			70-130	Pass	
Nitrate (as N)	%	103			70-130	Pass	
Nitrite (as N)	%	100			70-130	Pass	
Sulphate (as SO4)	%	104			70-130	Pass	
LCS - % Recovery							
Alkalinity (speciated)							
Carbonate Alkalinity (as CaCO3)	%	77			70-130	Pass	
Total Alkalinity (as CaCO3)	%	88			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Aluminium	%	109			80-120	Pass	
Aluminium (filtered)	%	105			80-120	Pass	
Antimony	%	107			80-120	Pass	
Arsenic	%	108			80-120	Pass	
Arsenic (filtered)	%	101			80-120	Pass	
Barium	%	111			80-120	Pass	
Cadmium	%	109			80-120	Pass	
Cadmium (filtered)	%	99			80-120	Pass	
Chromium	%	108			80-120	Pass	
Chromium (filtered)	%	102			80-120	Pass	
Cobalt	%	108			80-120	Pass	
Cobalt (filtered)	%	101			80-120	Pass	
Copper	%	112			80-120	Pass	
Copper (filtered)	%	105			80-120	Pass	
Iron	%	105			80-120	Pass	
Iron (filtered)	%	101			80-120	Pass	
Lead	%	100			80-120	Pass	
Lead (filtered)	%	93			80-120	Pass	
Manganese	%	110			80-120	Pass	
Manganese (filtered)	%	104			80-120	Pass	
Molybdenum	%	102			80-120	Pass	
Molybdenum (filtered)	%	93			80-120	Pass	
Nickel	%	108			80-120	Pass	
Nickel (filtered)	%	100			80-120	Pass	
Selenium	%	105			80-120	Pass	
Selenium (filtered)	%	102			80-120	Pass	
Strontium	%	110			80-120	Pass	
Strontium (filtered)	%	110			80-120	Pass	
Titanium	%	105			80-120	Pass	
Titanium (filtered)	%	104			80-120	Pass	

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Uranium			%	102			80-120	Pass	
Uranium (filtered)			%	95			80-120	Pass	
Vanadium			%	104			80-120	Pass	
Zinc			%	108			80-120	Pass	
Zinc (filtered)			%	101			80-120	Pass	
LCS - % Recovery									
Eurofins Suite B11C: Na/K/Ca/Mg									
Calcium			%	85			80-120	Pass	
Magnesium			%	95			80-120	Pass	
Potassium			%	91			80-120	Pass	
Sodium			%	96			80-120	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
				Result 1					
Ammonia (as N)	M23-Ja0000516	NCP	%	103			70-130	Pass	
Cyanide (total)	M22-De0041610	NCP	%	100			70-130	Pass	
Nitrate & Nitrite (as N)	M23-Ja0000516	NCP	%	107			70-130	Pass	
Nitrate (as N)	M23-Ja0000516	NCP	%	106			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Aluminium	M22-De0057798	NCP	%	97			75-125	Pass	
Aluminium (filtered)	M22-De0057627	NCP	%	105			75-125	Pass	
Antimony	M22-De0057798	NCP	%	99			75-125	Pass	
Antimony (filtered)	M22-De0057627	NCP	%	102			75-125	Pass	
Arsenic	M22-De0057798	NCP	%	97			75-125	Pass	
Arsenic (filtered)	M22-De0057627	NCP	%	103			75-125	Pass	
Barium	M22-De0057798	NCP	%	101			75-125	Pass	
Barium (filtered)	M22-De0057616	NCP	%	112			75-125	Pass	
Cadmium	M22-De0057798	NCP	%	103			75-125	Pass	
Cadmium (filtered)	M22-De0057627	NCP	%	102			75-125	Pass	
Chromium	M22-De0057798	NCP	%	101			75-125	Pass	
Chromium (filtered)	M22-De0057627	NCP	%	106			75-125	Pass	
Cobalt	M22-De0057798	NCP	%	101			75-125	Pass	
Cobalt (filtered)	M22-De0057627	NCP	%	103			75-125	Pass	
Copper	M22-De0057798	NCP	%	105			75-125	Pass	
Copper (filtered)	M22-De0057627	NCP	%	109			75-125	Pass	
Iron	M22-De0057798	NCP	%	94			75-125	Pass	
Iron (filtered)	M22-De0057627	NCP	%	100			75-125	Pass	
Lead	M22-De0057798	NCP	%	96			75-125	Pass	
Lead (filtered)	M22-De0057627	NCP	%	97			75-125	Pass	
Manganese	M22-De0057798	NCP	%	97			75-125	Pass	
Manganese (filtered)	M22-De0057627	NCP	%	100			75-125	Pass	
Molybdenum	M22-De0057798	NCP	%	98			75-125	Pass	
Molybdenum (filtered)	M22-De0057627	NCP	%	78			75-125	Pass	
Nickel	M22-De0057798	NCP	%	100			75-125	Pass	
Nickel (filtered)	M22-De0057627	NCP	%	105			75-125	Pass	
Selenium	M22-De0057798	NCP	%	101			75-125	Pass	
Selenium (filtered)	M22-De0057627	NCP	%	103			75-125	Pass	
Strontium	M22-De0057798	NCP	%	89			75-125	Pass	
Strontium (filtered)	M22-De0057616	NCP	%	120			75-125	Pass	
Titanium	M22-De0057798	NCP	%	98			75-125	Pass	
Titanium (filtered)	M22-De0057627	NCP	%	102			75-125	Pass	
Uranium	M22-De0057798	NCP	%	95			75-125	Pass	
Uranium (filtered)	M22-De0057627	NCP	%	99			75-125	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Vanadium	M22-De0057798	NCP	%	96			75-125	Pass	
Vanadium (filtered)	M22-De0057627	NCP	%	101			75-125	Pass	
Zinc	M22-De0057798	NCP	%	103			75-125	Pass	
Zinc (filtered)	M22-De0057627	NCP	%	107			75-125	Pass	
Spike - % Recovery									
Eurofins Suite B11C: Na/K/Ca/Mg				Result 1					
Calcium	M22-De0057623	NCP	%	80			75-125	Pass	
Magnesium	M22-De0057623	NCP	%	87			75-125	Pass	
Potassium	M22-De0057623	NCP	%	86			75-125	Pass	
Sodium	M22-De0057623	NCP	%	87			75-125	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
				Result 1	Result 2	RPD			
Ammonia (as N)	M23-Ja0000622	NCP	mg/L	12	12	<1	30%	Pass	
Chloride	B22-De0057732	NCP	mg/L	640	630	<1	30%	Pass	
Conductivity (at 25 °C)	N22-De0035512	NCP	uS/cm	16000	16000	1.5	30%	Pass	
Cyanide (total)	B22-De0057723	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Fluoride	N22-De0035513	NCP	mg/L	3.9	3.7	4.1	30%	Pass	
Nitrate & Nitrite (as N)	M23-Ja0000622	NCP	mg/L	< 0.5	< 0.5	<1	30%	Pass	
Nitrate (as N)	M23-Ja0000622	NCP	mg/L	< 0.5	< 0.2	<1	30%	Pass	
Nitrite (as N)	M23-Ja0000622	NCP	mg/L	< 0.2	< 0.2	<1	30%	Pass	
pH (at 25 °C)	N22-De0035512	NCP	pH Units	7.9	8.0	pass	30%	Pass	
Sulphate (as SO4)	B22-De0057732	NCP	mg/L	73	73	<1	30%	Pass	
Duplicate									
Alkalinity (speciated)				Result 1	Result 2	RPD			
Bicarbonate Alkalinity (as CaCO3)	N22-De0035512	NCP	mg/L	690	770	11	30%	Pass	
Carbonate Alkalinity (as CaCO3)	N22-De0035512	NCP	mg/L	< 10	< 10	<1	30%	Pass	
Hydroxide Alkalinity (as CaCO3)	N22-De0035512	NCP	mg/L	< 20	< 20	<1	30%	Pass	
Total Alkalinity (as CaCO3)	N22-De0035512	NCP	mg/L	690	770	11	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Aluminium	M22-De0057798	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Aluminium (filtered)	M22-De0057627	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Antimony	M22-De0057798	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Antimony (filtered)	M22-De0057627	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Arsenic	M22-De0057798	NCP	mg/L	0.012	0.011	8.8	30%	Pass	
Arsenic (filtered)	M22-De0057627	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Barium	M22-De0057798	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
Barium (filtered)	M22-De0057616	NCP	mg/L	0.03	0.02	2.1	30%	Pass	
Cadmium	M22-De0057798	NCP	mg/L	< 0.0002	< 0.0002	<1	30%	Pass	
Cadmium (filtered)	M22-De0057627	NCP	mg/L	< 0.0002	< 0.0002	<1	30%	Pass	
Chromium	M22-De0057798	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Chromium (filtered)	M22-De0057627	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Cobalt	M22-De0057798	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Cobalt (filtered)	M22-De0057627	NCP	mg/L	0.002	0.002	3.6	30%	Pass	
Copper	M22-De0057798	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Copper (filtered)	M22-De0057627	NCP	mg/L	0.005	0.005	2.5	30%	Pass	
Iron	M22-De0057798	NCP	mg/L	0.14	0.13	4.0	30%	Pass	
Iron (filtered)	M22-De0057627	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Lead	M22-De0057798	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Lead (filtered)	M22-De0057627	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Manganese	M22-De0057798	NCP	mg/L	0.009	0.009	1.2	30%	Pass	
Manganese (filtered)	M22-De0057627	NCP	mg/L	0.061	0.060	2.7	30%	Pass	
Molybdenum	M22-De0057798	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	

Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Molybdenum (filtered)	M22-De0057627	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Nickel	M22-De0057798	NCP	mg/L	0.001	0.001	11	30%	Pass	
Nickel (filtered)	M22-De0057627	NCP	mg/L	0.002	0.003	21	30%	Pass	
Selenium	M22-De0057798	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Selenium (filtered)	M22-De0057627	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Strontium	M22-De0057798	NCP	mg/L	0.10	0.10	2.4	30%	Pass	
Strontium (filtered)	M22-De0057616	NCP	mg/L	0.010	0.016	47	30%	Fail	Q15
Titanium	M22-De0057798	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Titanium (filtered)	M22-De0057627	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Uranium	M22-De0057798	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Uranium (filtered)	M22-De0057627	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Vanadium	M22-De0057798	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Vanadium (filtered)	M22-De0057627	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Zinc	M22-De0057798	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Zinc (filtered)	M22-De0057627	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Duplicate									
Eurofins Suite B11C: Na/K/Ca/Mg				Result 1	Result 2	RPD			
Calcium	M22-De0057623	NCP	mg/L	25	25	1.4	30%	Pass	
Magnesium	M22-De0057623	NCP	mg/L	26	26	1.7	30%	Pass	
Potassium	M22-De0057623	NCP	mg/L	1.5	1.5	<1	30%	Pass	
Sodium	M22-De0057623	NCP	mg/L	3.6	3.4	3.6	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
Q15	The RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.

Authorised by:

Zoe Flynn	Analytical Services Manager
Caitlin Breeze	Senior Analyst-Inorganic
Mary Makarios	Senior Analyst-Inorganic
Mary Makarios	Senior Analyst-Metal
Scott Beddoes	Senior Analyst-Inorganic

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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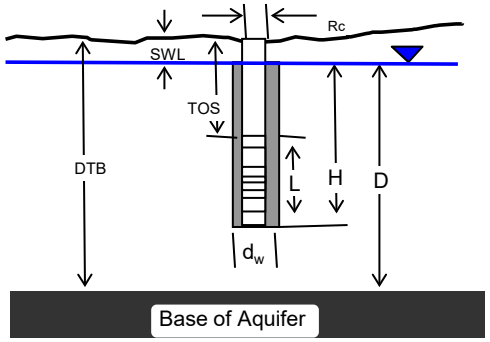
ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

APPENDIX J: GROUNDWATER SLUG TESTS AND MODELLING OUTPUT

THGW005 - 1

Parameters		Jacob Approximation		Hvorslev		Bouwer & Rice			
		*T = 2.3Q/4*pi*delta s*		*To=(ln(0.37/E)/F*		*Full Screen Saturation*		*Partial Screen Saturation*	
Bore depth (m)	42.9	slope	-0.182	E	1.0029	Le/R	160	A	5.6
Static WL (m)	15.77			F	0.0072	C	6	B	1
Hydraulic gradient (m/m)	0.038					Ho	5.8507	ln (Re/R)	#NUM!
Aquifer thickness (b,m)	**10**	**delta S**	-0.4191			Ht	6.3009		
Screen (Le) (m)	12	**S**	5.00E-05	To	-138.493	t	10.00		
Screen (sat) (Lw) (m)	12.00	**KD (m2/d)**	-0.629	**KD (m2/d)**	-0.825	**KD (m2/d)**	-0.656	**KD (m2/d)**	#NUM!
Bore radius (R) (m)	0.075	**K (m/d)**	**-0.0629**	**K (m/d)**	**-0.082**	**K (m/d)**	**-0.066**	**K (m/d)**	**#NUM!**
Effective porosity	**0.1**	**v (m/d)**	-0.023899	**v (m/d)**	-0.031332	**v (m/d)**	-0.024930	**v (m/d)**	#NUM!
Casing diameter (m)	0.05	**v (m/year)**	-8.723	**v (m/year)**	-11.436	**v (m/year)**	-9.099	**v (m/year)**	#NUM!
Q (m3/d)	**1.440**								
Pumping rate (L/min)	**1.000**								
log(Le/R)	**2.2**								

Note:
Bouwer & Rice should be equal or less than Hvorslev
Underlined are presumed data
When the bore is partially saturated (SWL<Le), the screen (Le) for Bower & Rice is Lw



	0.05	0.05
slope	0.019000	0.500

THGW005.2

Parameters

Bore depth (m)	42.9
Static WL (m)	15.77
Hydraulic gradient (m/m)	0.038
Aquifer thickness (b,m)	**10**
Screen (Le) (m)	12
Screen (sat) (Lw) (m)	12.00
Bore radius (R) (m)	0.075
Effective porosity	**0.1**
Casing diameter (m)	0.05
Q (m3/d)	1.440
Pumping rate (L/min)	**1.000**
log(Le/R)	2.2

Jacob Approximation

*T = 2.3Q/4*pi*delta s*

slope	0.6359

delta S	1.4642
S	5.00E-05
KD (m2/d)	0.180
K (m/d)	**0.0180**
v (m/d)	0.006840
v (m/year)	2.497

Hvorslev

To=(ln(0.37/E)/F

E	0.9948
F	-0.008

To	123.630
KD (m2/d)	0.924
K (m/d)	**0.092**
v (m/d)	0.035099
v (m/year)	12.811

Bouwer & Rice

Full Screen Saturation

Le/R	160
C	6
Ho	20.2804
Ht	18.5838
t	10.00

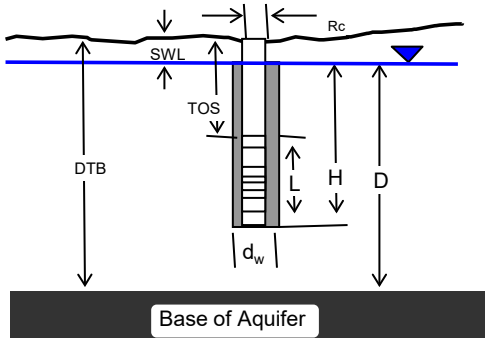
KD (m2/d)	0.773
K (m/d)	**0.077**
v (m/d)	0.029380
v (m/year)	10.724

Partial Screen Saturation

A	5.6
B	1
ln (Re/R)	#NUM!

KD (m2/d)	#NUM!
K (m/d)	**#NUM!**
v (m/d)	#NUM!
v (m/year)	#NUM!

Note:
Bouwer & Rice should be equal or less than Hvorslev
Underlined are presumed data
When the bore is partially saturated (SWL<Le), the screen (Le) for Bower & Rice is Lw



THGW005.3

Parameters

Bore depth (m)	42.9
Static WL (m)	15.77
Hydraulic gradient (m/m)	0.038
Aquifer thickness (b,m)	**10**
Screen (Le) (m)	12
Screen (sat) (Lw) (m)	12.00
Bore radius (R) (m)	0.075
Effective porosity	**0.1**
Casing diameter (m)	0.05
Q (m3/d)	**1.440**
Pumping rate (L/min)	**1.000**
log(Le/R)	**2.2**

Jacob Approximation

*T = 2.3Q/4*pi*delta s*

slope	0.5214
delta S	1.2006
S	5.00E-05
KD (m2/d)	0.220
K (m/d)	**0.0220**
v (m/d)	0.008342
v (m/year)	3.045

Hvorslev

To=(ln(0.37/E)/F

E	0.998
F	-0.007
To	141.750
KD (m2/d)	0.806
K (m/d)	**0.081**
v (m/d)	0.030612
v (m/year)	11.173

Bouwer & Rice

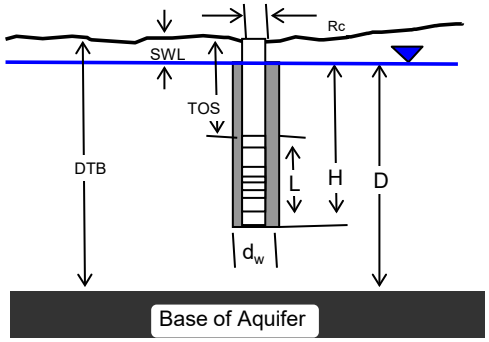
Full Screen Saturation

Le/R	160
C	6
Ho	17.9033
Ht	16.6525
t	10.00
KD (m2/d)	0.641
K (m/d)	**0.064**
v (m/d)	0.024356
v (m/year)	8.890

Partial Screen Saturation

A	5.6
B	1
ln (Re/R)	#NUM!
KD (m2/d)	#NUM!
K (m/d)	**#NUM!**
v (m/d)	#NUM!
v (m/year)	#NUM!

Note:
Bouwer & Rice should be equal or less than Hvorslev
Underlined are presumed data
When the bore is partially saturated (SWL<Le), the screen (Le) for Bower & Rice is Lw



THGW006.1

Parameters

Bore depth (m)	31.0
Static WL (m)	18.73
Hydraulic gradient (m/m)	0.236
Aquifer thickness (b,m)	**10**
Screen (Le) (m)	12
Screen (sat) (Lw) (m)	12.27
Bore radius (R) (m)	0.075
Effective porosity	**0.1**
Casing diameter (m)	0.05
Q (m3/d)	**115.2**
Pumping rate (L/min)	**80.000**
log(Le/R)	**2.2**

Jacob Approximation

*T = 2.3Q/4*pi*delta s*

slope	-1.14

delta S	-2.6249
S	5.00E-05
KD (m2/d)	-8.032
K (m/d)	**-0.8032**
v (m/d)	-1.895666
v (m/year)	-691.918

Hvorslev

To=(ln(0.37/E)/F

E	1.0435
F	-0.083

To	12.492
KD (m2/d)	8.979
K (m/d)	**0.898**
v (m/d)	2.119100
v (m/year)	773.471

Bouwer & Rice

Full Screen Saturation

Le/R	163.6
C	6
Ho	-6.0315
Ht	-2.7976
t	10.00

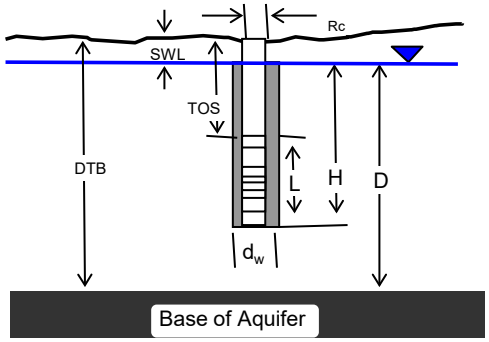
KD (m2/d)	6.824
K (m/d)	**0.682**
v (m/d)	1.610501
v (m/year)	587.833

Partial Screen Saturation

A	5.6
B	1
ln (Re/R)	#NUM!

KD (m2/d)	#NUM!
K (m/d)	**#NUM!**
v (m/d)	#NUM!
v (m/year)	#NUM!

Note:
Bouwer & Rice should be equal or less than Hvorslev
Underlined are presumed data
When the bore is partially saturated (SWL<Le), the screen (Le) for Bower & Rice is Lw



THGW006.2

Parameters

Bore depth (m)	31.0
Static WL (m)	18.73
Hydraulic gradient (m/m)	0.236
Aquifer thickness (b,m)	**10**
Screen (Le) (m)	12
Screen (sat) (Lw) (m)	12.27
Bore radius (R) (m)	0.075
Effective porosity	**0.1**
Casing diameter (m)	0.05
Q (m3/d)	**115.20**
Pumping rate (L/min)	**80.000**
log(Le/R)	**2.2**

Jacob Approximation

*T = 2.3Q/4*pi*delta s*

slope	-1.383

delta S	-3.1845
S	5.00E-05
KD (m2/d)	-6.621
K (m/d)	**-0.6621**
v (m/d)	-1.562588
v (m/year)	-570.345

Hvorslev

To=(ln(0.37/E)/F

E	1.0467
F	-0.084

To	12.380
KD (m2/d)	9.061
K (m/d)	**0.906**
v (m/d)	2.138316
v (m/year)	780.485

Bouwer & Rice

Full Screen Saturation

Le/R	163.6
C	6
Ho	-5.5242
Ht	-2.4347
t	10.00

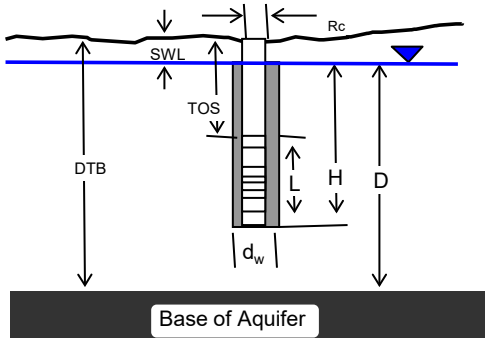
KD (m2/d)	7.278
K (m/d)	**0.728**
v (m/d)	1.717585
v (m/year)	626.919

Partial Screen Saturation

A	5.6
B	1
ln (Re/R)	#NUM!

KD (m2/d)	#NUM!
K (m/d)	**#NUM!**
v (m/d)	#NUM!
v (m/year)	#NUM!

Note:
Bouwer & Rice should be equal or less than Hvorslev
Underlined are presumed data
When the bore is partially saturated (SWL<Le), the screen (Le) for Bower & Rice is Lw



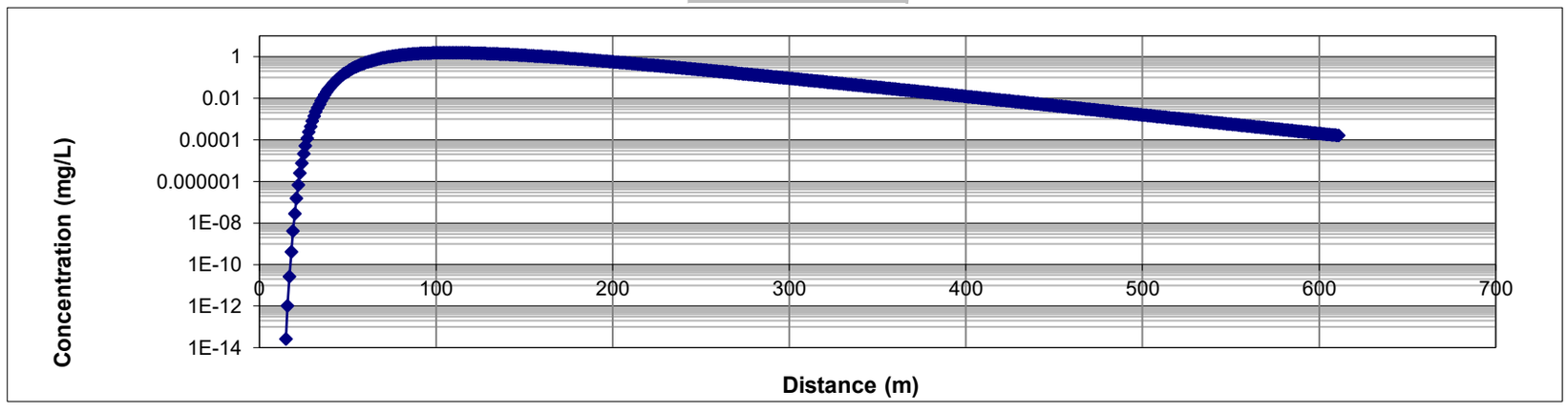
Project: 722092 Tick Hill
Scenario: Migration from tailings dam
Chemical of concern: Cyanide
Model Source: Domenico 1987

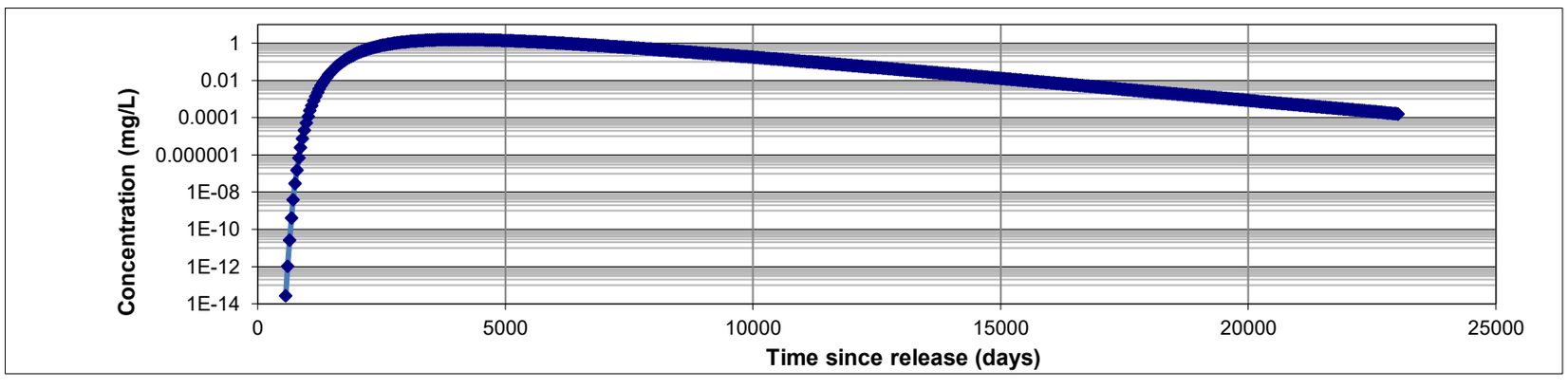
Introduction:

As contaminated groundwater flows through the environment the actual rate of contaminant migration will be affected by diffusion, advestion and retardation. The acual concentrations of the pollutant generally reduces with distance from the source as a result of various attenuation factors. These include hydrodynamic dispersion and biological or chemical breakdown. This model is a three dimentional steady state model. As such it presumes an ongoing source. If the source has actually diminished with time or has been remediated then application of this model would be ultra conservative and an instantaneous point source model would be more appropriate. However as remediation at this site has not yet occured and there may be residual sources we feel this model is applicable.
The model calculated an attenuation factor based on the ratio of the modeled concentration at some distance from the source, with the inital concentration at the source. When the criteria at the receptor (abstraction well, river or in this case river bank) is multiplied by the attenuation factor a groundwater criteria can be derived for groundwater at the centre of the plume.

$$C(x,y,z,t) = \frac{C_0}{8}\exp\left\{\left(\frac{x}{2\alpha_x}\right)\left[1-\sqrt{\left(1+\frac{4\lambda\alpha_x}{v}\right)}\right]\right\}\mathrm{erfc}\left[\frac{x-vt\sqrt{(1+4\lambda\alpha_x/v)}}{\sqrt{2(\alpha_x vt)}}\right]\left\{\mathrm{erf}\left[\frac{(y+Y/2)}{2\sqrt{(\alpha_y x)}}\right]-\mathrm{erf}\left[\frac{(y-Y/2)}{2\sqrt{(\alpha_y x)}}\right]\right\}\left\{\mathrm{erf}\left[\frac{(z+Z)}{2\sqrt{(\alpha_z x)}}\right]-\mathrm{erf}\left[\frac{(z-Z)}{2\sqrt{(\alpha_z x)}}\right]\right\}$$

Model Inputs	**Value**	**Units**	**Source/notes**
Aquifer parameters			
Aquifer Thickness (H)	25	m	KD = 17.5 m2/d
Hydraulic conductivity (K)	0.07	m/day	THGW005
Effective porosity (θ)	0.1	fraction	
Hydraulic gradient (i)	0.038	fraction	
Aquifer bulk density (ρb)	2.385	g/cm3	ρb=(1-θ)*2.65
Groundwater velocity (v)	0.027	m/day	v=K*(i/θ), Vg = 6.94 m/y
Fraction of organic carbon (foc)	0.0001	fraction	
	9.71	m/yr	
Contaminant parameters			
Chemical of concern	Cyanide		
Source concentration	350	mg/L	Concentration of cyanide in tailings at source at time of placement (E&ES 1990)
Source width (Y)	250	m	Area of impact
Vertical thickness of contamination (Z)	5	m	
Time since release (t)	10950	day	1993 - 30 years
Organic matter sorption coefficient (Koc)	1	L/kg	Concawe
Partition coefficient (Kd)	0.0001	cm3/g	Kd=Koc*foc
Retardation factor (R)	1.002	fraction	R=1+(ρb/θ)*Kd
Contaminant Velocity (v_s)	0.02654	m/day	v_s=v/R = 6.8 m/y
Biodegradation half-life	1.00E+03	days	Worst' case
Biodegradation rate constant (λ)	6.93E-04	$days^{-1}$	λ=ln(2)/Biodegradation half-life
	9.69	m/yr	
Scenario parameters			
Receptor	THGW008		Ecosystem/ Drinking
Allowed Conc. at Receptor	0.88	mg/L	observed concentration
Longitudinal Distance to Receptor along centreline (x)	200	m	Ephemeral watercourse
Lateral Distance to Receptor (Perpendicular to centreline (y)	0	m	0 = no offset and so result is at maximum
Vertical Distance to Receptor (z)	10	m	0 = no offset and so result is at maximum
Model Outputs			
Distance till contamination difuses to at base of aquifer (x')	6446	metres	approximation x'=((H-Z)^2)/αz
Time for groundwater to reach receptor	7537	days	
	21	years	
Scenario at steady state?	yes		At the receptor
Concentration at Receptor	0.565	mg/L	Based on current source concentration
Attenuation Factor at Receptor	1.61E-03	fraction	Max Conc. At Receptor/C_0
Site Remediation Target	545.5064	mg/L	To achieve allowed concentration at receptor





APPENDIX E TICK HILL HYDROGEOLOGICAL MODEL

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

HYDROGEOLOGICAL MODEL: TICK HILL GOLD MINE, QLD

TICK HILL MINING PTY LTD

21 JANUARY 2025
724050
VERSION 1

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

21 January 2025

Tick Hill Mining Pty Ltd
PO Box 2452
Mount Isa QLD 4825

Attention: **David Rutherford**
Manager

Dear David

Hydrogeological Model for PRCP; Tick Hill Gold Mine, Dajarra, QLD

Please find enclosed a copy of our report entitled as above. Thank you for the opportunity to undertake this work.

Should you have any queries, please do not hesitate to contact us on (07) 3852 6666.

For and on behalf of
Environmental Earth Sciences QLD

Project Manager
Dr Anna Sheldon
Principal Scientist

Project Director / Internal Reviewer
Mark Stuckey
Senior Principal Scientist

724050 V1

EXECUTIVE SUMMARY

Introduction and objectives

Environmental Earth Sciences QLD was commissioned by Tick Hill Mining Ptd Ltd to develop a hydrogeological model for Tick Hill Gold Mine, Dajarra, Queensland (the site). The site occupies mining leases ML7094, 7096 and 7097 and is located approximately 40 km south of Duchess and 140 km southeast of Mount Isa. The site covers an area of approximately 390 hectares (ha).

The investigation was required to meet the requirements of the progressive rehabilitation and closure plan (PRCP), specifically in response to a request for information (RFI) issued by the Department of Environment, Science and Innovation (DESI) in relation to the long-term pit water balance and pit water quality. The site is currently non-operational, however was previously an operational gold mine between 1990 and 1994 and tailings have been extracted for reprocessing between 2020 and 2022. The site is managed under Environmental Authority EPML00820613.

The objectives of the development of the hydrogeological model include the following:

- To use an analytical approach to determine the relationship between the mine pit and the surrounding aquifer in the long-term, including under extreme conditions;
- To determine the long-term water quality of the pit lake; and
- To determine whether there is any potential for the pit lake to impact on nearby sensitive receptors.

Findings

The findings of the development of a hydrogeological model of the pit lake at Tick Hill can be summarised as follows:

- The hydrogeological model indicates that the mine pit acts as a groundwater sink for the site, and will continue to do so under a wide range of climatic conditions.
- No plausible rainfall scenario was identified which raised the pit water level to either the level of the surrounding water-table, or to the top of the pit.
- The pit water level is controlled by the limited rainfall runoff due to the small catchment area around the pit.
- As the pit lake acts as a groundwater sink and evaporation dominates the water balance, salinity and associated dissolved ion and metal concentrations are predicted to increase over time. The expected pit salinity after 250 years was modelled at 28,000 mg/L TDS.
- Precipitation of calcite, dolomite and iron minerals is expected within the pit lake.
- No sensitive human or ecological receptors were identified that might be impacted by mine pit water quality.

Recommendations

Based on the hydrogeological model developed for the Tick Hill mine pit, the following recommendations are made:

- That the pit continue to be fenced to prevent access by visitors or stock.
- That the pit catchment continue to be controlled so that runoff inflow is limited.
- That pit water not be extracted for beneficial use without testing to determine its suitability for that use. Extracted pit water should not be discharged to watercourses.

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1 INTRODUCTION

Environmental Earth Sciences QLD was commissioned by Tick Hill Mining Ptd Ltd to develop a hydrogeological model for Tick Hill Gold Mine, Dajarra, Queensland (the site). The site occupies mining leases ML7094, 7096 and 7097 and is located approximately 40 km south of Duchess and 140 km southeast of Mount Isa. The site covers an area of approximately 390 hectares (ha).

The investigation was required to meet the requirements of the progressive rehabilitation and closure plan (PRCP), specifically in response to a request for information (RFI) issued by the Department of Environment, Science and Innovation (DESI) in relation to the long-term pit water balance and pit water quality. The site is currently non-operational, however was previously an operational gold mine between 1990 and 1994 and tailings have been extracted for reprocessing between 2020 and 2022. The site is managed under Environmental Authority EPML00820613.

2 OBJECTIVES

The objectives of the development of the hydrogeological model include the following:

- To use an analytical approach to determine the relationship between the mine pit and the surrounding aquifer in the long-term, including under extreme conditions;
- To determine the long-term water quality of the pit lake; and
- To determine whether there is any potential for the pit lake to impact on nearby sensitive receptors.

3 SCOPE OF WORK

In order to achieve our objective, Environmental Earth Sciences has identified that the scope of works will comprise the following:

- Long-term pit water quality model:
    - The previous salt balance for the pit included calibration of the potential range of groundwater inflows together with groundwater salinity.
    - The pit water quality model will be updated for a period of 250 years into the future, with consideration of groundwater inflows (including typical groundwater chemistry and seepage from the tailings storage facility [TSF]), evaporation, and mineral weathering of the pit walls.

    - Relevant inputs will include groundwater and pit water chemical results, mine geochemical information and waste rock weathering data.
    - The pit water quality model will include consideration of a subset of water level scenarios developed from the pit water balance below.
- Long-term pit water balance:
    - The previous pit water balance model predicted water levels for 50 years, based on a range of rainfall scenarios. This water balance model will be updated for a period of 250 years.
    - Climatic scenarios to be included in the model will be based on recently observed conditions (data from nearby weather stations), extremes of conditions observed at nearby weather stations, and predicted potential changes to regional climatic conditions over the modelled period.
    - Examine the potential behaviour of the pit as a source or sink of groundwater in relation to the surrounding landscape under the various climatic scenarios.
    - Also included in the model will be consideration of the influence of maximum extreme short-term events and whether these have the potential to cause the pit to act as a source zone for groundwater recharge (in response to DESI RFI Item 11).
- Preparation of a report detailing the works undertaken and recommendations for further investigation, management or remediation works (if required).

4 SITE SETTING

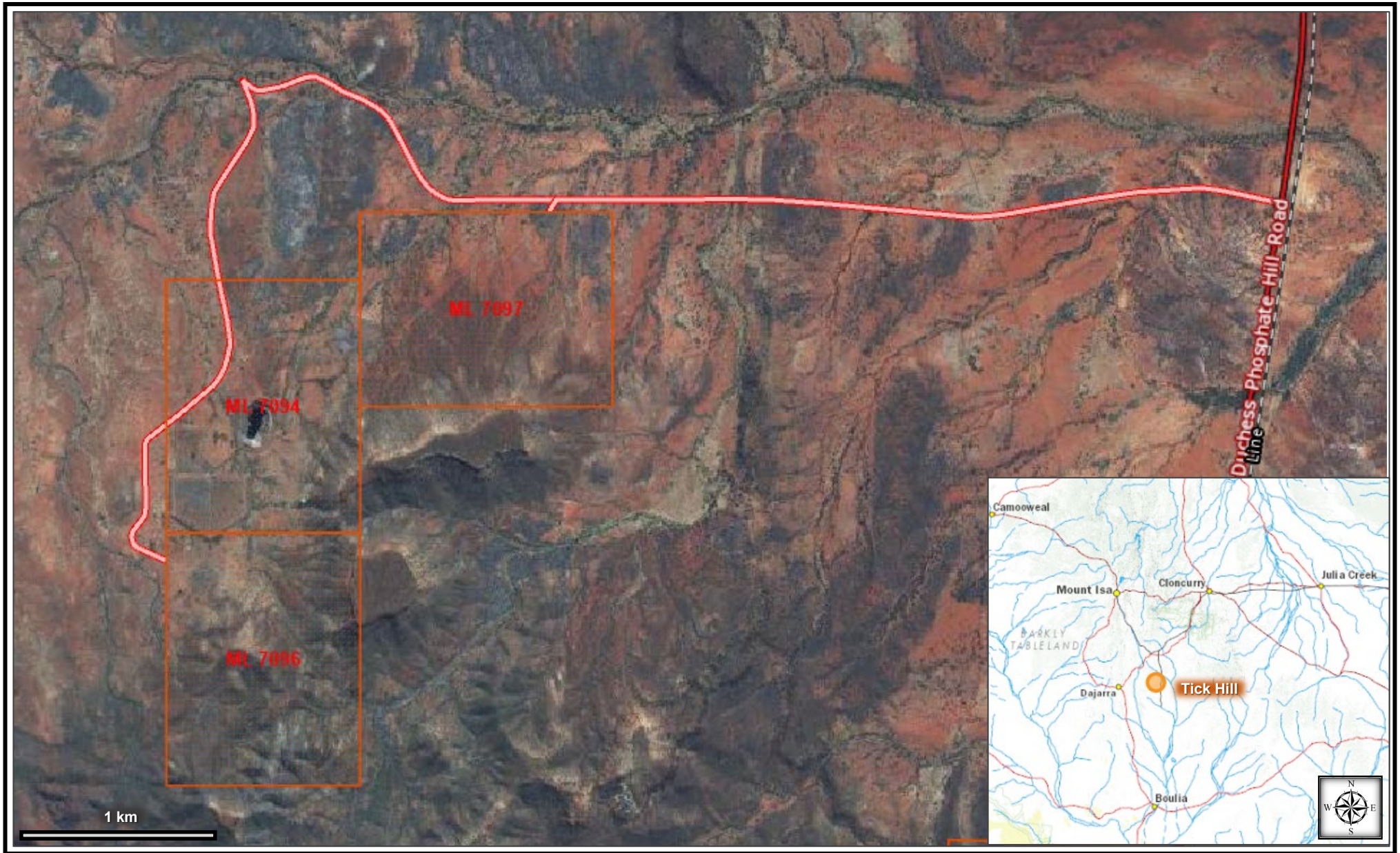
4.1 Site identification

Site identification details are provided in **Table 1**. A plan of the regional locality of the site, along with site lot configuration is provided in **Figure 1**. **Figure 2** presents the site layout, investigation area and surrounding land-use, including the layout during operations.

4.2 Site description and layout

The site is located approximately 40 km south of the locality of Duchess, and approximately 140 km southeast of Mount Isa. Tick Hill is accessed via the Duchess Phosphate Hill Road which runs north-south 5 km to the east of the site.

The site is currently comprised of the former mine features including the flooded open pit, the tailings and decant dams and the waste rock dump. Site features are shown on **Figure 2**. Also present are the water supply tank, located on the hill to the east of site and the core yard, located south of the waste rock dump (WRD). Adjacent to the core yard are shipping containers for storage of maintenance equipment. Almost all other mining infrastructure from the original operations has been removed from site.



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Base map QLD Globe (DNRM, 2023)

Title: Site Location – Tick Hill Mine Leases and Site Location

Location: Tick Hill Mine, QLD

Client: Tick Hill Mining Pty Ltd | Drawn By: A Sheldon | Date: May 2023

Figure 1

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Base map Google Earth (November 2022)

Title: Site Layout
Inset – mine layout during operations

Client: Tick Hill Mining Pty Ltd | Drawn By: A Sheldon | Date: June 2023

Location: Tick Hill Mine, QLD

Figure 2

Table 1: Site Identification

Item	Details
Site Owner	Tick Hill Mining Pty Ltd
Address	Tick Hill Gold Mine, Dajarra, QLD
Mine leases	ML7094, ML7096, ML7097
Lot & Plan number	Lot 13 on SP309109 (part), Lot 16 on SP309110 (part)
Area (Mining lease)	390 ha lease area + 8.5 km road access
Zoning	Rural – Extractive and Mineral Resource
Current land use	Non-operational gold mine
Proposed future land use	Rehabilitated mining land
Local Government Authority	Cloncurry Shire
Coordinates (site centre)	-21.64645 Lat, 139.92561 Long
Site Location and Layout	**Figure 1 and Figure 2**

The former site layout is shown in **Figure 3** below. This aerial photograph shows the open pit (centre), tailings and decant dam to the right (south) and WRD on the left (north). Also evident is the processing plant and mine operations to the east of the tailings dams.

Recent tailings re-working has included stripping and excavation of the eastern tailings cell. Cover material and some of the tailings are stockpiled on the western tailings cell. Some tailings material has been removed from site. Equipment involved in the tailings re-working project is present on and about the tailings cells, including screening and processing plant, pumps and pipe.

For the purposes of clarity in further discussion regarding site setting or nearby activities, distances as shown on **Figure 4** are taken from the Tick Hill mine pit.

4.3 Surrounding land use

The following adjacent land uses were observed at the time of the site inspection and based on the desktop assessment:

- North: Low density grazing land. The former Trekelano Copper mine is located 19 km to the north;
- South: Low density grazing land. The Monument / Phosphate Hill mine, airstrip and village are located 12 – 26 km south of the site;
- East: Low density grazing land, Duchess Phosphate Hill Road and the Phosphate Hill branch line of the Mount Isa Railway; and
- West: Low density grazing land.

Surrounding land uses are shown on **Figure 2**. Nearby mining and exploration leases are shown on **Figure 4**.

Figure 3: Aerial photograph of site during operations (from west to east)

4.4 Environmentally Relevant Activities

The site is managed under Environmental Authority (EA) EPML00820613 for the following Environmentally Relevant Activities (ERAs):

- Resource Activity, Schedule 3, 21: A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20 (ML7094, ML7096 and ML7097);
- Ancillary, Schedule 2, 31: Mineral processing 2(a) - Processing, in a year, the following quantities of mineral products, other than coke – 1,000t to 100,000t (ML7094); and
- Ancillary, Schedule 2, 60 – Waste Disposal 2: Operating a facility for disposing of, in a year, the following quantity of waste mentioned in subsection (1)(b)(a) less than 2,000 t (ML7094).

The EA is held by Tick Hill Mining Pty Ltd.

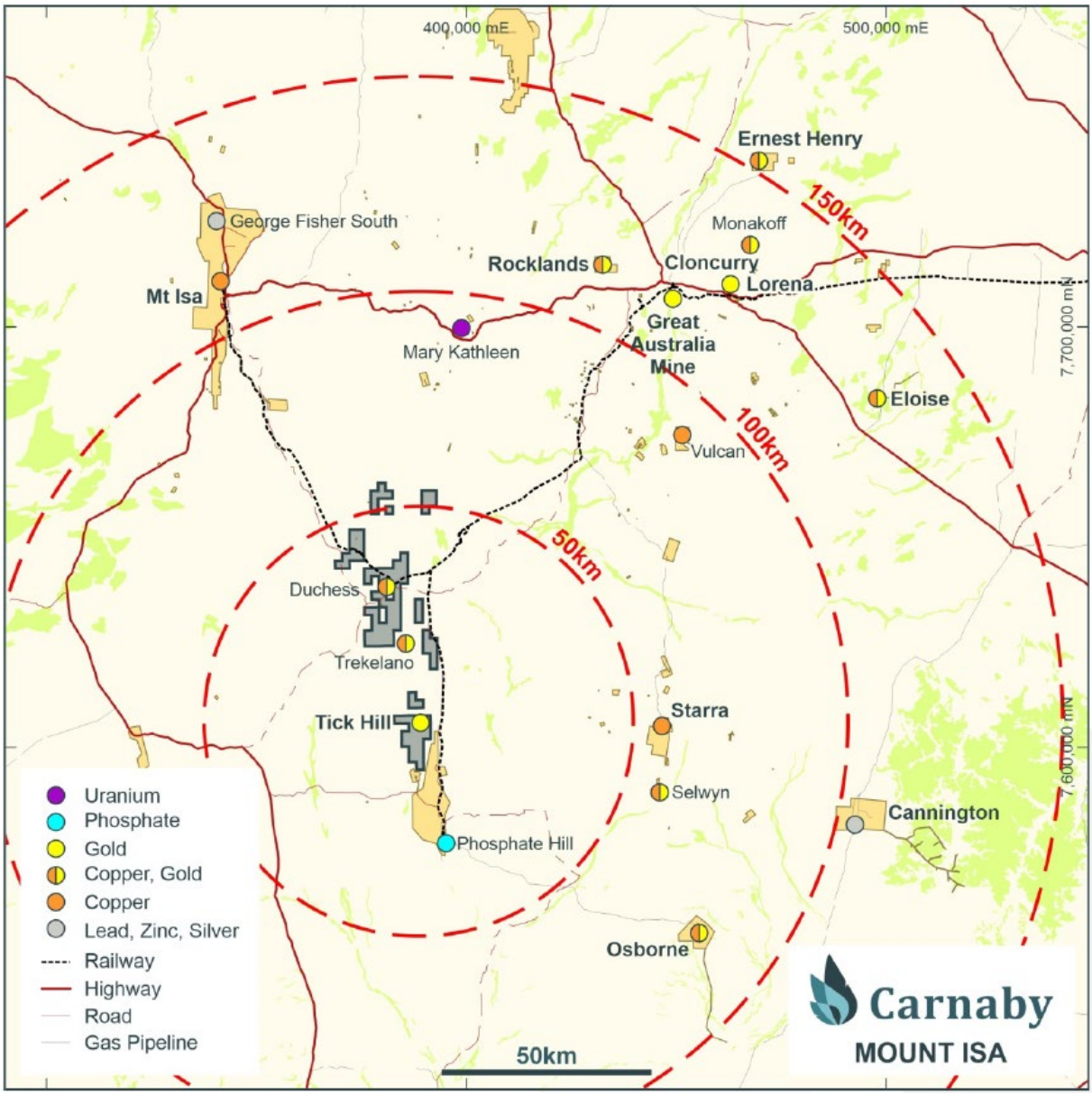
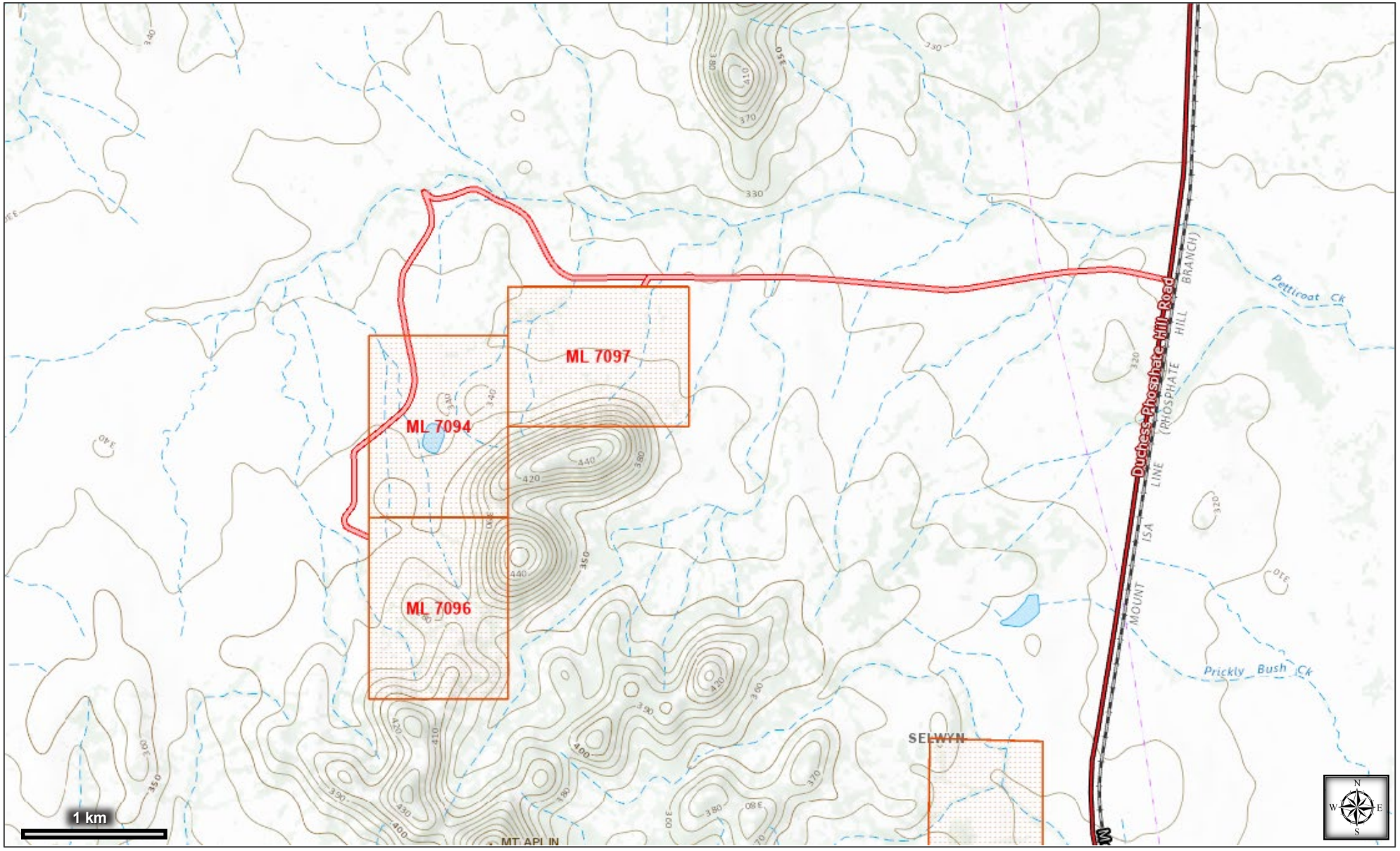


Figure 4: Mining and exploration leases within 150 km of the site

5 SITE ENVIRONMENTAL SETTING

5.1 Topography and vegetation

The regional topography is described as gently rolling to hilly terrain with flat top mesas. The site's elevation within the lease areas ranges from 320 to 450 m Australian Height Datum (mAHD) although the former operational areas of the site were between 320 and 360 mAHD (**Figure 5**). The site slopes gently to the northwest, bound by steep hills to the southeast.



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Base map QLD Globe (DNRM, 2023)
Contour interval 10 m

Title: 1:100,000 Topography and surface water bodies

Location: Tick Hill Mine, QLD

Client: Tick Hill Mining Pty Ltd

Drawn By: A Sheldon

Date: May 2023

Figure 5

Vegetation at the site consists of regrowth open woodlands, shrubs and grasses. Vegetation type are typically described as low open woodlands dominated by Eucalyptus leucophylla (Cloncurry box) or less extensively Corymbia terminalis (long-fruited bloodwood), low open woodlands and related associations, mainly lower slopes and valleys. Open plains to the west are described as Tussock grasslands dominated by Astrebla spp. (Mitchell grass) or Dichanthium spp. (bluegrass) often with Iseilema spp. on undulating downs or clay plains.

An aerial photograph from the time of site operations indicates that the site was extensively cleared, with topsoil scraped around the tailings dams. Recent site observations indicate that site vegetation has recovered well, particularly along drainage lines and in sheltered areas, and that significant weed infestation has not occurred.

5.2 Surface water drainage and hydrology

The site is drained by several ephemeral watercourses which flow to the north and northwest. These join the larger ephemeral watercourse Petticoat Creek around 1.5 km downstream. Petticoat Creek drains the area surrounding the mine and flows east into the Burke River which flows south into the Georgina River and into Lake Eyre. Watercourses are shown on **Figure 5**.

On site water bodies include the open pit, which has partially refilled to form a permanent water body. Part of the eastern tailings cell which has been excavated for tailings reclamation also intermittently holds water.

Ephemeral watercourses at the site are potentially losing streams which contribute to groundwater recharge.

5.2.1 Surface water environmental values

Surface water quality is managed according to the Environmental Protection (Water and Wetland Biodiversity Protection) Policy 2019 (EPP[WWD] 2019). The site is located within the Lake Eyre Basin, for which water quality objectives (WQOs) have not yet been nominated. When assessing the environmental values (EVs) for the site and surrounds, site and regional conditions, observed land uses and proximity of human and environmental receptors is considered.

Relevant environmental values are presented in **Table 2**. Relevant assessment guidelines have been adopted with consideration of these environmental values.

Where groundwaters interact with surface waters, groundwater quality should not compromise identified EVs and WQOs for those waters.

The pit lake is not utilised for water supply for any purpose. The pit lake is not accessible due to partial collapse of the northwestern section of the pit wall.

Table 2: Environmental Values for water

Environmental Value	Surface Water	Applicability	
		Water courses	Pit lake
Aquatic Ecosystems	While all water courses at or near the site are ephemeral, surface water quality is important to maintaining these ecosystems. Due to the regional land use for grazing, ephemeral waterways would be considered slightly to moderately disturbed. No mapped riverine aquatic conservation areas occur within the vicinity of the site. The site is mapped as having low conservation significance.	**Yes**	No
Irrigation	No irrigated agriculture occurs in the vicinity of the site	No	No
Farm Supply use	Farm Supply within this area is primarily for stock watering. Occupied residential properties are located 17 km and 23 km from site (see drinking water below).	**Yes**	No
Stock Water	Stock will utilise available surface water.	**Yes**	No
Aquaculture	Surface water in the area is not used for aquaculture.	No	No
Human Consumer	Surface water in the area is not used for the production of food.	No	No
Primary Recreation	Surface water in the area is highly ephemeral; the area is very isolated from common human recreational pursuits and is not used for primary, secondary or visual recreational use.	No	No
Secondary Recreation		No	No
Visual Recreation		No	No
Drinking water	The nearest residences are located approximately 17 km to the SE and 23 km W, both adjoining significant waterways isolated from the Petticoat Creek system. Therefore, no drinking water is sourced in the vicinity of the site, nor would site activities impact local surface waters at these locations.	No	No
Industrial Use	There are numerous mining operations in the region, but none within 30 km of the site. It is therefore no considered possible that site activities would impact on surface water at other mines. Site water supply is sourced from a borefield 15 km E.	No	No
Cultural, Spiritual and Ceremonial Values	There are no known environmental values in relation to cultural and spiritual values of surface water in the vicinity of the site.	No	No

5.2.2 Flood risk

No flood risk has been identified at the site. The pit catchment does not receive flow from any nearby watercourses.

5.3 Regional geology

The surface geology (1:100,000 scale) underlying the site is classified as the Corella Formation, Paleoproterozoic aged (2500 to 1600 MYA) Calcareous siltstone, sandstone and minor limestone, passing into calc-silicate granofels, commonly scapolitic, and marble; local quartzose sandstone passing into quartzite; local breccia; minor amphibolite.

The flat top hills which rise to the southeast of the site are capped by the Mount Birnie beds, which are comprised of Neoprotozoic to early Cambrian aged massive ferruginous sandstone, cross-bedded sandstone, conglomerate, red and green shale, mudstone and dolomite; basal tillite, and middle Cambrian aged Thorntonia Limestone with laterite cap.

5.4 Hydrogeology

5.4.1 Registered bore search

A search was undertaken of registered groundwater bores within a 5 km radius of the site using (QldGlobe May 2023). A summary is presented in **Table 3** and bore reports are provided in **Appendix A**.

5.4.2 Aquifers and aquitards

Based on bore logs from the site, groundwater is found in fractured and weathered zones within the Proterozoic metasediments and igneous rocks of the Corella formation. Comparison of water strike and standing water levels (SWLs) indicates that the regional aquifer is semi-confined to confined. Granofels typically has little to no primary porosity. Groundwater flow will therefore mainly occur through secondary porosity including fractures and weathering, and more porous interbedded layers.

Aquifer yield would be expected to be low. Occasional high flow zones may be encountered however lack of connectivity (effective porosity, specific storage or specific yield) within the aquifer means that sufficient long-term yield to supply a production bore or water supply is unlikely.

Groundwater is neutral to slightly alkaline and moderately to highly saline. Water chemistry is dominated by sodium and magnesium, and bicarbonate and chloride.

Within the landscape around Tick Hill, groundwater recharge areas are likely to be located in the ephemeral watercourses, and the limestone capped hills to the southeast.

5.4.3 Groundwater dependent ecosystems

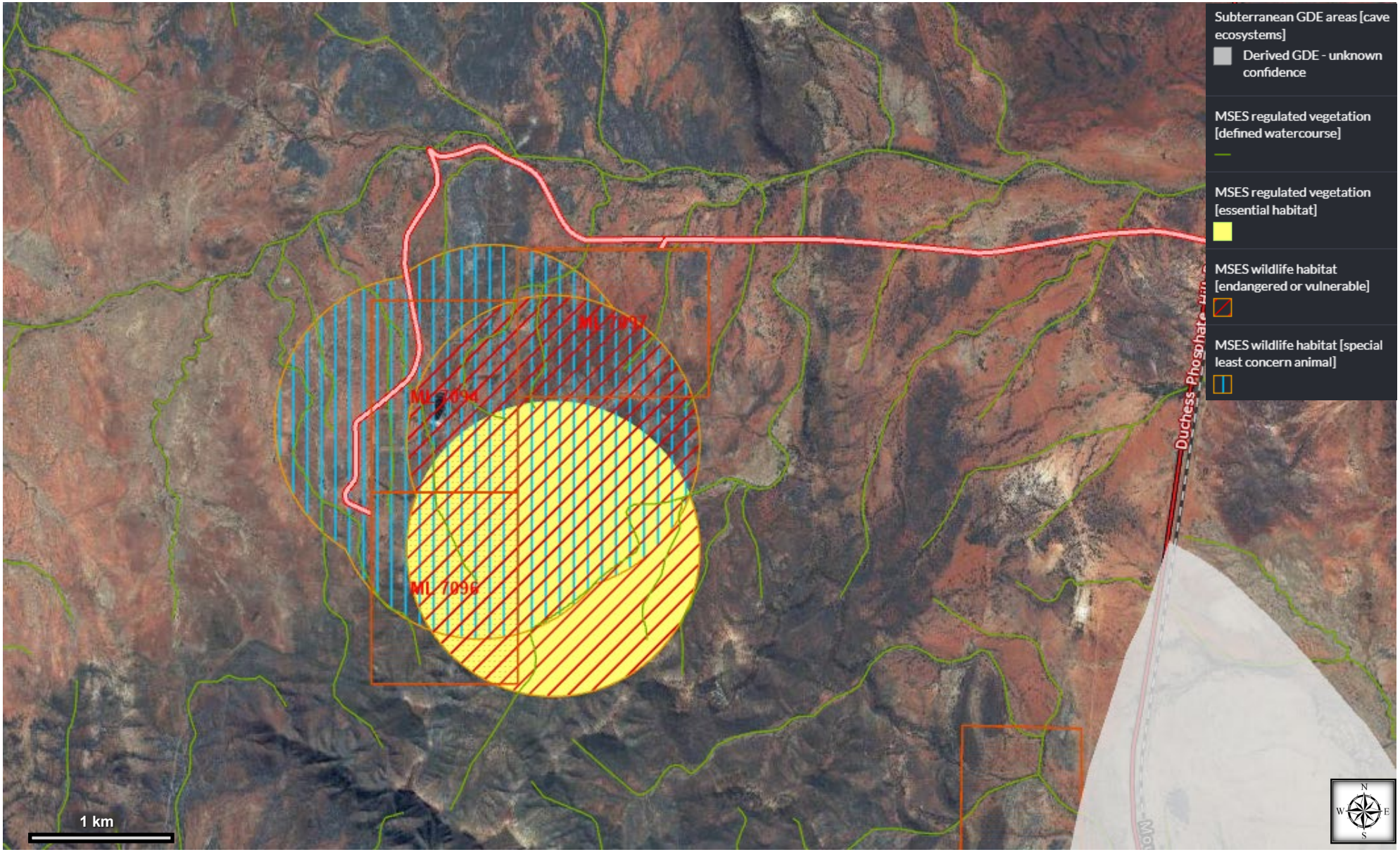
With reference to Groundwater Dependent Ecosystems (GDE) mapping (QldGlobe 2023) the site does not contain a GDE.

The closest off-site GDE is a cave ecosystem of the Devoncourt Limestone located 5 km to the southeast of the site. The GDE is described as a subterranean GDE of unknown confidence. The location of the GDE is shown on **Figure 6**.

Table 3: Registered groundwater bores

Bore ID	Direction from Site^	Distance from Site^ (km)	Installation date	Name	Depth (mbgl)	Screen (mbgl)	Water bearing zone (mbgl)	SWL (mbgl)	Aquifer lithology	Status	Use
RN5179	W	3.82	-	-	-	-	-	-	-	Abandoned & destroyed	Unknown
RN7550	E	5.55	1/1/1920	Prickley Bush Bore	68	Open from 64.9	64.9-68	30.5	Inca Formation	Abandoned & destroyed	Unknown
RN9277	W	0.66	-	-	-	-	-	-	-	Abandoned & destroyed	Unknown
RN184343	SW	0.61	11/1/2020	THGW003	40.5	28-40	30-32	18.7	Corella Formation Granite	Existing	Mine Monitoring
RN184344	S	0.95	11/1/2020	THGW005	42	29-41.5	31-32	18.7	Corella Formation Granite	Existing	Mine Monitoring
RN184345	E	0.16	11/1/2020	THGW006	30	17.5-29.5	20-30	18.5	Corella Formation Granite	Existing	Mine Monitoring
RN184353	N	4.19	11/1/2020	MBWB1	21	-	-	-	-	Abandoned & destroyed	Water supply
RN184352	NE	0.69	11/1/2020	THGW004	27.5	15-27	14.6-27	14.6	Corella Formation Granite	Existing	Mine Monitoring

Note: ^distance and direction taken from mine pit



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Base map QLD Globe (DNRM, 2023)
Contour interval 10 m

Title: Matters of State Environmental Significance & Groundwater Dependant Ecosystems

Client: Tick Hill Mining Pty Ltd | Drawn By: A Sheldon | Date: May 2023

Location: Tick Hill Mine, QLD

Figure 6

5.5 Climate and meteorology

Regional meteorological data has been sourced from the Bureau of Meteorology (BOM, 2024) (www.bom.gov.au, verified 10 September 2024). Due to the limited availability and continuity of data, several weather stations have been used. The Monument Airport weather station (037034 2000 – 2023), approximately 18 km from site has records since 2000. Mean maximum and minimum monthly temperatures and mean monthly rainfall recorded between 2000 and the present are presented in **Table 4**.

Evaporation is taken from climate data for Mount Isa Airport (029127, 1966 - 2023), presented in **Table 5**.

Annual rainfall data was sourced from Phosphate Hill (037106, 27 km S) and Devoncourt Station (029129, 62 km NNE) utilising data between 1994 and 2023. Summary data presented in **Table 6**.

Extreme event predictions were taken from the BOM 2016 Annual Exceedance Probability data for rare events, for the grid location of Tick Hill. AEP data are presented in the Tables Appendix.

Table 4: Average monthly climate data – The Monument (2000-2023)

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Max Temp (°C)	37.9	36.9	35.8	32.7	27.7	24.0	24.3	26.9	31.6	35.4	37.2	38.3
Min Temp (°C)	24.8	23.5	21.9	17.4	12.1	8.3	7.2	8.9	13.9	18.4	21.5	23.8
Rain (mm)	64.0	76.1	47.7	12.6	9.4	10.3	8.0	3.3	10.5	12.4	33.1	49.8

Table 5: Average monthly climate data – Mount Isa Airport (1966-2023)

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Ave Rain (mm)	64.0	76.1	47.7	12.6	9.4	10.3	8.0	3.3	10.5	12.4	33.1	49.8
Decile 9 Rain (mm)	241.8	208.4	171.4	40.6	26.8	23.2	16.1	8.4	26.3	59.3	78.1	152.2
Evaporation (mm/day)	9.6	8.9	8.9	8.3	6.4	5.3	5.5	6.9	8.9	10.5	11.0	10.5
Evaporation (mm/month)	297.6	249.2	275.9	249	198.4	159	170.5	213.9	267	325.5	330	325.5
Deficit	-233.6	-173.1	-228.2	-236.4	-189	-148.7	-162.5	-210.6	-256.5	-313.1	-296.9	-275.7

Table 6: Rainfall summary statistics – Phosphate Hill and Devoncourt Station

Station	Period	Annual Max	Annual Mean	Annual Median	Annual 10th percentile	Annual 90th percentile	Monthly Max
Devoncourt Station	1946 – 2024	1157.9	414.3	357.7	164.6	697.9	693.2
Phosphate Hill	1975 - 2024	663.3	320.5	263	142.5	557.3	388.5

5.6 Sensitive receptors

5.6.1 Sensitive human receptors

To identify sensitive human receptors, a review of the nearest sensitive land use, as defined in the *Planning Regulation 2017* (Queensland Government 2017), was undertaken. No sensitive land-uses or receptors were identified within a 500 m radius of the site.

5.6.2 Environmentally sensitive areas

With reference to the Department of Environment and Science 'Environmentally Sensitive Areas (ESA) Map' (see **Appendix B**), the nearest identified ESA to the site is the "Stanbroke Designated Landscape Area (DLA)". This area covers the former Lot 16 on CW62 and is classified as a declared Aboriginal Site under the Relicts Act 1971.

The Stanbroke DLA covers the western area of the site within Lot 16 on SP309110. The DLA is a Category C Environmentally Sensitive Area which extends approximately 70 km east-west and 54 km north-south and surrounds the township of Dajarra.

Four areas mapped as Matters of State Environmental Significance (MSES) occur at or adjacent to the site. These include:

- Essential Habitat: Regulated vegetation map category A or B which covers the limestone hills to the southeast of the mine;
- Wildlife habitat: special least concern, one or more special least concern taxa recorded in locality, which covers the mine and surrounds;
- Wildlife habitat: endangered or vulnerable, one or more critically endangered/ endangered/ vulnerable taxa recorded in the locality which covers the mine and surrounds; and
- Regulated vegetation: defined watercourse, which includes all watercourses within the mine lease area and surrounds.

A map showing the location of MSES in the vicinity of the mine is included as **Figure 6**.

6 MINE OPERATIONS

A detailed summary of site history was completed with the Environmental Site Assessment report (Environmental Earth Sciences 2023). That report includes a review of historical aerial photographs, site ownership, local and state government registers, previous reports and interviews with relevant persons. A limited extract is provided below with information relevant to development of the pit hydrogeological model.

6.1 Summary of Mine Operations 1993

A summary of mine operations is presented in the MIM Holdings Limited report (1993). At the time of this report the open pit had been mined and underground workings were under development. Schematics of the layout of the open cut and underground workings are shown in **Figures 7 and 8**.

The Tick Hill Gold Deposit was discovered in 1989 and open cut mining commence in 1991. Initially ore was transported off-site for processing. The open cut was 70 m deep and completed in 1992. While the open cut was mined, the infrastructure was under development for the underground mine. This included the vent shaft which joined each level of the underground mine, and the decline which runs off the open cut haul road, 25 m below ground surface.

A processing plant was set up on site, with ore processing involving crushing and milling followed by cyanide leach. Gold was then extracted via electrowinning and smelted in a gas furnace.

The mine aimed to operate on a total containment basis with no effluents leaving the site. The waste rock dump (WRD) was constructed in lifts of 5 m. The waste rock was assessed as containing no acid generating material or toxic properties. Topsoil from clearing the waste dump area was stockpiled for use as cover on the WRD at completion of operations.

The tailings dams were constructed of waste rock with clay sealant to comply with guidelines at the time of operations. Two tailings cells were constructed with a decant dam for return water. Planned rehabilitation of the tailings involved a waste rock cover and replacement of stockpiled topsoil.

Water for mine operations was pumped from the Pilgrims Creek borefield 15 km to the east of site.

Site staff and contractors lived at The Monument township to the south of Tick Hill.

Figure 7: Schematic of open cut and planned underground workings (Tick Hill 1993)

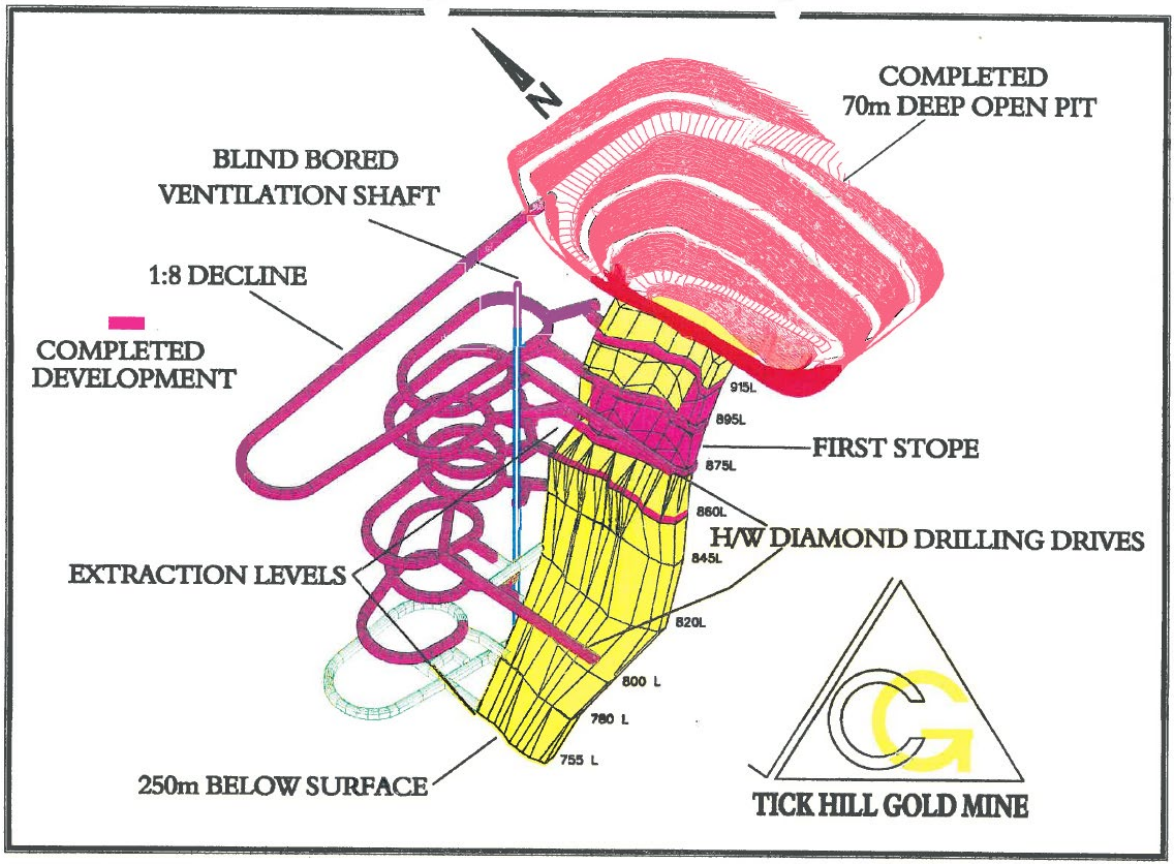
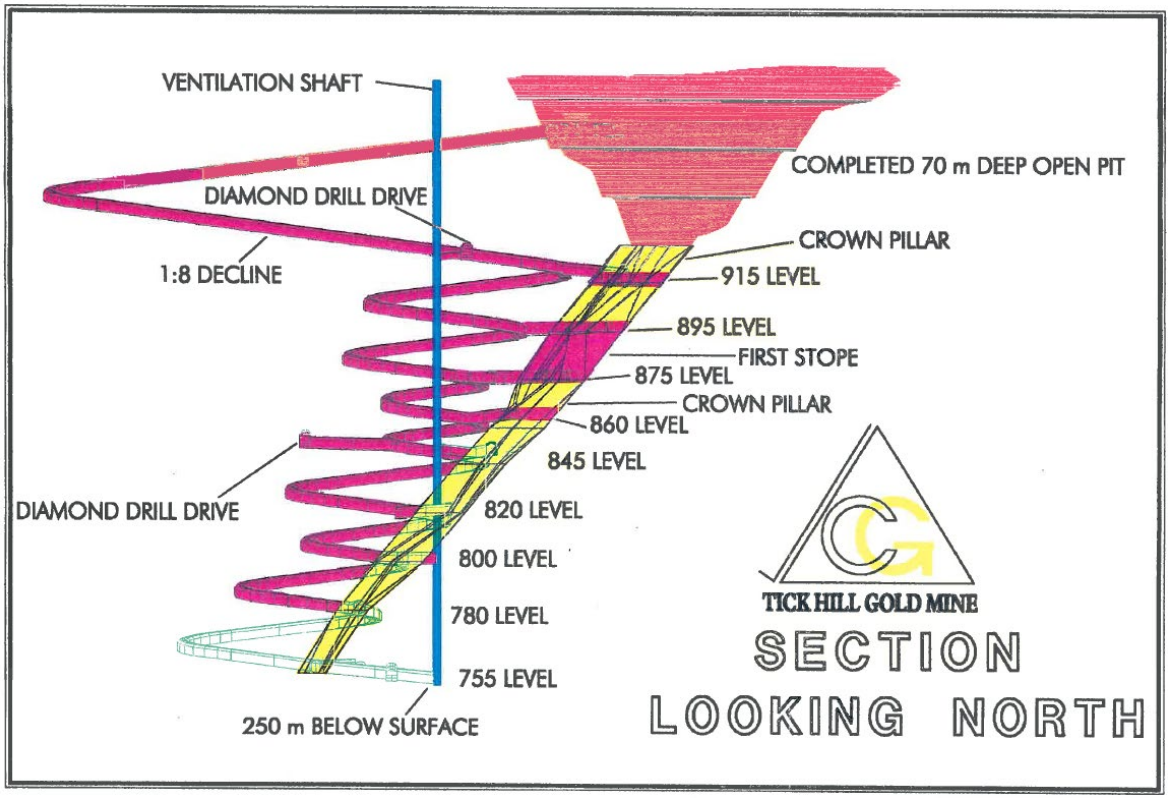


Figure 8: Cross section schematic of open cut and planned underground workings (Tick Hill 1993)



6.2 Previous environmental monitoring

6.2.1 Groundwater monitoring

Groundwater monitoring bores on site are summarised in **Table 7** and shown on **Figure 9**. Available borelogs are presented in **Appendix C**. Two bores, THGW001 and THGW002, are likely to have been installed circa 2012 by Diatreme Resources (**Photo 1**). No installation details are available for these bores. These bores were sampled on six occasions between 2012 and 2017, with typical analysis including major cations and anions, total and dissolved metals and cyanide. These bores were included in the site monitoring program following the installation of four additional bores in 2020.

Four bores, THGW003 to THGW006, were installed by Carnaby Resources in 2020 (**Photo 2**). These bores have been periodically monitored since installation. Installation logs are presented in **Appendix C**. Bores THGW001 to THGW006 were sampled on nine occasions between 2020 and 2022. At this time the mine vent shaft bore was also included in the monitoring program.

Three groundwater bores, THGW007 to THGW009, were installed in June 2023 as part of the ESA (Environmental Earth Sciences 2023), to address data gaps and further characterise groundwater at the site. One sampling event was conducted in June 2023 for all bores on site (bores TGHW001-THGW009).

The mine pit was sampled in 2012, however a collapse of the north-western wall removed a section of the haul road which prevented safe access to the water. A sample was collected in 2017, however it is not known how this was collected. In 2020 a flying fox arrangement was set up to allow sampling of the pit using a bailer. The pit was sampled nine times between 2020 and 2022, with both deep and shallow water sampled in June 2020.

Sampling events completed up to February 2022 were conducted by Carnaby, or the site operator at the time. Supplied results have been presented in **Table 37** in the Tables Appendix of Environmental Earth Sciences (2023), which collates all historical results. Relevant results have been incorporated in trend graphs prepared to assess ionic balance, cyanide and metals concentrations over time. Two additional groundwater sampling events were conducted by Environmental Earth Sciences, in December 2022 and June 2023.

Two cross sections have been prepared to show the influence of the mine pit on groundwater at the site. These run southwest to northeast (**Figure 10**) and northwest to southeast (**Figure 11**).

1. Bore THGW001. Bore THGW002 has similar surface structure.

2. Bore THGW004. Bores THGW003 – THGW006 are also installed with monuments.

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

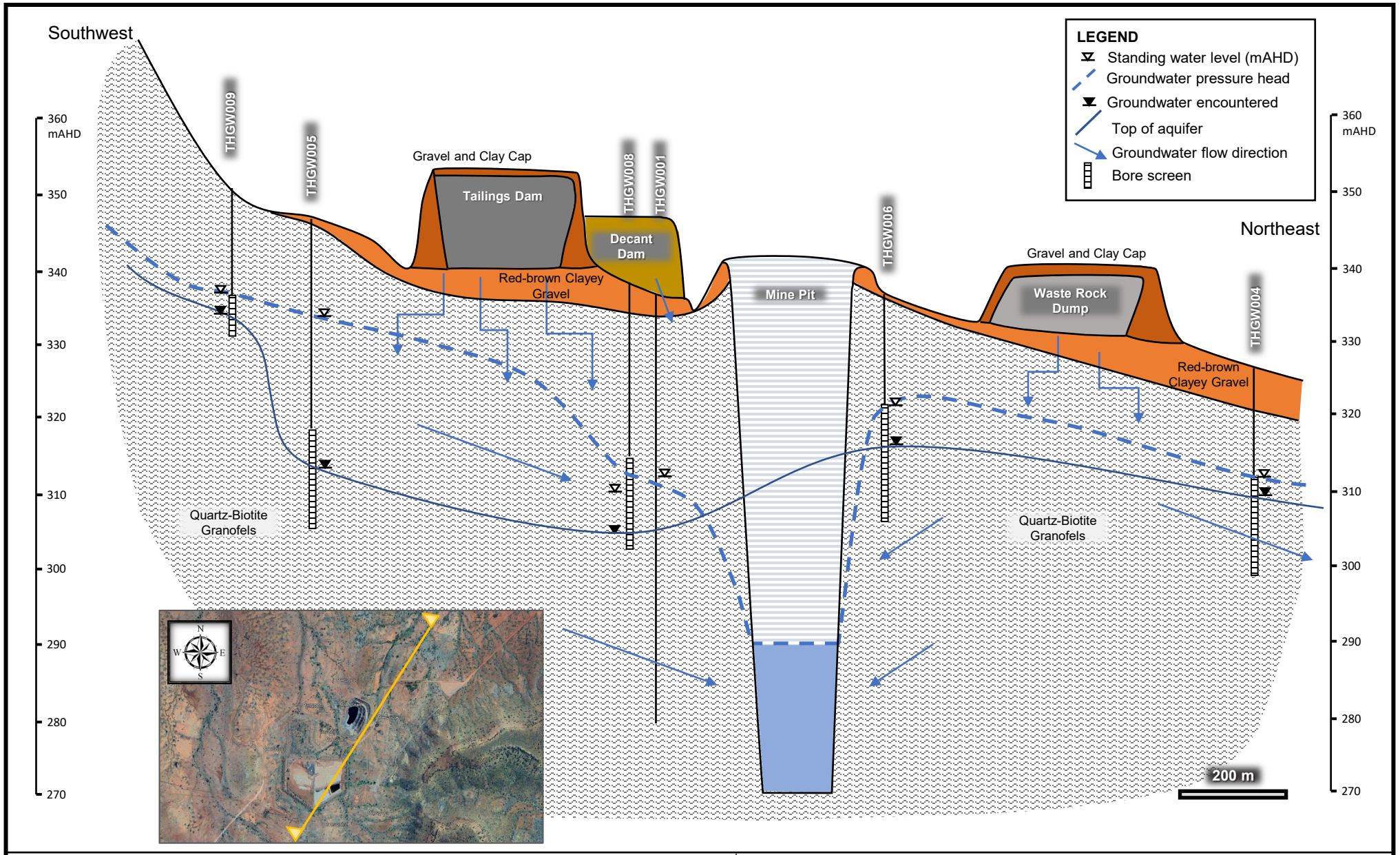
Base map Google Earth (November 2022)

Title: Groundwater monitoring bores with groundwater contours – June 2023

Client: Tick Hill Mining Pty Ltd | Drawn By: A Sheldon | Date: June 2023

Location: Tick Hill Mine, QLD

Figure 9



ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

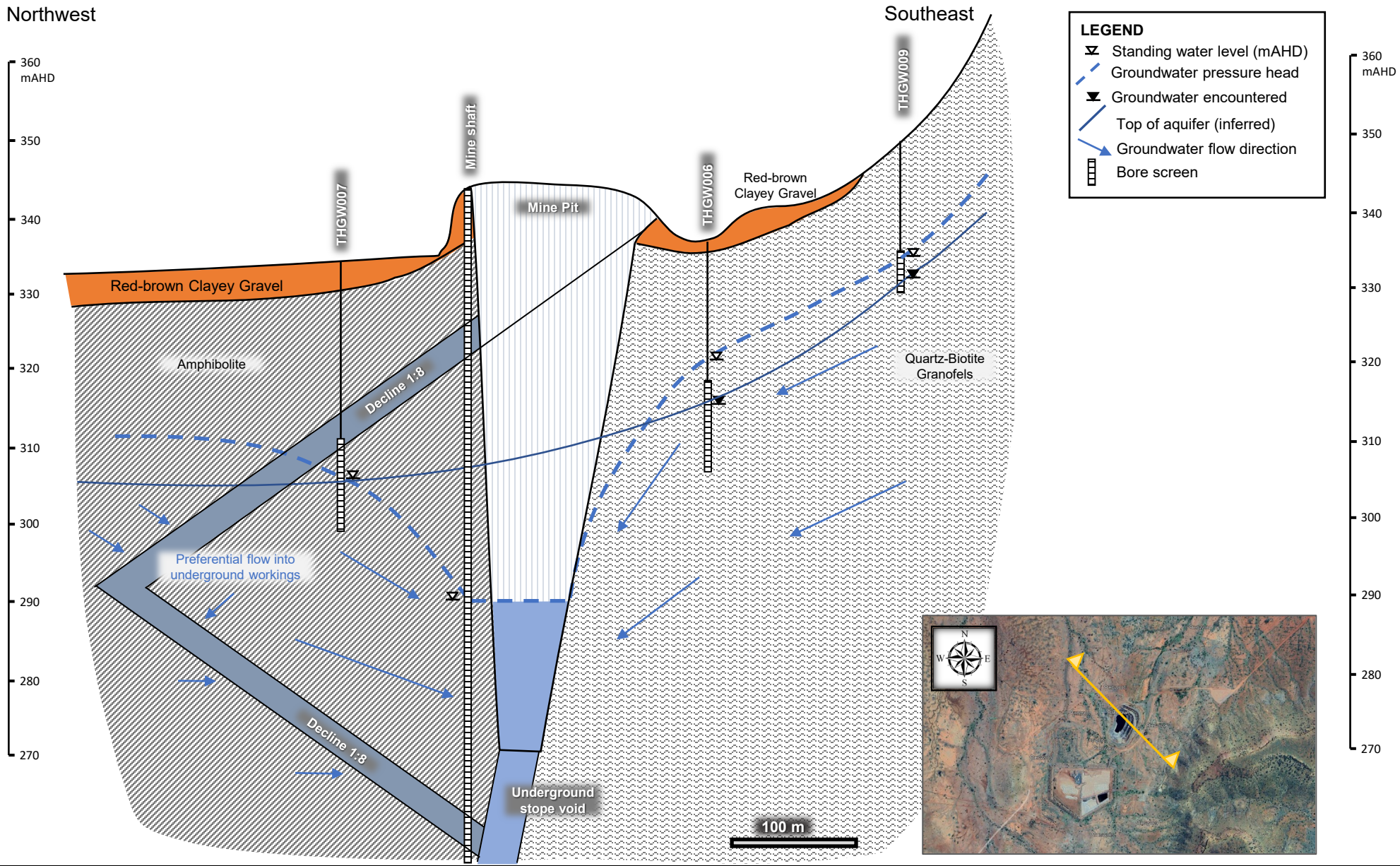
Base map Google Earth (November 2022)

Title: Conceptual Cross Section Southwest-Northeast – June 2023

Client: Tick Hill Mining Pty Ltd | Drawn By: A Sheldon | Date: June 2023

Location: Tick Hill Mine, QLD

Figure 10



ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Base map Google Earth (November 2022)

Title: Conceptual Cross Section Northwest-Southeast – June 2023

Client: Tick Hill Mining Pty Ltd

Drawn By: A Sheldon

Date: June 2023

Location: Tick Hill Mine, QLD

Figure 11

Table 7: Groundwater monitoring bore locations

Bore / location	Date	Northing	Easting	Top of Casing (mAHD)	Standpipe (m)	Target
THGW001	2012?	388681.2	7605808	338.23	0.11	Tailings dams
THGW002	2012?	388509.6	7605984	336.75	0.09	Decant dam
THGW003	2020	388276.7	7605699	341.032	0.87	Tailings Dam / western boundary
THGW004	2020	389234	7606544	327.269	0.62	Waste rock dump
THGW005	2020	388678.6	7605240	347.573	0.68	Tailings dam / upgradient
THGW006	2020	388990.1	7605926	337.573	0.65	Pit
THGW007	2023	388718.066	7606151.291	336.603	0.9	Pit / downgradient
THGW008	2023	388664.101	7605772.161	339.336	0.95	Tailings dams
THGW009	2023	388949.397	7605324.585	350.176	0.92	Upgradient
Pit Water	1991	388846	7605967	294	-	Pit
Mine Shaft Bore	1991	388744.3	7605997.7	340.721	-	Underground workings

6.2.2 Surface water monitoring

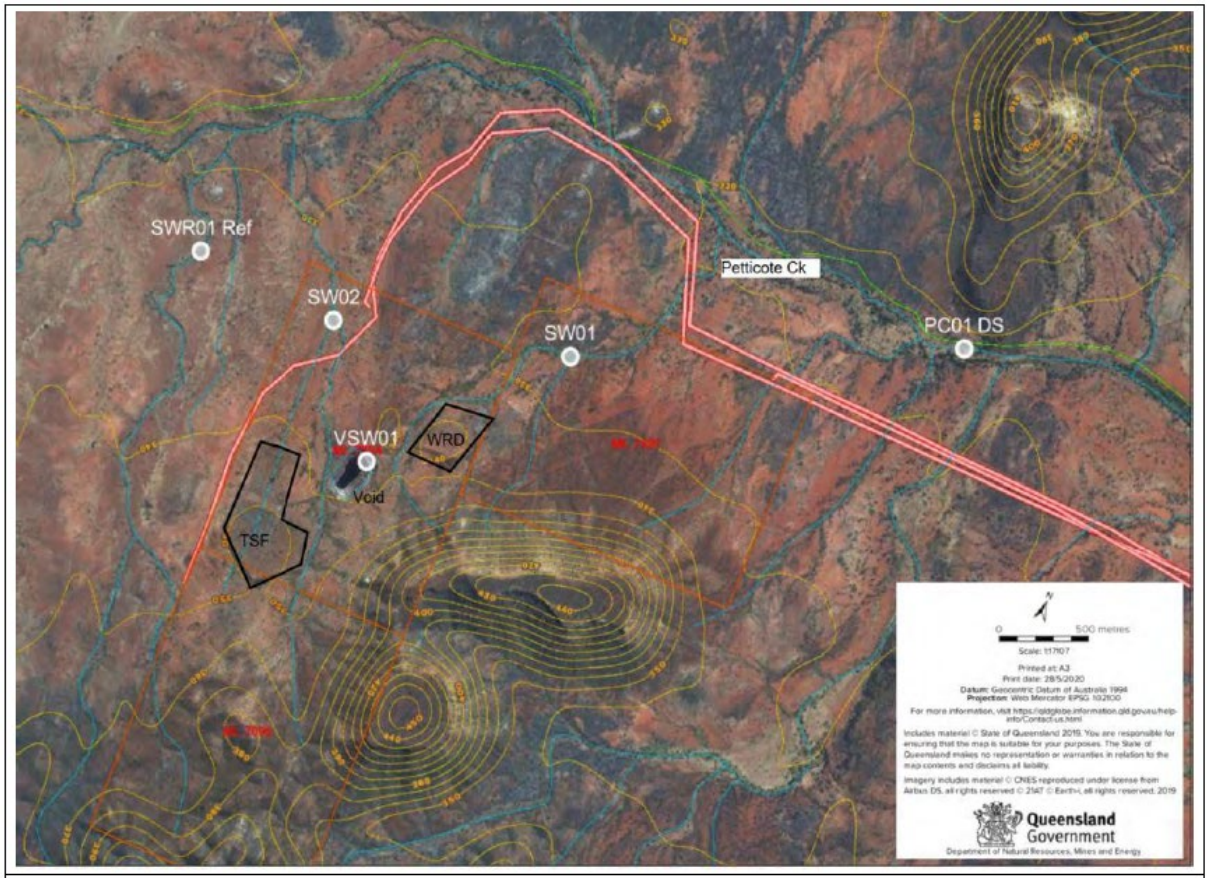
All watercourses on site are ephemeral and flow for a brief period after rainfall, consequently surface water monitoring data was only available from two sampling events, undertaken in 2015 and 2018. Surface water sample locations and their purpose are described in **Table 8** and sample locations presented on **Figure 12**.

All surface water samples were analysed for major anions and cations, nutrients, dissolved and total metals. Results are presented in **Table 38** in the Tables appendix of Environmental Earth Sciences (2023).

Table 8: Summary of surface water monitoring locations

Location	Description	Target
THSWR01 ref	Reference site in neighbouring watercourse to the west of site. Similar conditions to on-site watercourses	Background conditions
THSW01	Ephemeral watercourse to the northeast of site, downstream of waste rock dump	Waste rock dump
THSW02	Ephemeral watercourse to the northwest of site, downstream from the tailings dam, decant dam, open pit and former processing area.	Tailings, decant and mine pit
THSWPC01 DS	Petticoat Creek, downstream of site.	Downstream of site

Figure 12: Surface water monitoring locations



7 SITE CONDITIONS

The investigation works completed between December 2022 and June 2023 included two site visits by Principal Soil Scientist and Suitably Qualified Person (SQP) Dr Anna Sheldon of Environmental Earth Sciences. These site visits occurred on 19-20 December 2022, accompanied by Carnaby Resources Geologist Neill Kite, and on 8-12 June 2023, accompanied by Environmental Earth Sciences' Environmental Scientist Sam Weiss.

The section below collates observations and photographs from these site inspections, along with relevant information from the site history.

7.1 Significant site features

The current site layout of Tick Hill is shown on **Figure 2**, with an inset showing available information on the former site layout during mine operations during the 1990s. The aerial photograph in **Figure 3** also shows the site layout during mine operations.

The mine is located at the foot of a flat-topped mesa hill, on a northwest facing slope. Entry to the site is from the Duchess Phosphate Hill Road. The majority of operational structures have been removed from site, with only the major mining structures (open pit, waste rock

dump and tailings and decant dams) remaining. Some infrastructure associated with tailings reclamation works is also present on site.

7.1.1 Open pit

In the centre of the site is the open pit (**Photos 3 and 4**). The pit is elongated north-south, and 70 m deep, with water filling approximately 25 m depth. Water level varies by several meters, depending on rainfall. The former haul road into the pit collapsed in the northwest corner of the pit, preventing access to the water level. The pit rim is higher than the surrounding landscape (**Photo 5**) which means that the pit catchment is limited to the pit excavation boundary.

The area between the pit rim and bund wall drains externally, via gaps in the bund wall. These gaps are placed in locations that are not otherwise accessible so that the bund is still effective in preventing pit access (see **Photo 6**). The bund wall is surrounded by a barbed wire fence with warning signs.

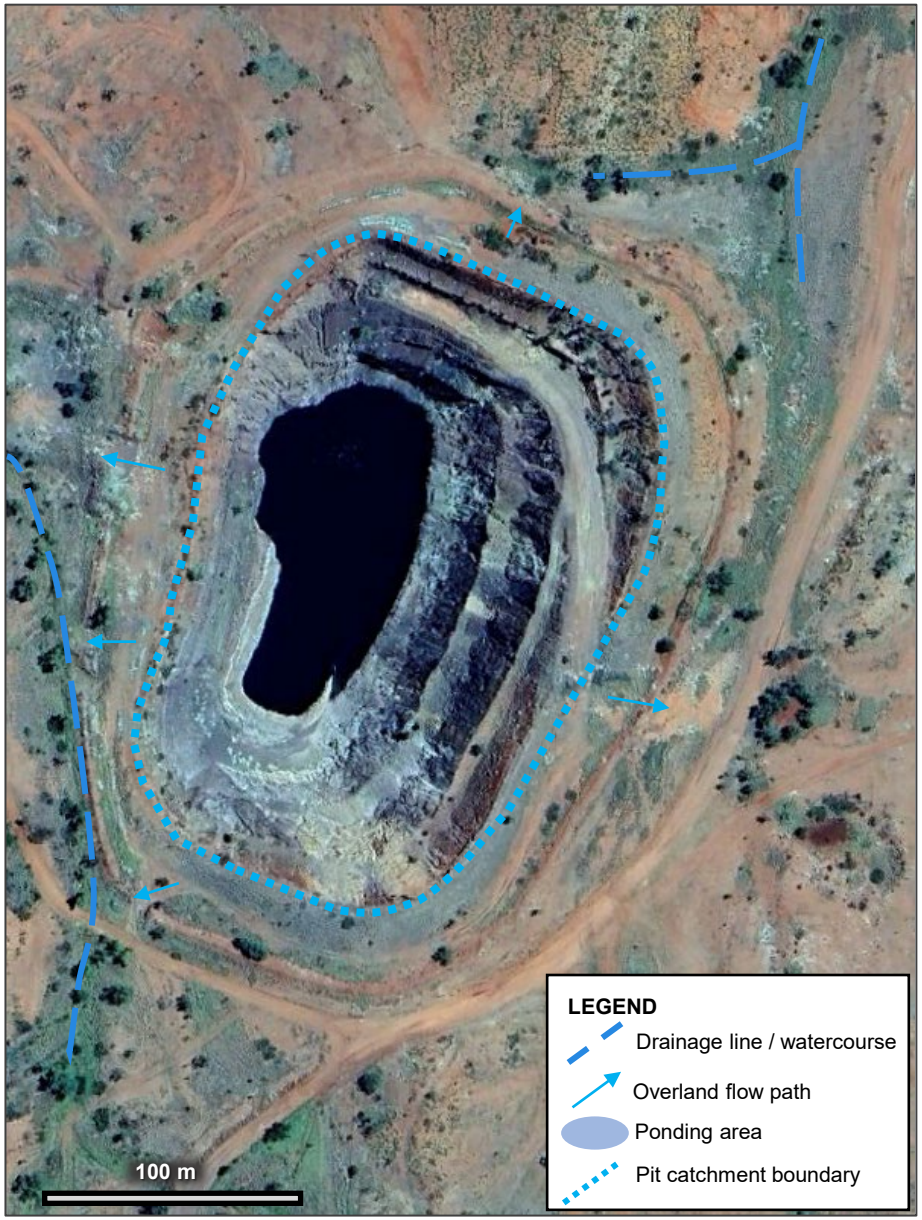
Drainage flows around the open pit are shown on **Figure 13**.

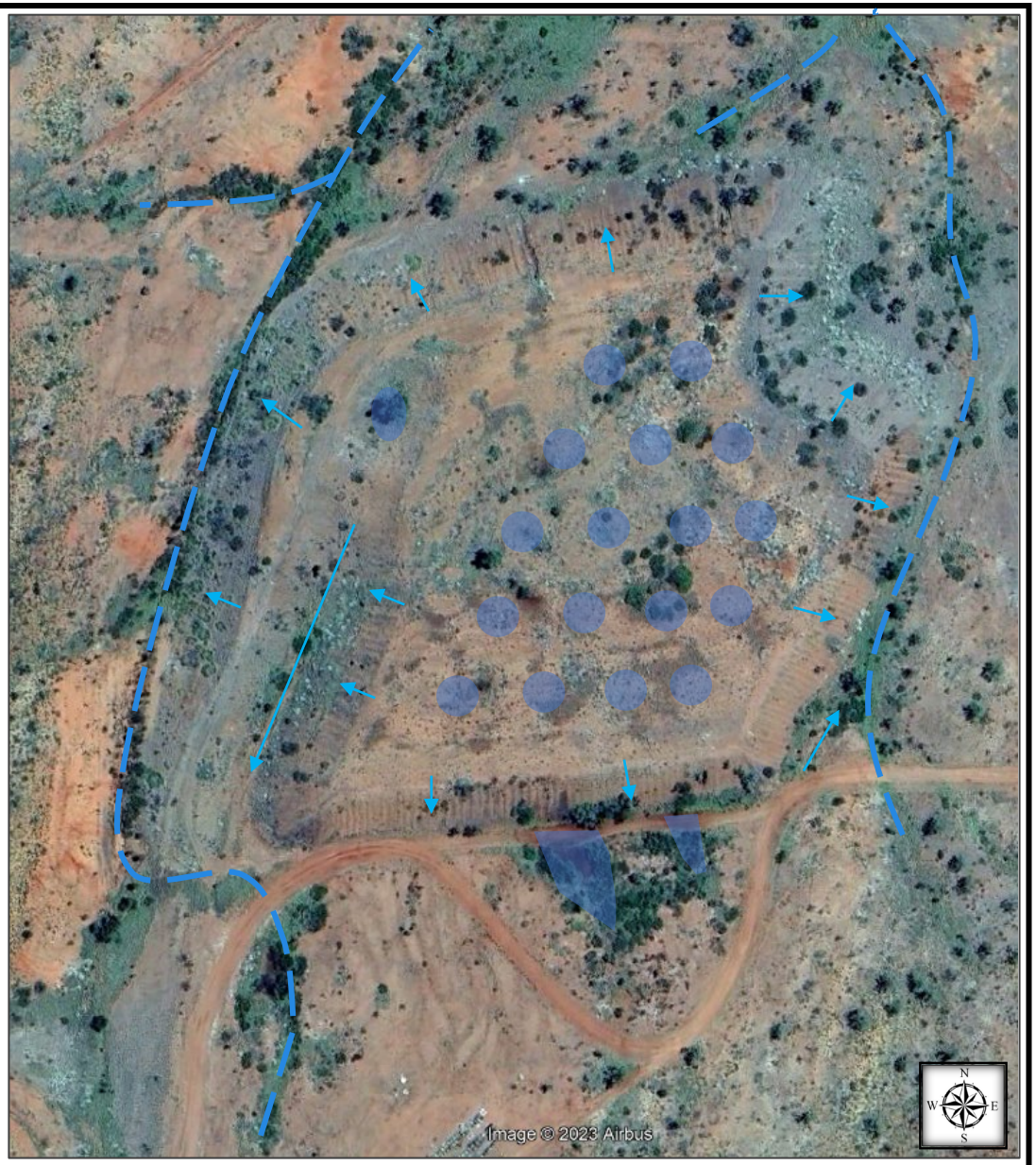
3. Mine open pit – facing south from haul road.

4. Mine open pit – facing west from pit rim. Note collapse of face in north west corner.

5. View of the open pit from the hill to the southeast. Note the raised rim relative to the surrounding landscape.

6. Gap in the bund on the southwestern side to allow drainage from the pit perimeter area.





ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Base map Google Earth (November 2022)

Title: Open pit area and waste rock dump drainage. Observations June 2023. Image November 2022.

Client: Tick Hill Mining Pty Ltd | Drawn By: A Sheldon | Date: June 2023

Location: Tick Hill Mine, QLD

Figure 13

7.1.2 Waste rock dump (WRD)

The WRD is located northeast of the pit. The WRD is diamond shaped and has a flat top (**Photo 7**). There is a small V in the northeast corner and the former access ramp acts as a drainage line towards the southwest corner.

The WRD was constructed in 5 m lifts and is capped with rock mulch and topsoil. Waste rock material at the mine was assessed as not having potential for acid or metalliferous drainage and waste rock was therefore considered inert.

Observations at the time of the December 2022 and June 2023 inspections indicate that the WRD is stable and becoming integrated into the surrounding landscape. The batters are stable and well vegetated (**Photos 8 and 9**), with one minor (stable) scour observed on the northern side. On the southern (uphill) side of the WRD an area of water ponding was observed adjacent to the WRD, where a minor drainage line meets the WRD (**Photo 10**).

No evidence of scalding or seepage was observed around the perimeter of the WRD.

The top of the WRD is generally flat and well vegetated (**Photos 11 and 12**). The surface of the WRD is slightly uneven, indicating that rainwater will pond and infiltrate. As described above, an area of ponding was also observed at the top of the ramp / drainage line on the WRD during recent site inspections. Drainage flows around the WRD are shown on **Figure 13**.

7. View of the waste rock dump from the hill to the southeast.

8. Waste rock dump batter – north side.

9. Waste rock dump batter – south side.

10. Waste rock dump batter – south side, with area of local ponding at base.

11. Top of waste rock dump showing access ramp / drainage line which flows to the left of the image.

12. Top of waste rock dump showing vegetation and slightly uneven surface.

7.1.3 Tailings Storage Facility (TSF)

The TSF consists of two cells, divided in to east and west with a total capacity of 600,000 m³. The TSF cells are built as a turkey nest dam and designed as Referable dams. The cells have a 500 mm clay liner in the base, and clay core in the walls. The cells range in depth from 6 on the up-slope side to 10 m on the down-slope site. Walls were built with a batter angle of 1:3. The cells have a flat top, and the perimeter embankments are higher than the cell surface. Excess runoff was designed to be directed to a spillway on the northern end of the eastern cell. The cover material was a waste rock mulch covered with topsoil. The cover was not designed or expected to restrict water infiltration. Clay and topsoil used for lining and cover were source from borrow pits and scrapes on site (Envirofin 2020).

At the time of the site inspections the tailings reclamation project had ceased, with the eastern cell remaining open. The entire eastern cell had been removed of cover, and the southern part of the eastern tailings cell had been substantially excavated (**Photo 13**). Stockpiles of tailings were located on the western cell, surrounded by an earth bund (**Photo 14**).

The northern part of the eastern tailings cell had the cover removed but minimal excavation of tailings. Erosion scours indicated flow of surface water to the north, towards the spillway (**Photo 15**). It was not possible to determine visually whether overflow of stormwater from the TSF had occurred. The central part of the eastern tailings cell had been partially excavated, while the southern part was split into two areas. The south-western section was excavated to the base of the tailings cell (**Photo 16**). The south-eastern section was excavated to the base of tailings and a plastic liner installed. This section of the cell was being used for water storage (**Photo 17**). Areas of disturbance and water flow on the tailings and decant dams is shown on **Figure 14**.

On the western cell cover material was stockpiled across the cell. Areas of intermittent ponding were also evident (**Photo 18**). Infrastructure associated with the tailings reclamation work remained on the western tailings cell and water storage cell. This includes a screening for processing tailings (**Photo 19**) and a gravity separation unit (**Photo 20**). Also remaining were two locked shipping containers, a tractor, pumps and generators, empty IBCs for peroxide and other rubbish. Large diameter pipe was also located on and around the tailings cells and from the water supply tank. In areas of the western cell not disturbed by the tailings reclamation project, low scrubby vegetation was well established (**Photo 21**). The TSF batter slopes were vegetated and in good condition (**Photo 22**).

13. TSF from the hill east of site, the eastern cell has been excavated for tailings reclamation.

14. Stockpiled excavated tailings with earth bund on western cell.

15. Northern section of eastern cell – cover removed from tailings, and surface erosion.

16. Southern section of eastern cell where tailings have been excavated to base of cell.

17. Southeast section of eastern cell which has been plastic lined for use as water storage.

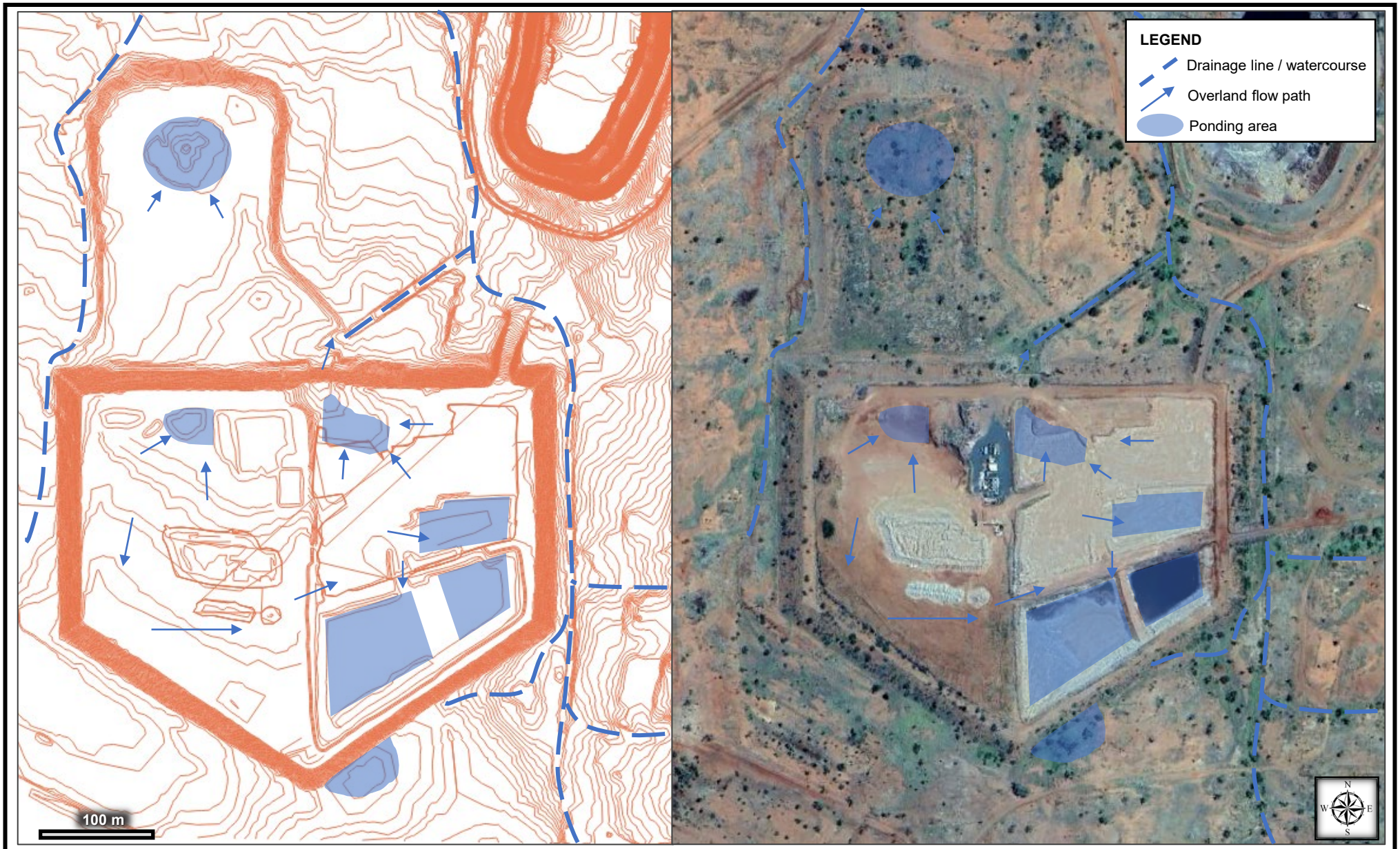
18. Stockpiled cover material and areas where water had ponded on northern end of western cell.

19. Screen used for processing excavated tailings.

20. Gravity separation unit used for processing of excavated tailings.

21. Vegetation on southern part of western tailings cell.

22. Vegetation on southern batter slope of western tailings cell.



ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Base map Google Earth (November 2022)

Title: Tailings and decant dam drainage. Observations June 2023. Image November 2022, contours October 2022.

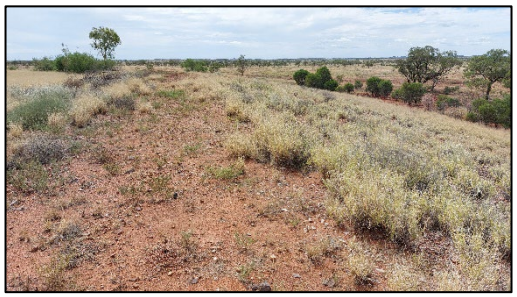
Client: Tick Hill Mining Pty Ltd | Drawn By: A Sheldon | Date: June 2023

Location: Tick Hill Mine, QLD

Figure 14

7.1.4 Decant dam

The decant dam was constructed to the same specifications as the TSF, with a capacity of 93,000 m³ (Envirofin 2020). The decant dam perimeter walls were in good condition and well vegetated (**Photo 23**). The decant dam surface has been subject to areas of subsidence (**Photo 24**) and in the northern centre of the dam was an area of tunnelling indicating a preferential flow path for water to enter the decant dam. Water flows on the decant dam are shown on **Figure 14**. Vegetation on the decant dam was well established.



23. Northern wall of decant dam, looking west.

24. Top of decant dam showing uneven surface and areas of subsidence.

7.1.5 Former processing plant area and remaining infrastructure

To the east of the TSF, and up-slope, was the former processing and administration area. The general layout can be estimated based on the diagram showing the site plans (**Figure 2**) and the aerial photograph of the site taking during operations (**Figure 3**).

Uphill of the former processing plant is the site water supply tank (**Photo 25**). This tank remains in use and currently supplies stock water for the surrounding area. Water is sourced from a borefield 15 km east of site.

The slope between the tank and tailings dam has been heavily disturbed, although little direct evidence of the processing plant remains. Landforms were either modified following plant removal or have eroded over time. The area is well vegetated with grass but has notably fewer trees than the surrounding landscape.

To the south west of the tank is a causeway crossing of a gully and a remnant concrete slab (**Photo 26**). This was the only remaining infrastructure observed on the slope. The processing plant area is shown in **Photos 27, 28 and 29**. The processing plant and other site infrastructure were relocated to other mines after closure of Tick Hill.

Further to the north and south of the WRD is the core yard (**Photo 30**). Two shipping containers had been located upslope of the core yard at the time of the December site visit, however these had been removed before the June visit.

The aerial photograph from the time of mine operations indicates that the ROM was located immediately south of the WRD, however nothing remains in this area.

25. Water supply tank. Water is sourced from a borefield 15 km east. Currently used for stock watering.

26. Remnant concrete slab, southwest of the water tank.

27. Processing plant area, looking north.

28. Processing plant area, looking south.

29. Processing plant area, looking west. Tailings dam in background.

30. Core yard, located south of WRD.

8 PIT HYDROGEOLOGICAL MODEL DEVELOPMENT

A hydrogeological model for the site was developed as part of the ESA completed in 2023. This was submitted with the PRCP. Following review of the PRCP submission, DESI issued an RFI for further information relating to the long-term pit chemistry and pit water balance. These were:

- Item 10. Further details are required regarding the predicted changes overtime in the water quality within the final void.
- Item 11. Update the water balance by providing consequence scenarios for extreme rainfall events on the pit equilibrium level.

The hydrogeological model for the mine pit has therefore been updated to address the RFI. As the pit water balance informs the chemical model, Item 11 is discussed prior to Item 10.

8.1 Groundwater migration

In order to assess potential infiltration and migration of groundwater at the site, along with potential impacts to receptors at points of groundwater discharge, hydraulic testing was conducted on two groundwater bores, THGW005 and THGW006.

Following sampling at each bore, a pressure transducer logger (diver) was installed into the bore and the bore pumped to extract water to be used for a slug test (falling head test). Following extraction of the required amount of water, the pump was removed and water levels were then allowed to recover, as a rising head test. Water pumped from the bore was then used to fill the bore to the top of casing, allowing a falling head test to be conducted. This process was repeated for two rounds for each bore.

Results of hydraulic testing were interpreted to determine the hydraulic conductivity (K) of the site aquifer, as summarised in **Table 9**. Interpretation of slug test results included use of bore construction data provided in borelogs (Carnaby Resources 2020) and standard values for metamorphic aquifer properties. Porosity was assumed to be 0.1.

For each bore, the results of two of the tests is presented below, representing the range of values obtained during test interpretation. The Hvorslev and Bouwer and Rice methods provided the most consistent results for interpretation for slug test results.

Comparison of the slug test results shows a 10x difference in K between the two bores, indicating the range of variability observed on site. This variability in K is not unexpected due to the Corella Formation geology of the site and the associated aquifer properties (**Section 5.4.2**).

In addition to the slug tests at individual bores, a mass balance model of the mine pit was developed to determine groundwater inflow from the aquifer. Details of the mass balance calculations are discussed in **Section 8.2**. Once the groundwater inflow component of the mass balance was determined, the Thiem equation was used to calculate K of the aquifer, using the hydraulic gradient between the pit wall and bore THGW001.

Table 9: Aquifer parameters

Bore	Lithology (water bearing zone)	Thickness (m)	K (m/d)	*i* (m/m)	V_g (m/d)	KD (m^2/d)
THGW005	Corella Formation	10	0.081	0.038	0.031	0.806
			0.064	0.038	0.064	0.641
THGW006	Corella Formation	10	0.898	0.236	2.12	8.98
			0.682	0.236	1.61	6.82
Pit	Corella Formation	25	0.0084	0.308	0.0284	0.21

Note: K – hydraulic conductivity, i – hydraulic gradient, V – velocity, KD – transmissivity

8.2 Pit water balance

The mine pit at Tick Hill has been abandoned and left to fill since mine closure in 1994. The pit lake is inaccessible due to collapse of the haul road in the northwest corner of the pit. Pit water levels are measured using the 'mine shaft' bore which is installed into the underground workings adjacent to the pit. Pit water levels have been measured since 2021 and have fluctuated within a range of 3.5 m. The fluctuations indicate that the pit lake has filled to the extent that the water level is now predominantly influenced by recent weather rather than pit refilling. The pit water level from 2021 to 2023 has therefore been used as the basis for the pit water balance.

8.2.1 Water balance components

The pit water balance can be calculated with the following equation:

$$\Delta Lv = (Gi - Go) + Rp + Rr - E - Wu$$

Where:

- ΔLv = the change in pit water level
- *Gi* = groundwater inflow, and *Go* = groundwater outflow
- *Rp* = rainfall into the pit lake
- *Rr* = rainfall runoff from the pit catchment into the pit
- *E* = evaporation from the pit lake
- *Wu* = water use (extraction) from the pit lake

Water balance components for the Tick Hill Pit lake are summarised in **Table 10** and area calculations provided in **Table 11** below.

Table 10: Water balance components

Component	Estimate method	Comments on uncertainty
Inflows		
Direct rainfall – pit lake	Rainfall x pit area	Rainfall estimates for various climate scenarios. Pit lake area adjustment with water level based on pit dimensions.
Surface runoff – pit catchment	Rainfall x catchment area with 0.65 runoff coefficient	Rainfall estimates for various climate scenarios.
Groundwater inflow	Thiem equation	Baseline estimate from current stable conditions. Groundwater inflow model incorporated into other scenarios.
Other inflows	Zero	No additional pit inflows.

Component	Estimate method	Comments on uncertainty
Outflows		
Evaporation from pit lake	Evaporation x pit lake area with 0.7 evaporation coefficient	Evaporation estimated from weather data. Coefficient to account for shading and wind protection of pit walls.
Water use / pumped outflow	Zero	No pit water extraction occurring.
Groundwater outflow	Zero	Pit water level well below surrounding aquifer. Assumed to be acting as groundwater sink.

Table 11: Mine void mass balance calculations

Parameter	Value	Notes
Mine pit catchment surface area (pit walls, catchment and water surface) (340 mAHD)	32,000 m²	
Pit surface at 290 mAHD water level	8,000 m²	Direct rainfall and evaporation
Exposed pit catchment area between 290 and 340 mAHD	24,000 m²	Runoff to pit
'Likely' runoff conditions	Runoff after 10 mm rainfall per event	Estimated likely scenario. Calibrates with runoff coefficient of 0.65.

8.2.2 Weather data used in water balance model

Due to the location of Tick Hill in northwest Queensland, available weather data is limited in either proximity to the site, or type and duration of data collected. The climate and weather data reviewed for the project was summarised in **Section 5.5**. For the purposes of developing the initial water balance model, the following data was used:

- Evaporation – Mount Isa Airport long term climate records.
- Annual rainfall (average rainfall) – Average of Phosphate Hill and Devoncourt Station, average of all data between 1994 and 2023.

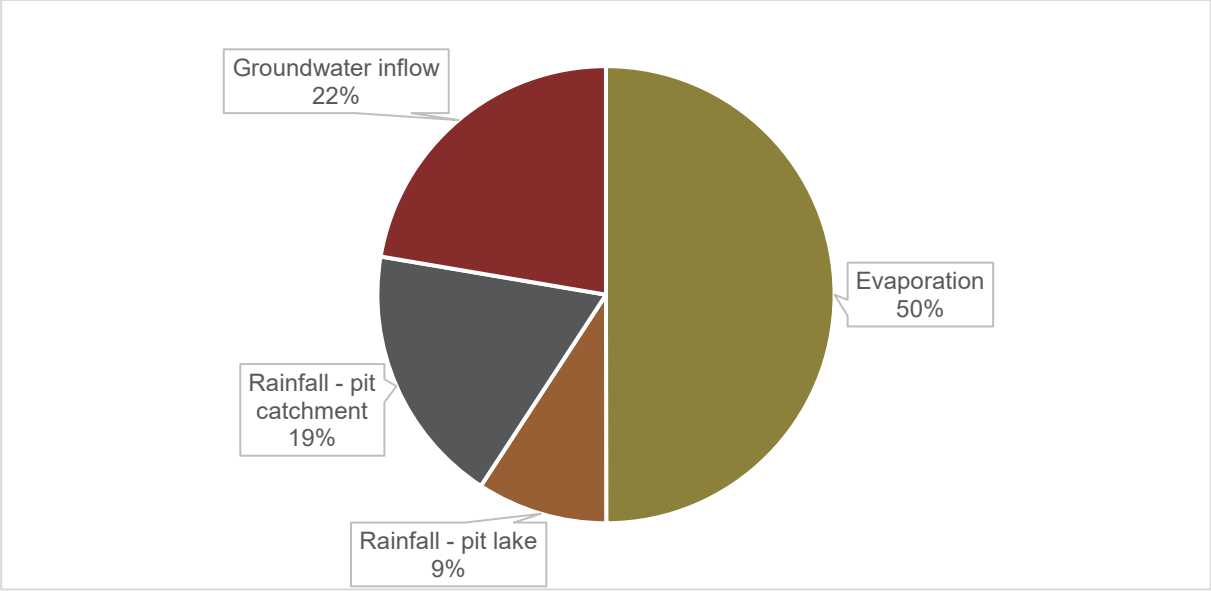
For the purposes of developing the water balance models under varying climate scenarios, the following data and estimates were used:

- Evaporation – Mount Isa Airport long term climate records.
- Twice annual rainfall (Twice rainfall) – Double the average of Phosphate Hill and Devoncourt Station, average of all data between 1994 and 2023.

- Maximum annual rainfall (Max rainfall) – Maximum recorded value from the average of Phosphate Hill and Devoncourt Station, all data between 1994 and 2023.
- Low range rainfall (Low rainfall) – 150 mm annual rainfall, estimate based on 10th percentile annual rainfall for Phosphate Hill and Devoncourt Station (**Table 6**).
- Annual rainfall (30 year cycle) – Yearly average of Phosphate Hill and Devoncourt Station, between 1994 and 2023, repeated for model duration.
- Annual rainfall (30 year cycle x 150%) – Yearly average x150% of Phosphate Hill and Devoncourt Station, between 1994 and 2023, repeated for model duration.
- Equilibrium rainfall – value adjusted in model until pit water level equal with surrounding aquifer level (45 m above base of pit | 310 mAHD).
- Extreme event data – BOM AEP grid data for Tick Hill, 1 in 2000 year 168 hour event.

8.2.3 Current pit conditions

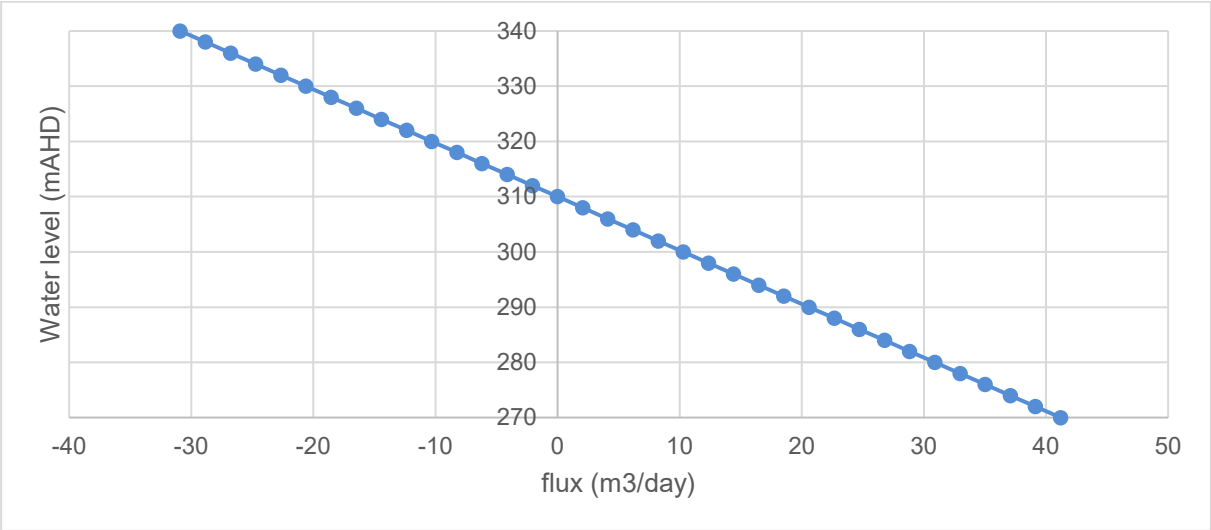
The current pit water balance was calculated using the conditions described in **Sections 8.2.1 and 8.2.2** above. The pit water balance components are summarised in **Graph 1**. This model was used to determine the rate of groundwater inflow into the pit, and therefore the K of the surrounding aquifer supplying water to the pit.



Graph 1. Pit water balance components – current stable conditions

The relationship between pit water level and groundwater inflow into the pit was then used to determine the flux of groundwater to or from the pit at different pit water levels. This is shown in **Graph 2**. When the water level in the pit lake is equal with the surrounding aquifer, at 310 mAHD, there is no net flux to or from groundwater. This is a 'flow through' pit lake scenario. When the pit water level is lower than the surrounding aquifer (<310 mAHD), groundwater flows into the pit in a 'groundwater sink' scenario. If the pit lake level is higher than the surrounding aquifer (>310 mAHD), water will flow from the pit into groundwater, and

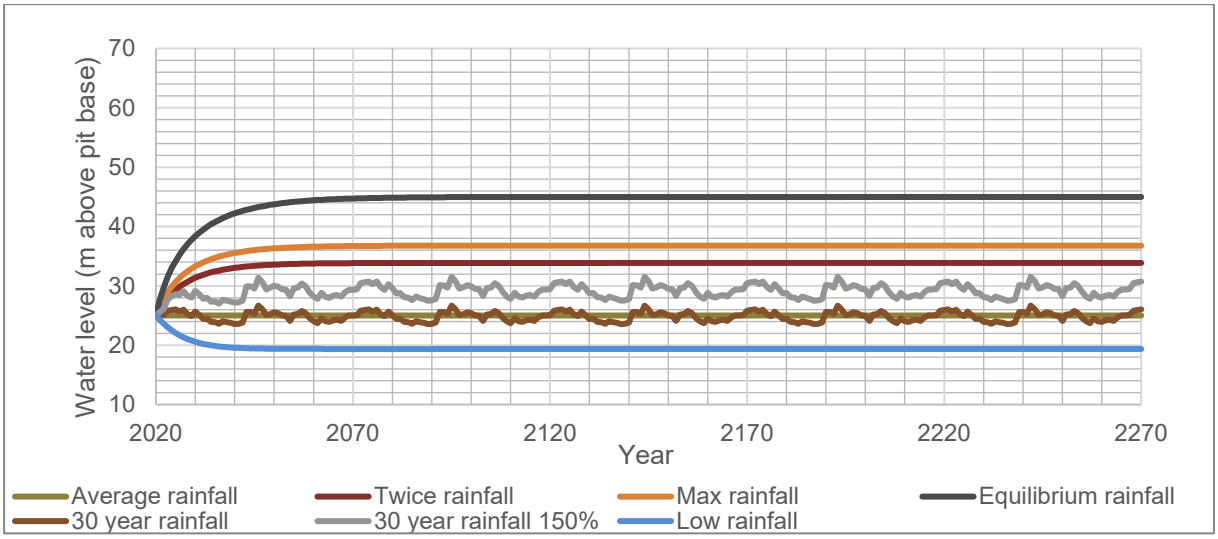
the pit lake acts as a 'groundwater source'. The current pit water level is approximately 290 mAHD, and the pit acts as a groundwater sink.



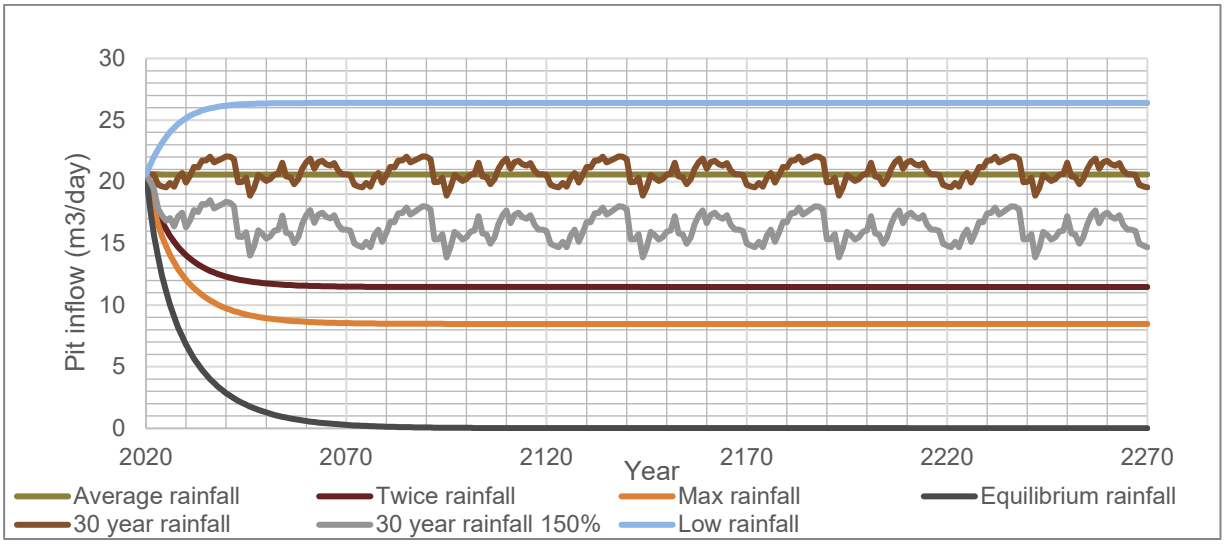
Graph 2. Groundwater flux into or out of pit depending on pit water level.

8.2.4 Pit water balance under various rainfall scenarios

Pit water levels and groundwater flux were modelled under a range of rainfall scenarios. Each scenario was modelled for a 250 year period, from 2020. All modelled conditions stabilised within approximately 70 years. Rainfall conditions used in the modelled scenarios are described in **Section 8.2.2** above. Pit water levels are presented in **Graph 3**, and associated groundwater inflows in **Graph 4**. The water balance values once the scenarios stabilise is presented in **Table 12**. Complete spreadsheets with the model calculations are presented in **Appendix D**.



Graph 3. Long term pit water level under various rainfall scenarios



Graph 4. Long term groundwater flux into pit under various rainfall scenarios

Comparison of pit water level and groundwater inflow response to the different rainfall scenarios shows that higher rainfall results in higher pit water levels, and subsequent lower groundwater inflow. The modelled conditions show that even with substantially higher rainfall than would be plausible for this location, there is no possibility that the pit water level would increase so that the pit can act as a source to recharge groundwater. The long-term average rainfall required to bring the pit water level in equilibrium with the regional aquifer is more than four times the current average rainfall.

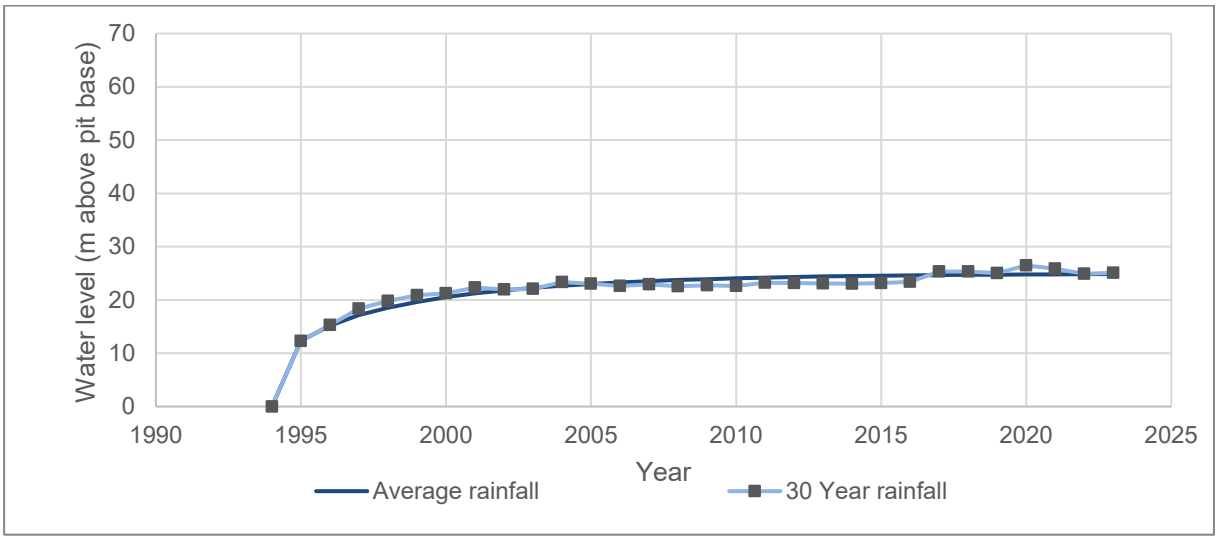
Table 12: Summary of pit water level model conditions

Model scenario	Rainfall	Evaporation	Pit direct rainfall	Pit catchment rainfall	Groundwater inflow	
Units	m/year	m^3/year	m^3/year	m^3/year	m^3/year	m^3/day
Average rainfall	0.396	16841	3112	6214	7515	20.6
Twice rainfall	0.792	23727	8767	10774	4184	11.5
Maximum rainfall	0.923	26245	11304	11851	3090	8.5
Equilibrium rainfall	1.219	34034	20502	13526	0	0
Low rainfall	0.15	13073	915	2525	9633	26.4
30 year rainfall	0.0953-0.923	15841-18047	792-7005	1474-14718	6888-8051	18.9-22.1
30 year 150% rainfall	0.143-1.38	18665-21797	1409-12559	2055-20877	5062-6575	13.9-18.0

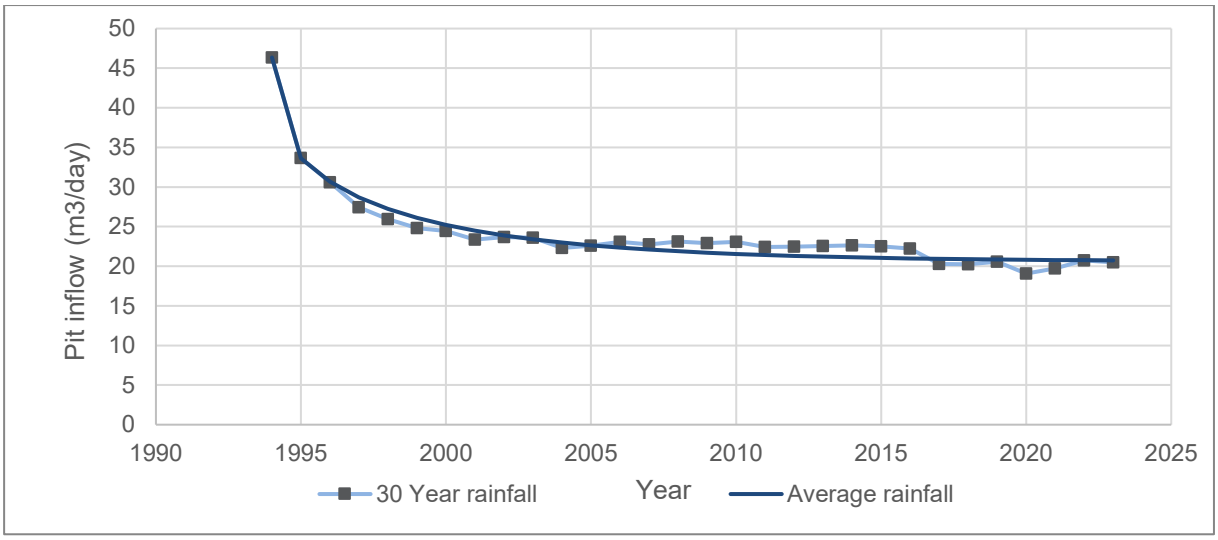
8.2.5 Pit filling since mine closure

The groundwater mass balance was used to model the filling of the mine pit after mine closure. Water level is shown in **Graph 5** and groundwater inflow is shown in **Graph 6**. Model results are presented in **Appendix D**. The 30 year rainfall data used in this model is

the averaged data between Phosphate Hill and Devoncourt Station for that period (1994 – 2023). Comparison of the long-term fluctuation in water levels from the '30 year rainfall' scenario above with the pit filling model indicates that seasonal variation was a greater influence on pit water level than pit filling from 2012.



Graph 5. Pit water level since 1994



Graph 6. Groundwater flux into pit since 1994

8.2.6 Extreme event water level response

A modified version of the mass balance model was used to determine the influence of short-term extreme rainfall events on pit water level. The rainfall events that were modelled were the 1 in 2000 year event for Tick Hill location (BOM 2016) for 168 hours (598 mm, see **Table 16**), and an event double that size (1,196 mm).

Because these events would take place over a short time frame it is assumed that no evaporation would occur, and short-term groundwater flux would be negligible. It is also assumed that in a continuous rainfall event a higher proportion would be shed as runoff, therefore no runoff coefficient has been applied. Three starting levels for the pit lake water level were modelled; 25 m is the current pit water level, 30 m would be the stable pit level for

more than 150% of the current rainfall, and 35 m is just below the pit level for a long-term average rainfall equal to the maximum rainfall. Results are shown in **Table 13**. All scenarios show that the water level of the pit does not reach equilibrium and does not become a groundwater source.

Table 13: Extreme rainfall event response – pit water level

Event Rainfall	Pit start height	Rainfall volume	Increase in pit level	Buffer to pit equilibrium level
m	m	m^3	m	m
0.598	25	19136	2.44	17.56
0.598	30	19136	1.99	13.01
0.598	35	19136	1.66	8.34
1.196	25	38272	4.87	15.13
1.196	30	38272	3.99	11.01
1.196	35	38272	3.32	6.68

8.3 Pit geochemical model

A mine pit geochemical model was developed to provide further detail on long-term water quality of the mine pit lake. The model used available geochemical data for the site to predict water quality over 250 years. The mine pit geochemical model utilised the mine water balance model scenarios developed above to determine the various potential influences on pit water composition over time.

A solute transport model to determine the influence of cyanide leaching on pit water quality was developed for the Environmental Site Assessment (Environmental Earth Sciences 2023). This found that the cyanide impact to groundwater between the TSF and open pit is stable, with concentrations likely to steadily decrease over time. It is not expected that cyanide impacted groundwater will adversely impact pit water quality to any significant extent and cyanide in pit water will be degraded by sunlight. As cyanide will not accumulate in the pit due to degradation, it is not included in the long-term pit water quality model.

8.3.1 Influences on pit water chemistry

The water chemistry of a mine pit after closure is influenced by a variety of physical, chemical, and environmental factors. Understanding these factors is required for predicting and managing water quality in closed mine pits and ensuring long-term environmental safety. Key factors may include:

- Geochemistry of the surrounding rocks:
    - **Acid mine drainage (AMD)**: When sulfide minerals (e.g., pyrite) are exposed to air and water, they can oxidize and produce sulfuric acid, which leads to the

release of metals (e.g., iron, copper, zinc) into the water, due to lowering of the pH of the pit water.

    - **Neutralising minerals**: The presence of minerals like limestone can buffer or neutralise acidity, limiting acid generation.

- Groundwater and surface water interactions:
    - **Influx of groundwater**: Groundwater entering the pit may bring dissolved minerals, metals, and contaminants, affecting water quality.
    - **Surface water runoff**: Rainwater or surface water flowing into the pit may introduce sediment, nutrients, or pollutants (e.g., pit wall runoff, mine waste).
- Pit lake hydrodynamics:
    - **Stratification**: Mine pits can form stratified layers of water, with different chemical properties at varying depths (e.g., oxygen-rich surface water vs. oxygen-deprived deeper layers).
    - **Mixing**: Natural or artificial mixing of water layers can lead to changes in water chemistry.
- Climate and precipitation:
    - **Rainfall**: Heavy precipitation can dilute concentrations of salts or chemicals in the water, but it may also increase runoff from nearby contaminated areas, leading to water quality changes.
    - **Evaporation**: In arid regions, evaporation can concentrate dissolved substances, increasing the salinity and mineral content of the water.
- Presence of biological activity:
    - **Microbial processes**: Microorganisms can influence water chemistry by driving processes like sulfate reduction (leading to hydrogen sulfide formation) or metal precipitation.
    - **Algal growth**: Nutrient-rich water may promote algal blooms, which can affect oxygen levels and lead to changes in water chemistry.
- Mining waste and tailings:
    - **Residual tailings**: Leftover tailings or waste materials can leach metals, acids, or other contaminants into the water over time.
    - **Waste rock piles**: Water percolating through waste rock piles may pick up contaminants before entering the pit lake.

- Remediation efforts:
    - **Water treatment**: Active treatment processes (e.g., adding lime to neutralize acid) or passive treatment systems (e.g., constructed wetlands) can influence the water chemistry after mine closure.
    - **Capping**: Covering exposed reactive materials can prevent water contamination and control water chemistry.

An initial review of these factors in relation to the Tick Hill pit lake is presented below.

8.3.2 Influences on pit water chemistry at Tick Hill

Geochemistry of the surrounding rocks:

The general influence of the geology of the regional aquifer on groundwater composition is discussed further below.

The potential for AMD associated with mine waste materials has been assessed on several occasions and found to not contain potential for acid generation. The Corella Formation contains units of limestone and calcareous sandstone which provide neutralising capacity.

Groundwater and surface water interactions:

The mine water balance indicates that groundwater inflow, surface water runoff from the pit catchment and rainfall are the main sources of water entering the pit. Groundwater and surface water quality will therefore influence pit water quality.

The pit catchment is limited to the area immediately surround the pit and does not include any mine waste materials, or any watercourse inflows.

Pit lake hydrodynamics:

Stratification and mixing have not been specifically addressed in this model. Factors which limit potential for stratification include low rainfall input and high evaporation. Meanwhile, the steep sides of the pit wall and depth of the pit limit mixing within the pit. Comparison of the mine shaft bore and pit lake water quality indicate that mixing between the underground workings and pit lake is limited.

Climate and precipitation:

The site is located in an arid climatic zone and evaporation is a major component of the pit water balance. Evaporation drives concentration of salts in the pit lake, and far exceeds the dilution influence of rainfall.

Rainfall runoff may wash sediments from the catchment into the pit lake, however due to the limited reactivity of the site geology it is not considered to be a significant source of salts or dissolved metals.

Presence of biological activity:

No evidence of algae was observed in the pit lake. Influence of microbial processes has not been considered in this model.

Mining waste and tailings:

The TSF is located upgradient of the mine pit, and is known to have influenced pit water chemistry as trace cyanide is detected in pit water samples, although it has been determined that concentrations will not accumulate to levels which have the potential for environmental harm (Environmental Earth Sciences 2023).

The WRD is located beyond the area of influence of inflow for the mine pit, and is not considered to have the potential to influence mine pit chemistry.

Remediation efforts:

No active or passive treatment processes are occurring to alter the water chemistry in the Tick Hill mine pit lake. The pit catchment does not contain any areas of capped mine waste materials that may alter water chemistry of runoff.

The TSF is currently partially uncapped, which may influence leaching to groundwater, however it is considered that the major influence of the TSF on groundwater quality is likely to have occurred during operations and soon after. Discussion of leach testing of the tailings material is discussed further below.

8.3.3 Comparison of groundwater and pit water quality

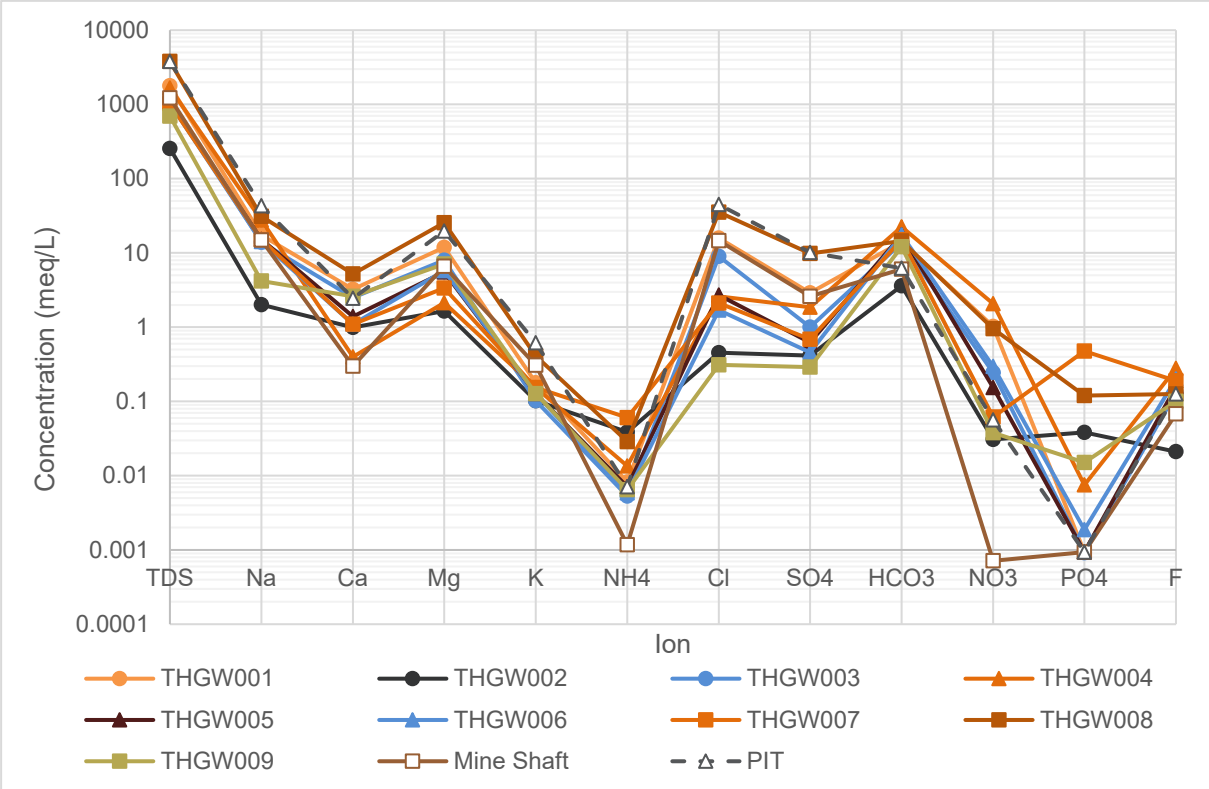
Review of the site water balance and potential influences on pit chemistry indicate that rainfall, runoff and groundwater inflows will have influenced the composition of pit water, while evaporation has caused concentration of salts in the pit over time.

As the pit has been refilling since 1994, the pit water composition provides an indication of how the different inflow components have influenced water quality over time. In order to determine how inflow chemistry should be attributed, pit water quality has been compared with groundwater and leach test results for mine tailings and mine waste rock.

Groundwater and pit water ionic composition are shown on a Schoeller plot in **Graph 7**. The aquifer occurs within the Corella Formation which is comprised of near-vertically bedded metasediments, with high variability between units. Hydraulic conductivity (K) is highly variable, with groundwater flow dominated by fractures and weathered zones.

While the pit receives water radially from the surrounding aquifer, groundwater contours indicate a steeper hydraulic gradient to the east (towards bore THGW006) and shallower gradients to the north and south (bores THGW001 and THGW008 to the south). This indicates that water inflow into the pit is dominated by flows that occur with the bedding (north-south) rather than against the bedding (particularly from the east). In addition to the open pit, there is a network of underground workings and access shafts which are situated below and to the west of the pit (**Figure 7**). These workings would intersect the aquifer and provide a component of groundwater inflow.

Groundwater is neutral to slightly alkaline and moderately to highly saline. Water chemistry is dominated by sodium and magnesium, and bicarbonate and chloride. The high sodium and chloride concentrations indicate the presence of connate sea water.



Graph 7. Schoeller plot of groundwater and pit chemistry – June 2023

Comparison of groundwater composition between monitoring bores and the mine pit indicates the following:

- Salinity of groundwater bores is generally correlated with depth, indicating that the deeper aquifer is less saline.
- The pit is more saline than all bores except bore THGW008.
- The pit has higher concentrations of sodium, magnesium, potassium, chloride and sulfate than most bores.
- The pit has lower or mid-range concentrations of calcium, ammonia, bicarbonate, nitrate, phosphate and fluoride compared to most bores.

While the majority of ions will accumulate in the pit via evapo-concentration, ammonia and nitrate will be lost via denitrification reactions and volatilisation. Bicarbonate concentrations will vary with pH. The overall salinity of the pit is well below the level at which precipitation of major ion minerals (such as gypsum) would occur.

Comparison of the mine pit and groundwater chemistry also indicates that dewatering and re-flooding of the mine workings and surrounding lithology during mine operations did not result in generation of acid via AMD reactions. This is consistent with the characterisation of the waste rock as not-acid forming (NAF).

Overall comparison between groundwater and pit water indicates that while general correlations are observed, no particular groundwater sample indicates a direct source for pit water accumulation. It was also not possible to determine a ratio of groundwater inputs to pit composition.

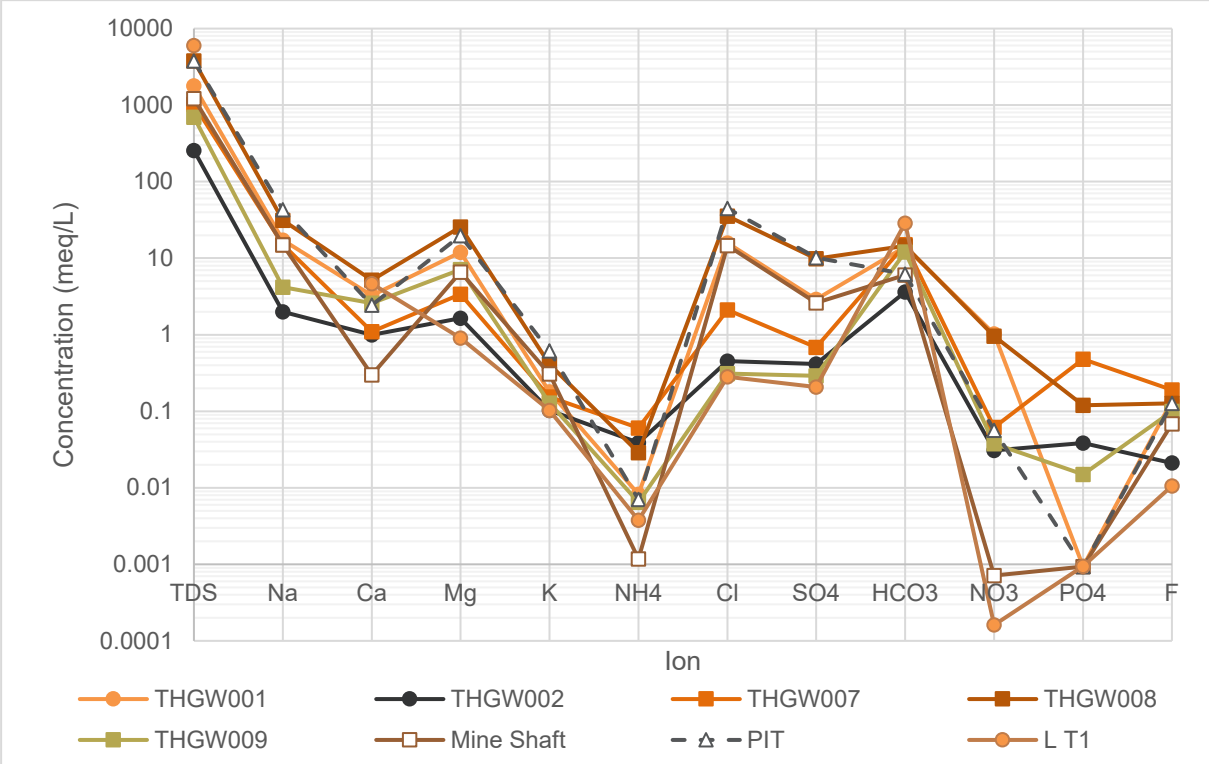
8.3.4 Comparison of leach test results and pit water quality

Due to the potential influence of rainfall runoff or infiltration on pit water quality, leach tests were conducted on waste rock and tailings samples. Waste rock was tested as a surrogate for runoff from the pit walls and tailings and tailings cover material as an indicator of potential leaching to groundwater from the TSF. The leach test completed was the Australian Standard Leach Procedure (ASLP) using deionised water. Results of the leach testing are presented in **Table 17** in the Tables Appendix (total concentration results for the same samples are provided in **Table 18**).

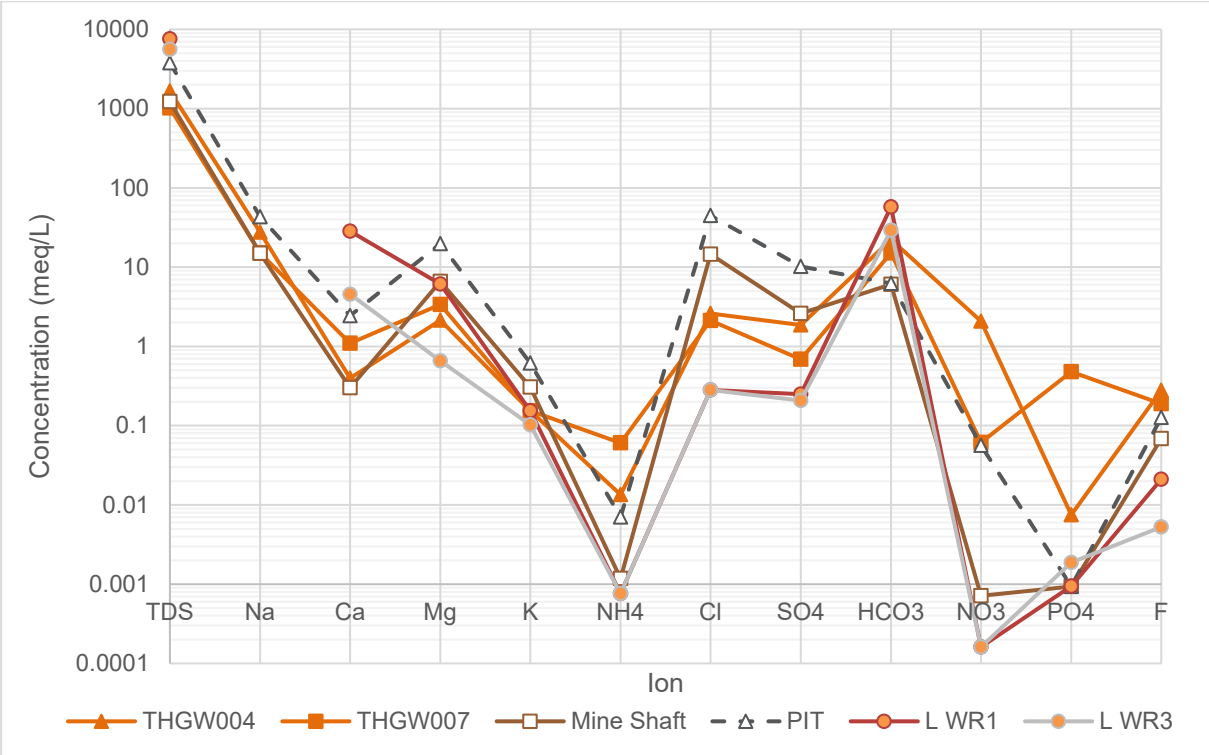
Leach test results are presented with pit water and selected groundwater results for the tailings material [L T1] (**Graph 8**) and waste rock [L WR1 and L WR3] (**Graph 9**).

The tailings leachate results had high salinity, calcium and bicarbonate results compared to groundwater and pit water, but had lower concentration of other ions. Of particular note were the very low concentrations of chloride and sulfate in the leachate. The waste rock samples also contained high salinity, calcium and bicarbonate, but low concentrations of other ions.

Overall, the leachate results indicate poor correlation with groundwater or pit water quality. If these samples are representative of runoff from the pit walls, this indicates that this is not a significant influence on pit water quality.



Graph 8. Schoeller plot of groundwater and pit chemistry with tailings leachate



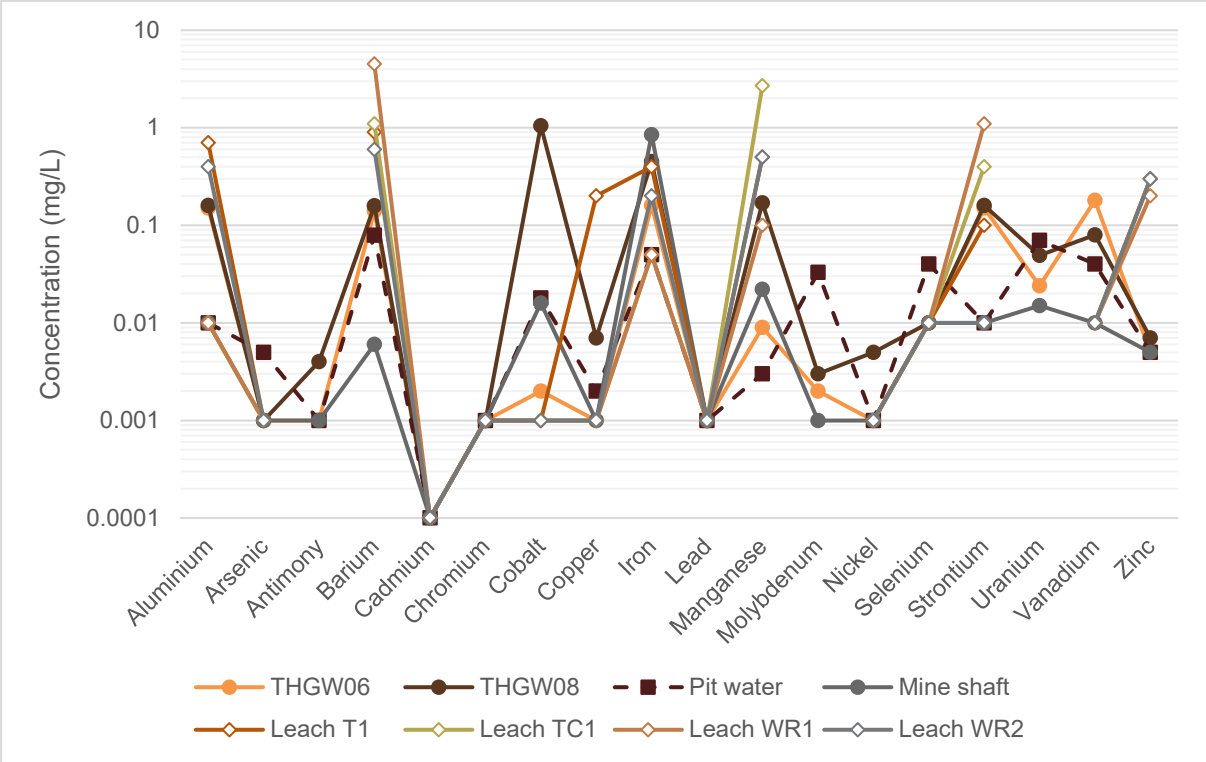
Graph 9. Schoeller plot of groundwater and pit chemistry with waste rock leachate

8.3.5 Metal concentrations in groundwater and pit water

Dissolved metal concentrations of pit water, groundwater and waste leachate were compared (**Graph 10**). For clarity, only the closest groundwater bores are included, however the full results are shown in **Tables 28 and 37** in the Tables Appendix od Environmental Earth Sciences (2023).

Results indicate that for the metals present, such as barium, iron and strontium, these were consistently observed between pit water, groundwater and leachate. Other metals, such as cadmium, chromium and lead were not detected in any locations. Leachate samples tended to have the highest metal concentrations, while the pit water and mine shaft location had lower concentrations than groundwater.

Overall metals concentrations are low, and sediment and pH may be significant in influencing minor variability between locations.



Graph 10. Dissolved metals concentrations in groundwater, pit and waste leachate

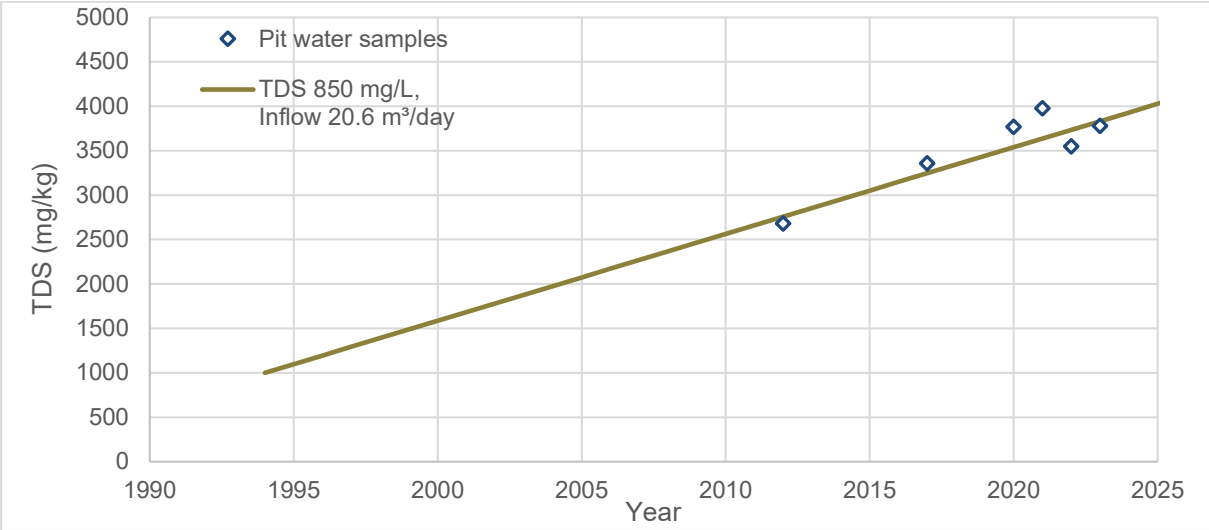
8.3.6 Pit salt balance

Analysis of groundwater and leachate (as a surrogate for runoff) samples indicates that while these correlate with pit water quality, they do not provide a consistent prediction for accumulation of ions or metals in the pit over time. For Tick Hill, the pit has been filling for 30 years, and has reached a stable water level. This differs from a current operational mine, where all pit water quality calculations require predictions.

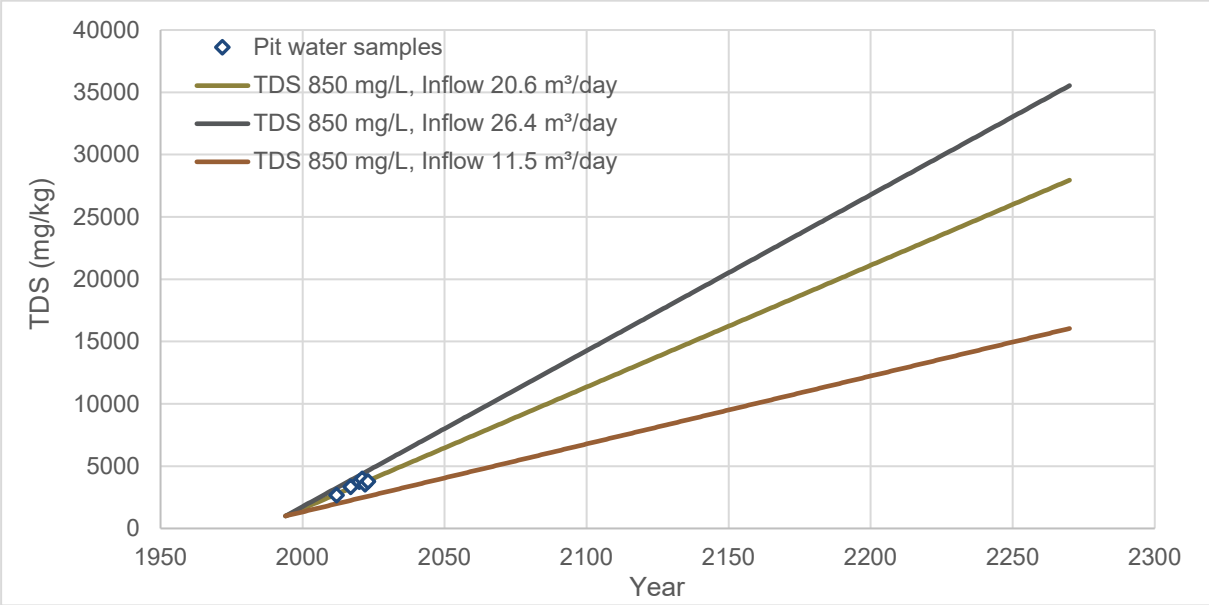
It is therefore considered that the current pit water quality provides the best available indication of how the various water sources combine to influence pit water composition. In order to determine how this would change into the future, a mass balance was developed using the pit water inflow (20.6 m^3/day) and estimate for groundwater inflow salinity. This was modelled from the initial filling with results shown in **Graph 11**, along with actual measurements of pit salinity between 2012 and 2023. Individual ion and metal concentrations were modelled with a direct concentration/ dilution from the 2021 to 2023 pit water quality results.

The pit water quality model was then extended for 250 years. Other groundwater inflow scenarios were also modelled. These were low groundwater inflow (11.5 m^3/day), which would occur under higher rainfall conditions (twice rainfall scenario – **Table 12**), and high groundwater inflow (26.4 m^3/day) which would occur under lower rainfall conditions (low rainfall scenario – **Table 12**). Predicted pit salinity for these models is shown in **Graph 12**. Of these, the low rainfall / high pit inflow scenario reaches TDS similar to seawater (35,000 mg/L) after 250 years. Continuation of current conditions results in a salinity of approximately 28,000 mg/L.

Calculated ion and metal concentrations for input into PHREEQC are presented in **Appendix E**.



Graph 11. Salt accumulation in pit since 1994, with measured values



Graph 12. Predicted salt accumulation in pit, with high and low groundwater inflow scenarios

8.3.7 Model of future groundwater chemistry

Groundwater composition over the 250-year period under the three scenarios was modelled in PHREEQC V3 (USGS 2021). Input data is presented in **Appendix E**, output is presented in **Appendix F**. Calculation intervals are approximately 9-10 years, calibrated against the overall pit salinity.

As the ion and metal concentrations in the pit concentrate over time, PHREEQC calculates the concentration of particular compounds in the pit water, including what compounds are likely to precipitate.

The saturation index (SI) indicates the potential for a compound to precipitate, with negative values indicating that a compound will remain in the dissolved phase and positive values indicating potential precipitation. As the overall ionic strength (salinity) of a solution increases, the saturation index of compounds will tend to increase.

The concentration of particular ions or compounds will also increase as the overall concentration of the pit water increases. Variation from strict concentration/ dilution effects occur when precipitation occurs. A selection of SIs and concentrations are presented below for ions and compounds. Note that concentrations are presented as log molality, which allows for comparison between compounds i.e., 4.0E-04 Ca is equivalent to 4.0E-04 $CaSO_4$. To summarise:

- Gypsum ($CaSO_4.2H_2O$) (**Graph 13**) has a solubility of 2530 mg/L in water. The SI is negative over the duration of the modelled period indicating that gypsum will predominately stay in solution. The modelled concentration of $CaSO_4$ (**Graph 14**) indicates that concentrations remain low but increase linearly.

- Calcite ($CaCO_3$) and Dolomite ($CaMg[CO_3]_2$) have low solubility and the SI values are positive from early in the modelled period (**Graphs 15 and 16**). Relative concentration of $CaCO_3$ and $MgCO_3$ increase over time as the SI becomes more positive (**Graphs 17 and 18**).

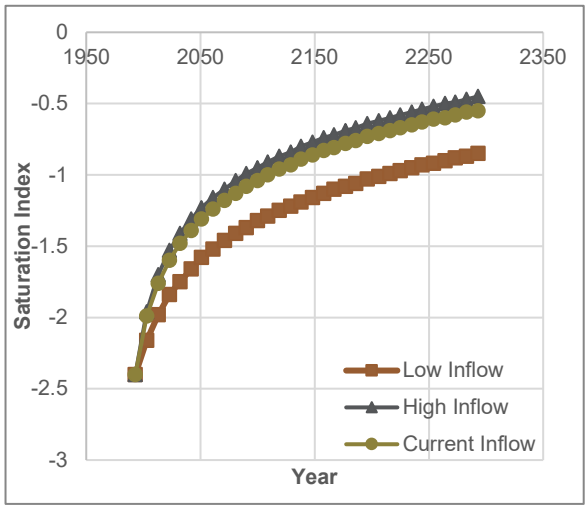
- Overall concentrations of carbonate and carbonate compounds (**Graph 19**), and calcium and calcium compounds (**Graph 20**) and sulfate and sulfate compounds (**Graph 21**) increase linearly and are not significantly impacted by calcite, dolomite or gypsum precipitation.

- The SI values for Goethite (FeOOH) (**Graph 22**) and $Fe(OH)_3$ (**Graph 23**) (and other iron compounds) are positive, indicating precipitation.

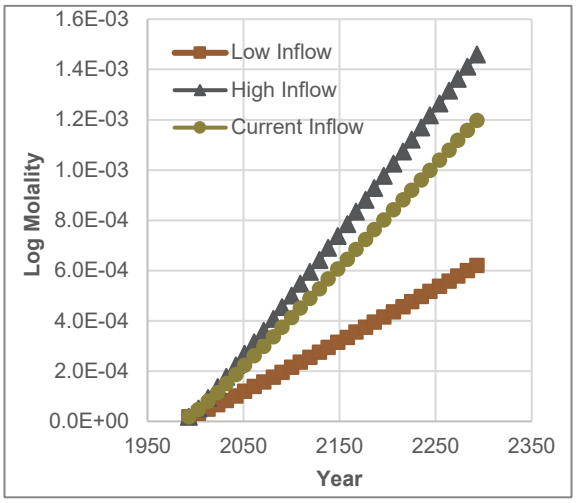
- Concentrations of $Fe(OH)_3$ (**Graph 24**) and ferric iron (**Graph 25**) compounds increase linearly.

- Concentrations of ferrous iron compounds (**Graph 26**) and Fe^{2+} (**Graph 27**) are substantially lower than the oxidised iron form, however relative concentrations increase as pit water concentrations increase. This is likely due to a shift in redox conditions as the pit becomes more saline and oxygen demand increases.

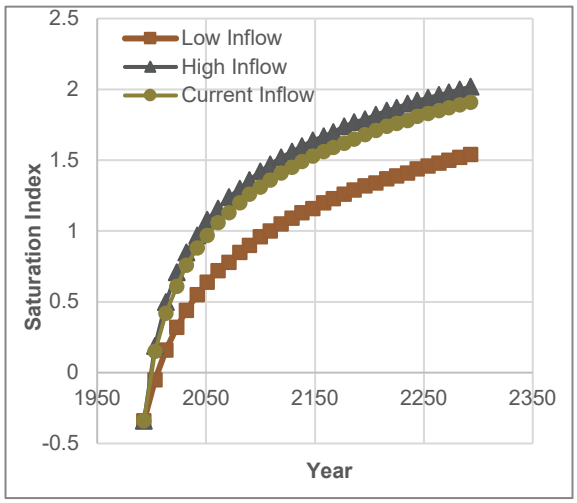
Modelling of pit water composition indicates that precipitation of calcite, dolomite and iron compounds is likely to occur. Gypsum and other salts are predicted to stay in solution. This is typical of moderate to high salinity water bodies. Within this range of salinity salt efflorescence is unlikely to occur around the pit lake perimeter.



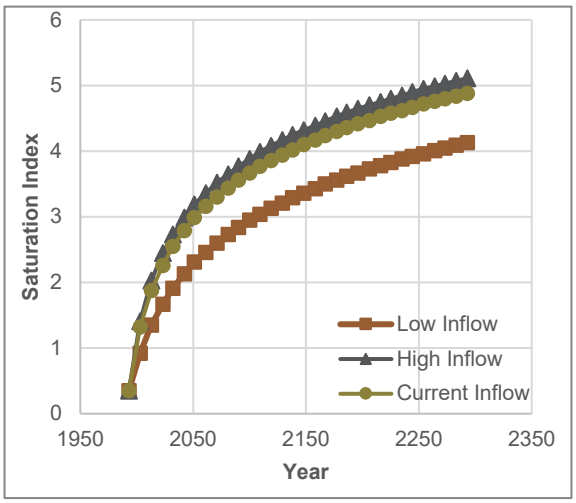
Graph 13. Saturation index for Gypsum ($CaSO_4.2H_2O$)



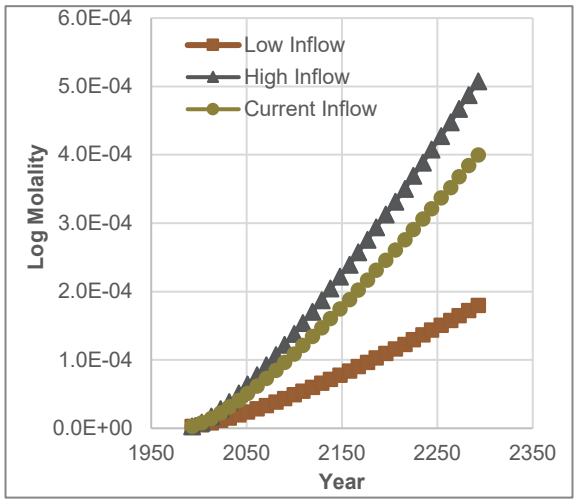
Graph 14. Concentration of $CaSO_4$ (log molality)



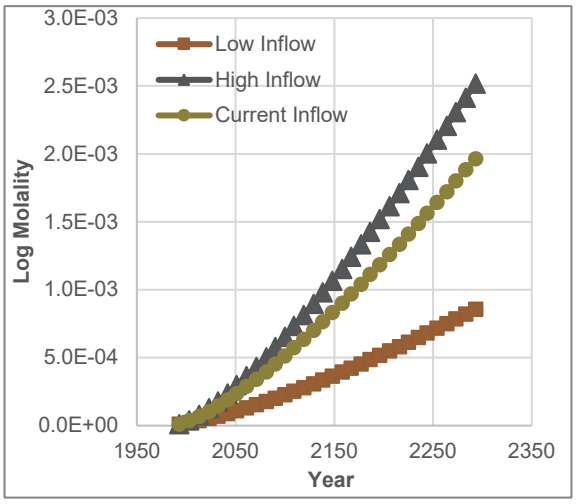
Graph 15. Saturation index for Calcite ($CaCO_3$)



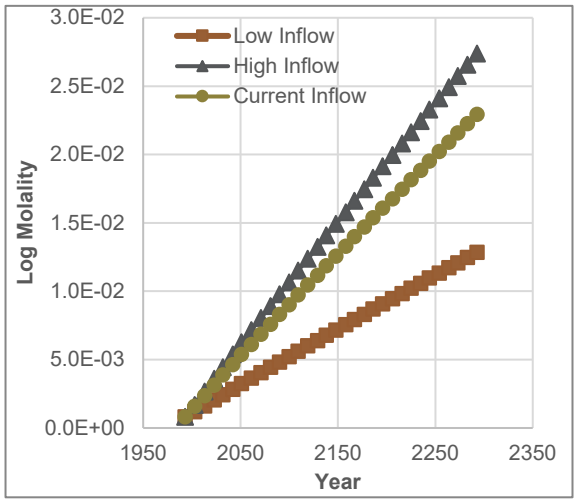
Graph 16. Saturation index for Dolomite ($CaMg[CO_3]_2$)



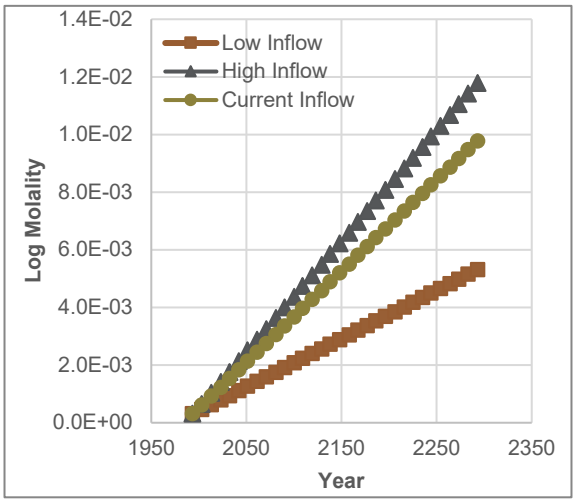
Graph 17. Concentration of $CaCO_3$ (log molality)



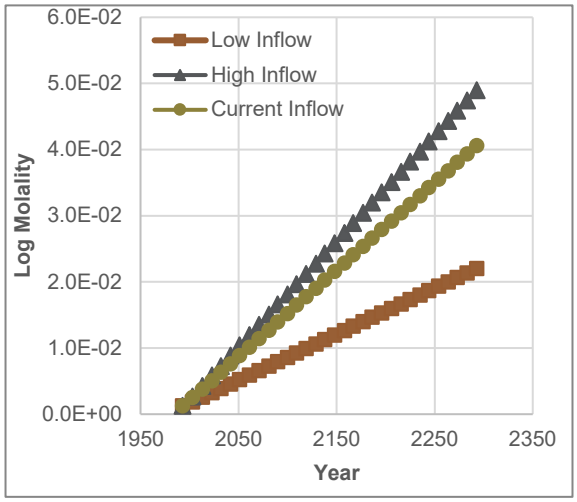
Graph 18. Concentration of $MgCO_3$ (log molality)



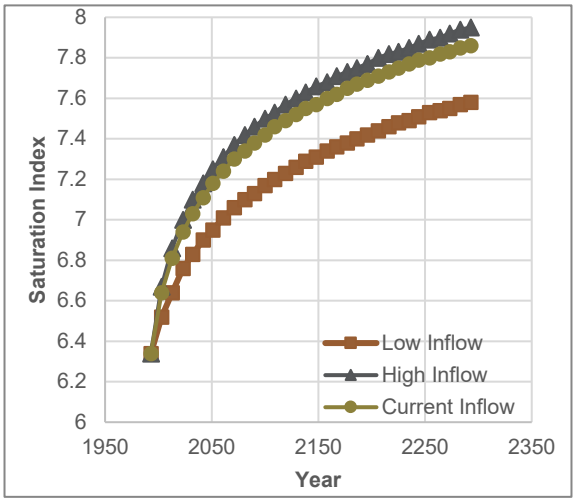
Graph 19. Concentration of Carbonate and carbonate compounds (log molality)



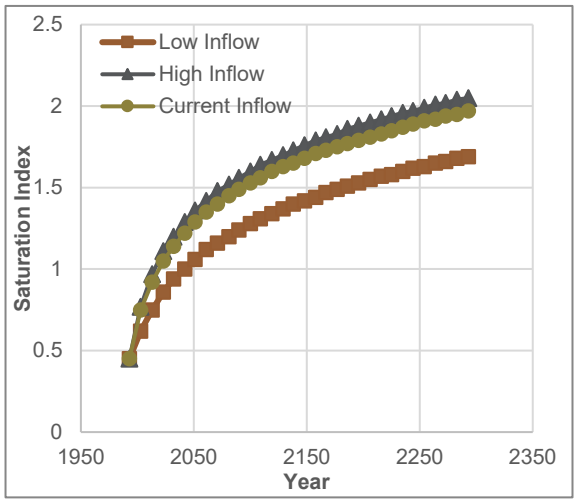
Graph 20. Concentration of Ca and Ca compounds (log molality)



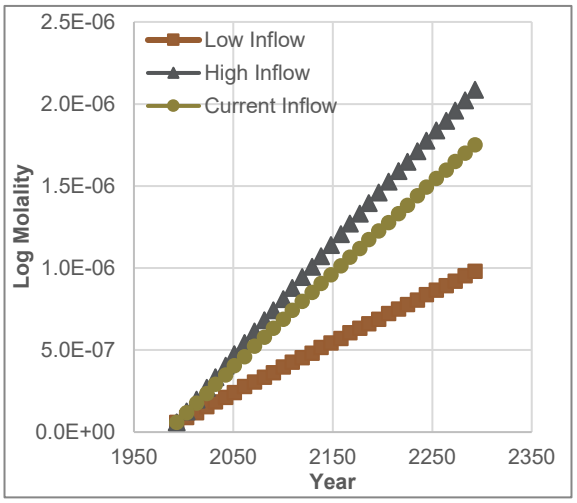
Graph 21. Concentration of SO_4 and SO_4 compounds (log molality)



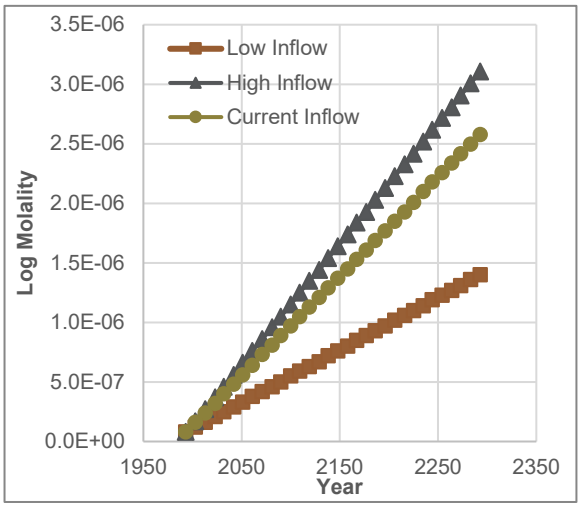
Graph 22. Saturation index for Goethite (FeOOH)



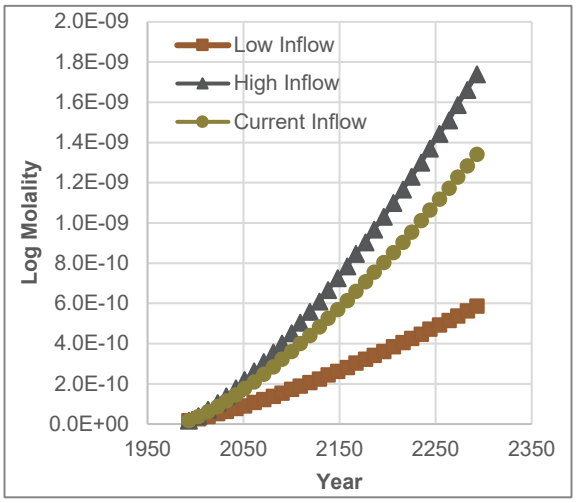
Graph 23. Saturation index for $Fe(OH)_3$



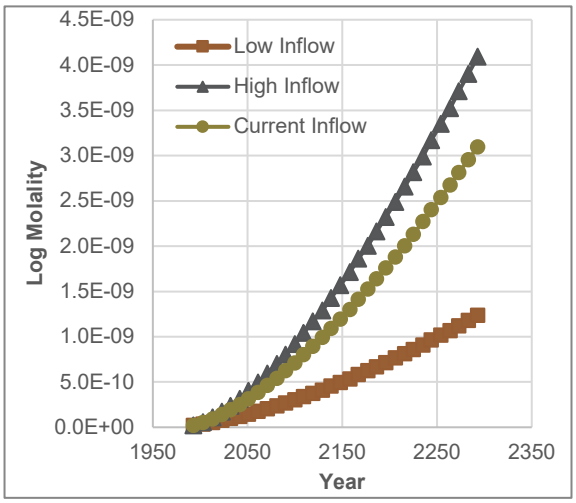
Graph 24. Concentration of $Fe(OH)_3$ (log molality)



Graph 25. Concentration of Ferric Iron compounds [Fe(3)] (log molality)



Graph 26. Concentration of Fe^{2+} (log molality)



Graph 27. Concentration of Ferrous Iron compounds [Fe(2)] (log molality)

8.3.8 Potential for exceedances of guideline values

As the salinity of the pit lake increases, the salinity, ion and metal concentrations will exceed various screening criteria. However, as the pit lake acts as a groundwater sink, is not accessible, and is not extracted for any beneficial use, these guideline value exceedances are not considered to be significant. While the pit lake may currently have incidental visitation by birds and wildlife, there are nearby stock-watering troughs which would provide an alternate water source when the pit lake becomes too saline.

9 QUALITATIVE RISK ASSESSMENT

9.1 Assessment Methodology

This section presents an assessment of the potential impacts to beneficial users of the pit lake. Potential impacts to groundwater and the surrounding environment as a result of the project have been assessed in the context of the mine pit and local hydrogeological setting, i.e., the CSM, and the relevant legislation and guidelines. The CSM was based on:

- a desktop study of existing information relating to the project site and catchment hydrogeology;
- assessment of mine pit water balance model, and
- assessment of mine pit geochemical model.

9.2 Likelihood and Consequence Matrix

A summary of the primary potential impacts of the different components of the project, based on the above discussion, has been provided in **Table 14**. The individual impacts are considered separately in terms of their likelihood and consequence; scores are attributed to both likelihood and consequence on a scale from 1 to 5 in each case. The risk is, in turn, scored as the sum of the likelihood and consequence scores.

Table 14: Risk matrix

		Likelihood				
Consequence		**Very unlikely (5)**	**Unlikely (4)**	**Possible (3)**	**Likely (2)**	**Very Likely (1)**
	Negligible (5)	10	9	8	7	6
	Minor (4)	9	8	7	6	5
	Moderate (3)	8	7	6	5	4
	Major (2)	7	6	5	4	3
	Critical (1)	6	5	4	3	2

Note(s):

1. Likelihood scale has five categories with scores from 5 to 1, i.e., Very Unlikely (5), Unlikely (4), Possible (3), Likely (2), Very Likely (1)
2. Consequence scale has five categories with scores from 5 to 1, i.e., Negligible (5), Minor (4), Moderate (3), Major (2), Critical (1)
3. Overall risk value = Consequence value + Likelihood value; consequence and likelihood are considered separately
4. Red denotes Extreme Risk (scores of 2-3), Orange denotes High Risk (scores of 4-5), Yellow denotes Moderate risk (scores of 6-7), Green denotes low risk (8-10)

9.3 Summary of Impacts

The risk matrix is illustrated in **Table 15** and confirms that potential impact of the pit lake to the local aquifer and nearby sensitive ecological receptors is low risk.

Table 15: Qualitative Impact Assessment

Component	Potential Impact to Receptor	Likelihood of Impact	Consequence of Impact	Level of Risk	Proposed Mitigation Measure	Observations
Mine pit to act as recharge source to groundwater	Contamination of groundwater	Very unlikely (5)	Minor (4)	Low (9)	Pit water level controlled by limited area of pit catchment	Pit water level not likely to increase to equilibrium with water table under any plausible rainfall scenario
Mine pit water impact to groundwater	Contamination of groundwater	Very unlikely (5)	Minor (4)	Low (9)	Prevent contamination impacts to mine pit	Risk based on current pit water chemistry and water balance
Direct overflow of contaminated water from pit flowing into nearby waterways	Contamination of surface water bodies	Very unlikely (5)	Minor (4)	Low (9)	Pit contains sufficient available volume to contain extreme rainfall events	Pit water level not likely to increase to top of pit under any plausible rainfall scenario
Pit water impacting on human or ecological receptors	Toxicity to human or ecological receptors	Very unlikely (5)	Minor (4)	Low (9)	Avoid extraction of pit water for beneficial uses	No known exposure pathway between pit and human or ecological receptors

10 SUMMARY OF FINDINGS

The findings of the development of a hydrogeological model of the pit lake at Tick Hill can be summarised as follows:

- The hydrogeological model indicates that the mine pit acts as a groundwater sink for the site, and will continue to do under a wide range of climatic conditions.
- No plausible rainfall scenario was identified which raised the water level to either the level of the surrounding water table, or to the top of the pit.
- The pit water level is controlled by the limited rainfall runoff due to the small catchment area around the pit.
- As the pit lake acts as a groundwater sink and evaporation dominates the water balance, salinity and associated dissolved ion and metal concentrations are predicted to increase over time. The expected pit salinity after 250 years is modelled as 28,000 mg/L TDS.
- Precipitation of calcite, dolomite and iron minerals is expected within the pit lake.
- No sensitive human or ecological receptors were identified that might be impacted by mine pit water quality.

11 RECOMMENDATIONS

Based on the hydrogeological model developed for the Tick Hill mine pit, the following recommendations are made:

- That the pit continue to be fenced to prevent access by visitors or stock.
- That the pit catchment continue to be controlled so that runoff inflow is limited.
- That pit water not be extracted for beneficial use without testing to determine its suitability for that use. Extracted pit water should not be discharged to watercourses.

12 LIMITATIONS

This report has been prepared by Environmental Earth Sciences QLD ACN 109 442 284 in response to and subject to the following limitations:

1. The specific instructions received from Tick Hill Mining Pty Ltd;

2. The specific scope of works set out in PO724067 issued by Environmental Earth Sciences for and on behalf of Tick Hill Mining Pty Ltd, is included in Section 3 (Scope of Work) of this report;

3. May not be relied upon by any third party not named in this report for any purpose except with the prior written consent of Environmental Earth Sciences QLD (which consent may or may not be given at the discretion of Environmental Earth Sciences QLD);

4. This report comprises the formal report, documentation sections, tables, figures and appendices as referred to in the index to this report and must not be released to any third party or copied in part without all the material included in this report for any reason;

5. The report only relates to the site referred to in the scope of works being located at Tick Hill Gold Mine ("the site");

6. The report relates to the site as at the date of the report as conditions may change thereafter due to natural processes and/or site activities;

7. No warranty or guarantee is made in regard to any other use than as specified in the scope of works and only applies to the depth tested and reported in this report;

8. Fill, soil, groundwater and rock to the depth tested on the site may be fit for the use specified in this report. Unless it is expressly stated in this report, the fill, soil and/or rock may not be suitable for classification as clean fill if deposited off site;

9. This report is not a geotechnical or planning report suitable for planning or zoning purposes; and

10. Our General Limitations set out at the back of the body of this report.

13 REFERENCES

ATC Williams (2022) Tick Hill Mine; Tailings Reclamation Project – Consequence Category Assessment. Report to Blue Cap Mining Pty Ltd. Report 120100.01-R02 Rev 1. June 2022.

Australian and New Zealand Environment Governments (ANZG) (2018). *Australian and New Zealand guidelines for fresh and marine water quality*. August 2018.

ANZG (2023). *Toxicant default guideline values for aquatic ecosystem protection. Perfluoro-octane sulfonate (PFOS) in freshwater*. Technical Brief, May 2023.

Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia (ARMCANZ) (2000). *Australian and New Zealand guidelines for fresh and marine water quality.*

Australian Standards (2005). *AS4482.1 – 2005. Guide to the sampling and investigation of potentially contaminated soil, Part 1, non-volatile and semi-volatile compounds*. – now withdrawn.

Bureau of Meteorology (BOM) (2023). *Atlas of groundwater dependent ecosystems*. Australian Government.

BOM (2024). *Climate data and weather observations.* Mount Isa: Station ID 029127, Duchess: Station ID 037019, The Monument: Station ID 037034.

Carnaby Resources (2021a) Tick Hill: Mining Leases MLs7094, 7096 & 7097 Initial Development Plan 1 July 2021 to 30 June 2025.

Carnaby Resources (2021b) Water extraction reporting to Associated Water (AWT) by mining tenure holders. Mineral Resources Act 1989 s334ZP and the Mineral Resources Regulation 2013 (MRR) s31A-31C.

Cloncurry Shire Council (2017) Cloncurry Shire Planning Scheme 2016. Version 2. 4 July 2017.

Department of Environment and Science (DES) (2023) *Queensland auditor handbook for contaminated land. Module 6: Content requirements for contaminated land investigation documents, certifications and audit reports*. ESR/2018/4224 Version 2.03 18 May 2023.

DES (2023). *Environmental authority locations interactive map*. Accessed May 2023.

Department of Natural Resources (1997) Salinity Management Handbook. Queensland Government, Coorparoo.

Drever J I (1997). *The Geochemistry of Natural Waters: Surface and Groundwater Environments.*

Environmental & Earth Services (1990) Assessment of cyanide decay and acid generation potential of tailings and tailings liquor, Tick Hill. Report to Kinhill Engineers Pty Ltd.

Environmental Earth Sciences (2023) Environmental Site Assessment – Tick Hill Gold Mine, QLD. Report to Carnaby Resources Pty Ltd. 722092 V1. 13 July 2023.

Envirofin (2020) Tick Hill Tailings Reclamation Project. EA Amendment Application Supporting Information. Report to Carnaby Resources Ltd. CR0002v2 10 August 2020

Hamon, R E, McLaughlin, M J, Gilkes, R J, Rate, A W, Zarcina, B, Robertson, A, Cozens, G, Radford, N, & Bettenay, L (2004). *Geochemical indices allow estimation of heavy metal background concentrations in soils.* Global Biogeochemical Cycles, vol. 18, GB1014.

Hem, J D (1985). *Study and interpretation of chemical characteristics of natural water*. United States Geological Survey (USGS) Water-Supply Paper 2254, Third Edition.

Hvorslev, M J (1951). *Time lag and soil permeability in ground-water observations*. U.S. Army Corps of Engineers, Waterways Experiment Station, Bulletin No. 36.

MIM Holdings (1993) Tick Hill Gold Mine; Visit by ASARCO Directors. Summary of operations report, March 1993.

National Environment Protection Council (NEPC) (2013). *National Environment Protection (Assessment of Site Contamination) Amendment Measure*, Adelaide, SA.

National Health and Medical Research Council (NHMRC)/ Natural Resource Management Ministerial Council (NRMMC) (2011). *Australian drinking water guidelines.* National Water Quality Management Strategy.

National Uniform Drillers Licensing Committee (NUDLC) (2020). *Minimum Construction the Requirements for Water Bores in Australia*. 4th Edition, Brisbane.

NHMRC & NRMMC (2008). *Guidelines for managing risks in recreational water.* Australian Government, February 2008.

Northcote, K. H. with Beckmann, G. G., Bettenay, E., Churchward, H. M., Van Dijk, D. C., Dimmock, G. M., Hubble, G. D., Isbell, R. F., McArthur, W. M., Murtha, G. G., Nicolls, K. D., Paton, T. R., Thompson, C. H., Webb, A. A. and Wright, M. J. (1960-1968). Atlas of Australian Soils, Sheets 1 to 10. With explanatory data (CSIRO Aust. and Melbourne University Press: Melbourne).

PA Scott Consulting (2022) Tick Hill Environmental Evaluation Groundwater Geochemistry Report. ML7097, ML7094, ML7096. Environmental Authority EPML00820613. Prepared for Carnaby Resources Pty Ltd, 20 April 2022.

Queensland Globe (2023) https://qldglobe.information.qld.gov.au/, accessed May 2023.

Queensland Government (1994) Environmental Protection (EP) Act (Amended June 2023)

Queensland Government (2019) Environmental Protection Regulation 2019

Queensland Government (2019) Environment Protection Policy (Water and Wetland Biodiversity) Policy.

Queensland Government (2023), Environmental Protection and Other Legislation Amendment Act.

United States Geological Survey [USGS] (2021) PHREEQC Version 3. Software release.

14 GLOSSARY OF TERMS

The following descriptions are of terms used in the text of this report.

Alluvial. Describes material deposited by, or in transit in, flowing water.

Anaerobic. Reducing or without oxygen.

Aquifer. A rock or sediment in a formation, group of formations, or part of a formation which is saturated and sufficiently permeable to transmit economic quantities of water to bores and springs.

Aquifer, confined. An aquifer that is overlain by a confining bed with significantly lower hydraulic conductivity than the aquifer.

Aquifer, perched. A region in the unsaturated zone where the soil is locally saturated because it overlies soil or rock of low permeability.

Background. The natural level of a property.

Baseline. An initial value of a measure.

Biodegradation. A biochemical process of microbial oxidation of complex organic compounds, to simpler chemical products. Micro-organisms derive the energy and cell carbon for growth from oxidation of organic compounds.

Bore. A hydraulic structure that facilitates the monitoring of groundwater level, collection of groundwater samples, or the extraction (or injection) of groundwater. Also known as a well, monitoring bore or piezometer, although piezometers are typically of small diameter and only used for measuring the groundwater elevation or potentiometric surface.

Borehole. An uncased well drill hole.

Cation Exchange Capacity (CEC). The maximum positive charge required to balance the negative charge on colloids (clays and other charged particles). The units are milli-equivalents per 100 grams of material or centimoles of charge per kilogram of exchanger.

Clay. A soil material composed of particles finer than 0.002 mm. When used as a soil texture group such soils contain at least 35% clay.

Colluvial. Unconsolidated soil and rock material moved down-slope by gravity.

Confined Aquifer. An aquifer that is confined between two low-permeability aquitards. The groundwater in these aquifers is usually under hydraulic pressure, i.e. its hydraulic head is above the top of the aquifer.

Confining layer. A layer with low vertical hydraulic conductivity that is stratigraphically adjacent to one or more aquifers. A confining layer is an aquitard. It may lie above or below the aquifer.

Contaminant. Generally, any chemical species introduced into the soil or water. More particularly relates to those species that render soil or water unfit for beneficial use.

Contamination. Is considered to have occurred when the concentration of a specific element or compound is established as being greater than the normally expected (or actually quantified) background concentration.

Diffusion. A process by which species in solution move, driven by concentration gradients (from high to low).

Dilution. The mixing of a small volume of contaminated leachate with a large volume of uncontaminated water. The concentration of contaminants is reduced by the volume of the lower concentrated water. However the physical process of dilution often causes chemical disequilibria resulting in the destruction of ligand bonds, the alteration of solubility products and the alteration of water pH. This usually causes precipitation by different chemical means of various species.

Discrete sample. Samples collected from different locations and depths that will not be composited but analysed individually.

Dispersion. A process by which species in solution mix with a second solution, thus reducing in concentration. In particular, relates to the reduction in concentration resulting from the movement of flowing groundwater.

Dissolved Oxygen (DO). Oxygen in the gaseous phase dissolved in water. Measured either as a concentration in mg/L or as a percentage of the theoretical saturation point, which is inversely related to temperature. At 19, 20 and 21 degrees Celsius, the oxygen concentrations in mg/L corresponding to 100% saturation are 9.4, 9.2 and 9.0 respectively.

Electrical Conductivity (EC). The EC of water is a measure of its ability to conduct an electric current. This property is related to the ionic content of the sample, which is in turn a function of the total dissolved (ionisable) solids (TDS) concentration. An estimate of TDS in fresh water can be obtained by multiplying EC by 0.65.

Flow path. The direction in which groundwater is moving.

Fluvial. A material deposited by, or in transit, in streams or watercourses.

Fracture. A break in the geological formation, e.g. a shear or a fault.

Gradient. The rate of inclination of a slope. The degree of deviation from the horizontal; also refers to pressure.

Groundwater. The water held in the pores in the ground below the water table.

Groundwater Elevation. The elevation of the groundwater surface measured relative to a specified datum such as the Australian Height Datum (mAHD) or an arbitrary survey datum onsite, or “reduced level” (mRL).

Head space. The air space at the top of a soil or water sample.

Heavy Metals. All metallic elements whose atomic mass exceeds that of calcium (20). Typical analysis for heavy metals includes cadmium (Cd), chromium (Cr), copper (Cu), nickel (Ni), lead (Pb), zinc (Zn), and the metalloid arsenic (As).

Heterogeneous. A condition of having different characteristics in proximate locations. Non-uniform. (Opposite of homogeneous).

Hydraulic Conductivity (K). A coefficient describing the rate at which water can move through a permeable medium. It has units of length per time. The units for hydraulic conductivity are typically $m^3/day/m^2$ or m/day.

Hydraulic Gradient (i). The rate of change in total head per unit of distance of flow in a given direction – the direction is that which yields a maximum rate of decrease in head. Hydraulic Gradient is unit less.

Hydraulic Head (h). The sum of the elevation head and the pressure head at a point in an aquifer. This is typically reported as an elevation above a fixed datum, such as sea level.

Infiltration. The passage of water, under the influence of gravity, from the land surface into the subsurface.

Ionic Exchange. Adsorption occurs when a particle with a charge imbalance, neutralises this charge by the attraction (and subsequent adherence of) ions of opposite charge from solution. There are two types of such a charge: pH dependent; and pH independent or crystalline charge. Metal hydroxides and oxy-hydroxides represent examples of the former type, whilst clay minerals are representative of the latter and are normally associated with cation exchange.

Ions. An ion is a charged element or compound as a result of an excess or deficit of electrons. Positively charged ions are called cations, whilst negatively charged ions are called anions. Cations are written with superscript $^{+}$, whilst anions use $^{-}$ as the superscript. The major aqueous ions are those that dominate total dissolved solids (TDS). These ions include: Cl^-, SO_4^{2-}, HCO_3^-, Na^+, Ca^{2+}, Mg^{2+}, K^+, NH_4^+, NO_3^-, NO_2^-, F^-, PO_4^{3-} and the heavy metals.

Perched Groundwater. Unconfined groundwater separated from an underlying main body of groundwater by an unsaturated zone. Perched groundwater typically occurs in discontinuous, often ephemeral, lenses, with unsaturated conditions both above and below.

Permeability (k). Property of porous medium relating to its ability to transmit or conduct liquid (usually water) under the influence of a driving force. Where water is the fluid, this is effectively the hydraulic conductivity. A function of the connectivity of pore spaces.

Piezometric or Potentiometric Surface. A surface that represents the level to which water will rise in cased bores. The water table is the potentiometric surface in an unconfined aquifer.

pH. A logarithmic index for the concentration of hydrogen ions in an aqueous solution, which is used as a measure of acidity.

Porosity (n). The ratio of the volume of void spaces in a rock or sediment to the total volume of the rock or sediment. Typically given as a percentage.

Porosity, effective (ne). The volume of the void spaces through which water or other fluids can travel in a rock or sediment divided by the total volume of the rock or sediment.

Precipitation (chemical). There are two types of precipitation, pH dependent precipitation and solubility controlled precipitation. As the pH is raised beyond a threshold level the precipitation of metal cations such as oxy-hydroxides and hydroxides occur. As the pH is raised further precipitation continues until there are very few metal cations remaining in solution. This reaction is entirely reversible. Solubility controlled precipitation occurs between two ions when, at a given temperature and pressure, the concentration of one of the ions exceeds a certain level.

Purge (bores). The pumping out of monitoring bore water to remove drilling debris or impurities; also conducted to bring fresh groundwater into the casing for sample collection. The later ensures that a more representative sample of an aquifer is taken.

QA/QC. Quality Assurance / Quality Control.

Recharge Area. Location of the replenishment of an aquifer by a natural process such as addition of water at the ground surface, or by an artificial system such as addition through a well

Recovery. The rate at which a water level in a bore rises after pumping ceases.

Saturated Zone. A zone in which the rock or soil pores are filled (saturated) with water.

Standing Water Level (SWL). The depth to the groundwater surface in a well or bore measured below a specific reference point – usually recorded as metres below the top of the well casing or below the ground surface.

Stratigraphy. A vertical sequence of geological units.

Total Dissolved Salts (TDS). The total dissolved salts comprise dissociated compounds and undissociated compounds, but not suspended material, colloids or dissolved gases.

Toxicity. The inherent potential or capacity of a material to cause adverse effects in a living organism.

Unsaturated Zone. The zone between the land surface and the water table, in which the rock or soil pores contain both air and water (water in the unsaturated zone is present at less than atmospheric pressure). It includes the root zone, intermediate zone and capillary fringe. Saturated bodies such as perched groundwater may exist in the unsaturated zone. Also referred to as the Vadose Zone.

Volatile. Having a low boiling or subliming pressure (a high vapour pressure).

Water table. Interface between the saturated zone and unsaturated zones. The surface in an aquifer at which pore water pressure is equal to atmospheric pressure.

Well. See **Bore** (monitoring bore).

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

ENVIRONMENTAL EARTH SCIENCES GENERAL LIMITATIONS

Scope of services
The work presented in this report is Environmental Earth Sciences response to the specific scope of works requested by, planned with and approved by the client. It cannot be relied on by any other third party for any purpose except with our prior written consent. Client may distribute this report to other parties and in doing so warrants that the report is suitable for the purpose it was intended for. However, any party wishing to rely on this report should contact us to determine the suitability of this report for their specific purpose.

Data should not be separated from the report
A report is provided inclusive of all documentation sections, limitations, tables, figures and appendices and should not be provided or copied in part without all supporting documentation for any reason, because misinterpretation may occur.

Subsurface conditions change
Understanding an environmental study will reduce exposure to the risk of the presence of contaminated soil and or groundwater. However, contaminants may be present in areas that were not investigated, or may migrate to other areas. Analysis cannot cover every type of contaminant that could possibly be present. When combined with field observations, field measurements and professional judgement, this approach increases the probability of identifying contaminated soil and or groundwater. Under no circumstances can it be considered that these findings represent the actual condition of the site at all points.

Environmental studies identify actual sub-surface conditions only at those points where samples are taken, when they are taken. Actual conditions between sampling locations differ from those inferred because no professional, no matter how qualified, and no sub-surface exploration program, no matter how comprehensive, can reveal what is hidden below the ground surface. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from that predicted. Nothing can be done to prevent the unanticipated. However, steps can be taken to help minimize the impact. For this reason, site owners should retain our services.

Problems with interpretation by others
Advice and interpretation is provided on the basis that subsequent work will be undertaken by Environmental Earth Sciences QLD. This will identify variances, maintain consistency in how data is interpreted, conduct additional tests that may be necessary and recommend solutions to problems encountered on site. Other parties may misinterpret our work and we cannot be responsible for how the information in this report is used. If further data is collected or comes to light we reserve the right to alter their conclusions.

Obtain regulatory approval
The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party. When approval from a statutory authority is required for a project, that approval should be directly sought by the client.

Limit of liability
This study has been carried out to a particular scope of works at a specified site and should not be used for any other purpose. This report is provided on the condition that Environmental Earth Sciences QLD disclaims all liability to any person or entity other than the client in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by any such person in reliance, whether in whole or in part, on the contents of this report. Furthermore, Environmental Earth Sciences QLD disclaims all liability in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by the client, or any such person in reliance, whether in whole or any part of the contents of this report of all matters not stated in the brief outlined in Environmental Earth Sciences QLD's proposal number and according to Environmental Earth Sciences general terms and conditions and special terms and conditions for contaminated sites.

To the maximum extent permitted by law, we exclude all liability of whatever nature, whether in contract, tort or otherwise, for the acts, omissions or default, whether negligent or otherwise for any loss or damage whatsoever that may arise in any way in connection with the supply of services. Under circumstances where liability cannot be excluded, such liability is limited to the value of the purchased service.

TABLES

Table 16: BOM Annual Exceedance Probability rainfall

Rare Design Rainfall Depth (mm)						
Issued:	10-Sep-24					
Location Label:						
Requested coordinate:	Latitude	-21.645	Longitude	139.928		
Nearest grid cell:	Latitude	21.6375 (S)	Longitude	139.9375 (E)		
		Annual Exceedance Probability (1 in x)				
Duration	**Duration in min**	**1 in 100**	**1 in 200**	**1 in 500**	**1 in 1000**	**1 in 2000**
1 min	1	5.74	6.53	7.54	8.34	9.17
2 min	2	9.8	11.1	12.7	14	15.3
3 min	3	13.8	15.6	18	19.8	21.7
4 min	4	17.6	19.9	22.9	25.3	27.8
5 min	5	21	23.9	27.6	30.4	33.4
10 min	10	34.9	39.7	45.9	50.8	55.9
15 min	15	44.9	51	59	65.3	71.8
20 min	20	52.4	59.6	68.9	76.2	83.8
25 min	25	58.5	66.5	76.8	84.9	93.4
30 min	30	63.5	72.1	83.3	92.1	101
45 min	45	74.7	84.7	97.8	108	119
1 hour	60	82.6	93.6	108	119	131
1.5 hour	90	93.6	106	122	135	149
2 hour	120	101	115	133	147	161
3 hour	180	113	128	148	164	180
4.5 hour	270	126	143	165	183	202
6 hour	360	136	155	179	198	218
9 hour	540	152	173	200	222	245
12 hour	720	165	188	218	242	267
18 hour	1080	187	214	247	273	301
24 hour	1440	206	234	270	299	329
30 hour	1800	222	250	287	317	347
36 hour	2160	236	265	304	334	365
48 hour	2880	261	291	333	366	399

Rare Design Rainfall Depth (mm)						
72 hour	4320	298	333	382	419	458
96 hour	5760	325	365	419	461	505
120 hour	7200	345	389	448	495	543
144 hour	8640	361	407	471	522	573
168 hour	10080	372	422	489	543	598
Copyright Commonwealth of Australia 2016 Bureau of Meteorology (ABN 92 637 533 532)						

Table 17: Waste rock and tailings ASLP leach results

Analyte grouping/Analyte	Unit	LOR	T1-ALS	TC1-ALS	WR1-ALS	WR3-ALS
Sample Date:			07/08/2024	07/08/2024	07/08/2024	07/08/2024
pH Value leach	pH Unit	0.01	5.04	5.65	6.42	5.06
Total Dissolved Solids	mg/L	10	5990	7490	7580	5600
Iodide	mg/L	1	----	----	<0.500	<0.200
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	1440	2360	2880	1460
Total Alkalinity as $CaCO_3$	mg/L	1	1440	2360	2880	1460
Sulfate as SO_4	mg/L	1	<10	<10	4	<10
Chloride	mg/L	1	<10	<10	<10	10
Calcium	mg/L	1	93	133	568	91
Magnesium	mg/L	1	11	14	74	8
Potassium	mg/L	1	4	9	6	4
Fluoride	mg/L	0.1	0.2	0.3	0.4	0.1
Ammonia as N	mg/L	0.01	0.05	0.06	0.01	0.01
Nitrite as N	mg/L	0.01	<0.01	<0.01	<0.01	<0.01
Nitrate as N	mg/L	0.01	<0.01	0.02	<0.01	<0.01
Reactive Phosphorus as P	mg/L	0.01	0.01	0.06	0.01	0.02
Aluminium	mg/L	0.1	0.7	<0.1	<0.1	0.4
Arsenic	mg/L	0.1	<0.1	<0.1	<0.1	<0.1
Barium	mg/L	0.1	0.9	1.1	4.5	0.6
Beryllium	mg/L	0.05	<0.05	<0.05	<0.05	<0.05

Analyte grouping/Analyte	Unit	LOR	T1-ALS	TC1-ALS	WR1-ALS	WR3-ALS
Boron	mg/L	0.1	0.2	0.2	<0.1	0.1
Cadmium	mg/L	0.05	<0.05	<0.05	<0.05	<0.05
Chromium	mg/L	0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	mg/L	0.1	<0.1	<0.1	<0.1	<0.1
Copper	mg/L	0.1	0.2	<0.1	<0.1	<0.1
Iron	mg/L	0.1	0.4	<0.1	<0.1	0.2
Lead	mg/L	0.1	<0.1	<0.1	<0.1	<0.1
Manganese	mg/L	0.1	0.5	2.7	<0.1	0.5
Nickel	mg/L	0.1	<0.1	<0.1	<0.1	<0.1
Selenium	mg/L	0.05	<0.05	<0.05	<0.05	<0.05
Strontium	mg/L	0.1	0.1	0.4	1.1	<0.1
Titanium	mg/L	0.1	<0.1	<0.1	<0.1	<0.1
Vanadium	mg/L	0.1	<0.1	<0.1	<0.1	<0.1
Zinc	mg/L	0.1	0.3	0.3	0.2	0.3
Mercury	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010

Table 18: Waste rock and tailings soil/rock solids results

Analyte grouping/Analyte	Unit	LOR	T1-ALS	TC1-ALS	WR1-ALS	WR3-ALS
Date			07/08/2024	07/08/2024	07/08/2024	07/08/2024
pH ($CaCl_2$)	pH Unit	0.1	7.8	8	8	8.1
pH Value	pH Unit	0.1	8.9	9.2	9.2	9.5
Electrical Conductivity @ 25°C	µS/cm	1	175	55	110	45
Moisture Content	%	1	3.4	<1.0	6.9	1
Bicarbonate Extractable K (Colwell)	mg/kg	100	163	446	280	138
Chloride	mg/kg	10	20	<10	20	<10
Ammonia as N	mg/kg	20	<20	<20	<20	<20
Nitrite as N (Sol.)	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Nitrate as N (Sol.)	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1

Analyte grouping/Analyte	Unit	LOR	T1-ALS	TC1-ALS	WR1-ALS	WR3-ALS
Nitrite + Nitrate as N (Sol.)	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Total Kjeldahl Nitrogen as N	mg/kg	20	60	30	80	<20
Total Nitrogen as N	mg/kg	20	60	30	80	<20
Bicarbonate Ext. P (Colwell)	mg/kg	5	<5	<5	<5	<5
Total Phosphorus as P	mg/kg	2	391	446	145	74
Total metals						
Arsenic	mg/kg	5	<5	<5	<5	<5
Barium	mg/kg	10	30	20	140	<10
Beryllium	mg/kg	1	<1	<1	<1	<1
Boron	mg/kg	50	<50	<50	<50	<50
Cadmium	mg/kg	1	<1	<1	<1	<1
Chromium	mg/kg	2	17	12	11	3
Cobalt	mg/kg	2	17	7	13	<2
Copper	mg/kg	5	95	9	9	10
Lead	mg/kg	5	<5	<5	<5	<5
Manganese	mg/kg	5	75	107	80	30
Nickel	mg/kg	2	15	10	7	<2
Selenium	mg/kg	5	<5	<5	<5	<5
Vanadium	mg/kg	5	18	22	38	<5
Zinc	mg/kg	5	11	10	5	<5
Mercury	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1

APPENDIX A: REGISTERED GROUNDWATER BORES

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
5179	Sub-Artesian Facility	Abandoned and Destroyed		Longreach	2450 - CLONCURRY

Details

Description	STANBROKE HLD		
Parish	4310 - STANBROKE		
Original Name			
Driller Name			
Drill Company			
Const Method			
Bore Line			
D/O File No	17/10/S/3	**Polygon**	
R/O File No		**Equipment**	
H/O File No	L2672B	**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles			

Location

Latitude	21-38-50	**Basin**	0012
Longitude	139-53-18	**Sub-area**	
GIS Latitude	-21.647101511	**Lot**	
GIS Longitude	139.88841749	**Plan**	
Easting	384981		
Northing	7605806	**Map Scale**	254 - 1: 250 000
Zone	54	**Map Series**	M - Metric Series
Accuracy		**Map No**	SF54-6
GPS Accuracy		**Map Name**	DUCHESS
Checked	No	**Prog Section**	

Casing

0 ***records for RN*** **5179**

Strata Logs

0 ***records for RN*** **5179**

Stratigraphies

0 ***records for RN*** **5179**

Aquifers

0 ***records for RN*** **5179**

Pump Tests Part 1

0 ***records for RN*** **5179**

Pump Tests Part 2

0 ***records for RN*** **5179**

Bore Report

From Year:

Bore Conditions	**0**	*records for RN*	**5179**
Elevations	**0**	*records for RN*	**5179**
Water Analysis Part 1	**0**	*records for RN*	**5179**
Water Analysis Part 2	**0**	*records for RN*	**5179**
Water Levels	**0**	*records for RN*	**5179**
Wire Line Logs	**0**	*records for RN*	**5179**
Field Measurements	**0**	*records for RN*	**5179**
Special Water Analysis	**0**	*records for RN*	**5179**

Bore Report

From Year:

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Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
7550	Sub-Artesian Facility	Abandoned and Destroyed	01/01/1920	Longreach	2450 - CLONCURRY

Details

Description	CHATSWORTH HOLDING		
Parish	4428 - TALPIN		
Original Name	PRICKLEY BUSH BORE		
Driller Name			
Drill Company			
Const Method	CABLE TOOL		
Bore Line			
D/O File No	17/10/C/02	**Polygon**	
R/O File No	17/10/C/02	**Equipment**	WL
H/O File No	L03461B	**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles			

Location

Latitude	21-39-27	**Basin**	0012
Longitude	139-58-39	**Sub-area**	
GIS Latitude	-21.657378473	**Lot**	
GIS Longitude	139.977583743	**Plan**	
Easting	394212		
Northing	7604740	**Map Scale**	254 - 1: 250 000
Zone	54	**Map Series**	M - Metric Series
Accuracy		**Map No**	SF54-6
GPS Accuracy		**Map Name**	DUCHESS
Checked	No	**Prog Section**	

Casing

3 ***records for RN*** **7550**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	01/01/1920	1	0.00	5.10	Steel Casing		WT - Wall Thickness	203
A	01/01/1920	2		64.90	Steel Casing		WT - Wall Thickness	152
A	01/01/1920	3	68.00	68.00	Open End			

Strata Logs

2 ***records for RN*** **7550**

Bore Report

From Year:

Rec	Top (m)	Bottom (m)	Strata Description
902			00/00/1920 SWL -30.50 M TMP NUL C
903			00/00/1920 DISCH 163.8 M3D ESTIMAT

Stratigraphies

1 *records for RN* 7550

Source	Rec	Top (m)	Bottom (m)	Strata Description
DNR	1	0.00	67.10	INCA FORMATION

Aquifers

1 *records for RN* 7550

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	0.00									XX	INCA FORMATION

Pump Tests Part 1

0 *records for RN* 7550

Pump Tests Part 2

0 *records for RN* 7550

Bore Conditions

0 *records for RN* 7550

Elevations

0 *records for RN* 7550

Water Analysis Part 1

0 *records for RN* 7550

Water Analysis Part 2

0 *records for RN* 7550

Water Levels

1 *records for RN* 7550

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project	Quality
X	01/01/1920		-30.50	N	Natural Surface		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality

From Year:

Wire Line Logs

0 *records for RN* 7550

Field Measurements

0 *records for RN* 7550

Special Water Analysis

0 *records for RN* 7550

Bore Report

From Year:

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Report Date: 18/05/2023 13:20

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
9277	Sub-Artesian Facility	Abandoned and Destroyed		Longreach	2450 - CLONCURRY

Details

Description	STANBROKE HLD		
Parish	4310 - STANBROKE		
Original Name			
Driller Name			
Drill Company			
Const Method			
Bore Line			
D/O File No	17/10/S/3	**Polygon**	
R/O File No		**Equipment**	
H/O File No	L6784B	**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles			

Location

Latitude	21-38-52	**Basin**	0012
Longitude	139-55-10	**Sub-area**	
GIS Latitude	-21.647656844	**Lot**	
GIS Longitude	139.919528273	**Plan**	
Easting	388181		
Northing	7605791	**Map Scale**	254 - 1: 250 000
Zone	54	**Map Series**	M - Metric Series
Accuracy		**Map No**	SF54-6
GPS Accuracy		**Map Name**	DUCHESS
Checked	No	**Prog Section**	

Casing

0 *records for RN* 9277

Strata Logs

0 *records for RN* 9277

Stratigraphies

0 *records for RN* 9277

Aquifers

0 *records for RN* 9277

Pump Tests Part 1

0 *records for RN* 9277

Pump Tests Part 2

0 *records for RN* 9277

Bore Report

From Year:

Bore Conditions	**0**	*records for RN*	**9277**
Elevations	**0**	*records for RN*	**9277**
Water Analysis Part 1	**0**	*records for RN*	**9277**
Water Analysis Part 2	**0**	*records for RN*	**9277**
Water Levels	**0**	*records for RN*	**9277**
Wire Line Logs	**0**	*records for RN*	**9277**
Field Measurements	**0**	*records for RN*	**9277**
Special Water Analysis	**0**	*records for RN*	**9277**

Bore Report

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Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
184343	Sub-Artesian Facility	Existing	11/01/2020	Longreach	2450 - CLONCURRY

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name	THGW003		
Driller Name	HARGRAVE, TREVOR		
Drill Company	AMWD		
Const Method	ROTARY AIR		
Bore Line			
D/O File No		Polygon	
R/O File No		Equipment	
H/O File No		RN of Bore Replaced	
Log Received Date	14/01/2020	Data Owner	
Roles	Mine Monitoring		

Location

Latitude	21-38-54	Basin	0012
Longitude	139-55-13	Sub-area	
GIS Latitude	-21.64841841	Lot	16
GIS Longitude	139.9203194	Plan	CW62
Easting	388277		
Northing	7605699	Map Scale	
Zone	54	Map Series	
Accuracy		Map No	
GPS Accuracy		Map Name	
Checked	Yes	Prog Section	

Casing

7 *records for RN* 184343

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	11/01/2020	1	0.00	40.50	Polyvinyl Chloride	6.000	WT - Wall Thickness	68
A	11/01/2020	2	28.00	40.00	Screen	1.000	AP - Aperture Size	68
X	11/01/2020	3	0.00	5.50	Polyvinyl Chloride	7.000	WT - Wall Thickness	168
X	11/01/2020	4	0.00	6.10	Grout			155
X	11/01/2020	5	6.10	25.00	Cuttings or other fill between casing and hole wall			133

Bore Report

From Year:

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	11/01/2020	6	25.00	26.70	Bentonite Seal			133
X	11/01/2020	7	26.70	40.50	Gravel Pack			133

Strata Logs

4 *records for RN* **184343**

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.00	TOPSOIL
2	1.00	30.00	GRANITE
3	30.00	32.00	FRACTURED GRANITE
4	32.00	40.50	GRANITE

Stratigraphies

0 *records for RN* **184343**

Aquifers

1 *records for RN* **184343**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	30.00	32.00	GNTE - Acid Intrusive, Granite	11/01/2020	-18.70	N	POTABLE		Y	FR	CORELLA FORMATION

Pump Tests Part 1

0 *records for RN* **184343**

Pump Tests Part 2

0 *records for RN* **184343**

Bore Conditions

0 *records for RN* **184343**

Elevations

0 *records for RN* **184343**

Water Analysis Part 1

0 *records for RN* **184343**

Bore Report

From Year:

Water Analysis Part 2

0 *records for RN* **184343**

Water Levels

0 *records for RN* **184343**

Wire Line Logs

0 *records for RN* **184343**

Field Measurements

1 *records for RN* **184343**

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
A	11/01/2020		950	8.5						AI	Air Lifting	GB	Groundwater - from Bore

Special Water Analysis

0 *records for RN* **184343**

Bore Report

From Year:

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Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
184344	Sub-Artesian Facility	Existing	11/01/2020	Longreach	2450 - CLONCURRY

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name	THGW005		
Driller Name	HARGRAVE, TREVOR		
Drill Company	AMWD		
Const Method	ROTARY AIR		
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	14/01/2020	**Data Owner**	
Roles	Mine Monitoring		

Location

Latitude	21-39-09	**Basin**	0012
Longitude	139-55-27	**Sub-area**	
GIS Latitude	-21.65258985	**Lot**	16
GIS Longitude	139.92416338	**Plan**	CW62
Easting	388678		
Northing	7605240	**Map Scale**	
Zone	54	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

9 *records for RN* **184344**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	11/01/2020	1	0.00	42.00	Polyvinyl Chloride	6.000	WT - Wall Thickness	68
A	11/01/2020	2	29.00	41.50	Perforated or Slotted Casing	1.000	AP - Aperture Size	68
X	11/01/2020	3	0.00	5.50	Polyvinyl Chloride	7.000	WT - Wall Thickness	168
X	11/01/2020	4	0.00	5.50	Grout			155
X	11/01/2020	5	5.50	6.10	Grout			133

Bore Report

From Year:

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	11/01/2020	6	6.10	26.60	Cuttings or other fill between casing and hole wall			133
X	11/01/2020	7	26.60	28.00	Bentonite Seal			133
X	11/01/2020	8	28.00	42.00	Gravel Pack			133
X	11/01/2020	9		41.00	Centraliser			

Strata Logs

3 *records for RN* 184344

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	31.00	GRANITE
2	31.00	32.00	FRACTURED GRANITE
3	32.00	40.00	GRANITE

Stratigraphies

0 *records for RN* 184344

Aquifers

1 *records for RN* 184344

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	31.00	32.00	GNTE - Acid Intrusive, Granite	11/01/2020	-18.70	N	POTABLE		Y	FR	CORELLA FORMATION

Pump Tests Part 1

0 *records for RN* 184344

Pump Tests Part 2

0 *records for RN* 184344

Bore Conditions

0 *records for RN* 184344

Elevations

0 *records for RN* 184344

Water Analysis Part 1

0 *records for RN* 184344

From Year:

Water Analysis Part 2

0 ***records for RN*** **184344**

Water Levels

0 ***records for RN*** **184344**

Wire Line Logs

0 ***records for RN*** **184344**

Field Measurements

1 ***records for RN*** **184344**

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
A	11/01/2020		950	8.5						AI	Air Lifting	GB	Groundwater - from Bore

Special Water Analysis

0 ***records for RN*** **184344**

Bore Report

From Year:

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Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
184345	Sub-Artesian Facility	Existing	11/01/2020	Longreach	2450 - CLONCURRY

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name	THGW006		
Driller Name	HARGRAVE, TREVOR		
Drill Company	AMWD		
Const Method	ROTARY AIR		
Bore Line			
D/O File No		Polygon	
R/O File No		Equipment	
H/O File No		RN of Bore Replaced	
Log Received Date	14/01/2020	Data Owner	
Roles	Mine Monitoring		

Location

Latitude	21-38-47	Basin	0012
Longitude	139-55-38	Sub-area	
GIS Latitude	-21.6464215	Lot	16
GIS Longitude	139.92722393	Plan	CW62
Easting	388990		
Northing	7605925	Map Scale	
Zone	54	Map Series	
Accuracy		Map No	
GPS Accuracy		Map Name	
Checked	Yes	Prog Section	

Casing

7 *records for RN* 184345

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	11/01/2020	1	0.00	30.00	Polyvinyl Chloride	6.000	WT - Wall Thickness	68
A	11/01/2020	2	17.50	29.50	Perforated or Slotted Casing	1.000	AP - Aperture Size	68
X	11/01/2020	3	0.00	5.50	Polyvinyl Chloride	7.000	WT - Wall Thickness	168
X	11/01/2020	4	0.00	6.50	Grout			154
X	11/01/2020	5	6.50	14.80	Cuttings or other fill between casing and hole wall			154

Bore Report

From Year:

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	11/01/2020	6	14.80	16.00	Bentonite Seal			154
X	11/01/2020	7	16.00	30.00	Gravel Pack			154

Strata Logs

3 *records for RN* **184345**

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	18.00	QUARTZ
2	18.00	21.00	CLAY AND QUARTZ
3	21.00	30.00	DARK GRANITE

Stratigraphies

0 *records for RN* **184345**

Aquifers

1 *records for RN* **184345**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	20.00		QUAR - Quartz	11/01/2020	-18.40	N	POTABLE		Y	PS	CORELLA FORMATION

Pump Tests Part 1

0 *records for RN* **184345**

Pump Tests Part 2

0 *records for RN* **184345**

Bore Conditions

0 *records for RN* **184345**

Elevations

0 *records for RN* **184345**

Water Analysis Part 1

0 *records for RN* **184345**

Water Analysis Part 2

0 *records for RN* **184345**

Water Levels

0 *records for RN* **184345**

Bore Report

From Year:

Wire Line Logs

0 *records for RN* **184345**

Field Measurements

1 *records for RN* **184345**

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
A	11/01/2020		1750	8.5						AI	Air Lifting	GB	Groundwater - from Bore

Special Water Analysis

0 *records for RN* **184345**

Bore Report

From Year:

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Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
184352	Sub-Artesian Facility	Existing	11/01/2020	Longreach	2450 - CLONCURRY

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name	THGW004		
Driller Name	HARGRAVE, TREVOR		
Drill Company	AMWD		
Const Method	ROTARY AIR		
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	14/01/2020	**Data Owner**	
Roles	Mine Monitoring		

Location

Latitude	21-38-27	**Basin**	0012
Longitude	139-55-47	**Sub-area**	
GIS Latitude	-21.64085402	**Lot**	13
GIS Longitude	139.92961307	**Plan**	SP223510
Easting	389233		
Northing	7606543	**Map Scale**	
Zone	54	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

7 ***records for RN*** **184352**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	11/01/2020	1	0.00	27.50	Polyvinyl Chloride	6.000	WT - Wall Thickness	68
A	11/01/2020	2	15.00	27.00	Perforated or Slotted Casing	1.000	AP - Aperture Size	68
X	11/01/2020	3	0.00	5.50	Polyvinyl Chloride	7.000	WT - Wall Thickness	168
X	11/01/2020	4	0.00	6.50	Grout			155
X	11/01/2020	5	6.50	12.00	Cuttings or other fill between casing and hole wall			133

Bore Report

From Year:

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	11/01/2020	6	12.00	13.60	Bentonite Seal			133
X	11/01/2020	7	13.60	27.50	Gravel Pack			133

Strata Logs

4 *records for RN* 184352

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.00	TOPSOIL
2	1.00	15.00	FRACTURED GRANITE
3	15.00	16.00	FRACTURED GRANITE AND CLAY
4	16.00	27.50	GRANITE

Stratigraphies

0 *records for RN* 184352

Aquifers

1 *records for RN* 184352

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	14.60		GNTE - Acid Intrusive, Granite	11/01/2020	-14.60	N	POTABLE		Y	FR	CORELLA FORMATION

Pump Tests Part 1

0 *records for RN* 184352

Pump Tests Part 2

0 *records for RN* 184352

Bore Conditions

0 *records for RN* 184352

Elevations

0 *records for RN* 184352

Water Analysis Part 1

0 *records for RN* 184352

Bore Report

From Year:

Water Analysis Part 2

0 *records for RN* **184352**

Water Levels

0 *records for RN* **184352**

Wire Line Logs

0 *records for RN* **184352**

Field Measurements

1 *records for RN* **184352**

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
A	11/01/2020		2760	8.8						XX	Unknown	GB	Groundwater - from Bore

Special Water Analysis

0 *records for RN* **184352**

Bore Report

From Year:

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Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
184353	Sub-Artesian Facility	Abandoned and Destroyed	11/01/2020	Longreach	2450 - CLONCURRY

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name	MBWB1		
Driller Name	HARGRAVE, TREVOR		
Drill Company	AMWD		
Const Method	ROTARY AIR		
Bore Line			
D/O File No		Polygon	
R/O File No		Equipment	
H/O File No		RN of Bore Replaced	
Log Received Date	14/01/2020	Data Owner	
Roles	Water Supply		

Location

Latitude	21-36-36	Basin	0012
Longitude	139-54-38	Sub-area	
GIS Latitude	-21.60999707	Lot	16
GIS Longitude	139.91052892	Plan	CW62
Easting	387234		
Northing	7609945	Map Scale	
Zone	54	Map Series	
Accuracy		Map No	
GPS Accuracy		Map Name	
Checked	Yes	Prog Section	

Casing

4 *records for RN* 184353

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	11/01/2020	1	0.00	4.00	Grout			311
X	11/01/2020	2	4.00	6.00	Grout			133
X	11/01/2020	3	6.00	21.00	Cuttings or other fill between casing and hole wall			133
X	11/01/2020	4	0.00	4.00	Polyvinyl Chloride			280

Strata Logs

4 *records for RN* 184353

Bore Report

From Year:

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.00	TOPSOIL
2	1.00	11.00	GRANITE
3	11.00	12.00	FRACTURED GRANITE AND CLAY
4	12.00	21.00	GRANITE

Stratigraphies
0 *records for RN* 184353

Aquifers
0 *records for RN* 184353

Pump Tests Part 1
0 *records for RN* 184353

Pump Tests Part 2
0 *records for RN* 184353

Bore Conditions
0 *records for RN* 184353

Elevations
0 *records for RN* 184353

Water Analysis Part 1
0 *records for RN* 184353

Water Analysis Part 2
0 *records for RN* 184353

Water Levels
0 *records for RN* 184353

Wire Line Logs
0 *records for RN* 184353

Field Measurements
0 *records for RN* 184353

Special Water Analysis
0 *records for RN* 184353

Bore Report

From Year:

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APPENDIX B: ENVIRONMENTALLY SENSITIVE AREAS

ENVIRONMENTALLY SENSITIVE AREAS - Mining Activities

Selected Mining Lease (ML)

CATEGORY A

- National Parks
- Conservation Parks
- Forest Reserves
- Special Wildlife Reserve
- Wet Tropics World Heritage Area
- Great Barrier Reef Marine Park Area
- Marine Parks other than General Use Zones

CATEGORY B

- Queensland Heritage Register Places
- Ramsar Sites
- Cultural Heritage Registered Areas and DLA's other than Stanbroke
- Special Forestry Areas
- Seaward Side of Highest Astronomical Tide
- Fish Habitat Areas
- Coordinated Conservation Areas
- Endangered Regional Ecosystems - regrowth and remnant (Biodiversity Status)
- General Use Zones of Marine Parks
- Marine Plants

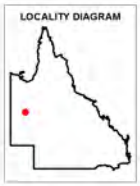
CATEGORY C

- Nature Refuges
- Resources Reserve
- State Forests
- Timber Reserves
- River Improvement Areas
- Stanbroke DLA
- Coastal Management District
- Dams and Weirs

OTHERS

- Towns
- Roads
- Repealed Wild River Nominated Waterways
- Repealed Wild River Preservation Areas
- Repealed Wild River High Preservation Areas
- Mahogany Glider Habitat
- Directory of Important Wetlands
- Queensland

LOCALITY DIAGRAM



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0 110 220 330 440 550 m

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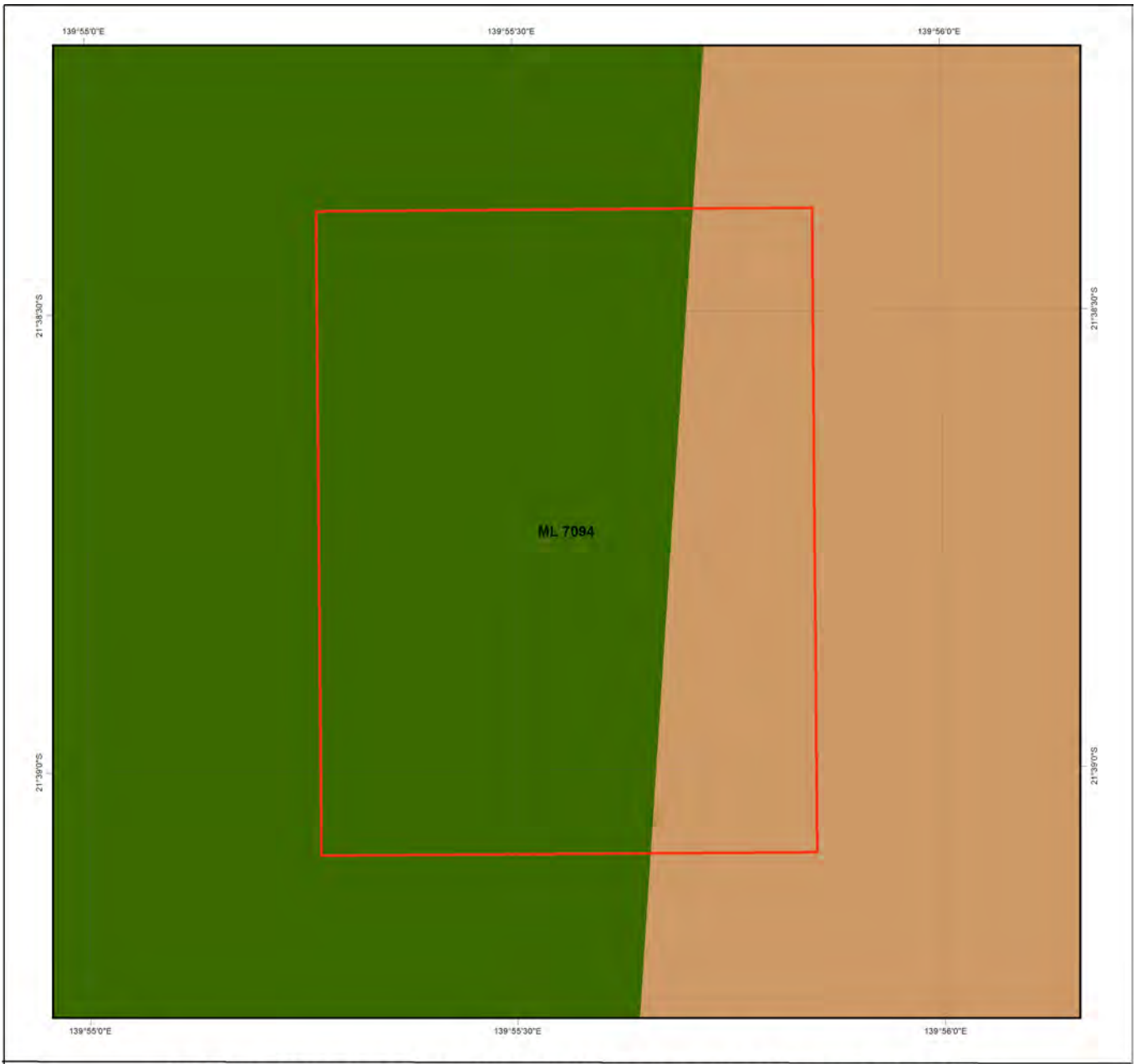


ENVIRONMENTALLY SENSITIVE AREAS - Mining Activities

Selected Mining Lease (ML)

CATEGORY A

- National Parks
- Conservation Parks
- Forest Reserves
- Special Wildlife Reserve
- Wet Tropics World Heritage Area
- Great Barrier Reef Marine Park Area
- Marine Parks other than General Use Zones

CATEGORY B

- Queensland Heritage Register Places
- Ramsar Sites
- Cultural Heritage Registered Areas and DLA's other than Stanbroke
- Special Forestry Areas
- Seaward Side of Highest Astronomical Tide
- Fish Habitat Areas
- Coordinated Conservation Areas
- Endangered Regional Ecosystems - regrowth and remnant (Biodiversity Status)
- General Use Zones of Marine Parks
- Marine Plants

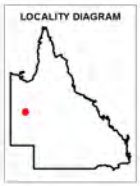
CATEGORY C

- Nature Refuges
- Resources Reserve
- State Forests
- Timber Reserves
- River Improvement Areas
- Stanbroke DLA
- Coastal Management District
- Dams and Weirs

OTHERS

- Towns
- Roads
- Repealed Wild River Nominated Waterways
- Repealed Wild River Preservation Areas
- Repealed Wild River High Preservation Areas
- Mahogany Glider Habitat
- Directory of Important Wetlands
- Queensland

LOCALITY DIAGRAM



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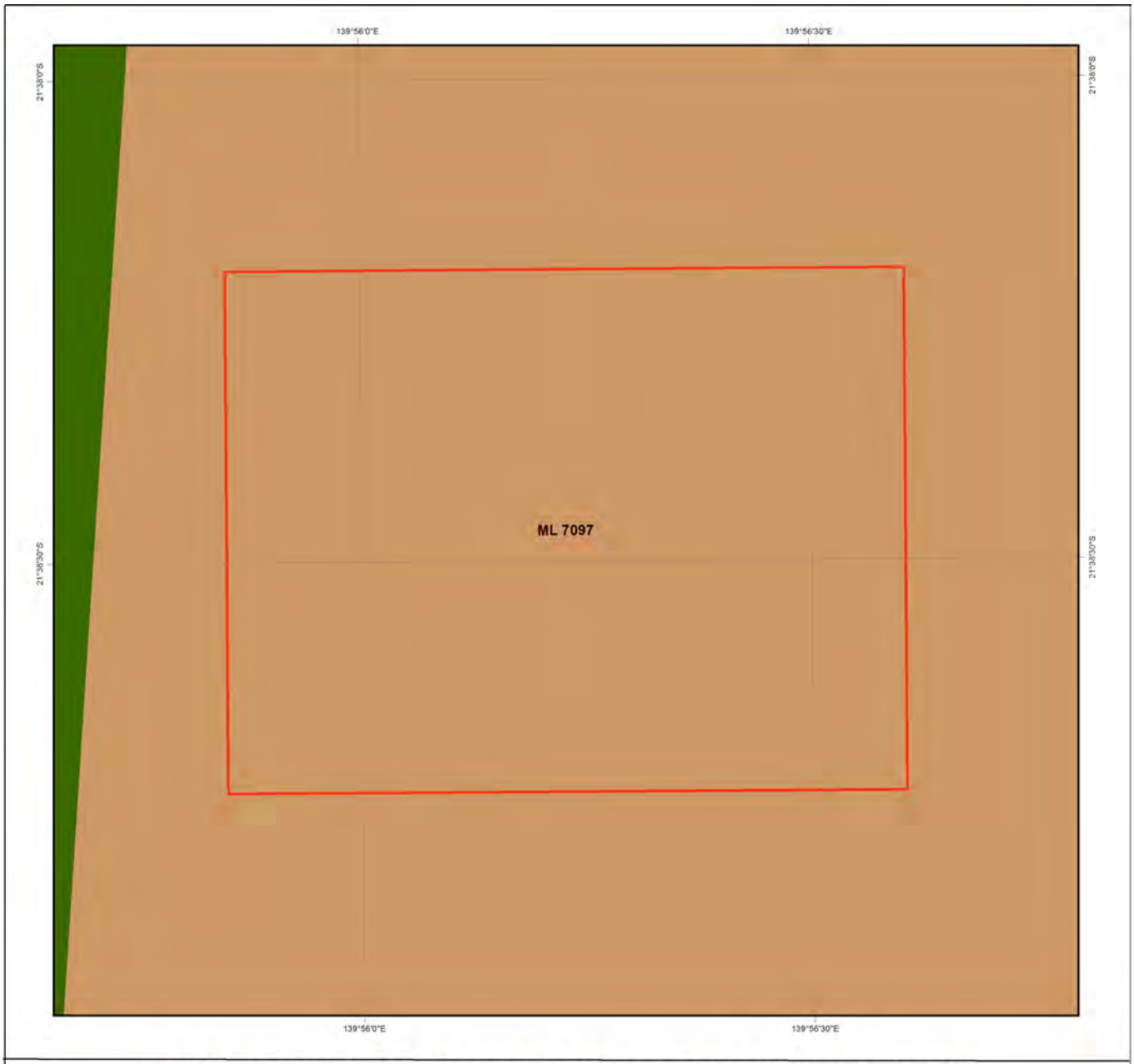


ENVIRONMENTALLY SENSITIVE AREAS - Mining Activities

Selected Mining Lease (ML)

CATEGORY A

- National Parks
- Conservation Parks
- Forest Reserves
- Special Wildlife Reserve
- Wet Tropics World Heritage Area
- Great Barrier Reef Marine Park Area
- Marine Parks other than General Use Zones

CATEGORY B

- Queensland Heritage Register Places
- Ramsar Sites
- Cultural Heritage Registered Areas and DLA's other than Stanbroke
- Special Forestry Areas
- Seaward Side of Highest Astronomical Tide
- Fish Habitat Areas
- Coordinated Conservation Areas
- Endangered Regional Ecosystems - regrowth and remnant (Biodiversity Status)
- General Use Zones of Marine Parks
- Marine Plants

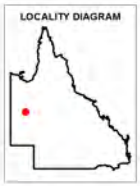
CATEGORY C

- Nature Refuges
- Resources Reserve
- State Forests
- Timber Reserves
- River Improvement Areas
- Stanbroke DLA
- Coastal Management District
- Dams and Weirs

OTHERS

- Towns
- Roads
- Repealed Wild River Nominated Waterways
- Repealed Wild River Preservation Areas
- Repealed Wild River High Preservation Areas
- Mahogany Glider Habitat
- Directory of Important Wetlands
- Queensland

LOCALITY DIAGRAM



N

0 100 200 300 400 500 m

This product is projected into GDA 1994 MGA Zone 54

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NOTE TO USER: Themes presented in this map are indicative only. Field survey may be required to verify the 'true' spatial extent and value. Not all environmentally sensitive areas are presented in this map. A user should refer to the particular circumstances relevant to their situation to assess the 'completeness' of themes provided.

The user should note that some boundaries and indicated values are ambient and may change over time (e.g. regional ecosystem boundaries and conservation status, watercourse mapping etc).

The user should be aware that due to multiple overlapping themes/ layers present, some themes/layers may be obscured by others. Ordering in the Legend does not accurately reflect the order by which themes/layers are displayed.

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APPENDIX C: SITE GROUNDWATER BORELOGS

MACQUARIE FRANKLIN

Consultants for business, agriculture and environment

Borehole log for Groundwater

ID THGW 003
Sheet 1 of 1

Project: TICK HILL
Location: TICK HILL (CARNABY RESOURCES)

Coordinates: 388276.7E 7605898.6N
Datum: MGA94 - 54
RL: 341.0
Inclination: VERTICAL
Bearing: –

Drill type: RC
Equipment: DE 810
Drill fluid(s): –

Hole started: 9/1/20
Hole finished: 9/1/20
Drilled by: DOAN PKYRITSIS (AMWD)
Logged by: PAUL TAN
Checked by:

Bit types/size	Water	Penetration 1 2 3 4	Notes samples and tests	Metres RL	Metres Depth	Graphic log	USCS Symbol	Materials (Soil type, colour, plasticity or particle characteristics, secondary and minor components)	Moisture condition	Consistency density index	Casing details	Structure, geology and interpretation
HAMMER K 172mm								COLLUVIUM (BROWN CLAY)	D	F/H	CEMENT	CLAY
								PARA AMPHIBOLITE, MODERATE OX	D	H/D		ROCK
								PEGMATITE	D	H/VD		ROCK
				5				PEGMATITE MODERATELY OXIDISED. WHITE - BROWN	D	H/VD		ROCK
								QUARTZ BIOTITE GRANODIORITE WEAKLY WEATHERED - BROWN - GREEN	D	H/VD		ROCK
				10				PEGMATITE. FRESH. PINK-GREY	D	H/VD		ROCK
								QUARTZ BIOTITE GRANODIORITE FRESH. PINK GREY	D	H/VD		ROCK
HAMMER 133mm				15				BIOTITE SCHIST FRESH, BLACK	D	H/VD	DRILL CUTTINGS	ROCK
HAMMER				20				~~PEGMATITE. FRESH PINK-GREY~~ QUARTZ BIOTITE GRANODIORITE. FRESH. PINK - BLACK	D	H/VD		ROCK
				25				PEGMATITE. FRESH PINK-GREY	D	H/VD	BENTONITE	ROCK
				30				PEGMATITE WITH QUARTZ BIOTITE GRANODIORITE - FRESH.	M	H/VD	GRAVEL	ROCK
								PEGMATITE, PINK, FRESH	D	H/VD		ROCK
				35				PEGMATITE, PINK, FRESH	M	H/VD		ROCK
				40				PEGMATITE, PINK, FRESH.	D	H/VD		ROCK
								Conductivity 950 uS PH 6.5				

MOISTURE
D = Dry
M = Moist
W = Wet
mbgl = m below ground level
magl = m above ground level

WATER
Water level
Water inflow
Water outflow
GNE = Groundwater not encountered

PENETRATION
1 2 3 4
No resistance
Refusal

GRAPHIC LOG KEY
CLAY (CH, CI)
SILT (SM)
ROOTS
COBBLES (63-200mm)
BOULDERS (>200mm)
SAND (SP)
GRAVEL (GP, GW
FRACTURES

Collar 8.5m above gl

CONSISTENCY (silt, clay, sandy clay, silty clay) VS = Very soft (<25kPa; exudes in fingers when squeezed); S = Soft (25 – 50kPa; easily penetrated by fist); F = Firm (50 – 100kPa; easily penetrated by thumb); St = Stiff (100 – 200kPa; indented by thumb, penetrated with difficulty); VSt = Very Stiff (200 – 400kPa; easily indented by thumbnail; H = Hard (>400kPa; indented by thumbnail with difficulty); Fb = Friable (crumbles or powders when scraped by thumbnail.
RELATIVE DENSITY (sand and gravel) VL = Very loose (ravelling); L = Loose (easy shovelling); MD = Medium dense (hard shovelling); D = Dense *picking); VD = Very dense (hard picking)

PVC Installation
0 - 6 m 150mm CLASS 9 PVC COLLAR PIPE
collar - 28m Plain 50mm PVC
28m - 40m Slotted 50mm PVC
40 - 40.5 m Plain 50mm PVC
+ capped cap.

0 - 6.1m Cement Kill
6.1m - 25m RC drill cuttings
25m - 26.7m Bentonite
26.7m - 40.5m Gravel

MACQUARIE FRANKLIN

Consultants for business, agriculture and environment

Borehole log for Groundwater

ID: THGW 00 K

Sheet 1 of 1

Project: TICK HILL

Location: TICK HILL (CARNABY RESOURCES)

Coordinates: 389233.9E 7606543.5N

Datum: MGA94-54

RL: 327.3

Inclination: VERTICAL

Bearing: –

Drill type: RC

Equipment: DE 810

Drill fluid(s): –

Hole started: 9/1/20

Hole finished: 9/1/20

Drilled by: DEAN KYRITSIS (AMWD)

Logged by: PAUL TAN

Checked by:

Bit types/size	Water	Penetration 1 2 3 4	Notes samples and tests	Metres KL	Metres Depth	Graphic log	USCS Symbol	Materials (Soil type, colour, plasticity or particle characteristics, secondary and minor components)	Moisture condition	Consistency density index	Casing details	Structure, geology and interpretation
HAMMER 172mm								COLLUVIUM, BROWN, CLAY RICH	D	ST/MD		CLAY
					5			STRONGLY WEATHERED QUARTZ BIOTITE GRANOFELS SAPROCK HIGH CLAY %. GREEN/GREY + BROWN	D	VST/D	DRILL CUTTING CEMENT	CLAY
HAMMER 133mm					10			WEAKLY OXIDISED QTZ-BIOTITE GRANOFELS PINK-BROWN	D	H/VD		ROCK
								FRESH QUARTZ BIOTITE GRANOFELS PINK-GREY		H/VD	BENTONITE	ROCK
					15			PEGMATITE, FRESH, PINK WHITE	D	H/VD		ROCK
								PEGMATITE + QTZ BIOTITE GRANOFELS	M	H/VD		ROCK
					20			PEGMATITE, FRESH, PINK WHITE	D	H/VD	SAND/GRAVEL	ROCK
					25			QUARTZ BIOTITE GRANOFELS FRESH, BLACK	D	H/VD		ROCK
								Conductivity 2.76 mS pH 8.8				

MOISTURE: D = Dry; M = Moist; W = Wet; mbgl = m below ground level; magl = m above ground level

WATER: Water level; Water inflow; Water outflow; GNE = Groundwater not encountered

PENETRATION: 1 2 3 4 — No resistance; Refusal

GRAPHIC LOG KEY: CLAY (CH, CI); SILT (SM); ROOTS; COBBLES (63-200mm); SAND (SP); GRAVEL (GP, GW); FRACTURES; BOULDERS (>200mm)

Collar 8.5 m above gl

CONSISTENCY (silt, clay, sandy clay, silty clay) VS = Very soft (<25kPa; exudes in fingers when squeezed); S = Soft (25 – 50kPa; easily penetrated by fist); F = Firm (50 – 100kPa; easily penetrated by thumb); St = Stiff (100 – 200kPa; indented by thumb, penetrated with difficulty); VSt = Very Stiff (200 – 400kPa; easily indented by thumbnail; H = Hard (>400kPa; indented by thumbnail with difficulty); Fb = Friable (crumbles or powders when scraped by thumbnail.

RELATIVE DENSITY (sand and gravel) VL = Very loose (ravelling); L = Loose (easy shovelling); MD = Medium dense (hard shovelling); D = Dense *picking); VD = Very dense (hard picking)

PVC INSTALLATION

0-6m 150mm CLASS 9 PVC COLLAR PIPE

Collar-15m PLAIN 50mm PVC

15m - 27m SLOTTED 50mm PVC

27 - 27.5m PLAIN 50mm PVC + GLUED CAP

0-6.5m CEMENT FILL

6.5 - 12m RC DRILL CUTTINGS

12m - 13.6m BENTONITE

13.6m - 27.5m GRAVEL

MACQUARIE FRANKLIN

Consultants for business, agriculture and environment

Borehole log for Groundwater

ID: TMGW005

Sheet 1 of 1

Project: TICK HILL **Location:** TICK HILL (CARNABY RESOURCES)

Coordinates: 388678.6E 7605239.9N **Drill type:** RC **Hole started:** 8/1/20

Datum: MGA 94 - 54 **Hole finished:** 8/1/20

RL: 347.57m **Equipment:** DE 810 **Drilled by:** DEAN KAYRITSIS (AMWD)

Inclination: VERTICAL **Logged by:** PAUL TAN

Bearing: — **Drill fluid(s):** — **Checked by:**

Bit types/size	Water	Penetration 1 2 3 4	Notes samples and tests	Metres RL	Metres Depth	Graphic log	USCS Symbol	Materials Soil type, colour, plasticity or particle characteristics, secondary and minor components	Moisture condition	Consistency density index	Casing details	Structure, geology and interpretation
								COLLUVIUM / CLAY RED BROWN	D	F/MD		CLAY
								QUARTZ BIOTITE GRANOFELS, MODERATE OX	D	H/VD		ROCK
HAMMER 117mm					5			QUARTZ BIOTITE GRANOFELS, WEAKLY WEATHERED, GREY WHITE	D	H/VD	CEMENT	ROCK
					10			QUARTZ BIOTITE GRANOFELS FRESH PINK-GREY	D	H/VD	DRILL CUTTINGS	ROCK
HAMMER 133mm					15							
					20			MODERATELY-WEAKLY WEATHERED QUARTZ BIOTITE GRANOFELS WITH SOME CLAY, BROWN	D	H/D		ROCK
					25			QUARTZITE, FRESH, PINK	D	H/VD	BENTONITE	ROCK
					30			CALC SILICATE, FRESH GREEN-BROWN / GREY	D	H/VD	GRAVEL	ROCK
					35							
					40							
								Conductivity > 950 uS pH 8.5				

MOISTURE: D = Dry; M = Moist; W = Wet; mbgl = m below ground level; magl = m above ground level

WATER: Water level; Water inflow; Water outflow; GNE = Groundwater not encountered

PENETRATION: 1 2 3 4 — No resistance; Refusal

GRAPHIC LOG KEY: CLAY (CH, CI); SILT (SM); ROOTS; COBBLES (63-200mm); SAND (SP); GRAVEL (GP, GW); FRACTURES; BOULDERS (>200mm)

Collar 8.5m above gl

CONSISTENCY (silt, clay, sandy clay, silty clay) VS = Very soft (<25kPa; exudes in fingers when squeezed); S = Soft (25 – 50kPa; easily penetrated by fist); F = Firm (50 – 100kPa; easily penetrated by thumb); St = Stiff (100 – 200kPa; indented by thumb, penetrated with difficulty); VSt = Very Stiff (200 – 400kPa; easily indented by thumbnail; H = Hard (>400kPa; indented by thumbnail with difficulty); Fb = Friable (crumbles or powders when scraped by thumbnail.

RELATIVE DENSITY (sand and gravel) VL = Very loose (ravelling); L = Loose (easy shovelling); MD = Medium dense (hard shovelling); D = Dense *picking); VD = Very dense (hard picking)

PVC Installation
0-6m 150mm CLASS 9 PVC COLLAR PIPE
collar - 29.5m Plain 50mm PVC
29.5 - 41.5m Slotted 50mm PVC
41.5 - 42m Plain 50mm PVC + glued cap.

0 - 6.1m Cement fill
6.1 - 26.6m RC drill cuttings
26.6 - 28m Bentonite
28 - 42m gravel

MACQUARIE FRANKLIN

Consultants for business, agriculture and environment

Borehole log for Groundwater

ID THGW006
Sheet 2 of 1

Project: TICK HILL
Location: TICK HILL (GARNABY RESOURCES)

Coordinates: 388990E 7605926N
Datum: MGA94 / 54
RL: 337.5m
Inclination: VERTICAL
Bearing: —

Drill type: RC
Equipment: DE810
Drill fluid(s): —

Hole started: THGW006 7/11/20
Hole finished: 7/11/20
Drilled by: DEAN KYRITSIS (AMWD)
Logged by: PAUL TAN
Checked by:

Bit types/size	Water	Penetration 1 2 3 4	Notes samples and tests	Metres RL	Metres Depth	Graphic log	USCS Symbol	Materials (Soil type, colour, plasticity or particle characteristics, secondary and minor components)	Moisture condition	Consistency density index	Casing details	Structure, geology and interpretation
HAMMER 172mm								Quartzite, PARTIALLY OXIDISED WHITE - PINK	D	H/VD	CEMENT	ROCK
					5			Quartzite, MODERATELY OXIDISED WHITE - PINK	D	H/VD		ROCK.
								Quartzite with minor clay	D	VST/D		ROCK
HAMMER 133mm					10			QUARTZITE, FRESH RED/PINK & WHITE	D	H/VD	DRILL CUTTINGS	ROCK.
					15						BENTONITE	
								Qtz BIOTITE GRANOFELS. VERY WEATHERED WITH HIGH % CLAY	M	ST/D		CLAY/ROCK AQUIFER
					20			PARA AMPHIBOLITE FRESH PINK - GREEN 20-21m WEAK OXIDATION	M	H/VD		ROCK
					25			QTZ BIOTITE GRANOFELS FRESH PINK & GREEN/BLACK. 28-29m WEAK OXIDATION	M	H/VD		ROCK
					30			Conductivity 1780 uS pH 8.5				

MOISTURE
D = Dry
M = Moist
W = Wet
mbgl = m below ground level
magl = m above ground level

WATER
Water level
Water inflow
Water outflow
GNE = Groundwater not encountered

PENETRATION
1 2 3 4
No resistance
Refusal

GRAPHIC LOG KEY
CLAY (CH, CI)
SILT (SM)
ROOTS
COBBLES (63-200mm)
BOULDERS (>200mm)
SAND (SP)
GRAVEL (GP, GW
FRACTURES

Collar 8.5 m above gl

CONSISTENCY (silt, clay, sandy clay, silty clay) VS = Very soft (<25kPa; exudes in fingers when squeezed); S = Soft (25 – 50kPa; easily penetrated by fist); F = Firm (50 – 100kPa; easily penetrated by thumb); St = Stiff (100 – 200kPa; indented by thumb, penetrated with difficulty); VSt = Very Stiff (200 – 400kPa; easily indented by thumbnail; H = Hard (>400kPa; indented by thumbnail with difficulty); Fb = Friable (crumbles or powders when scraped by thumbnail.
RELATIVE DENSITY (sand and gravel) VL = Very loose (ravelling); L = Loose (easy shovelling); MD = Medium dense (hard shovelling); D = Dense *picking); VD = Very dense (hard picking)

PVC Installation: 0-6m 150m CLASS 9 PVC COLLAR PIPE

Collar - 17.5m Plain 50mm PVC
17.5 - 29.5 Slotted 50mm PVC
29.5 - 30m Plain 50mm PVC + glued cap

0 - 6.5m cement fill
6.5 - 14.8m RC drill cuttings
14.8 - 16m bentonite
16m - 30m gravel

Geological Borelog

LOCATION Tick Hill Tailings		**Borehole Log: THGW07**	**Logged by** Anna Sheldon
SURFACE ELEVATION	**JOB NUMBER** 722092		
GROUNDWATER	**DATUM**	**PROJECT:** Tick Hill	**Proj. Manager** Anna Sheldon
DRILL METHOD SFA/AH	**DATE DRILLED** 9/06/23		

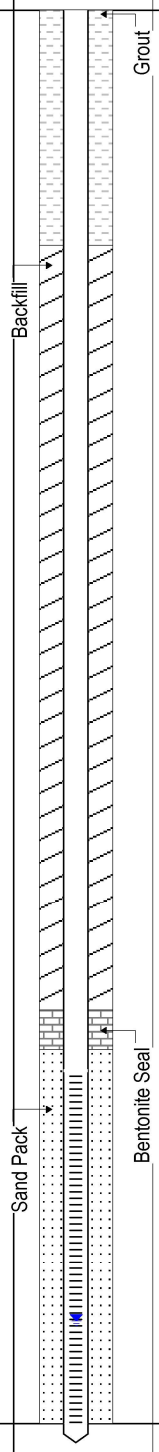
STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES: Undisturbed	SAMPLES: Disturbed	SAMPLES: Lost	SAMPLES: Duplicate	Moisture Content	PID/FID: Background	PID/FID: Reading	pH: pH - soil	pH: pH - water	Construction Details	Comments
Soil Red gravelly clay Red clay Red brown, gravelly clay **Rock** Heavily weathered biotite granofel. Brown clayey sand with mica		1.0 2.0 3.0 4.0 5.0					D D					Grout	
Red and grey granofels, hard and weathered.		6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0					D					Backfill	Refusal AH
White Quartzite		15.0											
Weathered biotite granofel. Green-grey and red, hard		16.0 17.0 18.0 19.0 20.0 21.0											
White Quartzite		22.0											
Weathered Red and grey biotite granofel		23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0										Sand Pack Bentonite Seal	
Pink and grey quartz granofel. very hard		31.0 32.0 33.0 34.0 35.0 36.0											
End of borehole at 36 m		37.0 38.0											

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Geological Borelog

LOCATION Tick Hill Tailings		**Borehole Log: THGW08**	**Logged by** Anna Sheldon
SURFACE ELEVATION	**JOB NUMBER** 722092		
GROUNDWATER	**DATUM**	**PROJECT:** Tick Hill	**Proj. Manager** Anna Sheldon
DRILL METHOD SFA/AH	**DATE DRILLED** 9/06/23		

STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES: Undisturbed	SAMPLES: Disturbed	SAMPLES: Lost	SAMPLES: Duplicate	Moisture Content	PID/FID: Background	PID/FID: Reading	pH: pH - soil	pH: pH - water	Construction Details	Comments
Soil Red-brown sandy clay		1.0					D						
Brown and grey clayey sand with gravel -coarse, angular weathered biotite granofel gravel		2.0											
		3.0					D						
Rock Very hard black biotite granofel with minor quartz -bands of weathered clay		4.0											
		5.0											
White quartzite with minor biotite granofel		6.0					D						
Very hard black biotite granofel.		7.0											
White quartzite with minor biotite		8.0											
		9.0											
		10.0					D						
		11.0											
		12.0											
		13.0											
Very hard Biotite shcist		14.0											
Dark grey biotite granofel		15.0					D						
		16.0											
		17.0											
White quartzite with pink weathering		18.0											
		19.0											
		20.0					D						
		21.0											
Very hard black biotite granofel with monir quartz and muscovitel		22.0											
		23.0											
		24.0											
		25.0					D						
		26.0											
		27.0											
Very hard black biotite granofel with pink quartzite		28.0											
		29.0											
		30.0					D						
		31.0											
		32.0											
		33.0											
		34.0											
		35.0					D						
		36.0											
End of borehole at 36 m		37.0											
		38.0											



Refusal AH

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Geological Borelog

LOCATION Tick Hill Tailings		**Borehole Log: THGW09**	**Logged by** Anna Sheldon
SURFACE ELEVATION	**JOB NUMBER** 722092		
GROUNDWATER	**DATUM**	**PROJECT:** Tick Hill	**Proj. Manager** Anna Sheldon
DRILL METHOD AH	**DATE DRILLED** 9/06/23		

STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES: Undisturbed	SAMPLES: Disturbed	SAMPLES: Lost	SAMPLES: Duplicate	Moisture Content	PID/FID: Background	PID/FID: Reading	pH: pH - soil	pH: pH - water	Construction Details	Comments
Rock Heavily weathered granofel wit hquartz, biotite/amphibole and red clay		1.0 2.0 3.0					D D					Grout	
Grey-white-pink quartz-biotite granofel with hard green-grey layers		4.0											
Very hard, dark grey biotite granofel with minor quartz and k-feldspar		5.0 6.0											Refusal AH
Very hard, Pink and grey biotite-feldspar granofel with minor plagiolcase		7.0 8.0 9.0 10.0										Backfill	
Dark grey biotite granofel with feldspar,quartz, amphibole		11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0										Bentonite Seal Sand Pack	
End of borehole at 21 m		22.0 23.0 24.0											

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

APPENDIX D: PIT WATER BALANCE MODEL CALCULATIONS

	Average rainfall															pit level	Aquifer level				
year	Rainfall	catchment	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change lev	GW inflow	GW inflow	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
1994	0.396	0.2574	3.0615	3753.28	0	23.611	1751.373	30248.63	693.5437	7785.997	4726	12.9	12.35831	16917.75	46.35	0	45	45	50	180	3.6
1995	0.396	0.2574	3.0615	9046.541	12.35831	36.65643	4221.339	27778.66	1671.65	7150.227	-225	-0.6	2.853829	12271.64	33.62094	12.35831	45	32.64169	50	180	3.6
1996	0.396	0.2574	3.0615	10594.57	15.21214	39.66893	4943.687	27056.31	1957.7	6964.295	-1673	-4.6	1.926937	11198.75	30.6815	15.21214	45	29.78786	50	180	3.6
1997	0.396	0.2574	3.0615	11708.92	17.13908	41.70301	5463.672	26536.33	2163.614	6830.451	-2715	-7.4	1.420191	10474.31	28.69675	17.13908	45	27.86092	50	180	3.6
1998	0.396	0.2574	3.0615	12565.89	18.55927	43.20216	5863.553	26136.45	2321.967	6727.522	-3516	-9.6	1.095581	9940.394	27.23396	18.55927	45	26.44073	50	180	3.6
1999	0.396	0.2574	3.0615	13247.65	19.65485	44.35866	6181.682	25818.32	2447.946	6645.635	-4154	-11.4	0.869414	9528.51	26.10551	19.65485	45	25.34515	50	180	3.6
2000	0.396	0.2574	3.0615	13801.5	20.52426	45.27641	6440.118	25559.88	2550.287	6579.114	-4672	-12.8	0.703335	9201.654	25.21001	20.52426	45	24.47574	50	180	3.6
2001	0.396	0.2574	3.0615	14257.84	21.2276	46.01885	6653.059	25346.94	2634.612	6524.303	-5099	-14.0	0.576924	8937.235	24.48558	21.2276	45	23.7724	50	180	3.6
2002	0.396	0.2574	3.0615	14637.7	21.80452	46.62785	6830.314	25169.69	2704.804	6478.677	-5454	-14.9	0.47818	8720.341	23.89134	21.80452	45	23.19548	50	180	3.6
2003	0.396	0.2574	3.0615	14956.34	22.2827	47.13262	6978.997	25021	2763.683	6440.406	-5752	-15.8	0.39953	8540.569	23.39882	22.2827	45	22.7173	50	180	3.6
2004	0.396	0.2574	3.0615	15225.2	22.68223	47.55436	7104.452	24895.55	2813.363	6408.114	-6004	-16.4	0.335937	8390.366	22.9873	22.68223	45	22.31777	50	180	3.6
2005	0.396	0.2574	3.0615	15453.11	23.01817	47.90898	7210.803	24789.2	2855.478	6380.739	-6217	-17.0	0.283904	8264.07	22.64129	23.01817	45	21.98183	50	180	3.6
2006	0.396	0.2574	3.0615	15647.05	23.30207	48.20867	7301.298	24698.7	2891.314	6357.446	-6398	-17.5	0.240923	8157.337	22.34887	23.30207	45	21.69793	50	180	3.6
2007	0.396	0.2574	3.0615	15812.57	23.54299	48.46298	7378.535	24621.46	2921.9	6337.565	-6553	-18.0	0.205143	8066.762	22.10072	23.54299	45	21.45701	50	180	3.6
2008	0.396	0.2574	3.0615	15954.2	23.74814	48.67953	7444.622	24555.38	2948.07	6320.554	-6686	-18.3	0.175169	7989.638	21.88942	23.74814	45	21.25186	50	180	3.6
2009	0.396	0.2574	3.0615	16075.63	23.92331	48.86444	7501.286	24498.71	2970.509	6305.969	-6799	-18.6	0.149925	7923.783	21.709	23.92331	45	21.07669	50	180	3.6
2010	0.396	0.2574	3.0615	16179.93	24.07323	49.0227	7549.955	24450.05	2989.782	6293.442	-6897	-18.9	0.128572	7867.419	21.55457	24.07323	45	20.92677	50	180	3.6
2011	0.396	0.2574	3.0615	16269.64	24.2018	49.15842	7591.817	24408.18	3006.36	6282.666	-6981	-19.1	0.110443	7819.083	21.42214	24.2018	45	20.7982	50	180	3.6
2012	0.396	0.2574	3.0615	16346.91	24.31225	49.27501	7627.869	24372.13	3020.636	6273.386	-7053	-19.3	0.095004	7777.561	21.30839	24.31225	45	20.68775	50	180	3.6
2013	0.396	0.2574	3.0615	16413.51	24.40725	49.37529	7658.95	24341.05	3032.944	6265.386	-7115	-19.5	0.081821	7741.845	21.21053	24.40725	45	20.59275	50	180	3.6
2014	0.396	0.2574	3.0615	16470.99	24.48907	49.46166	7685.768	24314.23	3043.564	6258.483	-7169	-19.6	0.070539	7711.084	21.12626	24.48907	45	20.51093	50	180	3.6
2015	0.396	0.2574	3.0615	16520.61	24.55961	49.53612	7708.927	24291.07	3052.735	6252.522	-7215	-19.8	0.060865	7684.565	21.0536	24.55961	45	20.44039	50	180	3.6
2016	0.396	0.2574	3.0615	16563.5	24.62047	49.60037	7728.937	24271.06	3060.659	6247.372	-7255	-19.9	0.052558	7661.683	20.99091	24.62047	45	20.37953	50	180	3.6
2017	0.396	0.2574	3.0615	16600.57	24.67303	49.65585	7746.237	24253.76	3067.51	6242.919	-7290	-20.0	0.045413	7641.924	20.93678	24.67303	45	20.32697	50	180	3.6
2018	0.396	0.2574	3.0615	16632.64	24.71845	49.70379	7761.2	24238.8	3073.435	6239.067	-7320	-20.1	0.039261	7624.851	20.89	24.71845	45	20.28155	50	180	3.6
2019	0.396	0.2574	3.0615	16660.39	24.75771	49.74523	7774.149	24225.85	3078.563	6235.734	-7346	-20.1	0.033958	7610.09	20.84956	24.75771	45	20.24229	50	180	3.6
2020	0.396	0.2574	3.0615	16684.41	24.79166	49.78108	7785.357	24214.64	3083.001	6232.849	-7369	-20.2	0.029384	7597.324	20.81459	24.79166	45	20.20834	50	180	3.6
2021	0.396	0.2574	3.0615	16705.21	24.82105	49.8121	7795.062	24204.94	3086.844	6230.351	-7388	-20.2	0.025435	7586.277	20.78432	24.82105	45	20.17895	50	180	3.6
2022	0.396	0.2574	3.0615	16723.22	24.84648	49.83895	7803.467	24196.53	3090.173	6228.188	-7405	-20.3	0.022023	7576.715	20.75812	24.84648	45	20.15352	50	180	3.6
2023	0.396	0.2574	3.0615	16738.82	24.86851	49.8622	7810.749	24189.25	3093.056	6226.313	-7419	-20.3	0.019074	7568.435	20.73544	24.86851	45	20.13149	50	180	3.6
2024	0.396	0.2574	3.0615	16752.35	24.88758	49.88233	7817.058	24182.94	3095.555	6224.689	-7432	-20.4	0.016523	7561.264	20.71579	24.88758	45	20.11242	50	180	3.6
2025	0.396	0.2574	3.0615	16764.06	24.9041	49.89977	7822.525	24177.47	3097.72	6223.282	-7443	-20.4	0.014317	7555.052	20.69877	24.9041	45	20.0959	50	180	3.6
2026	0.396	0.2574	3.0615	16774.22	24.91842	49.91488	7827.264	24172.74	3099.597	6222.062	-7453	-20.4	0.012407	7549.67	20.68403	24.91842	45	20.08158	50	180	3.6

	30 Year rainfall															pit level	Aquifer level				
year	Rainfall	catchment	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change lev	GW inflow	GW inflow	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
1994	0.3934	0.25571	3.0615	3753.28	0	23.611	1751.373	30248.63	688.9901	7734.876	4671	12.8	12.32652	16917.75	46.35	0	45	45	50	180	3.6
1995	0.41355	0.268808	3.0615	9029.986	12.32652	36.62288	4213.614	27786.39	1742.54	7469.189	182	0.5	2.958348	12283.59	33.65368	12.32652	45	32.67348	50	180	3.6
1996	0.65755	0.427408	3.0615	10635.62	15.28487	39.74571	4962.841	27037.16	3263.316	11555.88	4184	11.5	3.093991	11171.4	30.60658	15.28487	45	29.71513	50	180	3.6
1997	0.4714	0.30641	3.0615	12455.35	18.37886	43.01173	5811.973	26188.03	2739.764	8024.273	-1691	-4.6	1.430995	10008.22	27.41977	18.37886	45	26.62114	50	180	3.6
1998	0.4648	0.30212	3.0615	13345.57	19.80986	44.52228	6227.371	25772.63	2894.482	7786.427	-2665	-7.3	1.092849	9470.235	25.94585	19.80986	45	25.19014	50	180	3.6
1999	0.31895	0.207318	3.0615	14046.12	20.90271	45.6759	6554.265	25445.73	2090.483	5275.346	-6680	-18.3	0.362983	9059.378	24.82021	20.90271	45	24.09729	50	180	3.6
2000	0.5311	0.345215	3.0615	14282.77	21.26569	46.05906	6664.691	25335.31	3539.617	8746.129	-1997	-5.5	1.039192	8922.914	24.44634	21.26569	45	23.73431	50	180	3.6
2001	0.18505	0.120283	3.0615	14971.2	22.30488	47.15603	6985.932	25014.07	1292.747	3008.755	-10670	-29.2	-0.30597	8532.23	23.37597	22.30488	45	22.69512	50	180	3.6
2002	0.28595	0.185868	3.0615	14766.82	21.99891	46.83305	6890.564	25109.44	1970.357	4667.028	-8129	-22.3	0.075149	8647.259	23.69112	21.99891	45	23.00109	50	180	3.6
2003	0.6398	0.41587	3.0615	14816.89	22.07406	46.91238	6913.927	25086.07	4423.531	10432.55	39	0.1	1.252283	8619.006	23.61372	22.07406	45	22.92594	50	180	3.6
2004	0.2369	0.153985	3.0615	15663.68	23.32634	48.23429	7309.062	24690.94	1731.517	3802.034	-10130	-27.8	-0.27116	8148.211	22.32387	23.32634	45	21.67366	50	180	3.6
2005	0.1726	0.11219	3.0615	15478.33	23.05518	47.94805	7222.571	24777.43	1246.616	2779.78	-11452	-31.4	-0.4433	8250.153	22.60316	23.05518	45	21.94482	50	180	3.6
2006	0.3826	0.24869	3.0615	15177.68	22.61188	47.4801	7082.281	24917.72	2709.681	6196.787	-6271	-17.2	0.302953	8416.813	23.05976	22.61188	45	22.38812	50	180	3.6
2007	0.19565	0.127173	3.0615	15382.83	22.91484	47.7999	7178.007	24821.99	1404.377	3156.675	-10822	-29.6	-0.35091	8302.918	22.74772	22.91484	45	22.08516	50	180	3.6
2008	0.34545	0.224543	3.0615	15145.33	22.56392	47.42948	7067.186	24932.81	2441.359	5598.476	-7105	-19.5	0.188101	8434.843	23.10916	22.56392	45	22.43608	50	180	3.6
2009	0.2512	0.16328	3.0615	15272.41	22.75202	47.62804	7126.482	24873.52	1790.172	4061.348	-9421	-25.8	-0.14829	8364.127	22.91542	22.75202	45	22.24798	50	180	3.6
2010	0.4778	0.31057	3.0615	15172.19	22.60374	47.4715	7079.716	24920.28	3382.689	7739.492	-4050	-11.1	0.617238	8419.875	23.06815	22.60374	45	22.39626	50	180	3.6
2011	0.3023	0.196495	3.0615	15591.53	23.22097	48.12306	7275.391	24724.61	2199.351	4858.262	-8534	-23.4	-0.04757	8187.825	22.4324	23.22097	45	21.77903	50	180	3.6
2012	0.2999	0.194935	3.0615	15559.01	23.1734	48.07285	7260.216	24739.78	2177.339	4822.65	-8559	-23.4	-0.04866	8205.708	22.48139	23.1734	45	21.8266	50	180	3.6
2013	0.2866	0.18629	3.0615	15525.77	23.12474	48.02148	7244.708	24755.29	2076.333	4611.663	-8838	-24.2	-0.08472	8224.004	22.53152	23.12474	45	21.87526	50	180	3.6
2014	0.3432	0.22308	3.0615	15468	23.04002	47.93205	7217.75	24782.25	2477.132	5528.424	-7462	-20.4	0.109925	8255.854	22.61878	23.04002	45	21.95998	50	180	3.6
2015	0.3949	0.256685	3.0615	15542.98	23.14995	48.04808	7252.738	24747.26	2864.106	6352.251	-6327	-17.3	0.260302	8214.528	22.50556	23.14995	45	21.85005	50	180	3.6
2016	0.92285	0.599853	3.0615	15721.26	23.41025	48.32286	7335.929	24664.07	6769.962	14794.8	5844	16.0	1.902986	8116.667	22.23744	23.41025	45	21.58975	50	180	3.6
2017	0.41455	0.269458	3.0615	17055.5	25.31323	50.33165	7958.518	24041.48	3299.204	6478.158	-7278	-19.9	0.015467	7401.239	20.27737	25.31323	45	19.68677	50	180	3.6
2018	0.3094	0.20111	3.0615	17066.57	25.3287	50.34798	7963.683	24036.32	2463.963	4833.944	-9769	-26.8	-0.29801	7395.424	20.26144	25.3287	45	19.6713	50	180	3.6
2019	0.8818	0.57317	3.0615	16853.97	25.03069	50.0334	7864.478	24135.52	6934.897	13833.76	3915	10.7	1.452371	7507.46	20.56838	25.03069	45	19.96931	50	180	3.6
2020	0.24565	0.159673	3.0615	17902.67	26.48307	51.56652	8353.829	23646.17	2052.118	3775.643	-12075	-33.1	-0.61211	6961.441	19.07244	26.48307	45	18.51693	50	180	3.6
2021	0.0953	0.061945	3.0615	17456.83	25.87095	50.92038	8145.789	23854.21	776.2937	1477.649	-15203	-41.7	-0.98349	7191.564	19.70292	25.87095	45	19.12905	50	180	3.6
2022	0.46785	0.304103	3.0615	16752.26	24.88746	49.8822	7817.019	24182.98	3657.192	7354.105	-5741	-15.7	0.232869	7561.309	20.71591	24.88746	45	20.11254	50	180	3.6
2023	0.49925	0.324513	3.0615	16917.78	25.12033	50.12802	7894.252	24105.75	3941.205	7822.616	-5154	-14.1	0.29386	7473.761	20.47606	25.12033	45	19.87967	50	180	3.6
2024	0.36485	0.237153	3.0615	17127.8	25.41419	50.43822	7992.256	24007.74	2915.975	5693.497	-8518	-23.3	-0.14452	7363.285	20.17338	25.41419	45	19.58581	50	180	3.6
2025	0.29045	0.188793	3.0615	17024.35	25.26967	50.28566	7943.982	24056.02	2307.33	4541.596	-10175	-27.9	-0.34716	7417.617	20.32224	25.26967	45	19.73033	50	180	3.6
2026	0.3806	0.24739	3.0615	16777.12	24.92251	49.91921	7828.62	24171.38	2979.573	5979.758	-7818	-21.4	-0.03445	7548.131	20.67981	24.92251	45	20.07749	50	180	3.6

	Average rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2020	0.396	0.2574	3.0615	16832.15	25	50.001	7854.296	24145.7	3110.301	6215.104	-7507	-20.6	0.001561	7519	20.6	25	45	20	50	180	3.6
2021	0.396	0.2574	3.0615	16833.26	25.00156	50.00264729	7854.813	24145.19	3110.506	6214.971	-7508	-20.6	0.001354	7518.413	20.59839266	25.00156	45	19.99844	50	180	3.6
2022	0.396	0.2574	3.0615	16834.22	25.00291	50.00407621	7855.262	24144.74	3110.684	6214.855	-7509	-20.6	0.001174	7517.904	20.59699839	25.00291	45	19.99709	50	180	3.6
2023	0.396	0.2574	3.0615	16835.05	25.00409	50.00531574	7855.652	24144.35	3110.838	6214.755	-7509	-20.6	0.001019	7517.463	20.59578893	25.00409	45	19.99591	50	180	3.6
2024	0.396	0.2574	3.0615	16835.78	25.00511	50.00639099	7855.99	24144.01	3110.972	6214.668	-7510	-20.6	0.000884	7517.08	20.59473975	25.00511	45	19.99489	50	180	3.6
2025	0.396	0.2574	3.0615	16836.41	25.00599	50.00732374	7856.283	24143.72	3111.088	6214.593	-7511	-20.6	0.000767	7516.748	20.59382962	25.00599	45	19.99401	50	180	3.6
2026	0.396	0.2574	3.0615	16836.95	25.00676	50.0081329	7856.537	24143.46	3111.189	6214.527	-7511	-20.6	0.000665	7516.46	20.59304009	25.00676	45	19.99324	50	180	3.6
2027	0.396	0.2574	3.0615	16837.42	25.00742	50.00883483	7856.757	24143.24	3111.276	6214.471	-7512	-20.6	0.000577	7516.21	20.59235518	25.00742	45	19.99258	50	180	3.6
2028	0.396	0.2574	3.0615	16837.83	25.008	50.00944376	7856.949	24143.05	3111.352	6214.421	-7512	-20.6	0.0005	7515.993	20.59176101	25.008	45	19.992	50	180	3.6
2029	0.396	0.2574	3.0615	16838.19	25.0085	50.00997201	7857.115	24142.89	3111.417	6214.379	-7512	-20.6	0.000434	7515.805	20.59124557	25.0085	45	19.9915	50	180	3.6
2030	0.396	0.2574	3.0615	16838.5	25.00893	50.01043028	7857.259	24142.74	3111.474	6214.342	-7513	-20.6	0.000377	7515.641	20.59079842	25.00893	45	19.99107	50	180	3.6
2031	0.396	0.2574	3.0615	16838.77	25.00931	50.01082783	7857.384	24142.62	3111.524	6214.309	-7513	-20.6	0.000327	7515.5	20.59041051	25.00931	45	19.99069	50	180	3.6
2032	0.396	0.2574	3.0615	16839	25.00964	50.01117271	7857.492	24142.51	3111.567	6214.282	-7513	-20.6	0.000283	7515.377	20.59007399	25.00964	45	19.99036	50	180	3.6
2033	0.396	0.2574	3.0615	16839.2	25.00992	50.01147191	7857.586	24142.41	3111.604	6214.257	-7513	-20.6	0.000246	7515.27	20.58978205	25.00992	45	19.99008	50	180	3.6
2034	0.396	0.2574	3.0615	16839.37	25.01017	50.01173147	7857.668	24142.33	3111.636	6214.236	-7514	-20.6	0.000213	7515.178	20.58952879	25.01017	45	19.98983	50	180	3.6
2035	0.396	0.2574	3.0615	16839.53	25.01038	50.01195664	7857.738	24142.26	3111.664	6214.218	-7514	-20.6	0.000185	7515.098	20.58930908	25.01038	45	19.98962	50	180	3.6
2036	0.396	0.2574	3.0615	16839.66	25.01056	50.01215199	7857.8	24142.2	3111.689	6214.202	-7514	-20.6	0.000161	7515.028	20.58911847	25.01056	45	19.98944	50	180	3.6
2037	0.396	0.2574	3.0615	16839.77	25.01073	50.01232146	7857.853	24142.15	3111.71	6214.189	-7514	-20.6	0.000139	7514.968	20.58895311	25.01073	45	19.98927	50	180	3.6
2038	0.396	0.2574	3.0615	16839.87	25.01086	50.01246848	7857.899	24142.1	3111.728	6214.177	-7514	-20.6	0.000121	7514.916	20.58880965	25.01086	45	19.98914	50	180	3.6
2039	0.396	0.2574	3.0615	16839.96	25.01099	50.01259602	7857.939	24142.06	3111.744	6214.166	-7514	-20.6	0.000105	7514.87	20.5886852	25.01099	45	19.98901	50	180	3.6
2040	0.396	0.2574	3.0615	16840.03	25.01109	50.01270667	7857.974	24142.03	3111.758	6214.157	-7514	-20.6	9.09E-05	7514.831	20.58857723	25.01109	45	19.98891	50	180	3.6
2041	0.396	0.2574	3.0615	16840.1	25.01118	50.01280267	7858.004	24142	3111.77	6214.15	-7514	-20.6	7.89E-05	7514.797	20.58848357	25.01118	45	19.98882	50	180	3.6
2042	0.396	0.2574	3.0615	16840.15	25.01126	50.01288595	7858.03	24141.97	3111.78	6214.143	-7514	-20.6	6.84E-05	7514.767	20.58840231	25.01126	45	19.98874	50	180	3.6
2043	0.396	0.2574	3.0615	16840.2	25.01133	50.01295819	7858.053	24141.95	3111.789	6214.137	-7514	-20.6	5.94E-05	7514.741	20.58833181	25.01133	45	19.98867	50	180	3.6
2044	0.396	0.2574	3.0615	16840.24	25.01139	50.01302087	7858.073	24141.93	3111.797	6214.132	-7514	-20.6	5.15E-05	7514.719	20.58827066	25.01139	45	19.98861	50	180	3.6
2045	0.396	0.2574	3.0615	16840.28	25.01144	50.01307524	7858.09	24141.91	3111.804	6214.128	-7514	-20.6	4.47E-05	7514.699	20.5882176	25.01144	45	19.98856	50	180	3.6
2046	0.396	0.2574	3.0615	16840.31	25.01148	50.01312242	7858.105	24141.9	3111.809	6214.124	-7514	-20.6	3.88E-05	7514.683	20.58817157	25.01148	45	19.98852	50	180	3.6
2047	0.396	0.2574	3.0615	16840.34	25.01152	50.01316334	7858.118	24141.88	3111.815	6214.121	-7514	-20.6	3.36E-05	7514.668	20.58813164	25.01152	45	19.98848	50	180	3.6
2048	0.396	0.2574	3.0615	16840.36	25.01156	50.01319885	7858.129	24141.87	3111.819	6214.118	-7514	-20.6	2.92E-05	7514.655	20.588097	25.01156	45	19.98844	50	180	3.6
2049	0.396	0.2574	3.0615	16840.38	25.01159	50.01322965	7858.138	24141.86	3111.823	6214.115	-7514	-20.6	2.53E-05	7514.644	20.58806694	25.01159	45	19.98841	50	180	3.6
2050	0.396	0.2574	3.0615	16840.4	25.01161	50.01325637	7858.147	24141.85	3111.826	6214.113	-7514	-20.6	2.2E-05	7514.635	20.58804087	25.01161	45	19.98839	50	180	3.6
2051	0.396	0.2574	3.0615	16840.42	25.01163	50.01327955	7858.154	24141.85	3111.829	6214.111	-7514	-20.6	1.91E-05	7514.627	20.58801825	25.01163	45	19.98837	50	180	3.6
2052	0.396	0.2574	3.0615	16840.43	25.01165	50.01329966	7858.16	24141.84	3111.832	6214.11	-7514	-20.6	1.65E-05	7514.619	20.58799863	25.01165	45	19.98835	50	180	3.6
2053	0.396	0.2574	3.0615	16840.44	25.01167	50.01331711	7858.166	24141.83	3111.834	6214.108	-7515	-20.6	1.43E-05	7514.613	20.5879816	25.01167	45	19.98833	50	180	3.6
2054	0.396	0.2574	3.0615	16840.45	25.01168	50.01333224	7858.171	24141.83	3111.836	6214.107	-7515	-20.6	1.24E-05	7514.608	20.58796683	25.01168	45	19.98832	50	180	3.6
2055	0.396	0.2574	3.0615	16840.46	25.0117	50.01334538	7858.175	24141.83	3111.837	6214.106	-7515	-20.6	1.08E-05	7514.603	20.58795402	25.0117	45	19.9883	50	180	3.6
2056	0.396	0.2574	3.0615	16840.47	25.01171	50.01335677	7858.178	24141.82	3111.839	6214.105	-7515	-20.6	9.36E-06	7514.599	20.5879429	25.01171	45	19.98829	50	180	3.6
2057	0.396	0.2574	3.0615	16840.48	25.01172	50.01336665	7858.181	24141.82	3111.84	6214.104	-7515	-20.6	8.12E-06	7514.596	20.58793326	25.01172	45	19.98828	50	180	3.6
2058	0.396	0.2574	3.0615	16840.48	25.01172	50.01337522	7858.184	24141.82	3111.841	6214.103	-7515	-20.6	7.05E-06	7514.593	20.58792489	25.01172	45	19.98828	50	180	3.6
2059	0.396	0.2574	3.0615	16840.49	25.01173	50.01338266	7858.186	24141.81	3111.842	6214.103	-7515	-20.6	6.11E-06	7514.59	20.58791764	25.01173	45	19.98827	50	180	3.6
2060	0.396	0.2574	3.0615	16840.49	25.01174	50.01338912	7858.189	24141.81	3111.843	6214.102	-7515	-20.6	5.3E-06	7514.588	20.58791134	25.01174	45	19.98826	50	180	3.6
2061	0.396	0.2574	3.0615	16840.49	25.01174	50.01339471	7858.19	24141.81	3111.843	6214.102	-7515	-20.6	4.6E-06	7514.586	20.58790588	25.01174	45	19.98826	50	180	3.6
2062	0.396	0.2574	3.0615	16840.5	25.01175	50.01339957	7858.192	24141.81	3111.844	6214.101	-7515	-20.6	3.99E-06	7514.584	20.58790114	25.01175	45	19.98825	50	180	3.6
2063	0.396	0.2574	3.0615	16840.5	25.01175	50.01340379	7858.193	24141.81	3111.844	6214.101	-7515	-20.6	3.46E-06	7514.582	20.58789703	25.01175	45	19.98825	50	180	3.6
2064	0.396	0.2574	3.0615	16840.5	25.01175	50.01340744	7858.194	24141.81	3111.845	6214.101	-7515	-20.6	3E-06	7514.581	20.58789346	25.01175	45	19.98825	50	180	3.6
2065	0.396	0.2574	3.0615	16840.51	25.01176	50.01341061	7858.195	24141.8	3111.845	6214.101	-7515	-20.6	2.61E-06	7514.58	20.58789037	25.01176	45	19.98824	50	180	3.6
2066	0.396	0.2574	3.0615	16840.51	25.01176	50.01341336	7858.196	24141.8	3111.846	6214.1	-7515	-20.6	2.26E-06	7514.579	20.58788768	25.01176	45	19.98824	50	180	3.6
2067	0.396	0.2574	3.0615	16840.51	25.01176	50.01341575	7858.197	24141.8	3111.846	6214.1	-7515	-20.6	1.96E-06	7514.578	20.58788535	25.01176	45	19.98824	50	180	3.6
2068	0.396	0.2574	3.0615	16840.51	25.01176	50.01341782	7858.198	24141.8	3111.846	6214.1	-7515	-20.6	1.7E-06	7514.577	20.58788333	25.01176	45	19.98824	50	180	3.6
2069	0.396	0.2574	3.0615	16840.51	25.01177	50.01341962	7858.198	24141.8	3111.846	6214.1	-7515	-20.6	1.48E-06	7514.577	20.58788158	25.01177	45	19.98823	50	180	3.6
2070	0.396	0.2574	3.0615	16840.51	25.01177	50.01342118	7858.199	24141.8	3111.847	6214.1	-7515	-20.6	1.28E-06	7514.576	20.58788006	25.01177	45	19.98823	50	180	3.6
2071	0.396	0.2574	3.0615	16840.51	25.01177	50.01342253	7858.199	24141.8	3111.847	6214.1	-7515	-20.6	1.11E-06	7514.576	20.58787874	25.01177	45	19.98823	50	180	3.6
2072	0.396	0.2574	3.0615	16840.51	25.01177	50.0134237	7858.199	24141.8	3111.847	6214.099	-7515	-20.6	9.64E-07	7514.575	20.58787759	25.01177	45	19.98823	50	180	3.6
2073	0.396	0.2574	3.0615	16840.51	25.01177	50.01342472	7858.2	24141.8	3111.847	6214.099	-7515	-20.6	8.36E-07	7514.575	20.5878766	25.01177	45	19.98823	50	180	3.6
2074	0.396	0.2574	3.0615	16840.52	25.01177	50.0134256	7858.2	24141.8	3111.847	6214.099	-7515	-20.6	7.26E-07	7514.575	20.58787574	25.01177	45	19.98823	50	180	3.6
2075	0.396	0.2574	3.0615	16840.52	25.01177	50.01342637	7858.2	24141.8	3111.847	6214.099	-7515	-20.6	6.29E-07	7514.574	20.58787499	25.01177	45	19.98823	50	180	3.6
2076	0.396	0.2574	3.0615	16840.52	25.01177	50.01342703	7858.2	24141.8	3111.847	6214.099	-7515	-20.6	5.46E-07	7514.574	20.58787434	25.01177	45	19.98823	50	180	3.6
2077	0.396	0.2574	3.0615	16840.52	25.01177	50.01342761	7858.201	24141.8	3111.847	6214.099	-7515	-20.6	4.74E-07	7514.574	20.58787378	25.01177	45	19.98823	50	180	3.6
2078	0.396	0.2574	3.0615	16840.52	25.01177	50.01342811	7858.201	24141.8	3111.848	6214.099	-7515	-20.6	4.11E-07	7514.574	20.58787329	25.01177	45	19.98823	50	180	3.6
2079	0.396	0.2574	3.0615	16840.52	25.01177	50.01342854	7858.201	24141.8	3111.848	6214.099	-7515	-20.6	3.57E-07	7514.574	20.58787287	25.01177	45	19.98823	50	180	3.6

	Average rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2080	0.396	0.2574	3.0615	16840.52	25.01177	50.01342892	7858.201	24141.8	3111.848	6214.099	-7515	-20.6	3.09E-07	7514.573	20.5878725	25.01177	45	19.98823	50	180	3.6
2081	0.396	0.2574	3.0615	16840.52	25.01177	50.01342924	7858.201	24141.8	3111.848	6214.099	-7515	-20.6	2.68E-07	7514.573	20.58787219	25.01177	45	19.98823	50	180	3.6
2082	0.396	0.2574	3.0615	16840.52	25.01177	50.01342953	7858.201	24141.8	3111.848	6214.099	-7515	-20.6	2.33E-07	7514.573	20.58787191	25.01177	45	19.98823	50	180	3.6
2083	0.396	0.2574	3.0615	16840.52	25.01178	50.01342977	7858.201	24141.8	3111.848	6214.099	-7515	-20.6	2.02E-07	7514.573	20.58787167	25.01178	45	19.98822	50	180	3.6
2084	0.396	0.2574	3.0615	16840.52	25.01178	50.01342999	7858.201	24141.8	3111.848	6214.099	-7515	-20.6	1.75E-07	7514.573	20.58787146	25.01178	45	19.98822	50	180	3.6
2085	0.396	0.2574	3.0615	16840.52	25.01178	50.01343017	7858.201	24141.8	3111.848	6214.099	-7515	-20.6	1.52E-07	7514.573	20.58787128	25.01178	45	19.98822	50	180	3.6
2086	0.396	0.2574	3.0615	16840.52	25.01178	50.01343033	7858.201	24141.8	3111.848	6214.099	-7515	-20.6	1.32E-07	7514.573	20.58787112	25.01178	45	19.98822	50	180	3.6
2087	0.396	0.2574	3.0615	16840.52	25.01178	50.01343047	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.14E-07	7514.573	20.58787099	25.01178	45	19.98822	50	180	3.6
2088	0.396	0.2574	3.0615	16840.52	25.01178	50.01343059	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	9.93E-08	7514.573	20.58787087	25.01178	45	19.98822	50	180	3.6
2089	0.396	0.2574	3.0615	16840.52	25.01178	50.0134307	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	8.61E-08	7514.573	20.58787077	25.01178	45	19.98822	50	180	3.6
2090	0.396	0.2574	3.0615	16840.52	25.01178	50.01343079	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	7.47E-08	7514.573	20.58787068	25.01178	45	19.98822	50	180	3.6
2091	0.396	0.2574	3.0615	16840.52	25.01178	50.01343087	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	6.48E-08	7514.573	20.5878706	25.01178	45	19.98822	50	180	3.6
2092	0.396	0.2574	3.0615	16840.52	25.01178	50.01343093	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	5.62E-08	7514.573	20.58787054	25.01178	45	19.98822	50	180	3.6
2093	0.396	0.2574	3.0615	16840.52	25.01178	50.01343099	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	4.88E-08	7514.573	20.58787048	25.01178	45	19.98822	50	180	3.6
2094	0.396	0.2574	3.0615	16840.52	25.01178	50.01343105	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	4.23E-08	7514.573	20.58787043	25.01178	45	19.98822	50	180	3.6
2095	0.396	0.2574	3.0615	16840.52	25.01178	50.01343109	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	3.67E-08	7514.573	20.58787038	25.01178	45	19.98822	50	180	3.6
2096	0.396	0.2574	3.0615	16840.52	25.01178	50.01343113	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	3.18E-08	7514.573	20.58787035	25.01178	45	19.98822	50	180	3.6
2097	0.396	0.2574	3.0615	16840.52	25.01178	50.01343116	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.76E-08	7514.573	20.58787031	25.01178	45	19.98822	50	180	3.6
2098	0.396	0.2574	3.0615	16840.52	25.01178	50.01343119	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.4E-08	7514.573	20.58787028	25.01178	45	19.98822	50	180	3.6
2099	0.396	0.2574	3.0615	16840.52	25.01178	50.01343122	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.08E-08	7514.573	20.58787026	25.01178	45	19.98822	50	180	3.6
2100	0.396	0.2574	3.0615	16840.52	25.01178	50.01343124	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.8E-08	7514.573	20.58787024	25.01178	45	19.98822	50	180	3.6
2101	0.396	0.2574	3.0615	16840.52	25.01178	50.01343126	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.57E-08	7514.573	20.58787022	25.01178	45	19.98822	50	180	3.6
2102	0.396	0.2574	3.0615	16840.52	25.01178	50.01343127	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.36E-08	7514.573	20.5878702	25.01178	45	19.98822	50	180	3.6
2103	0.396	0.2574	3.0615	16840.52	25.01178	50.01343129	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.18E-08	7514.573	20.58787019	25.01178	45	19.98822	50	180	3.6
2104	0.396	0.2574	3.0615	16840.52	25.01178	50.0134313	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.02E-08	7514.573	20.58787018	25.01178	45	19.98822	50	180	3.6
2105	0.396	0.2574	3.0615	16840.52	25.01178	50.01343131	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	8.87E-09	7514.573	20.58787017	25.01178	45	19.98822	50	180	3.6
2106	0.396	0.2574	3.0615	16840.52	25.01178	50.01343132	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	7.69E-09	7514.573	20.58787016	25.01178	45	19.98822	50	180	3.6
2107	0.396	0.2574	3.0615	16840.52	25.01178	50.01343133	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	6.67E-09	7514.573	20.58787015	25.01178	45	19.98822	50	180	3.6
2108	0.396	0.2574	3.0615	16840.52	25.01178	50.01343134	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	5.79E-09	7514.573	20.58787014	25.01178	45	19.98822	50	180	3.6
2109	0.396	0.2574	3.0615	16840.52	25.01178	50.01343134	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	5.02E-09	7514.573	20.58787014	25.01178	45	19.98822	50	180	3.6
2110	0.396	0.2574	3.0615	16840.52	25.01178	50.01343135	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	4.36E-09	7514.573	20.58787013	25.01178	45	19.98822	50	180	3.6
2111	0.396	0.2574	3.0615	16840.52	25.01178	50.01343135	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	3.78E-09	7514.573	20.58787013	25.01178	45	19.98822	50	180	3.6
2112	0.396	0.2574	3.0615	16840.52	25.01178	50.01343136	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	3.28E-09	7514.573	20.58787012	25.01178	45	19.98822	50	180	3.6
2113	0.396	0.2574	3.0615	16840.52	25.01178	50.01343136	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.84E-09	7514.573	20.58787012	25.01178	45	19.98822	50	180	3.6
2114	0.396	0.2574	3.0615	16840.52	25.01178	50.01343136	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.47E-09	7514.573	20.58787012	25.01178	45	19.98822	50	180	3.6
2115	0.396	0.2574	3.0615	16840.52	25.01178	50.01343137	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.14E-09	7514.573	20.58787012	25.01178	45	19.98822	50	180	3.6
2116	0.396	0.2574	3.0615	16840.52	25.01178	50.01343137	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.86E-09	7514.573	20.58787011	25.01178	45	19.98822	50	180	3.6
2117	0.396	0.2574	3.0615	16840.52	25.01178	50.01343137	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.61E-09	7514.573	20.58787011	25.01178	45	19.98822	50	180	3.6
2118	0.396	0.2574	3.0615	16840.52	25.01178	50.01343137	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.4E-09	7514.573	20.58787011	25.01178	45	19.98822	50	180	3.6
2119	0.396	0.2574	3.0615	16840.52	25.01178	50.01343137	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.21E-09	7514.573	20.58787011	25.01178	45	19.98822	50	180	3.6
2120	0.396	0.2574	3.0615	16840.52	25.01178	50.01343137	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.05E-09	7514.573	20.58787011	25.01178	45	19.98822	50	180	3.6
2121	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	9.13E-10	7514.573	20.58787011	25.01178	45	19.98822	50	180	3.6
2122	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	7.92E-10	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2123	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	6.87E-10	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2124	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	5.96E-10	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2125	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	5.17E-10	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2126	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	4.49E-10	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2127	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	3.89E-10	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2128	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	3.38E-10	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2129	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.93E-10	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2130	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.54E-10	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2131	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.2E-10	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2132	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.91E-10	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2133	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.66E-10	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2134	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.44E-10	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2135	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.25E-10	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2136	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.08E-10	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2137	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	9.4E-11	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2138	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	8.15E-11	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2139	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	7.07E-11	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6

	Average rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2140	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	6.14E-11	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2141	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	5.32E-11	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2142	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	4.62E-11	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2143	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	4.01E-11	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2144	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	3.48E-11	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2145	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	3.02E-11	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2146	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.62E-11	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2147	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.27E-11	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2148	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.97E-11	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2149	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.71E-11	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2150	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.48E-11	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2151	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.29E-11	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2152	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.12E-11	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2153	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	9.68E-12	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2154	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	8.39E-12	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2155	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	7.28E-12	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2156	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	6.32E-12	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2157	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	5.48E-12	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2158	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	4.76E-12	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2159	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	4.13E-12	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2160	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	3.58E-12	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2161	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	3.11E-12	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2162	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.69E-12	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2163	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.34E-12	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2164	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.03E-12	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2165	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.76E-12	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2166	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.53E-12	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2167	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.32E-12	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2168	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.15E-12	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2169	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	9.96E-13	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2170	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	8.64E-13	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2171	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	7.5E-13	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2172	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	6.51E-13	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2173	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	5.65E-13	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2174	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	4.9E-13	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2175	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	4.25E-13	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2176	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	3.69E-13	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2177	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	3.2E-13	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2178	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.77E-13	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2179	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.41E-13	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2180	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.09E-13	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2181	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.81E-13	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2182	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.57E-13	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2183	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.37E-13	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2184	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.18E-13	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2185	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.03E-13	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2186	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	8.89E-14	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2187	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	7.77E-14	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2188	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	6.75E-14	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2189	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	5.82E-14	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2190	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	5.1E-14	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2191	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	4.41E-14	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2192	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	3.84E-14	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2193	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	3.31E-14	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2194	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.85E-14	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2195	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.5E-14	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2196	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.18E-14	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2197	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.9E-14	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2198	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.7E-14	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2199	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.44E-14	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6

	Average rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change lev	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2200	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.23E-14	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2201	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.09E-14	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2202	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.04E-14	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2203	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	7.99E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2204	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	7.06E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2205	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	6.48E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2206	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	4.51E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2207	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	4.51E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2208	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	4.4E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2209	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	4.05E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2210	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.89E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2211	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.55E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2212	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.55E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2213	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	2.2E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2214	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2215	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2216	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2217	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2218	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2219	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2220	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2221	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2222	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2223	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2224	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2225	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2226	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2227	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2228	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2229	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2230	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2231	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2232	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2233	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2234	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2235	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2236	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2237	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2238	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2239	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2240	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2241	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2242	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2243	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2244	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2245	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2246	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2247	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2248	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2249	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2250	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2251	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2252	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2253	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2254	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2255	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2256	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2257	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2258	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2259	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6

	Average rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change lev	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2260	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2261	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2262	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2263	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2264	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2265	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2266	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2267	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2268	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2269	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6
2270	0.396	0.2574	3.0615	16840.52	25.01178	50.01343138	7858.202	24141.8	3111.848	6214.099	-7515	-20.6	1.5E-15	7514.573	20.5878701	25.01178	45	19.98822	50	180	3.6

	Twice rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2020	0.792	0.5148	3.0615	16832.15	25	50.001	7854.296	24145.7	6220.602	12430.21	1819	5.0	1.188861	7519	20.6	25	45	20	50	180	3.6
2021	0.792	0.5148	3.0615	17687.68	26.18886	51.25596117	8253.509	23746.49	6536.779	12224.69	1074	2.9	0.986954	7072.048	19.37547366	26.18886	45	18.81114	50	180	3.6
2022	0.792	0.5148	3.0615	18414.03	27.17582	52.29779032	8592.441	23407.56	6805.213	12050.21	441	1.2	0.831242	6701.002	18.35891054	27.17582	45	17.82418	50	180	3.6
2023	0.792	0.5148	3.0615	19037.12	28.00706	53.17524923	8883.19	23116.81	7035.486	11900.53	-101	-0.3	0.707786	6388.497	17.50273142	28.00706	45	16.99294	50	180	3.6
2024	0.792	0.5148	3.0615	19575.84	28.71484	53.92238813	9134.57	22865.43	7234.579	11771.12	-570	-1.6	0.60783	6122.405	16.77371185	28.71484	45	16.28516	50	180	3.6
2025	0.792	0.5148	3.0615	20044.48	29.32267	54.56401367	9353.249	22646.75	7407.773	11658.55	-978	-2.7	0.525564	5893.891	16.14764676	29.32267	45	15.67733	50	180	3.6
2026	0.792	0.5148	3.0615	20454.16	29.84824	55.11879911	9544.416	22455.58	7559.178	11560.13	-1335	-3.7	0.456964	5696.305	15.60631576	29.84824	45	15.15176	50	180	3.6
2027	0.792	0.5148	3.0615	20813.74	30.3052	55.60117051	9712.203	22287.8	7692.065	11473.76	-1648	-4.5	0.399147	5524.51	15.13564264	30.3052	45	14.6948	50	180	3.6
2028	0.792	0.5148	3.0615	21130.38	30.70435	56.02251002	9859.956	22140.04	7809.086	11397.69	-1924	-5.3	0.349986	5374.45	14.7245213	30.70435	45	14.29565	50	180	3.6
2029	0.792	0.5148	3.0615	21409.99	31.05433	56.39195564	9990.43	22009.57	7912.421	11330.53	-2167	-5.9	0.307878	5242.873	14.36403533	31.05433	45	13.94567	50	180	3.6
2030	0.792	0.5148	3.0615	21657.48	31.36221	56.71695116	10105.91	21894.09	8003.884	11271.08	-2383	-6.5	0.271584	5127.126	14.04692147	31.36221	45	13.63779	50	180	3.6
2031	0.792	0.5148	3.0615	21876.98	31.6338	57.0036353	10208.34	21791.66	8085.003	11218.35	-2574	-7.1	0.240137	5025.024	13.76718988	31.6338	45	13.3662	50	180	3.6
2032	0.792	0.5148	3.0615	22071.98	31.87393	57.25712395	10299.33	21700.67	8157.069	11171.51	-2743	-7.5	0.212765	4934.745	13.51984874	31.87393	45	13.12607	50	180	3.6
2033	0.792	0.5148	3.0615	22245.47	32.0867	57.4817192	10380.29	21619.71	8221.187	11129.83	-2894	-7.9	0.188848	4854.756	13.30070029	32.0867	45	12.9133	50	180	3.6
2034	0.792	0.5148	3.0615	22400.04	32.27555	57.68106717	10452.41	21547.59	8278.309	11092.7	-3029	-8.3	0.167878	4783.758	13.10618683	32.27555	45	12.72445	50	180	3.6
2035	0.792	0.5148	3.0615	22537.89	32.44342	57.85827907	10516.73	21483.27	8329.253	11059.59	-3149	-8.6	0.149438	4720.644	12.9332726	32.44342	45	12.55658	50	180	3.6
2036	0.792	0.5148	3.0615	22660.95	32.59286	58.01602546	10574.16	21425.84	8374.734	11030.02	-3256	-8.9	0.13318	4664.463	12.77935182	32.59286	45	12.40714	50	180	3.6
2037	0.792	0.5148	3.0615	22770.91	32.72604	58.15661058	10625.47	21374.53	8415.37	11003.61	-3352	-9.2	0.118815	4614.394	12.64217611	32.72604	45	12.27396	50	180	3.6
2038	0.792	0.5148	3.0615	22869.23	32.84486	58.28203178	10671.35	21328.65	8451.707	10979.99	-3438	-9.4	0.106097	4569.726	12.51979658	32.84486	45	12.15514	50	180	3.6
2039	0.792	0.5148	3.0615	22957.21	32.95095	58.39402729	10712.4	21287.6	8484.22	10958.86	-3514	-9.6	0.094816	4529.839	12.41051713	32.95095	45	12.04905	50	180	3.6
2040	0.792	0.5148	3.0615	23035.97	33.04577	58.49411534	10749.15	21250.85	8513.329	10939.94	-3583	-9.8	0.084796	4494.193	12.31285639	33.04577	45	11.95423	50	180	3.6
2041	0.792	0.5148	3.0615	23106.53	33.13057	58.58362611	10782.08	21217.92	8539.404	10922.99	-3644	-10.0	0.075883	4462.313	12.2255164	33.13057	45	11.86943	50	180	3.6
2042	0.792	0.5148	3.0615	23169.76	33.20645	58.66372835	10811.58	21188.42	8562.772	10907.8	-3699	-10.1	0.067945	4433.785	12.14735676	33.20645	45	11.79355	50	180	3.6
2043	0.792	0.5148	3.0615	23226.45	33.2744	58.73545153	10838.03	21161.97	8583.723	10894.18	-3749	-10.3	0.060869	4408.241	12.07737298	33.2744	45	11.7256	50	180	3.6
2044	0.792	0.5148	3.0615	23277.29	33.33526	58.79970443	10861.76	21138.24	8602.513	10881.97	-3793	-10.4	0.054553	4385.358	12.01467832	33.33526	45	11.66474	50	180	3.6
2045	0.792	0.5148	3.0615	23322.91	33.38982	58.85729089	10883.04	21116.96	8619.371	10871.01	-3833	-10.5	0.048913	4364.848	11.95848843	33.38982	45	11.61018	50	180	3.6
2046	0.792	0.5148	3.0615	23363.85	33.43873	58.90892318	10902.15	21097.85	8634.501	10861.17	-3868	-10.6	0.043871	4346.46	11.90810831	33.43873	45	11.56127	50	180	3.6
2047	0.792	0.5148	3.0615	23400.6	33.4826	58.95523341	10919.29	21080.71	8648.082	10852.35	-3900	-10.7	0.039361	4329.966	11.86292117	33.4826	45	11.5174	50	180	3.6
2048	0.792	0.5148	3.0615	23433.59	33.52196	58.9967834	10934.69	21065.31	8660.276	10844.42	-3929	-10.8	0.035326	4315.168	11.82237884	33.52196	45	11.47804	50	180	3.6
2049	0.792	0.5148	3.0615	23463.22	33.55729	59.03407304	10948.52	21051.48	8671.227	10837.3	-3955	-10.8	0.031711	4301.888	11.78599353	33.55729	45	11.44271	50	180	3.6
2050	0.792	0.5148	3.0615	23489.84	33.589	59.06754768	10960.94	21039.06	8681.064	10830.91	-3978	-10.9	0.028474	4289.966	11.7533307	33.589	45	11.411	50	180	3.6
2051	0.792	0.5148	3.0615	23513.75	33.61747	59.09760447	10972.1	21027.9	8689.901	10825.16	-3999	-11.0	0.025572	4279.261	11.72400284	33.61747	45	11.38253	50	180	3.6
2052	0.792	0.5148	3.0615	23535.24	33.64304	59.12459788	10982.12	21017.88	8697.841	10820	-4017	-11.0	0.02297	4269.647	11.69766406	33.64304	45	11.35696	50	180	3.6
2053	0.792	0.5148	3.0615	23554.54	33.66601	59.14884456	10991.13	21008.87	8704.976	10815.37	-4034	-11.1	0.020636	4261.012	11.6740054	33.66601	45	11.33399	50	180	3.6
2054	0.792	0.5148	3.0615	23571.9	33.68665	59.17062757	10999.23	21000.77	8711.389	10811.2	-4049	-11.1	0.018542	4253.254	11.65275067	33.68665	45	11.31335	50	180	3.6
2055	0.792	0.5148	3.0615	23587.49	33.70519	59.1902001	11006.51	20993.49	8717.153	10807.45	-4063	-11.1	0.016662	4246.283	11.6336528	33.70519	45	11.29481	50	180	3.6
2056	0.792	0.5148	3.0615	23601.51	33.72185	59.20778879	11013.05	20986.95	8722.335	10804.08	-4075	-11.2	0.014975	4240.019	11.61649066	33.72185	45	11.27815	50	180	3.6
2057	0.792	0.5148	3.0615	23614.12	33.73683	59.22359659	11018.93	20981.07	8726.993	10801.05	-4086	-11.2	0.01346	4234.389	11.60106623	33.73683	45	11.26317	50	180	3.6
2058	0.792	0.5148	3.0615	23625.45	33.75029	59.23780531	11024.22	20975.78	8731.181	10798.33	-4096	-11.2	0.0121	4229.329	11.58720209	33.75029	45	11.24971	50	180	3.6
2059	0.792	0.5148	3.0615	23635.64	33.76239	59.25057793	11028.97	20971.03	8734.946	10795.88	-4105	-11.2	0.010878	4224.78	11.57473923	33.76239	45	11.23761	50	180	3.6
2060	0.792	0.5148	3.0615	23644.8	33.77327	59.26206059	11033.25	20966.75	8738.332	10793.68	-4113	-11.3	0.00978	4220.69	11.56353505	33.77327	45	11.22673	50	180	3.6
2061	0.792	0.5148	3.0615	23653.04	33.78305	59.27238434	11037.09	20962.91	8741.377	10791.7	-4120	-11.3	0.008794	4217.014	11.55346166	33.78305	45	11.21695	50	180	3.6
2062	0.792	0.5148	3.0615	23660.45	33.79184	59.2816668	11040.55	20959.45	8744.115	10789.93	-4126	-11.3	0.007907	4213.708	11.54440431	33.79184	45	11.20816	50	180	3.6
2063	0.792	0.5148	3.0615	23667.11	33.79975	59.29001352	11043.66	20956.34	8746.578	10788.32	-4132	-11.3	0.00711	4210.735	11.53626002	33.79975	45	11.20025	50	180	3.6
2064	0.792	0.5148	3.0615	23673.11	33.80686	59.29751923	11046.45	20953.55	8748.792	10786.89	-4137	-11.3	0.006394	4208.062	11.52893633	33.80686	45	11.19314	50	180	3.6
2065	0.792	0.5148	3.0615	23678.49	33.81325	59.30426902	11048.97	20951.03	8750.784	10785.59	-4142	-11.3	0.005751	4205.658	11.52235024	33.81325	45	11.18675	50	180	3.6
2066	0.792	0.5148	3.0615	23683.34	33.819	59.31033928	11051.23	20948.77	8752.576	10784.43	-4146	-11.4	0.005172	4203.496	11.51642719	33.819	45	11.181	50	180	3.6
2067	0.792	0.5148	3.0615	23687.7	33.82417	59.31579866	11053.27	20946.73	8754.187	10783.38	-4150	-11.4	0.004652	4201.552	11.51110021	33.82417	45	11.17583	50	180	3.6
2068	0.792	0.5148	3.0615	23691.62	33.82883	59.3207088	11055.1	20944.9	8755.636	10782.44	-4154	-11.4	0.004184	4199.803	11.50630915	33.82883	45	11.17117	50	180	3.6
2069	0.792	0.5148	3.0615	23695.15	33.83301	59.32512511	11056.74	20943.26	8756.94	10781.59	-4157	-11.4	0.003763	4198.23	11.50199994	33.83301	45	11.16699	50	180	3.6
2070	0.792	0.5148	3.0615	23698.33	33.83677	59.32909736	11058.22	20941.78	8758.113	10780.83	-4159	-11.4	0.003385	4196.815	11.49812402	33.83677	45	11.16323	50	180	3.6
2071	0.792	0.5148	3.0615	23701.18	33.84016	59.33267031	11059.56	20940.44	8759.168	10780.14	-4162	-11.4	0.003045	4195.543	11.49463773	33.84016	45	11.15984	50	180	3.6
2072	0.792	0.5148	3.0615	23703.75	33.8432	59.33588416	11060.75	20939.25	8760.117	10779.52	-4164	-11.4	0.002739	4194.398	11.49150181	33.8432	45	11.1568	50	180	3.6
2073	0.792	0.5148	3.0615	23706.06	33.84594	59.33877507	11061.83	20938.17	8760.97	10778.97	-4166	-11.4	0.002464	4193.369	11.48868101	33.84594	45	11.15406	50	180	3.6
2074	0.792	0.5148	3.0615	23708.14	33.8484	59.34137555	11062.8	20937.2	8761.738	10778.47	-4168	-11.4	0.002216	4192.442	11.4861436	33.8484	45	11.1516	50	180	3.6
2075	0.792	0.5148	3.0615	23710	33.85062	59.3437148	11063.67	20936.33	8762.429	10778.02	-4170	-11.4	0.001993	4191.609	11.48386108	33.85062	45	11.14938	50	180	3.6
2076	0.792	0.5148	3.0615	23711.69	33.85261	59.3458191	11064.46	20935.54	8763.05	10777.62	-4171	-11.4	0.001793	4190.86	11.48180781	33.85261	45	11.14739	50	180	3.6
2077	0.792	0.5148	3.0615	23713.2	33.85441	59.34771208	11065.16	20934.84	8763.609	10777.25	-4172	-11.4	0.001613	4190.186	11.47996074	33.85441	45	11.14559	50	180	3.6
2078	0.792	0.5148	3.0615	23714.56	33.85602	59.34941498	11065.8	20934.2	8764.112	10776.93	-4174	-11.4	0.001451	4189.579	11.47829914	33.85602	45	11.14398	50	180	3.6
2079	0.792	0.5148	3.0615	23715.78	33.85747	59.35094691	11066.37	20933.63	8764.565	10776.63	-4175	-11.4	0.001306	4189.034	11.47680436	33.85747	45	11.14253	50	180	3.6

	Twice rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2080	0.792	0.5148	3.0615	23716.89	33.85878	59.35232503	11066.88	20933.12	8764.972	10776.37	-4176	-11.4	0.001174	4188.543	11.47545966	33.85878	45	11.14122	50	180	3.6
2081	0.792	0.5148	3.0615	23717.88	33.85995	59.35356482	11067.35	20932.65	8765.338	10776.13	-4176	-11.4	0.001057	4188.101	11.47424994	33.85995	45	11.14005	50	180	3.6
2082	0.792	0.5148	3.0615	23718.77	33.86101	59.35468015	11067.76	20932.24	8765.667	10775.92	-4177	-11.4	0.000951	4187.704	11.47316166	33.86101	45	11.13899	50	180	3.6
2083	0.792	0.5148	3.0615	23719.57	33.86196	59.35568354	11068.14	20931.86	8765.964	10775.72	-4178	-11.4	0.000855	4187.347	11.4721826	33.86196	45	11.13804	50	180	3.6
2084	0.792	0.5148	3.0615	23720.29	33.86281	59.35658622	11068.47	20931.53	8766.23	10775.55	-4179	-11.4	0.000769	4187.025	11.47130181	33.86281	45	11.13719	50	180	3.6
2085	0.792	0.5148	3.0615	23720.94	33.86358	59.35739831	11068.78	20931.22	8766.47	10775.39	-4179	-11.4	0.000692	4186.736	11.47050942	33.86358	45	11.13642	50	180	3.6
2086	0.792	0.5148	3.0615	23721.52	33.86428	59.3581289	11069.05	20930.95	8766.686	10775.25	-4180	-11.5	0.000623	4186.476	11.46979655	33.86428	45	11.13572	50	180	3.6
2087	0.792	0.5148	3.0615	23722.05	33.8649	59.35878617	11069.29	20930.71	8766.88	10775.13	-4180	-11.5	0.00056	4186.242	11.46915521	33.8649	45	11.1351	50	180	3.6
2088	0.792	0.5148	3.0615	23722.52	33.86546	59.35937749	11069.51	20930.49	8767.055	10775.01	-4180	-11.5	0.000504	4186.031	11.46857824	33.86546	45	11.13454	50	180	3.6
2089	0.792	0.5148	3.0615	23722.95	33.86596	59.35990947	11069.71	20930.29	8767.212	10774.91	-4181	-11.5	0.000453	4185.842	11.46805915	33.86596	45	11.13404	50	180	3.6
2090	0.792	0.5148	3.0615	23723.33	33.86642	59.36038808	11069.89	20930.11	8767.353	10774.82	-4181	-11.5	0.000408	4185.671	11.46759216	33.86642	45	11.13358	50	180	3.6
2091	0.792	0.5148	3.0615	23723.67	33.86682	59.36081866	11070.05	20929.95	8767.481	10774.74	-4181	-11.5	0.000367	4185.518	11.46717202	33.86682	45	11.13318	50	180	3.6
2092	0.792	0.5148	3.0615	23723.98	33.86719	59.36120604	11070.2	20929.8	8767.595	10774.66	-4182	-11.5	0.00033	4185.38	11.46679403	33.86719	45	11.13281	50	180	3.6
2093	0.792	0.5148	3.0615	23724.26	33.86752	59.36155455	11070.33	20929.67	8767.698	10774.6	-4182	-11.5	0.000297	4185.256	11.46645397	33.86752	45	11.13248	50	180	3.6
2094	0.792	0.5148	3.0615	23724.51	33.86782	59.3618681	11070.44	20929.56	8767.791	10774.54	-4182	-11.5	0.000267	4185.144	11.46614803	33.86782	45	11.13218	50	180	3.6
2095	0.792	0.5148	3.0615	23724.74	33.86808	59.36215018	11070.55	20929.45	8767.874	10774.48	-4182	-11.5	0.00024	4185.044	11.46587278	33.86808	45	11.13192	50	180	3.6
2096	0.792	0.5148	3.0615	23724.94	33.86833	59.36240397	11070.64	20929.36	8767.949	10774.43	-4183	-11.5	0.000216	4184.953	11.46562515	33.86833	45	11.13167	50	180	3.6
2097	0.792	0.5148	3.0615	23725.12	33.86854	59.3626323	11070.73	20929.27	8768.016	10774.39	-4183	-11.5	0.000195	4184.872	11.46540236	33.86854	45	11.13146	50	180	3.6
2098	0.792	0.5148	3.0615	23725.29	33.86874	59.36283772	11070.8	20929.2	8768.077	10774.35	-4183	-11.5	0.000175	4184.799	11.46520193	33.86874	45	11.13126	50	180	3.6
2099	0.792	0.5148	3.0615	23725.44	33.86891	59.36302253	11070.87	20929.13	8768.132	10774.31	-4183	-11.5	0.000158	4184.733	11.4650216	33.86891	45	11.13109	50	180	3.6
2100	0.792	0.5148	3.0615	23725.57	33.86907	59.3631888	11070.94	20929.06	8768.181	10774.28	-4183	-11.5	0.000142	4184.674	11.46485936	33.86907	45	11.13093	50	180	3.6
2101	0.792	0.5148	3.0615	23725.69	33.86921	59.36333839	11070.99	20929.01	8768.225	10774.25	-4183	-11.5	0.000127	4184.62	11.4647134	33.86921	45	11.13079	50	180	3.6
2102	0.792	0.5148	3.0615	23725.8	33.86934	59.36347297	11071.04	20928.96	8768.265	10774.23	-4183	-11.5	0.000115	4184.572	11.46458208	33.86934	45	11.13066	50	180	3.6
2103	0.792	0.5148	3.0615	23725.89	33.86945	59.36359405	11071.09	20928.91	8768.301	10774.2	-4183	-11.5	0.000103	4184.529	11.46446393	33.86945	45	11.13055	50	180	3.6
2104	0.792	0.5148	3.0615	23725.98	33.86956	59.36370298	11071.13	20928.87	8768.333	10774.18	-4183	-11.5	9.28E-05	4184.491	11.46435764	33.86956	45	11.13044	50	180	3.6
2105	0.792	0.5148	3.0615	23726.06	33.86965	59.36380099	11071.16	20928.84	8768.362	10774.16	-4184	-11.5	8.35E-05	4184.456	11.46426201	33.86965	45	11.13035	50	180	3.6
2106	0.792	0.5148	3.0615	23726.13	33.86973	59.36388917	11071.2	20928.8	8768.388	10774.15	-4184	-11.5	7.52E-05	4184.424	11.46417597	33.86973	45	11.13027	50	180	3.6
2107	0.792	0.5148	3.0615	23726.19	33.86981	59.3639685	11071.23	20928.77	8768.411	10774.13	-4184	-11.5	6.76E-05	4184.396	11.46409857	33.86981	45	11.13019	50	180	3.6
2108	0.792	0.5148	3.0615	23726.25	33.86987	59.36403987	11071.25	20928.75	8768.432	10774.12	-4184	-11.5	6.08E-05	4184.371	11.46402893	33.86987	45	11.13013	50	180	3.6
2109	0.792	0.5148	3.0615	23726.3	33.86994	59.36410408	11071.28	20928.72	8768.451	10774.11	-4184	-11.5	5.47E-05	4184.348	11.46396627	33.86994	45	11.13006	50	180	3.6
2110	0.792	0.5148	3.0615	23726.35	33.86999	59.36416185	11071.3	20928.7	8768.468	10774.1	-4184	-11.5	4.92E-05	4184.327	11.4639099	33.86999	45	11.13001	50	180	3.6
2111	0.792	0.5148	3.0615	23726.39	33.87004	59.36421382	11071.32	20928.68	8768.484	10774.09	-4184	-11.5	4.43E-05	4184.309	11.46385919	33.87004	45	11.12996	50	180	3.6
2112	0.792	0.5148	3.0615	23726.42	33.87008	59.36426059	11071.34	20928.66	8768.497	10774.08	-4184	-11.5	3.99E-05	4184.292	11.46381356	33.87008	45	11.12992	50	180	3.6
2113	0.792	0.5148	3.0615	23726.46	33.87012	59.36430266	11071.35	20928.65	8768.51	10774.07	-4184	-11.5	3.59E-05	4184.277	11.46377251	33.87012	45	11.12988	50	180	3.6
2114	0.792	0.5148	3.0615	23726.49	33.87016	59.36434051	11071.36	20928.64	8768.521	10774.06	-4184	-11.5	3.23E-05	4184.263	11.46373558	33.87016	45	11.12984	50	180	3.6
2115	0.792	0.5148	3.0615	23726.52	33.87019	59.36437456	11071.38	20928.62	8768.531	10774.05	-4184	-11.5	2.9E-05	4184.251	11.46370235	33.87019	45	11.12981	50	180	3.6
2116	0.792	0.5148	3.0615	23726.54	33.87022	59.3644052	11071.39	20928.61	8768.54	10774.05	-4184	-11.5	2.61E-05	4184.24	11.46367246	33.87022	45	11.12978	50	180	3.6
2117	0.792	0.5148	3.0615	23726.56	33.87025	59.36443276	11071.4	20928.6	8768.548	10774.04	-4184	-11.5	2.35E-05	4184.231	11.46364556	33.87025	45	11.12975	50	180	3.6
2118	0.792	0.5148	3.0615	23726.58	33.87027	59.36445756	11071.41	20928.59	8768.556	10774.04	-4184	-11.5	2.11E-05	4184.222	11.46362137	33.87027	45	11.12973	50	180	3.6
2119	0.792	0.5148	3.0615	23726.6	33.87029	59.36447987	11071.42	20928.58	8768.562	10774.03	-4184	-11.5	1.9E-05	4184.214	11.4635996	33.87029	45	11.12971	50	180	3.6
2120	0.792	0.5148	3.0615	23726.62	33.87031	59.36449994	11071.42	20928.58	8768.568	10774.03	-4184	-11.5	1.71E-05	4184.207	11.46358001	33.87031	45	11.12969	50	180	3.6
2121	0.792	0.5148	3.0615	23726.63	33.87033	59.364518	11071.43	20928.57	8768.573	10774.03	-4184	-11.5	1.54E-05	4184.2	11.46356239	33.87033	45	11.12967	50	180	3.6
2122	0.792	0.5148	3.0615	23726.64	33.87034	59.36453425	11071.44	20928.56	8768.578	10774.02	-4184	-11.5	1.38E-05	4184.194	11.46354654	33.87034	45	11.12966	50	180	3.6
2123	0.792	0.5148	3.0615	23726.66	33.87036	59.36454887	11071.44	20928.56	8768.583	10774.02	-4184	-11.5	1.25E-05	4184.189	11.46353227	33.87036	45	11.12964	50	180	3.6
2124	0.792	0.5148	3.0615	23726.67	33.87037	59.36456202	11071.45	20928.55	8768.586	10774.02	-4184	-11.5	1.12E-05	4184.185	11.46351944	33.87037	45	11.12963	50	180	3.6
2125	0.792	0.5148	3.0615	23726.68	33.87038	59.36457385	11071.45	20928.55	8768.59	10774.02	-4184	-11.5	1.01E-05	4184.18	11.46350789	33.87038	45	11.12962	50	180	3.6
2126	0.792	0.5148	3.0615	23726.68	33.87039	59.3645845	11071.46	20928.54	8768.593	10774.01	-4184	-11.5	9.07E-06	4184.177	11.46349751	33.87039	45	11.12961	50	180	3.6
2127	0.792	0.5148	3.0615	23726.69	33.8704	59.36459407	11071.46	20928.54	8768.596	10774.01	-4184	-11.5	8.16E-06	4184.173	11.46348816	33.8704	45	11.1296	50	180	3.6
2128	0.792	0.5148	3.0615	23726.7	33.87041	59.36460269	11071.46	20928.54	8768.599	10774.01	-4184	-11.5	7.34E-06	4184.17	11.46347975	33.87041	45	11.12959	50	180	3.6
2129	0.792	0.5148	3.0615	23726.7	33.87042	59.36461044	11071.47	20928.53	8768.601	10774.01	-4184	-11.5	6.61E-06	4184.167	11.46347219	33.87042	45	11.12958	50	180	3.6
2130	0.792	0.5148	3.0615	23726.71	33.87042	59.36461742	11071.47	20928.53	8768.603	10774.01	-4184	-11.5	5.94E-06	4184.165	11.46346538	33.87042	45	11.12958	50	180	3.6
2131	0.792	0.5148	3.0615	23726.72	33.87043	59.36462369	11071.47	20928.53	8768.605	10774.01	-4184	-11.5	5.35E-06	4184.163	11.46345926	33.87043	45	11.12957	50	180	3.6
2132	0.792	0.5148	3.0615	23726.72	33.87043	59.36462934	11071.47	20928.53	8768.606	10774.01	-4184	-11.5	4.81E-06	4184.161	11.46345375	33.87043	45	11.12957	50	180	3.6
2133	0.792	0.5148	3.0615	23726.72	33.87044	59.36463442	11071.47	20928.53	8768.608	10774	-4184	-11.5	4.33E-06	4184.159	11.4634488	33.87044	45	11.12956	50	180	3.6
2134	0.792	0.5148	3.0615	23726.73	33.87044	59.36463899	11071.48	20928.52	8768.609	10774	-4184	-11.5	3.89E-06	4184.157	11.46344434	33.87044	45	11.12956	50	180	3.6
2135	0.792	0.5148	3.0615	23726.73	33.87045	59.3646431	11071.48	20928.52	8768.61	10774	-4184	-11.5	3.5E-06	4184.156	11.46344033	33.87045	45	11.12955	50	180	3.6
2136	0.792	0.5148	3.0615	23726.73	33.87045	59.3646468	11071.48	20928.52	8768.612	10774	-4184	-11.5	3.15E-06	4184.154	11.46343672	33.87045	45	11.12955	50	180	3.6
2137	0.792	0.5148	3.0615	23726.74	33.87045	59.36465013	11071.48	20928.52	8768.613	10774	-4184	-11.5	2.84E-06	4184.153	11.46343347	33.87045	45	11.12955	50	180	3.6
2138	0.792	0.5148	3.0615	23726.74	33.87046	59.36465312	11071.48	20928.52	8768.613	10774	-4184	-11.5	2.55E-06	4184.152	11.46343055	33.87046	45	11.12954	50	180	3.6
2139	0.792	0.5148	3.0615	23726.74	33.87046	59.36465581	11071.48	20928.52	8768.614	10774	-4184	-11.5	2.3E-06	4184.151	11.46342792	33.87046	45	11.12954	50	180	3.6

	Twice rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2140	0.792	0.5148	3.0615	23726.74	33.87046	59.36465824	11071.48	20928.52	8768.615	10774	-4184	-11.5	2.07E-06	4184.15	11.46342555	33.87046	45	11.12954	50	180	3.6
2141	0.792	0.5148	3.0615	23726.74	33.87046	59.36466042	11071.48	20928.52	8768.616	10774	-4184	-11.5	1.86E-06	4184.15	11.46342343	33.87046	45	11.12954	50	180	3.6
2142	0.792	0.5148	3.0615	23726.75	33.87046	59.36466238	11071.49	20928.51	8768.616	10774	-4184	-11.5	1.67E-06	4184.149	11.46342151	33.87046	45	11.12954	50	180	3.6
2143	0.792	0.5148	3.0615	23726.75	33.87047	59.36466414	11071.49	20928.51	8768.617	10774	-4184	-11.5	1.5E-06	4184.148	11.46341979	33.87047	45	11.12953	50	180	3.6
2144	0.792	0.5148	3.0615	23726.75	33.87047	59.36466573	11071.49	20928.51	8768.617	10774	-4184	-11.5	1.35E-06	4184.148	11.46341824	33.87047	45	11.12953	50	180	3.6
2145	0.792	0.5148	3.0615	23726.75	33.87047	59.36466716	11071.49	20928.51	8768.618	10774	-4184	-11.5	1.22E-06	4184.147	11.46341685	33.87047	45	11.12953	50	180	3.6
2146	0.792	0.5148	3.0615	23726.75	33.87047	59.36466845	11071.49	20928.51	8768.618	10774	-4184	-11.5	1.1E-06	4184.147	11.46341559	33.87047	45	11.12953	50	180	3.6
2147	0.792	0.5148	3.0615	23726.75	33.87047	59.3646696	11071.49	20928.51	8768.618	10774	-4184	-11.5	9.86E-07	4184.146	11.46341446	33.87047	45	11.12953	50	180	3.6
2148	0.792	0.5148	3.0615	23726.75	33.87047	59.36467064	11071.49	20928.51	8768.619	10774	-4184	-11.5	8.87E-07	4184.146	11.46341345	33.87047	45	11.12953	50	180	3.6
2149	0.792	0.5148	3.0615	23726.75	33.87047	59.36467158	11071.49	20928.51	8768.619	10774	-4184	-11.5	7.98E-07	4184.146	11.46341254	33.87047	45	11.12953	50	180	3.6
2150	0.792	0.5148	3.0615	23726.75	33.87047	59.36467242	11071.49	20928.51	8768.619	10774	-4184	-11.5	7.18E-07	4184.145	11.46341171	33.87047	45	11.12953	50	180	3.6
2151	0.792	0.5148	3.0615	23726.75	33.87047	59.36467318	11071.49	20928.51	8768.619	10774	-4184	-11.5	6.46E-07	4184.145	11.46341098	33.87047	45	11.12953	50	180	3.6
2152	0.792	0.5148	3.0615	23726.76	33.87048	59.36467386	11071.49	20928.51	8768.62	10774	-4184	-11.5	5.81E-07	4184.145	11.46341031	33.87048	45	11.12952	50	180	3.6
2153	0.792	0.5148	3.0615	23726.76	33.87048	59.36467447	11071.49	20928.51	8768.62	10774	-4184	-11.5	5.23E-07	4184.145	11.46340971	33.87048	45	11.12952	50	180	3.6
2154	0.792	0.5148	3.0615	23726.76	33.87048	59.36467503	11071.49	20928.51	8768.62	10774	-4184	-11.5	4.7E-07	4184.144	11.46340917	33.87048	45	11.12952	50	180	3.6
2155	0.792	0.5148	3.0615	23726.76	33.87048	59.36467552	11071.49	20928.51	8768.62	10774	-4184	-11.5	4.23E-07	4184.144	11.46340869	33.87048	45	11.12952	50	180	3.6
2156	0.792	0.5148	3.0615	23726.76	33.87048	59.36467597	11071.49	20928.51	8768.62	10774	-4184	-11.5	3.81E-07	4184.144	11.46340825	33.87048	45	11.12952	50	180	3.6
2157	0.792	0.5148	3.0615	23726.76	33.87048	59.36467637	11071.49	20928.51	8768.62	10774	-4184	-11.5	3.42E-07	4184.144	11.46340786	33.87048	45	11.12952	50	180	3.6
2158	0.792	0.5148	3.0615	23726.76	33.87048	59.36467673	11071.49	20928.51	8768.62	10774	-4184	-11.5	3.08E-07	4184.144	11.46340751	33.87048	45	11.12952	50	180	3.6
2159	0.792	0.5148	3.0615	23726.76	33.87048	59.36467706	11071.49	20928.51	8768.62	10774	-4184	-11.5	2.77E-07	4184.144	11.46340719	33.87048	45	11.12952	50	180	3.6
2160	0.792	0.5148	3.0615	23726.76	33.87048	59.36467735	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.49E-07	4184.144	11.46340691	33.87048	45	11.12952	50	180	3.6
2161	0.792	0.5148	3.0615	23726.76	33.87048	59.36467761	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.24E-07	4184.143	11.46340665	33.87048	45	11.12952	50	180	3.6
2162	0.792	0.5148	3.0615	23726.76	33.87048	59.36467785	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.02E-07	4184.143	11.46340642	33.87048	45	11.12952	50	180	3.6
2163	0.792	0.5148	3.0615	23726.76	33.87048	59.36467806	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.82E-07	4184.143	11.46340621	33.87048	45	11.12952	50	180	3.6
2164	0.792	0.5148	3.0615	23726.76	33.87048	59.36467825	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.63E-07	4184.143	11.46340602	33.87048	45	11.12952	50	180	3.6
2165	0.792	0.5148	3.0615	23726.76	33.87048	59.36467843	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.47E-07	4184.143	11.46340585	33.87048	45	11.12952	50	180	3.6
2166	0.792	0.5148	3.0615	23726.76	33.87048	59.36467858	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.32E-07	4184.143	11.4634057	33.87048	45	11.12952	50	180	3.6
2167	0.792	0.5148	3.0615	23726.76	33.87048	59.36467872	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.19E-07	4184.143	11.46340557	33.87048	45	11.12952	50	180	3.6
2168	0.792	0.5148	3.0615	23726.76	33.87048	59.36467885	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.07E-07	4184.143	11.46340544	33.87048	45	11.12952	50	180	3.6
2169	0.792	0.5148	3.0615	23726.76	33.87048	59.36467896	11071.49	20928.51	8768.621	10774	-4184	-11.5	9.63E-08	4184.143	11.46340533	33.87048	45	11.12952	50	180	3.6
2170	0.792	0.5148	3.0615	23726.76	33.87048	59.36467906	11071.49	20928.51	8768.621	10774	-4184	-11.5	8.67E-08	4184.143	11.46340524	33.87048	45	11.12952	50	180	3.6
2171	0.792	0.5148	3.0615	23726.76	33.87048	59.36467915	11071.49	20928.51	8768.621	10774	-4184	-11.5	7.8E-08	4184.143	11.46340515	33.87048	45	11.12952	50	180	3.6
2172	0.792	0.5148	3.0615	23726.76	33.87048	59.36467924	11071.49	20928.51	8768.621	10774	-4184	-11.5	7.01E-08	4184.143	11.46340507	33.87048	45	11.12952	50	180	3.6
2173	0.792	0.5148	3.0615	23726.76	33.87048	59.36467931	11071.49	20928.51	8768.621	10774	-4184	-11.5	6.31E-08	4184.143	11.46340499	33.87048	45	11.12952	50	180	3.6
2174	0.792	0.5148	3.0615	23726.76	33.87048	59.36467938	11071.49	20928.51	8768.621	10774	-4184	-11.5	5.68E-08	4184.143	11.46340493	33.87048	45	11.12952	50	180	3.6
2175	0.792	0.5148	3.0615	23726.76	33.87048	59.36467944	11071.49	20928.51	8768.621	10774	-4184	-11.5	5.11E-08	4184.143	11.46340487	33.87048	45	11.12952	50	180	3.6
2176	0.792	0.5148	3.0615	23726.76	33.87048	59.36467949	11071.49	20928.51	8768.621	10774	-4184	-11.5	4.6E-08	4184.143	11.46340482	33.87048	45	11.12952	50	180	3.6
2177	0.792	0.5148	3.0615	23726.76	33.87048	59.36467954	11071.49	20928.51	8768.621	10774	-4184	-11.5	4.13E-08	4184.143	11.46340477	33.87048	45	11.12952	50	180	3.6
2178	0.792	0.5148	3.0615	23726.76	33.87048	59.36467958	11071.49	20928.51	8768.621	10774	-4184	-11.5	3.72E-08	4184.143	11.46340473	33.87048	45	11.12952	50	180	3.6
2179	0.792	0.5148	3.0615	23726.76	33.87048	59.36467962	11071.49	20928.51	8768.621	10774	-4184	-11.5	3.35E-08	4184.143	11.46340469	33.87048	45	11.12952	50	180	3.6
2180	0.792	0.5148	3.0615	23726.76	33.87048	59.36467966	11071.49	20928.51	8768.621	10774	-4184	-11.5	3.01E-08	4184.143	11.46340465	33.87048	45	11.12952	50	180	3.6
2181	0.792	0.5148	3.0615	23726.76	33.87048	59.36467969	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.71E-08	4184.143	11.46340462	33.87048	45	11.12952	50	180	3.6
2182	0.792	0.5148	3.0615	23726.76	33.87048	59.36467972	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.44E-08	4184.143	11.4634046	33.87048	45	11.12952	50	180	3.6
2183	0.792	0.5148	3.0615	23726.76	33.87048	59.36467974	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.19E-08	4184.143	11.46340457	33.87048	45	11.12952	50	180	3.6
2184	0.792	0.5148	3.0615	23726.76	33.87048	59.36467977	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.97E-08	4184.143	11.46340455	33.87048	45	11.12952	50	180	3.6
2185	0.792	0.5148	3.0615	23726.76	33.87048	59.36467979	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.77E-08	4184.143	11.46340453	33.87048	45	11.12952	50	180	3.6
2186	0.792	0.5148	3.0615	23726.76	33.87048	59.36467981	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.6E-08	4184.143	11.46340451	33.87048	45	11.12952	50	180	3.6
2187	0.792	0.5148	3.0615	23726.76	33.87048	59.36467982	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.44E-08	4184.143	11.46340449	33.87048	45	11.12952	50	180	3.6
2188	0.792	0.5148	3.0615	23726.76	33.87048	59.36467984	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.29E-08	4184.143	11.46340448	33.87048	45	11.12952	50	180	3.6
2189	0.792	0.5148	3.0615	23726.76	33.87048	59.36467985	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.16E-08	4184.143	11.46340446	33.87048	45	11.12952	50	180	3.6
2190	0.792	0.5148	3.0615	23726.76	33.87048	59.36467986	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.05E-08	4184.143	11.46340445	33.87048	45	11.12952	50	180	3.6
2191	0.792	0.5148	3.0615	23726.76	33.87048	59.36467987	11071.49	20928.51	8768.621	10774	-4184	-11.5	9.41E-09	4184.143	11.46340444	33.87048	45	11.12952	50	180	3.6
2192	0.792	0.5148	3.0615	23726.76	33.87048	59.36467988	11071.49	20928.51	8768.621	10774	-4184	-11.5	8.47E-09	4184.143	11.46340443	33.87048	45	11.12952	50	180	3.6
2193	0.792	0.5148	3.0615	23726.76	33.87048	59.36467989	11071.49	20928.51	8768.621	10774	-4184	-11.5	7.62E-09	4184.143	11.46340442	33.87048	45	11.12952	50	180	3.6
2194	0.792	0.5148	3.0615	23726.76	33.87048	59.3646799	11071.49	20928.51	8768.621	10774	-4184	-11.5	6.85E-09	4184.143	11.46340442	33.87048	45	11.12952	50	180	3.6
2195	0.792	0.5148	3.0615	23726.76	33.87048	59.36467991	11071.49	20928.51	8768.621	10774	-4184	-11.5	6.17E-09	4184.143	11.46340441	33.87048	45	11.12952	50	180	3.6
2196	0.792	0.5148	3.0615	23726.76	33.87048	59.36467992	11071.49	20928.51	8768.621	10774	-4184	-11.5	5.55E-09	4184.143	11.4634044	33.87048	45	11.12952	50	180	3.6
2197	0.792	0.5148	3.0615	23726.76	33.87048	59.36467992	11071.49	20928.51	8768.621	10774	-4184	-11.5	4.99E-09	4184.143	11.4634044	33.87048	45	11.12952	50	180	3.6
2198	0.792	0.5148	3.0615	23726.76	33.87048	59.36467993	11071.49	20928.51	8768.621	10774	-4184	-11.5	4.49E-09	4184.143	11.46340439	33.87048	45	11.12952	50	180	3.6
2199	0.792	0.5148	3.0615	23726.76	33.87048	59.36467993	11071.49	20928.51	8768.621	10774	-4184	-11.5	4.04E-09	4184.143	11.46340439	33.87048	45	11.12952	50	180	3.6

	Twice rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2200	0.792	0.5148	3.0615	23726.76	33.87048	59.36467994	11071.49	20928.51	8768.621	10774	-4184	-11.5	3.64E-09	4184.143	11.46340438	33.87048	45	11.12952	50	180	3.6
2201	0.792	0.5148	3.0615	23726.76	33.87048	59.36467994	11071.49	20928.51	8768.621	10774	-4184	-11.5	3.27E-09	4184.143	11.46340438	33.87048	45	11.12952	50	180	3.6
2202	0.792	0.5148	3.0615	23726.76	33.87048	59.36467994	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.94E-09	4184.143	11.46340438	33.87048	45	11.12952	50	180	3.6
2203	0.792	0.5148	3.0615	23726.76	33.87048	59.36467995	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.65E-09	4184.143	11.46340437	33.87048	45	11.12952	50	180	3.6
2204	0.792	0.5148	3.0615	23726.76	33.87048	59.36467995	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.38E-09	4184.143	11.46340437	33.87048	45	11.12952	50	180	3.6
2205	0.792	0.5148	3.0615	23726.76	33.87048	59.36467995	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.14E-09	4184.143	11.46340437	33.87048	45	11.12952	50	180	3.6
2206	0.792	0.5148	3.0615	23726.76	33.87048	59.36467995	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.93E-09	4184.143	11.46340437	33.87048	45	11.12952	50	180	3.6
2207	0.792	0.5148	3.0615	23726.76	33.87048	59.36467996	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.73E-09	4184.143	11.46340436	33.87048	45	11.12952	50	180	3.6
2208	0.792	0.5148	3.0615	23726.76	33.87048	59.36467996	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.56E-09	4184.143	11.46340436	33.87048	45	11.12952	50	180	3.6
2209	0.792	0.5148	3.0615	23726.76	33.87048	59.36467996	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.4E-09	4184.143	11.46340436	33.87048	45	11.12952	50	180	3.6
2210	0.792	0.5148	3.0615	23726.76	33.87048	59.36467996	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.26E-09	4184.143	11.46340436	33.87048	45	11.12952	50	180	3.6
2211	0.792	0.5148	3.0615	23726.76	33.87048	59.36467996	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.14E-09	4184.143	11.46340436	33.87048	45	11.12952	50	180	3.6
2212	0.792	0.5148	3.0615	23726.76	33.87048	59.36467996	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.02E-09	4184.143	11.46340436	33.87048	45	11.12952	50	180	3.6
2213	0.792	0.5148	3.0615	23726.76	33.87048	59.36467996	11071.49	20928.51	8768.621	10774	-4184	-11.5	9.2E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2214	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	8.28E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2215	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	7.45E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2216	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	6.7E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2217	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	6.03E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2218	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	5.42E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2219	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	4.88E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2220	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	4.39E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2221	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	3.95E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2222	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	3.55E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2223	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	3.2E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2224	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.88E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2225	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.59E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2226	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.33E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2227	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.09E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2228	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.88E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2229	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.7E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2230	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.53E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2231	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.37E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2232	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.23E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2233	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.11E-10	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2234	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	9.99E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2235	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	8.99E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2236	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	8.09E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2237	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	7.28E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2238	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	6.55E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2239	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	5.89E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2240	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	5.3E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2241	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	4.77E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2242	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	4.29E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2243	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	3.86E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2244	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	3.47E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2245	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	3.12E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2246	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.81E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2247	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.53E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2248	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.27E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2249	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.05E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2250	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.84E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2251	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.66E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2252	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.49E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2253	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.34E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2254	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.21E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2255	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	1.09E-11	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2256	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	9.77E-12	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2257	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	8.79E-12	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2258	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	7.9E-12	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2259	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	7.11E-12	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6

	Twice rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change lev	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2260	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	6.4E-12	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2261	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	5.76E-12	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2262	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	5.18E-12	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2263	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	4.66E-12	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2264	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	4.19E-12	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2265	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	3.77E-12	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2266	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	3.39E-12	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2267	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	3.05E-12	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2268	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.75E-12	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2269	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.47E-12	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6
2270	0.792	0.5148	3.0615	23726.76	33.87048	59.36467997	11071.49	20928.51	8768.621	10774	-4184	-11.5	2.22E-12	4184.143	11.46340435	33.87048	45	11.12952	50	180	3.6

	30 year rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2020	0.3934	0.25571	3.0615	16832.15	25	50.001	7854.296	24145.7	3089.88	6174.298	-7568	-20.7	-0.00623	7519	20.6	25	45	20	50	180	3.6
2021	0.41355	0.2688075	3.0615	16827.72	24.99377	49.99441846	7852.228	24147.77	3247.289	6491.102	-7089	-19.4	0.055018	7521.344	20.60642193	24.99377	45	20.00623	50	180	3.6
2022	0.65755	0.4274075	3.0615	16866.84	25.04878	50.05249593	7870.482	24129.52	5175.236	10313.14	-1378	-3.8	0.777868	7500.66	20.54975293	25.04878	45	19.95122	50	180	3.6
2023	0.4714	0.30641	3.0615	17424.78	25.82665	50.87361321	8130.833	23869.17	3832.875	7313.751	-6278	-17.2	0.114387	7208.22	19.74854906	25.82665	45	19.17335	50	180	3.6
2024	0.4648	0.30212	3.0615	17507.59	25.94104	50.99436056	8169.475	23830.52	3797.172	7199.678	-6511	-17.8	0.080112	7165.216	19.63073003	25.94104	45	19.05896	50	180	3.6
2025	0.31895	0.2073175	3.0615	17565.71	26.02115	51.0789267	8196.594	23803.41	2614.304	4934.863	-10017	-27.4	-0.35154	7135.098	19.54821476	26.02115	45	18.97885	50	180	3.6
2026	0.5311	0.345215	3.0615	17311.41	25.66961	50.70783919	8077.93	23922.07	4290.189	8258.257	-4763	-13.0	0.310017	7267.261	19.9103028	25.66961	45	19.33039	50	180	3.6
2027	0.18505	0.1202825	3.0615	17535.57	25.97963	51.03509355	8182.532	23817.47	1514.178	2864.825	-13157	-36.0	-0.73399	7150.709	19.59098488	25.97963	45	19.02037	50	180	3.6
2028	0.28595	0.1858675	3.0615	17007.18	25.24564	50.26029801	7935.97	24064.03	2269.29	4472.721	-10265	-28.1	-0.35768	7426.651	20.34699039	25.24564	45	19.75436	50	180	3.6
2029	0.6398	0.41587	3.0615	16752.62	24.88796	49.88273382	7817.185	24182.82	5001.435	10056.91	-1694	-4.6	0.750506	7561.12	20.71539803	24.88796	45	20.11204	50	180	3.6
2030	0.2369	0.153985	3.0615	17288.97	25.63847	50.6749681	8067.46	23932.54	1911.181	3685.252	-11693	-32.0	-0.54708	7278.967	19.94237671	25.63847	45	19.36153	50	180	3.6
2031	0.1726	0.11219	3.0615	16897.16	25.09139	50.09746735	7884.632	24115.37	1360.887	2705.503	-12831	-35.2	-0.67804	7484.643	20.50587214	25.09139	45	19.90861	50	180	3.6
2032	0.3826	0.24869	3.0615	16417.79	24.41334	49.38172425	7660.945	24339.05	2931.078	6052.879	-7434	-20.4	0.039907	7739.554	21.20425731	24.41334	45	20.58666	50	180	3.6
2033	0.19565	0.1271725	3.0615	16445.81	24.45325	49.4238496	7674.021	24325.98	1501.422	3093.596	-11851	-32.5	-0.53769	7724.551	21.16315357	24.45325	45	20.54675	50	180	3.6
2034	0.34545	0.2245425	3.0615	16070.25	23.91556	48.85626427	7498.776	24501.22	2590.452	5501.566	-7978	-21.9	-0.00687	7926.696	21.71697404	23.91556	45	21.08444	50	180	3.6
2035	0.2512	0.16328	3.0615	16065.48	23.90869	48.84900925	7496.549	24503.45	1883.133	4000.923	-10181	-27.9	-0.30042	7929.279	21.72405312	23.90869	45	21.09131	50	180	3.6
2036	0.4778	0.31057	3.0615	15857.56	23.60826	48.53188162	7399.53	24600.47	3535.495	7640.168	-4682	-12.8	0.454127	8042.224	22.03348989	23.60826	45	21.39174	50	180	3.6
2037	0.3023	0.196495	3.0615	16172.38	24.06239	49.01125783	7546.43	24453.57	2281.286	4805.004	-9086	-24.9	-0.16095	7871.495	21.56573933	24.06239	45	20.93761	50	180	3.6
2038	0.2999	0.194935	3.0615	16060.45	23.90144	48.84135975	7494.201	24505.8	2247.511	4777.038	-9036	-24.8	-0.1473	7932.004	21.73151711	23.90144	45	21.09856	50	180	3.6
2039	0.2866	0.18629	3.0615	15958.35	23.75414	48.68586987	7446.561	24553.44	2134.184	4574.06	-9250	-25.3	-0.16957	7987.381	21.88323611	23.75414	45	21.24586	50	180	3.6
2040	0.3432	0.22308	3.0615	15841.22	23.58457	48.50686991	7391.905	24608.1	2536.902	5489.574	-7815	-21.4	0.031979	8051.132	22.05789503	23.58457	45	21.41543	50	180	3.6
2041	0.3949	0.256685	3.0615	15863.28	23.61655	48.54062689	7402.197	24597.8	2923.128	6313.887	-6626	-18.2	0.190868	8039.109	22.02495671	23.61655	45	21.38345	50	180	3.6
2042	0.92285	0.5998525	3.0615	15995.24	23.80742	48.74210761	7463.774	24536.23	6887.944	14718.12	5611	15.4	1.81921	7967.352	21.82836222	23.80742	45	21.19258	50	180	3.6
2043	0.41455	0.2694575	3.0615	17280.44	25.62663	50.6624656	8063.48	23936.52	3342.716	6449.875	-7488	-20.5	-0.02535	7283.42	19.95457601	25.62663	45	19.37337	50	180	3.6
2044	0.3094	0.20111	3.0615	17262.19	25.60127	50.63570339	8054.963	23945.04	2492.206	4815.586	-9954	-27.3	-0.33041	7292.952	19.98068919	25.60127	45	19.39873	50	180	3.6
2045	0.8818	0.57317	3.0615	17025.2	25.27086	50.28692191	7944.379	24055.62	7005.354	13787.96	3768	10.3	1.407949	7417.169	20.32101215	25.27086	45	19.72914	50	180	3.6
2046	0.24565	0.1596725	3.0615	18046.43	26.67881	51.77315285	8420.911	23579.09	2068.597	3764.932	-12213	-33.5	-0.63236	6887.851	18.87082471	26.67881	45	18.32119	50	180	3.6
2047	0.0953	0.061945	3.0615	17584.08	26.04645	51.10563279	8205.167	23794.83	781.9524	1473.971	-15328	-42.0	-0.99968	7125.587	19.52215633	26.04645	45	18.95355	50	180	3.6
2048	0.46785	0.3041025	3.0615	16865.4	25.04677	50.05036658	7869.813	24130.19	3681.892	7338.05	-5845	-16.0	0.210419	7501.418	20.55183064	25.04677	45	19.95323	50	180	3.6
2049	0.49925	0.3245125	3.0615	17015.43	25.25719	50.27248488	7939.819	24060.18	3963.954	7807.83	-5244	-14.4	0.274398	7422.311	20.33509907	25.25719	45	19.74281	50	180	3.6
2050	0.36485	0.2371525	3.0615	17212.07	25.53158	50.56213898	8031.576	23968.42	2930.32	5684.172	-8598	-23.6	-0.15917	7319.151	20.05246955	25.53158	45	19.46842	50	180	3.6
2051	0.29045	0.1887925	3.0615	17097.86	25.37241	50.39411405	7978.284	24021.72	2317.293	4535.12	-10245	-28.1	-0.35928	7378.993	20.2164196	25.37241	45	19.62759	50	180	3.6
2052	0.3806	0.24739	3.0615	16841.48	25.01313	50.01485565	7858.649	24141.35	2991.002	5972.329	-7878	-21.6	-0.04633	7514.065	20.58648037	25.01313	45	19.98687	50	180	3.6
2053	0.1	0.065	3.0615	16808.56	24.9668	49.96595087	7843.288	24156.71	784.3288	1570.186	-14454	-39.6	-0.88261	7531.483	20.63419913	24.9668	45	20.0332	50	180	3.6
2054	0.70035	0.4552275	3.0615	16187.57	24.08419	49.0342682	7553.518	24446.48	5290.106	11128.71	231	0.6	1.071627	7863.3	21.54328699	24.08419	45	20.91581	50	180	3.6
2055	0.4231	0.275015	3.0615	16943.07	25.15581	50.16547715	7906.054	24093.95	3345.051	6626.197	-6972	-19.1	0.061801	7460.422	20.43951168	25.15581	45	19.84419	50	180	3.6
2056	0.5945	0.386425	3.0615	16987.16	25.21761	50.23071416	7926.63	24073.37	4712.381	9302.552	-2972	-8.1	0.563286	7437.188	20.37585678	25.21761	45	19.78239	50	180	3.6
2057	0.2903	0.188695	3.0615	17391.71	25.7809	50.82531853	8115.403	23884.6	2355.901	4506.904	-10529	-28.8	-0.40706	7225.42	19.79567252	25.7809	45	19.2191	50	180	3.6
2058	0.13915	0.0904475	3.0615	17098.89	25.37384	50.39562177	7978.762	24021.24	1110.245	2172.661	-13816	-37.9	-0.80683	7378.456	20.21494844	25.37384	45	19.62616	50	180	3.6
2059	0.1978	0.12857	3.0615	16525.82	24.567	49.54392951	7711.356	24288.64	1525.306	3122.791	-11878	-32.5	-0.54412	7681.785	21.04598579	24.567	45	20.433	50	180	3.6
2060	0.2634	0.17121	3.0615	16144.87	24.02288	48.96955138	7533.592	24466.41	1984.348	4188.894	-9972	-27.3	-0.2768	7886.349	21.60643433	24.02288	45	20.97712	50	180	3.6
2061	0.59815	0.3887975	3.0615	15952.78	23.74608	48.67736459	7443.959	24556.04	4452.604	9547.327	-1953	-5.4	0.811069	7990.41	21.89153512	23.74608	45	21.25392	50	180	3.6
2062	0.2081	0.135265	3.0615	16518.88	24.55715	49.53352907	7708.119	24291.88	1604.06	3285.841	-11629	-31.9	-0.5116	7685.489	21.056134	24.55715	45	20.44285	50	180	3.6
2063	0.3179	0.206635	3.0615	16160.65	24.04555	48.99348123	7540.957	24459.04	2397.27	5054.094	-8709	-23.9	-0.11026	7877.826	21.58308482	24.04555	45	20.95445	50	180	3.6
2064	0.43585	0.2833025	3.0615	16083.96	23.93529	48.87709194	7505.171	24494.83	3271.129	6939.446	-5873	-16.1	0.272598	7919.278	21.69665148	23.93529	45	21.06471	50	180	3.6
2065	0.39615	0.2574975	3.0615	16273.9	24.20789	49.16484661	7593.802	24406.2	3008.285	6284.535	-6981	-19.1	0.110053	7816.794	21.41587532	24.20789	45	20.79211	50	180	3.6
2066	0.30025	0.1951625	3.0615	16350.89	24.31794	49.28101811	7629.731	24370.27	2290.827	4756.163	-9304	-25.5	-0.20033	7775.42	21.30252117	24.31794	45	20.68206	50	180	3.6
2067	0.54575	0.3547375	3.0615	16210.87	24.11761	49.06954685	7564.391	24435.61	4128.266	8668.227	-3414	-9.4	0.58648	7850.735	21.50886391	24.11761	45	20.88239	50	180	3.6
2068	0.48125	0.3128125	3.0615	16622.5	24.70409	49.68863464	7756.468	24243.53	3732.8	7583.68	-5306	-14.5	0.299651	7630.248	20.90478999	24.70409	45	20.29591	50	180	3.6
2069	0.3934	0.25571	3.0615	16834.81	25.00374	50.00494577	7855.535	24144.46	3090.368	6173.981	-7570	-20.7	-0.00673	7517.595	20.59614992	25.00374	45	19.99626	50	180	3.6
2070	0.41355	0.2688075	3.0615	16830.02	24.99701	49.99784237	7853.304	24146.7	3247.734	6490.813	-7091	-19.4	0.054582	7520.125	20.60308106	24.99701	45	20.00299	50	180	3.6
2071	0.65755	0.4274075	3.0615	16868.83	25.05159	50.05545908	7871.414	24128.59	5175.848	10312.74	-1380	-3.8	0.777415	7499.604	20.54686164	25.05159	45	19.94841	50	180	3.6
2072	0.4714	0.30641	3.0615	17426.48	25.82901	50.87609856	8131.627	23868.37	3833.249	7313.508	-6280	-17.2	0.114074	7207.335	19.74612399	25.82901	45	19.17099	50	180	3.6
2073	0.4648	0.30212	3.0615	17509.07	25.94308	50.99651521	8170.166	23829.83	3797.493	7199.469	-6512	-17.8	0.079844	7164.449	19.62862764	25.94308	45	19.05692	50	180	3.6
2074	0.31895	0.2073175	3.0615	17567	26.02292	51.08079841	8197.194	23802.81	2614.495	4934.738	-10018	-27.4	-0.35175	7134.432	19.54638844	26.02292	45	18.97708	50	180	3.6
2075	0.5311	0.345215	3.0615	17312.54	25.67118	50.7094951	8078.458	23921.54	4290.469	8258.075	-4764	-13.1	0.309796	7266.671	19.90868705	25.67118	45	19.32882	50	180	3.6
2076	0.18505	0.1202825	3.0615	17536.55	25.98097	51.0365161	8182.988	23817.01	1514.262	2864.77	-13158	-36.0	-0.73412	7150.203	19.58959683	25.98097	45	19.01903	50	180	3.6
2077	0.28595	0.1858675	3.0615	17008.04	25.24685	50.2615761	7936.373	24063.63	2269.406	4472.646	-10266	-28.1	-0.35782	7426.196	20.34574329	25.24685	45	19.75315	50	180	3.6
2078	0.6398	0.41587	3.0615	16753.37	24.88903	49.8838609	7817.538	24182.46	5001.661	10056.76	-1695	-4.6	0.750334	7560.719	20.71429829	24.88903	45	20.11097	50	180	3.6
2079	0.2369	0.153985	3.0615	17289.62	25.63936	50.67591364	8067.761	23932.24	1911.253	3685.206	-11693	-32.0	-0.54718	7278.631	19.94145411	25.63936	45	19.36064	50	180	3.6

	30 year rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2080	0.1726	0.11219	3.0615	16897.73	25.09218	50.09830922	7884.897	24115.1	1360.933	2705.473	-12831	-35.2	-0.67813	7484.344	20.50505069	25.09218	45	19.90782	50	180	3.6
2081	0.3826	0.24869	3.0615	16418.29	24.41405	49.38247615	7661.179	24338.82	2931.167	6052.821	-7434	-20.4	0.039809	7739.286	21.20352365	24.41405	45	20.58595	50	180	3.6
2082	0.19565	0.1271725	3.0615	16446.24	24.45386	49.42449874	7674.223	24325.78	1501.462	3093.57	-11851	-32.5	-0.53776	7724.32	21.16252018	24.45386	45	20.54614	50	180	3.6
2083	0.34545	0.2245425	3.0615	16070.63	23.9161	48.85683899	7498.952	24501.05	2590.513	5501.526	-7979	-21.9	-0.00695	7926.491	21.71641326	23.9161	45	21.0839	50	180	3.6
2084	0.2512	0.16328	3.0615	16065.81	23.90916	48.84950511	7496.701	24503.3	1883.171	4000.899	-10182	-27.9	-0.30048	7929.103	21.72356929	23.90916	45	21.09084	50	180	3.6
2085	0.4778	0.31057	3.0615	15857.85	23.60867	48.53231501	7399.662	24600.34	3535.559	7640.127	-4682	-12.8	0.454063	8042.069	22.03306701	23.60867	45	21.39133	50	180	3.6
2086	0.3023	0.196495	3.0615	16172.62	24.06274	49.01162339	7546.543	24453.46	2281.32	4804.982	-9086	-24.9	-0.16099	7871.365	21.56538264	24.06274	45	20.93726	50	180	3.6
2087	0.2999	0.194935	3.0615	16060.66	23.90174	48.84167755	7494.299	24505.7	2247.54	4777.019	-9036	-24.8	-0.14734	7931.891	21.73120701	23.90174	45	21.09826	50	180	3.6
2088	0.2866	0.18629	3.0615	15958.53	23.7544	48.68614575	7446.645	24553.35	2134.209	4574.044	-9250	-25.3	-0.16961	7987.283	21.88296692	23.7544	45	21.2456	50	180	3.6
2089	0.3432	0.22308	3.0615	15841.38	23.58479	48.50710946	7391.978	24608.02	2536.927	5489.558	-7815	-21.4	0.031947	8051.046	22.05766129	23.58479	45	21.41521	50	180	3.6
2090	0.3949	0.256685	3.0615	15863.41	23.61674	48.54083283	7402.26	24597.74	2923.152	6313.871	-6626	-18.2	0.19084	8039.036	22.02475576	23.61674	45	21.38326	50	180	3.6
2091	0.92285	0.5998525	3.0615	15995.36	23.80758	48.74228343	7463.828	24536.17	6887.994	14718.08	5611	15.4	1.819175	7967.29	21.82819067	23.80758	45	21.19242	50	180	3.6
2092	0.41455	0.2694575	3.0615	17280.54	25.62676	50.66260484	8063.524	23936.48	3342.734	6449.863	-7488	-20.5	-0.02537	7283.371	19.95444014	25.62676	45	19.37324	50	180	3.6
2093	0.3094	0.20111	3.0615	17262.27	25.60139	50.6358247	8055.002	23945	2492.218	4815.579	-9954	-27.3	-0.33042	7292.908	19.98057083	25.60139	45	19.39861	50	180	3.6
2094	0.8818	0.57317	3.0615	17025.27	25.27096	50.28702894	7944.413	24055.59	7005.384	13787.94	3768	10.3	1.40793	7417.131	20.32090772	25.27096	45	19.72904	50	180	3.6
2095	0.24565	0.1596725	3.0615	18046.5	26.67889	51.77324024	8420.94	23579.06	2068.604	3764.927	-12213	-33.5	-0.63237	6887.82	18.87073944	26.67889	45	18.32111	50	180	3.6
2096	0.0953	0.061945	3.0615	17584.14	26.04652	51.1057112	8205.192	23794.81	781.9548	1473.969	-15328	-42.0	-0.99969	7125.559	19.52207982	26.04652	45	18.95348	50	180	3.6
2097	0.46785	0.3041025	3.0615	16865.45	25.04683	50.0504378	7869.835	24130.16	3681.902	7338.043	-5846	-16.0	0.21041	7501.393	20.55176114	25.04683	45	19.95317	50	180	3.6
2098	0.49925	0.3245125	3.0615	17015.47	25.25724	50.27254612	7939.838	24060.16	3963.964	7807.823	-5244	-14.4	0.274389	7422.289	20.33503931	25.25724	45	19.74276	50	180	3.6
2099	0.36485	0.2371525	3.0615	17212.1	25.53163	50.56219155	8031.592	23968.41	2930.326	5684.168	-8598	-23.6	-0.15918	7319.133	20.05241825	25.53163	45	19.46837	50	180	3.6
2100	0.29045	0.1887925	3.0615	17097.89	25.37245	50.39416009	7978.299	24021.7	2317.297	4535.117	-10245	-28.1	-0.35929	7378.977	20.21637467	25.37245	45	19.62755	50	180	3.6
2101	0.3806	0.24739	3.0615	16841.51	25.01316	50.01489628	7858.662	24141.34	2991.007	5972.326	-7878	-21.6	-0.04633	7514.051	20.58644073	25.01316	45	19.98684	50	180	3.6
2102	0.1	0.065	3.0615	16808.58	24.96683	49.96598619	7843.3	24156.7	784.33	1570.186	-14454	-39.6	-0.88261	7531.47	20.63416467	24.96683	45	20.03317	50	180	3.6
2103	0.70035	0.4552275	3.0615	16187.59	24.08422	49.0343	7553.528	24446.47	5290.113	11128.71	231	0.6	1.071621	7863.288	21.54325597	24.08422	45	20.91578	50	180	3.6
2104	0.4231	0.275015	3.0615	16943.09	25.15584	50.1655033	7906.062	24093.94	3345.055	6626.194	-6972	-19.1	0.061798	7460.412	20.43948617	25.15584	45	19.84416	50	180	3.6
2105	0.5945	0.386425	3.0615	16987.18	25.21764	50.2307368	7926.637	24073.36	4712.386	9302.549	-2972	-8.1	0.563282	7437.18	20.37583469	25.21764	45	19.78236	50	180	3.6
2106	0.2903	0.188695	3.0615	17391.73	25.78092	50.82533772	8115.409	23884.59	2355.903	4506.903	-10529	-28.8	-0.40707	7225.414	19.7956538	25.78092	45	19.21908	50	180	3.6
2107	0.13915	0.0904475	3.0615	17098.9	25.37385	50.39563877	7978.767	24021.23	1110.245	2172.66	-13816	-37.9	-0.80683	7378.45	20.21493186	25.37385	45	19.62615	50	180	3.6
2108	0.1978	0.12857	3.0615	16525.83	24.56702	49.54394479	7711.361	24288.64	1525.307	3122.79	-11878	-32.5	-0.54413	7681.779	21.04597088	24.56702	45	20.43298	50	180	3.6
2109	0.2634	0.17121	3.0615	16144.87	24.02289	48.96956492	7533.597	24466.4	1984.349	4188.893	-9972	-27.3	-0.2768	7886.344	21.60642112	24.02289	45	20.97711	50	180	3.6
2110	0.59815	0.3887975	3.0615	15952.78	23.74609	48.67737642	7443.963	24556.04	4452.606	9547.326	-1953	-5.4	0.811067	7990.406	21.89152358	23.74609	45	21.25391	50	180	3.6
2111	0.2081	0.135265	3.0615	16518.89	24.55716	49.5335389	7708.122	24291.88	1604.06	3285.841	-11629	-31.9	-0.5116	7685.485	21.05612442	24.55716	45	20.44284	50	180	3.6
2112	0.3179	0.206635	3.0615	16160.65	24.04556	48.99348992	7540.96	24459.04	2397.271	5054.094	-8709	-23.9	-0.11026	7877.823	21.58307634	24.04556	45	20.95444	50	180	3.6
2113	0.43585	0.2833025	3.0615	16083.96	23.9353	48.87709947	7505.173	24494.83	3271.13	6939.446	-5873	-16.1	0.272597	7919.275	21.69664413	23.9353	45	21.0647	50	180	3.6
2114	0.39615	0.2574975	3.0615	16273.9	24.20789	49.16485304	7593.804	24406.2	3008.285	6284.535	-6981	-19.1	0.110052	7816.792	21.41586905	24.20789	45	20.79211	50	180	3.6
2115	0.30025	0.1951625	3.0615	16350.9	24.31795	49.28102363	7629.733	24370.27	2290.827	4756.162	-9304	-25.5	-0.20033	7775.418	21.30251578	24.31795	45	20.68205	50	180	3.6
2116	0.54575	0.3547375	3.0615	16210.87	24.11761	49.06955166	7564.392	24435.61	4128.267	8668.226	-3414	-9.4	0.586479	7850.734	21.50885922	24.11761	45	20.88239	50	180	3.6
2117	0.48125	0.3128125	3.0615	16622.5	24.70409	49.68863869	7756.469	24243.53	3732.801	7583.679	-5306	-14.5	0.29965	7630.247	20.90478604	24.70409	45	20.29591	50	180	3.6
2118	0.3934	0.25571	3.0615	16834.81	25.00374	50.00494923	7855.537	24144.46	3090.368	6173.981	-7570	-20.7	-0.00673	7517.593	20.59614655	25.00374	45	19.99626	50	180	3.6
2119	0.41355	0.2688075	3.0615	16830.02	24.99701	49.99784537	7853.305	24146.7	3247.734	6490.813	-7091	-19.4	0.054582	7520.124	20.60307812	24.99701	45	20.00299	50	180	3.6
2120	0.65755	0.4274075	3.0615	16868.84	25.05159	50.05546168	7871.415	24128.58	5175.849	10312.74	-1380	-3.8	0.777415	7499.604	20.5468591	25.05159	45	19.94841	50	180	3.6
2121	0.4714	0.30641	3.0615	17426.49	25.82901	50.87610074	8131.628	23868.37	3833.25	7313.508	-6280	-17.2	0.114074	7207.334	19.74612186	25.82901	45	19.17099	50	180	3.6
2122	0.4648	0.30212	3.0615	17509.08	25.94308	50.9965171	8170.166	23829.83	3797.493	7199.469	-6512	-17.8	0.079844	7164.448	19.62862579	25.94308	45	19.05692	50	180	3.6
2123	0.31895	0.2073175	3.0615	17567	26.02293	51.08080005	8197.195	23802.81	2614.495	4934.738	-10018	-27.4	-0.35175	7134.431	19.54638684	26.02293	45	18.97707	50	180	3.6
2124	0.5311	0.345215	3.0615	17312.54	25.67118	50.70949656	8078.458	23921.54	4290.469	8258.075	-4764	-13.1	0.309796	7266.67	19.90868563	25.67118	45	19.32882	50	180	3.6
2125	0.18505	0.1202825	3.0615	17536.55	25.98098	51.03651735	8182.988	23817.01	1514.262	2864.77	-13158	-36.0	-0.73412	7150.202	19.58959561	25.98098	45	19.01902	50	180	3.6
2126	0.28595	0.1858675	3.0615	17008.05	25.24685	50.26157722	7936.373	24063.63	2269.406	4472.646	-10266	-28.1	-0.35782	7426.196	20.3457422	25.24685	45	19.75315	50	180	3.6
2127	0.6398	0.41587	3.0615	16753.38	24.88903	49.88386189	7817.538	24182.46	5001.661	10056.76	-1695	-4.6	0.750334	7560.719	20.71429732	24.88903	45	20.11097	50	180	3.6
2128	0.2369	0.153985	3.0615	17289.62	25.63937	50.67591447	8067.762	23932.24	1911.253	3685.206	-11693	-32.0	-0.54718	7278.63	19.9414533	25.63937	45	19.36063	50	180	3.6
2129	0.1726	0.11219	3.0615	16897.73	25.09218	50.09830996	7884.897	24115.1	1360.933	2705.473	-12831	-35.2	-0.67813	7484.343	20.50504997	25.09218	45	19.90782	50	180	3.6
2130	0.3826	0.24869	3.0615	16418.29	24.41406	49.38247681	7661.179	24338.82	2931.167	6052.821	-7434	-20.4	0.039809	7739.286	21.20352301	24.41406	45	20.58594	50	180	3.6
2131	0.19565	0.1271725	3.0615	16446.24	24.45386	49.42449931	7674.223	24325.78	1501.462	3093.57	-11851	-32.5	-0.53776	7724.32	21.16251962	24.45386	45	20.54614	50	180	3.6
2132	0.34545	0.2245425	3.0615	16070.63	23.9161	48.8568395	7498.953	24501.05	2590.513	5501.526	-7979	-21.9	-0.00695	7926.491	21.71641277	23.9161	45	21.0839	50	180	3.6
2133	0.2512	0.16328	3.0615	16065.81	23.90916	48.84950554	7496.701	24503.3	1883.171	4000.899	-10182	-27.9	-0.30048	7929.103	21.72356886	23.90916	45	21.09084	50	180	3.6
2134	0.4778	0.31057	3.0615	15857.85	23.60867	48.53231539	7399.662	24600.34	3535.559	7640.127	-4682	-12.8	0.454062	8042.069	22.03306664	23.60867	45	21.39133	50	180	3.6
2135	0.3023	0.196495	3.0615	16172.62	24.06274	49.01162371	7546.543	24453.46	2281.32	4804.982	-9086	-24.9	-0.16099	7871.365	21.56538232	24.06274	45	20.93726	50	180	3.6
2136	0.2999	0.194935	3.0615	16060.66	23.90174	48.84167783	7494.299	24505.7	2247.54	4777.019	-9036	-24.8	-0.14734	7931.89	21.73120674	23.90174	45	21.09826	50	180	3.6
2137	0.2866	0.18629	3.0615	15958.53	23.7544	48.68614599	7446.645	24553.35	2134.209	4574.044	-9250	-25.3	-0.16961	7987.283	21.88296668	23.7544	45	21.2456	50	180	3.6
2138	0.3432	0.22308	3.0615	15841.38	23.5848	48.50710967	7391.978	24608.02	2536.927	5489.558	-7815	-21.4	0.031947	8051.046	22.05766108	23.5848	45	21.4152	50	180	3.6
2139	0.3949	0.256685	3.0615	15863.41	23.61674	48.54083301	7402.26	24597.74	2923.152	6313.871	-6626	-18.2	0.19084	8039.036	22.02475558	23.61674	45	21.38326	50	180	3.6

	30 year rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2140	0.92285	0.5998525	3.0615	15995.36	23.80758	48.74228358	7463.828	24536.17	6887.994	14718.08	5611	15.4	1.819175	7967.29	21.82819052	23.80758	45	21.19242	50	180	3.6
2141	0.41455	0.2694575	3.0615	17280.54	25.62676	50.66260496	8063.524	23936.48	3342.734	6449.863	-7488	-20.5	-0.02537	7283.371	19.95444002	25.62676	45	19.37324	50	180	3.6
2142	0.3094	0.20111	3.0615	17262.27	25.60139	50.6358248	8055.002	23945	2492.218	4815.579	-9954	-27.3	-0.33042	7292.908	19.98057072	25.60139	45	19.39861	50	180	3.6
2143	0.8818	0.57317	3.0615	17025.27	25.27096	50.28702903	7944.413	24055.59	7005.384	13787.94	3768	10.3	1.40793	7417.131	20.32090763	25.27096	45	19.72904	50	180	3.6
2144	0.24565	0.1596725	3.0615	18046.5	26.67889	51.77324032	8420.94	23579.06	2068.604	3764.927	-12213	-33.5	-0.63237	6887.82	18.87073936	26.67889	45	18.32111	50	180	3.6
2145	0.0953	0.061945	3.0615	17584.14	26.04652	51.10571127	8205.192	23794.81	781.9548	1473.969	-15328	-42.0	-0.99969	7125.559	19.52207975	26.04652	45	18.95348	50	180	3.6
2146	0.46785	0.3041025	3.0615	16865.45	25.04683	50.05043786	7869.835	24130.16	3681.902	7338.043	-5846	-16.0	0.21041	7501.393	20.55176108	25.04683	45	19.95317	50	180	3.6
2147	0.49925	0.3245125	3.0615	17015.47	25.25724	50.27254618	7939.838	24060.16	3963.964	7807.823	-5244	-14.4	0.274389	7422.289	20.33503925	25.25724	45	19.74276	50	180	3.6
2148	0.36485	0.2371525	3.0615	17212.1	25.53163	50.5621916	8031.592	23968.41	2930.326	5684.168	-8598	-23.6	-0.15918	7319.133	20.0524182	25.53163	45	19.46837	50	180	3.6
2149	0.29045	0.1887925	3.0615	17097.89	25.37245	50.39416013	7978.299	24021.7	2317.297	4535.117	-10245	-28.1	-0.35929	7378.977	20.21637463	25.37245	45	19.62755	50	180	3.6
2150	0.3806	0.24739	3.0615	16841.51	25.01316	50.01489631	7858.662	24141.34	2991.007	5972.326	-7878	-21.6	-0.04633	7514.051	20.5864407	25.01316	45	19.98684	50	180	3.6
2151	0.1	0.065	3.0615	16808.58	24.96683	49.96598622	7843.3	24156.7	784.33	1570.186	-14454	-39.6	-0.88261	7531.47	20.63416464	24.96683	45	20.03317	50	180	3.6
2152	0.70035	0.4552275	3.0615	16187.59	24.08422	49.03430002	7553.528	24446.47	5290.113	11128.71	231	0.6	1.071621	7863.288	21.54325594	24.08422	45	20.91578	50	180	3.6
2153	0.4231	0.275015	3.0615	16943.09	25.15584	50.16550332	7906.062	24093.94	3345.055	6626.194	-6972	-19.1	0.061798	7460.412	20.43948615	25.15584	45	19.84416	50	180	3.6
2154	0.5945	0.386425	3.0615	16987.18	25.21764	50.23073682	7926.637	24073.36	4712.386	9302.549	-2972	-8.1	0.563282	7437.18	20.37583467	25.21764	45	19.78236	50	180	3.6
2155	0.2903	0.188695	3.0615	17391.73	25.78092	50.82533774	8115.409	23884.59	2355.903	4506.903	-10529	-28.8	-0.40707	7225.414	19.79565378	25.78092	45	19.21908	50	180	3.6
2156	0.13915	0.0904475	3.0615	17098.9	25.37385	50.39563879	7978.767	24021.23	1110.245	2172.66	-13816	-37.9	-0.80683	7378.45	20.21493184	25.37385	45	19.62615	50	180	3.6
2157	0.1978	0.12857	3.0615	16525.83	24.56702	49.5439448	7711.361	24288.64	1525.307	3122.79	-11878	-32.5	-0.54413	7681.779	21.04597087	24.56702	45	20.43298	50	180	3.6
2158	0.2634	0.17121	3.0615	16144.87	24.02289	48.96956493	7533.597	24466.4	1984.349	4188.893	-9972	-27.3	-0.2768	7886.344	21.60642111	24.02289	45	20.97711	50	180	3.6
2159	0.59815	0.3887975	3.0615	15952.78	23.74609	48.67737643	7443.963	24556.04	4452.606	9547.326	-1953	-5.4	0.811067	7990.406	21.89152357	23.74609	45	21.25391	50	180	3.6
2160	0.2081	0.135265	3.0615	16518.89	24.55716	49.5335389	7708.122	24291.88	1604.06	3285.841	-11629	-31.9	-0.5116	7685.485	21.05612441	24.55716	45	20.44284	50	180	3.6
2161	0.3179	0.206635	3.0615	16160.65	24.04556	48.99348992	7540.96	24459.04	2397.271	5054.094	-8709	-23.9	-0.11026	7877.823	21.58307633	24.04556	45	20.95444	50	180	3.6
2162	0.43585	0.2833025	3.0615	16083.96	23.9353	48.87709948	7505.173	24494.83	3271.13	6939.446	-5873	-16.1	0.272597	7919.275	21.69664412	23.9353	45	21.0647	50	180	3.6
2163	0.39615	0.2574975	3.0615	16273.9	24.20789	49.16485304	7593.804	24406.2	3008.285	6284.535	-6981	-19.1	0.110052	7816.792	21.41586905	24.20789	45	20.79211	50	180	3.6
2164	0.30025	0.1951625	3.0615	16350.9	24.31795	49.28102364	7629.733	24370.27	2290.827	4756.162	-9304	-25.5	-0.20033	7775.418	21.30251578	24.31795	45	20.68205	50	180	3.6
2165	0.54575	0.3547375	3.0615	16210.87	24.11761	49.06955167	7564.392	24435.61	4128.267	8668.226	-3414	-9.4	0.586479	7850.734	21.50885921	24.11761	45	20.88239	50	180	3.6
2166	0.48125	0.3128125	3.0615	16622.5	24.70409	49.6886387	7756.469	24243.53	3732.801	7583.679	-5306	-14.5	0.29965	7630.247	20.90478604	24.70409	45	20.29591	50	180	3.6
2167	0.3934	0.25571	3.0615	16834.81	25.00374	50.00494923	7855.537	24144.46	3090.368	6173.981	-7570	-20.7	-0.00673	7517.593	20.59614654	25.00374	45	19.99626	50	180	3.6
2168	0.41355	0.2688075	3.0615	16830.02	24.99701	49.99784537	7853.305	24146.7	3247.734	6490.813	-7091	-19.4	0.054582	7520.124	20.60307812	24.99701	45	20.00299	50	180	3.6
2169	0.65755	0.4274075	3.0615	16868.84	25.05159	50.05546168	7871.415	24128.58	5175.849	10312.74	-1380	-3.8	0.777415	7499.604	20.5468591	25.05159	45	19.94841	50	180	3.6
2170	0.4714	0.30641	3.0615	17426.49	25.82901	50.87610075	8131.628	23868.37	3833.25	7313.508	-6280	-17.2	0.114074	7207.334	19.74612186	25.82901	45	19.17099	50	180	3.6
2171	0.4648	0.30212	3.0615	17509.08	25.94308	50.9965171	8170.166	23829.83	3797.493	7199.469	-6512	-17.8	0.079844	7164.448	19.62862579	25.94308	45	19.05692	50	180	3.6
2172	0.31895	0.2073175	3.0615	17567	26.02293	51.08080005	8197.195	23802.81	2614.495	4934.738	-10018	-27.4	-0.35175	7134.431	19.54638684	26.02293	45	18.97707	50	180	3.6
2173	0.5311	0.345215	3.0615	17312.54	25.67118	50.70949656	8078.458	23921.54	4290.469	8258.075	-4764	-13.1	0.309796	7266.67	19.90868563	25.67118	45	19.32882	50	180	3.6
2174	0.18505	0.1202825	3.0615	17536.55	25.98098	51.03651735	8182.988	23817.01	1514.262	2864.77	-13158	-36.0	-0.73412	7150.202	19.58959561	25.98098	45	19.01902	50	180	3.6
2175	0.28595	0.1858675	3.0615	17008.05	25.24685	50.26157722	7936.373	24063.63	2269.406	4472.646	-10266	-28.1	-0.35782	7426.196	20.3457422	25.24685	45	19.75315	50	180	3.6
2176	0.6398	0.41587	3.0615	16753.38	24.88903	49.88386189	7817.538	24182.46	5001.661	10056.76	-1695	-4.6	0.750334	7560.719	20.71429732	24.88903	45	20.11097	50	180	3.6
2177	0.2369	0.153985	3.0615	17289.62	25.63937	50.67591447	8067.762	23932.24	1911.253	3685.206	-11693	-32.0	-0.54718	7278.63	19.9414533	25.63937	45	19.36063	50	180	3.6
2178	0.1726	0.11219	3.0615	16897.73	25.09218	50.09830996	7884.897	24115.1	1360.933	2705.473	-12831	-35.2	-0.67813	7484.343	20.50504997	25.09218	45	19.90782	50	180	3.6
2179	0.3826	0.24869	3.0615	16418.29	24.41406	49.38247681	7661.179	24338.82	2931.167	6052.821	-7434	-20.4	0.039809	7739.286	21.20352301	24.41406	45	20.58594	50	180	3.6
2180	0.19565	0.1271725	3.0615	16446.24	24.45386	49.42449931	7674.223	24325.78	1501.462	3093.57	-11851	-32.5	-0.53776	7724.32	21.16251962	24.45386	45	20.54614	50	180	3.6
2181	0.34545	0.2245425	3.0615	16070.63	23.9161	48.8568395	7498.953	24501.05	2590.513	5501.526	-7979	-21.9	-0.00695	7926.491	21.71641277	23.9161	45	21.0839	50	180	3.6
2182	0.2512	0.16328	3.0615	16065.81	23.90916	48.84950554	7496.701	24503.3	1883.171	4000.899	-10182	-27.9	-0.30048	7929.103	21.72356886	23.90916	45	21.09084	50	180	3.6
2183	0.4778	0.31057	3.0615	15857.85	23.60867	48.53231539	7399.662	24600.34	3535.559	7640.127	-4682	-12.8	0.454062	8042.069	22.03306664	23.60867	45	21.39133	50	180	3.6
2184	0.3023	0.196495	3.0615	16172.62	24.06274	49.01162371	7546.543	24453.46	2281.32	4804.982	-9086	-24.9	-0.16099	7871.365	21.56538232	24.06274	45	20.93726	50	180	3.6
2185	0.2999	0.194935	3.0615	16060.66	23.90174	48.84167783	7494.299	24505.7	2247.54	4777.019	-9036	-24.8	-0.14734	7931.89	21.73120674	23.90174	45	21.09826	50	180	3.6
2186	0.2866	0.18629	3.0615	15958.53	23.7544	48.68614599	7446.645	24553.35	2134.209	4574.044	-9250	-25.3	-0.16961	7987.283	21.88296668	23.7544	45	21.2456	50	180	3.6
2187	0.3432	0.22308	3.0615	15841.38	23.5848	48.50710967	7391.978	24608.02	2536.927	5489.558	-7815	-21.4	0.031947	8051.046	22.05766108	23.5848	45	21.4152	50	180	3.6
2188	0.3949	0.256685	3.0615	15863.41	23.61674	48.54083301	7402.26	24597.74	2923.152	6313.871	-6626	-18.2	0.19084	8039.036	22.02475558	23.61674	45	21.38326	50	180	3.6
2189	0.92285	0.5998525	3.0615	15995.36	23.80758	48.74228358	7463.828	24536.17	6887.994	14718.08	5611	15.4	1.819175	7967.29	21.82819052	23.80758	45	21.19242	50	180	3.6
2190	0.41455	0.2694575	3.0615	17280.54	25.62676	50.66260496	8063.524	23936.48	3342.734	6449.863	-7488	-20.5	-0.02537	7283.371	19.95444002	25.62676	45	19.37324	50	180	3.6
2191	0.3094	0.20111	3.0615	17262.27	25.60139	50.6358248	8055.002	23945	2492.218	4815.579	-9954	-27.3	-0.33042	7292.908	19.98057072	25.60139	45	19.39861	50	180	3.6
2192	0.8818	0.57317	3.0615	17025.27	25.27096	50.28702903	7944.413	24055.59	7005.384	13787.94	3768	10.3	1.40793	7417.131	20.32090763	25.27096	45	19.72904	50	180	3.6
2193	0.24565	0.1596725	3.0615	18046.5	26.67889	51.77324032	8420.94	23579.06	2068.604	3764.927	-12213	-33.5	-0.63237	6887.82	18.87073936	26.67889	45	18.32111	50	180	3.6
2194	0.0953	0.061945	3.0615	17584.14	26.04652	51.10571127	8205.192	23794.81	781.9548	1473.969	-15328	-42.0	-0.99969	7125.559	19.52207975	26.04652	45	18.95348	50	180	3.6
2195	0.46785	0.3041025	3.0615	16865.45	25.04683	50.05043786	7869.835	24130.16	3681.902	7338.043	-5846	-16.0	0.21041	7501.393	20.55176108	25.04683	45	19.95317	50	180	3.6
2196	0.49925	0.3245125	3.0615	17015.47	25.25724	50.27254618	7939.838	24060.16	3963.964	7807.823	-5244	-14.4	0.274389	7422.289	20.33503925	25.25724	45	19.74276	50	180	3.6
2197	0.36485	0.2371525	3.0615	17212.1	25.53163	50.5621916	8031.592	23968.41	2930.326	5684.168	-8598	-23.6	-0.15918	7319.133	20.0524182	25.53163	45	19.46837	50	180	3.6
2198	0.29045	0.1887925	3.0615	17097.89	25.37245	50.39416013	7978.299	24021.7	2317.297	4535.117	-10245	-28.1	-0.35929	7378.977	20.21637463	25.37245	45	19.62755	50	180	3.6
2199	0.3806	0.24739	3.0615	16841.51	25.01316	50.01489631	7858.662	24141.34	2991.007	5972.326	-7878	-21.6	-0.04633	7514.051	20.5864407	25.01316	45	19.98684	50	180	3.6

	30 year rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2200	0.1	0.065	3.0615	16808.58	24.96683	49.96598622	7843.3	24156.7	784.33	1570.186	-14454	-39.6	-0.88261	7531.47	20.63416464	24.96683	45	20.03317	50	180	3.6
2201	0.70035	0.4552275	3.0615	16187.59	24.08422	49.03430002	7553.528	24446.47	5290.113	11128.71	231	0.6	1.071621	7863.288	21.54325594	24.08422	45	20.91578	50	180	3.6
2202	0.4231	0.275015	3.0615	16943.09	25.15584	50.16550332	7906.062	24093.94	3345.055	6626.194	-6972	-19.1	0.061798	7460.412	20.43948615	25.15584	45	19.84416	50	180	3.6
2203	0.5945	0.386425	3.0615	16987.18	25.21764	50.23073682	7926.637	24073.36	4712.386	9302.549	-2972	-8.1	0.563282	7437.18	20.37583467	25.21764	45	19.78236	50	180	3.6
2204	0.2903	0.188695	3.0615	17391.73	25.78092	50.82533774	8115.409	23884.59	2355.903	4506.903	-10529	-28.8	-0.40707	7225.414	19.79565378	25.78092	45	19.21908	50	180	3.6
2205	0.13915	0.0904475	3.0615	17098.9	25.37385	50.39563879	7978.767	24021.23	1110.245	2172.66	-13816	-37.9	-0.80683	7378.45	20.21493184	25.37385	45	19.62615	50	180	3.6
2206	0.1978	0.12857	3.0615	16525.83	24.56702	49.5439448	7711.361	24288.64	1525.307	3122.79	-11878	-32.5	-0.54413	7681.779	21.04597087	24.56702	45	20.43298	50	180	3.6
2207	0.2634	0.17121	3.0615	16144.87	24.02289	48.96956493	7533.597	24466.4	1984.349	4188.893	-9972	-27.3	-0.2768	7886.344	21.60642111	24.02289	45	20.97711	50	180	3.6
2208	0.59815	0.3887975	3.0615	15952.78	23.74609	48.67737643	7443.963	24556.04	4452.606	9547.326	-1953	-5.4	0.811067	7990.406	21.89152357	23.74609	45	21.25391	50	180	3.6
2209	0.2081	0.135265	3.0615	16518.89	24.55716	49.5335389	7708.122	24291.88	1604.06	3285.841	-11629	-31.9	-0.5116	7685.485	21.05612441	24.55716	45	20.44284	50	180	3.6
2210	0.3179	0.206635	3.0615	16160.65	24.04556	48.99348992	7540.96	24459.04	2397.271	5054.094	-8709	-23.9	-0.11026	7877.823	21.58307633	24.04556	45	20.95444	50	180	3.6
2211	0.43585	0.2833025	3.0615	16083.96	23.9353	48.87709948	7505.173	24494.83	3271.13	6939.446	-5873	-16.1	0.272597	7919.275	21.69664412	23.9353	45	21.0647	50	180	3.6
2212	0.39615	0.2574975	3.0615	16273.9	24.20789	49.16485304	7593.804	24406.2	3008.285	6284.535	-6981	-19.1	0.110052	7816.792	21.41586905	24.20789	45	20.79211	50	180	3.6
2213	0.30025	0.1951625	3.0615	16350.9	24.31795	49.28102364	7629.733	24370.27	2290.827	4756.162	-9304	-25.5	-0.20033	7775.418	21.30251578	24.31795	45	20.68205	50	180	3.6
2214	0.54575	0.3547375	3.0615	16210.87	24.11761	49.06955167	7564.392	24435.61	4128.267	8668.226	-3414	-9.4	0.586479	7850.734	21.50885921	24.11761	45	20.88239	50	180	3.6
2215	0.48125	0.3128125	3.0615	16622.5	24.70409	49.6886387	7756.469	24243.53	3732.801	7583.679	-5306	-14.5	0.29965	7630.247	20.90478604	24.70409	45	20.29591	50	180	3.6
2216	0.3934	0.25571	3.0615	16834.81	25.00374	50.00494923	7855.537	24144.46	3090.368	6173.981	-7570	-20.7	-0.00673	7517.593	20.59614654	25.00374	45	19.99626	50	180	3.6
2217	0.41355	0.2688075	3.0615	16830.02	24.99701	49.99784537	7853.305	24146.7	3247.734	6490.813	-7091	-19.4	0.054582	7520.124	20.60307812	24.99701	45	20.00299	50	180	3.6
2218	0.65755	0.4274075	3.0615	16868.84	25.05159	50.05546168	7871.415	24128.58	5175.849	10312.74	-1380	-3.8	0.777415	7499.604	20.5468591	25.05159	45	19.94841	50	180	3.6
2219	0.4714	0.30641	3.0615	17426.49	25.82901	50.87610075	8131.628	23868.37	3833.25	7313.508	-6280	-17.2	0.114074	7207.334	19.74612186	25.82901	45	19.17099	50	180	3.6
2220	0.4648	0.30212	3.0615	17509.08	25.94308	50.9965171	8170.166	23829.83	3797.493	7199.469	-6512	-17.8	0.079844	7164.448	19.62862579	25.94308	45	19.05692	50	180	3.6
2221	0.31895	0.2073175	3.0615	17567	26.02293	51.08080005	8197.195	23802.81	2614.495	4934.738	-10018	-27.4	-0.35175	7134.431	19.54638684	26.02293	45	18.97707	50	180	3.6
2222	0.5311	0.345215	3.0615	17312.54	25.67118	50.70949656	8078.458	23921.54	4290.469	8258.075	-4764	-13.1	0.309796	7266.67	19.90868563	25.67118	45	19.32882	50	180	3.6
2223	0.18505	0.1202825	3.0615	17536.55	25.98098	51.03651735	8182.988	23817.01	1514.262	2864.77	-13158	-36.0	-0.73412	7150.202	19.58959561	25.98098	45	19.01902	50	180	3.6
2224	0.28595	0.1858675	3.0615	17008.05	25.24685	50.26157722	7936.373	24063.63	2269.406	4472.646	-10266	-28.1	-0.35782	7426.196	20.3457422	25.24685	45	19.75315	50	180	3.6
2225	0.6398	0.41587	3.0615	16753.38	24.88903	49.88386189	7817.538	24182.46	5001.661	10056.76	-1695	-4.6	0.750334	7560.719	20.71429732	24.88903	45	20.11097	50	180	3.6
2226	0.2369	0.153985	3.0615	17289.62	25.63937	50.67591447	8067.762	23932.24	1911.253	3685.206	-11693	-32.0	-0.54718	7278.63	19.9414533	25.63937	45	19.36063	50	180	3.6
2227	0.1726	0.11219	3.0615	16897.73	25.09218	50.09830996	7884.897	24115.1	1360.933	2705.473	-12831	-35.2	-0.67813	7484.343	20.50504997	25.09218	45	19.90782	50	180	3.6
2228	0.3826	0.24869	3.0615	16418.29	24.41406	49.38247681	7661.179	24338.82	2931.167	6052.821	-7434	-20.4	0.039809	7739.286	21.20352301	24.41406	45	20.58594	50	180	3.6
2229	0.19565	0.1271725	3.0615	16446.24	24.45386	49.42449931	7674.223	24325.78	1501.462	3093.57	-11851	-32.5	-0.53776	7724.32	21.16251962	24.45386	45	20.54614	50	180	3.6
2230	0.34545	0.2245425	3.0615	16070.63	23.9161	48.8568395	7498.953	24501.05	2590.513	5501.526	-7979	-21.9	-0.00695	7926.491	21.71641277	23.9161	45	21.0839	50	180	3.6
2231	0.2512	0.16328	3.0615	16065.81	23.90916	48.84950554	7496.701	24503.3	1883.171	4000.899	-10182	-27.9	-0.30048	7929.103	21.72356886	23.90916	45	21.09084	50	180	3.6
2232	0.4778	0.31057	3.0615	15857.85	23.60867	48.53231539	7399.662	24600.34	3535.559	7640.127	-4682	-12.8	0.454062	8042.069	22.03306664	23.60867	45	21.39133	50	180	3.6
2233	0.3023	0.196495	3.0615	16172.62	24.06274	49.01162371	7546.543	24453.46	2281.32	4804.982	-9086	-24.9	-0.16099	7871.365	21.56538232	24.06274	45	20.93726	50	180	3.6
2234	0.2999	0.194935	3.0615	16060.66	23.90174	48.84167783	7494.299	24505.7	2247.54	4777.019	-9036	-24.8	-0.14734	7931.89	21.73120674	23.90174	45	21.09826	50	180	3.6
2235	0.2866	0.18629	3.0615	15958.53	23.7544	48.68614599	7446.645	24553.35	2134.209	4574.044	-9250	-25.3	-0.16961	7987.283	21.88296668	23.7544	45	21.2456	50	180	3.6
2236	0.3432	0.22308	3.0615	15841.38	23.5848	48.50710967	7391.978	24608.02	2536.927	5489.558	-7815	-21.4	0.031947	8051.046	22.05766108	23.5848	45	21.4152	50	180	3.6
2237	0.3949	0.256685	3.0615	15863.41	23.61674	48.54083301	7402.26	24597.74	2923.152	6313.871	-6626	-18.2	0.19084	8039.036	22.02475558	23.61674	45	21.38326	50	180	3.6
2238	0.92285	0.5998525	3.0615	15995.36	23.80758	48.74228358	7463.828	24536.17	6887.994	14718.08	5611	15.4	1.819175	7967.29	21.82819052	23.80758	45	21.19242	50	180	3.6
2239	0.41455	0.2694575	3.0615	17280.54	25.62676	50.66260496	8063.524	23936.48	3342.734	6449.863	-7488	-20.5	-0.02537	7283.371	19.95444002	25.62676	45	19.37324	50	180	3.6
2240	0.3094	0.20111	3.0615	17262.27	25.60139	50.6358248	8055.002	23945	2492.218	4815.579	-9954	-27.3	-0.33042	7292.908	19.98057072	25.60139	45	19.39861	50	180	3.6
2241	0.8818	0.57317	3.0615	17025.27	25.27096	50.28702903	7944.413	24055.59	7005.384	13787.94	3768	10.3	1.40793	7417.131	20.32090763	25.27096	45	19.72904	50	180	3.6
2242	0.24565	0.1596725	3.0615	18046.5	26.67889	51.77324032	8420.94	23579.06	2068.604	3764.927	-12213	-33.5	-0.63237	6887.82	18.87073936	26.67889	45	18.32111	50	180	3.6
2243	0.0953	0.061945	3.0615	17584.14	26.04652	51.10571127	8205.192	23794.81	781.9548	1473.969	-15328	-42.0	-0.99969	7125.559	19.52207975	26.04652	45	18.95348	50	180	3.6
2244	0.46785	0.3041025	3.0615	16865.45	25.04683	50.05043786	7869.835	24130.16	3681.902	7338.043	-5846	-16.0	0.21041	7501.393	20.55176108	25.04683	45	19.95317	50	180	3.6
2245	0.49925	0.3245125	3.0615	17015.47	25.25724	50.27254618	7939.838	24060.16	3963.964	7807.823	-5244	-14.4	0.274389	7422.289	20.33503925	25.25724	45	19.74276	50	180	3.6
2246	0.36485	0.2371525	3.0615	17212.1	25.53163	50.5621916	8031.592	23968.41	2930.326	5684.168	-8598	-23.6	-0.15918	7319.133	20.0524182	25.53163	45	19.46837	50	180	3.6
2247	0.29045	0.1887925	3.0615	17097.89	25.37245	50.39416013	7978.299	24021.7	2317.297	4535.117	-10245	-28.1	-0.35929	7378.977	20.21637463	25.37245	45	19.62755	50	180	3.6
2248	0.3806	0.24739	3.0615	16841.51	25.01316	50.01489631	7858.662	24141.34	2991.007	5972.326	-7878	-21.6	-0.04633	7514.051	20.5864407	25.01316	45	19.98684	50	180	3.6
2249	0.1	0.065	3.0615	16808.58	24.96683	49.96598622	7843.3	24156.7	784.33	1570.186	-14454	-39.6	-0.88261	7531.47	20.63416464	24.96683	45	20.03317	50	180	3.6
2250	0.70035	0.4552275	3.0615	16187.59	24.08422	49.03430002	7553.528	24446.47	5290.113	11128.71	231	0.6	1.071621	7863.288	21.54325594	24.08422	45	20.91578	50	180	3.6
2251	0.4231	0.275015	3.0615	16943.09	25.15584	50.16550332	7906.062	24093.94	3345.055	6626.194	-6972	-19.1	0.061798	7460.412	20.43948615	25.15584	45	19.84416	50	180	3.6
2252	0.5945	0.386425	3.0615	16987.18	25.21764	50.23073682	7926.637	24073.36	4712.386	9302.549	-2972	-8.1	0.563282	7437.18	20.37583467	25.21764	45	19.78236	50	180	3.6
2253	0.2903	0.188695	3.0615	17391.73	25.78092	50.82533774	8115.409	23884.59	2355.903	4506.903	-10529	-28.8	-0.40707	7225.414	19.79565378	25.78092	45	19.21908	50	180	3.6
2254	0.13915	0.0904475	3.0615	17098.9	25.37385	50.39563879	7978.767	24021.23	1110.245	2172.66	-13816	-37.9	-0.80683	7378.45	20.21493184	25.37385	45	19.62615	50	180	3.6
2255	0.1978	0.12857	3.0615	16525.83	24.56702	49.5439448	7711.361	24288.64	1525.307	3122.79	-11878	-32.5	-0.54413	7681.779	21.04597087	24.56702	45	20.43298	50	180	3.6
2256	0.2634	0.17121	3.0615	16144.87	24.02289	48.96956493	7533.597	24466.4	1984.349	4188.893	-9972	-27.3	-0.2768	7886.344	21.60642111	24.02289	45	20.97711	50	180	3.6
2257	0.59815	0.3887975	3.0615	15952.78	23.74609	48.67737643	7443.963	24556.04	4452.606	9547.326	-1953	-5.4	0.811067	7990.406	21.89152357	23.74609	45	21.25391	50	180	3.6
2258	0.2081	0.135265	3.0615	16518.89	24.55716	49.5335389	7708.122	24291.88	1604.06	3285.841	-11629	-31.9	-0.5116	7685.485	21.05612441	24.55716	45	20.44284	50	180	3.6
2259	0.3179	0.206635	3.0615	16160.65	24.04556	48.99348992	7540.96	24459.04	2397.271	5054.094	-8709	-23.9	-0.11026	7877.823	21.58307633	24.04556	45	20.95444	50	180	3.6

	30 year rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change lev	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2260	0.43585	0.2833025	3.0615	16083.96	23.9353	48.87709948	7505.173	24494.83	3271.13	6939.446	-5873	-16.1	0.272597	7919.275	21.69664412	23.9353	45	21.0647	50	180	3.6
2261	0.39615	0.2574975	3.0615	16273.9	24.20789	49.16485304	7593.804	24406.2	3008.285	6284.535	-6981	-19.1	0.110052	7816.792	21.41586905	24.20789	45	20.79211	50	180	3.6
2262	0.30025	0.1951625	3.0615	16350.9	24.31795	49.28102364	7629.733	24370.27	2290.827	4756.162	-9304	-25.5	-0.20033	7775.418	21.30251578	24.31795	45	20.68205	50	180	3.6
2263	0.54575	0.3547375	3.0615	16210.87	24.11761	49.06955167	7564.392	24435.61	4128.267	8668.226	-3414	-9.4	0.586479	7850.734	21.50885921	24.11761	45	20.88239	50	180	3.6
2264	0.48125	0.3128125	3.0615	16622.5	24.70409	49.6886387	7756.469	24243.53	3732.801	7583.679	-5306	-14.5	0.29965	7630.247	20.90478604	24.70409	45	20.29591	50	180	3.6
2265	0.3934	0.25571	3.0615	16834.81	25.00374	50.00494923	7855.537	24144.46	3090.368	6173.981	-7570	-20.7	-0.00673	7517.593	20.59614654	25.00374	45	19.99626	50	180	3.6
2266	0.41355	0.2688075	3.0615	16830.02	24.99701	49.99784537	7853.305	24146.7	3247.734	6490.813	-7091	-19.4	0.054582	7520.124	20.60307812	24.99701	45	20.00299	50	180	3.6
2267	0.65755	0.4274075	3.0615	16868.84	25.05159	50.05546168	7871.415	24128.58	5175.849	10312.74	-1380	-3.8	0.777415	7499.604	20.5468591	25.05159	45	19.94841	50	180	3.6
2268	0.4714	0.30641	3.0615	17426.49	25.82901	50.87610075	8131.628	23868.37	3833.25	7313.508	-6280	-17.2	0.114074	7207.334	19.74612186	25.82901	45	19.17099	50	180	3.6
2269	0.4648	0.30212	3.0615	17509.08	25.94308	50.9965171	8170.166	23829.83	3797.493	7199.469	-6512	-17.8	0.079844	7164.448	19.62862579	25.94308	45	19.05692	50	180	3.6
2270	0.31895	0.2073175	3.0615	17567	26.02293	51.08080005	8197.195	23802.81	2614.495	4934.738	-10018	-27.4	-0.35175	7134.431	19.54638684	26.02293	45	18.97707	50	180	3.6

	Equilibrium rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2020	1.291	0.83915	3.0615	16832.15	25	50.001	7854.296	24145.7	10139.9	20261.87	13570	37.2	2.684978	7519	20.6	25	45	20	50	180	3.6
2021	1.291	0.83915	3.0615	18794.46	27.68498	52.83526325	8769.96	23230.04	11322.02	19493.49	12021	32.9	2.112966	6509.582	17.8344722	27.68498	45	17.31502	50	180	3.6
2022	1.291	0.83915	3.0615	20414.78	29.79794	55.0657099	9526.039	22473.96	12298.12	18859.02	10742	29.4	1.727641	5715.213	15.65811747	29.79794	45	15.20206	50	180	3.6
2023	1.291	0.83915	3.0615	21789.39	31.52559	56.88940774	10167.47	21832.53	13126.2	18320.77	9658	26.5	1.448079	5065.706	13.87864724	31.52559	45	13.47441	50	180	3.6
2024	1.291	0.83915	3.0615	22976.06	32.97366	58.41799952	10721.2	21278.8	13841.06	17856.11	8721	23.9	1.235162	4521.301	12.38712627	32.97366	45	12.02634	50	180	3.6
2025	1.291	0.83915	3.0615	24013.11	34.20883	59.72183659	11205.11	20794.89	14465.8	17450.03	7903	21.7	1.067339	4056.942	11.11490935	34.20883	45	10.79117	50	180	3.6
2026	1.291	0.83915	3.0615	24927.7	35.27617	60.84852009	11631.88	20368.12	15016.76	17091.91	7181	19.7	0.931633	3655.676	10.01554974	35.27617	45	9.723835	50	180	3.6
2027	1.291	0.83915	3.0615	25739.97	36.2078	61.83195161	12010.91	19989.09	15506.08	16773.85	6540	17.9	0.819704	3305.428	9.055968019	36.2078	45	8.792202	50	180	3.6
2028	1.291	0.83915	3.0615	26465.43	37.0275	62.69723076	12349.42	19650.58	15943.1	16489.78	5967	16.3	0.725922	2997.261	8.211673287	37.0275	45	7.972498	50	180	3.6
2029	1.291	0.83915	3.0615	27116.3	37.75342	63.46351435	12653.13	19346.87	16335.2	16234.92	5454	14.9	0.646336	2724.35	7.463973299	37.75342	45	7.246576	50	180	3.6
2030	1.291	0.83915	3.0615	27702.47	38.39976	64.14578613	12926.65	19073.35	16688.31	16005.4	4991	13.7	0.578077	2481.36	6.798247713	38.39976	45	6.60024	50	180	3.6
2031	1.291	0.83915	3.0615	28232.04	38.97784	64.75600429	13173.77	18826.23	17007.33	15798.03	4573	12.5	0.519013	2264.032	6.202828324	38.97784	45	6.022163	50	180	3.6
2032	1.291	0.83915	3.0615	28711.78	39.49685	65.30387462	13397.62	18602.38	17296.33	15610.18	4195	11.5	0.467519	2068.909	5.668244737	39.49685	45	5.50315	50	180	3.6
2033	1.291	0.83915	3.0615	29147.38	39.96437	65.79738805	13600.89	18399.11	17558.74	15439.62	3851	10.6	0.422335	1893.145	5.186699803	39.96437	45	5.035631	50	180	3.6
2034	1.291	0.83915	3.0615	29543.7	40.3867	66.24320473	13785.82	18214.18	17797.49	15284.43	3538	9.7	0.382465	1734.369	4.751694892	40.3867	45	4.613296	50	180	3.6
2035	1.291	0.83915	3.0615	29904.91	40.76917	66.6469348	13954.37	18045.63	18015.09	15142.99	3253	8.9	0.347114	1590.581	4.357755922	40.76917	45	4.230831	50	180	3.6
2036	1.291	0.83915	3.0615	30234.64	41.11628	67.01334783	14108.23	17891.77	18213.72	15013.88	2993	8.2	0.315635	1460.084	4.000229002	41.11628	45	3.883717	50	180	3.6
2037	1.291	0.83915	3.0615	30536.04	41.43192	67.34653182	14248.87	17751.13	18395.29	14895.86	2755	7.5	0.287499	1341.421	3.675125265	41.43192	45	3.568083	50	180	3.6
2038	1.291	0.83915	3.0615	30811.86	41.71942	67.65001584	14377.58	17622.42	18561.45	14787.86	2537	7.0	0.262268	1233.335	3.379001214	41.71942	45	3.280584	50	180	3.6
2039	1.291	0.83915	3.0615	31064.57	41.98168	67.92686598	14495.49	17504.51	18713.68	14688.91	2338	6.4	0.239575	1134.736	3.108865144	41.98168	45	3.018316	50	180	3.6
2040	1.291	0.83915	3.0615	31296.31	42.22126	68.17976119	14603.63	17396.37	18853.29	14598.16	2155	5.9	0.21911	1044.668	2.862103044	42.22126	45	2.778741	50	180	3.6
2041	1.291	0.83915	3.0615	31509.01	42.44037	68.41105421	14702.88	17297.12	18981.42	14514.88	1987	5.4	0.200612	962.293	2.636419251	42.44037	45	2.55963	50	180	3.6
2042	1.291	0.83915	3.0615	31704.38	42.64098	68.62282071	14794.05	17205.95	19099.12	14438.38	1833	5.0	0.183856	886.8728	2.429788432	42.64098	45	2.359018	50	180	3.6
2043	1.291	0.83915	3.0615	31883.97	42.82484	68.8168995	14877.85	17122.15	19207.3	14368.06	1691	4.6	0.168649	817.752	2.240416365	42.82484	45	2.175162	50	180	3.6
2044	1.291	0.83915	3.0615	32049.15	42.99349	68.99492566	14954.92	17045.08	19306.81	14303.38	1561	4.3	0.154824	754.3483	2.066707627	42.99349	45	2.006512	50	180	3.6
2045	1.291	0.83915	3.0615	32201.16	43.14831	69.15835801	15025.86	16974.14	19398.38	14243.85	1441	3.9	0.142236	696.1422	1.907238775	43.14831	45	1.851688	50	180	3.6
2046	1.291	0.83915	3.0615	32341.13	43.29055	69.30850212	15091.17	16908.83	19482.7	14189.05	1331	3.6	0.130757	642.6686	1.7607359	43.29055	45	1.709452	50	180	3.6
2047	1.291	0.83915	3.0615	32470.07	43.42131	69.44652967	15151.34	16848.66	19560.38	14138.56	1229	3.4	0.120278	593.5103	1.626055741	43.42131	45	1.578695	50	180	3.6
2048	1.291	0.83915	3.0615	32588.91	43.54158	69.57349485	15206.79	16793.21	19631.96	14092.02	1135	3.1	0.110699	548.2919	1.502169675	43.54158	45	1.458417	50	180	3.6
2049	1.291	0.83915	3.0615	32698.47	43.65228	69.69034833	15257.91	16742.09	19697.97	14049.12	1049	2.9	0.101933	506.6748	1.388150074	43.65228	45	1.347719	50	180	3.6
2050	1.291	0.83915	3.0615	32799.52	43.75421	69.79794928	15305.07	16694.93	19758.84	14009.55	969	2.7	0.093905	468.3529	1.283158618	43.75421	45	1.245785	50	180	3.6
2051	1.291	0.83915	3.0615	32892.75	43.84812	69.89707565	15348.57	16651.43	19815	13973.05	895	2.5	0.086546	433.0492	1.186436228	43.84812	45	1.15188	50	180	3.6
2052	1.291	0.83915	3.0615	32978.79	43.93467	69.98843309	15388.72	16611.28	19866.83	13939.36	827	2.3	0.079793	400.5124	1.097294354	43.93467	45	1.065334	50	180	3.6
2053	1.291	0.83915	3.0615	33058.22	44.01446	70.07266274	15425.78	16574.22	19914.68	13908.26	765	2.1	0.073593	370.5142	1.01510741	44.01446	45	0.985541	50	180	3.6
2054	1.291	0.83915	3.0615	33131.56	44.08805	70.15034797	15460	16540	19958.86	13879.54	707	1.9	0.067897	342.8467	0.939306164	44.08805	45	0.911948	50	180	3.6
2055	1.291	0.83915	3.0615	33199.29	44.15595	70.22202035	15491.61	16508.39	19999.67	13853.02	653	1.8	0.062661	317.3208	0.869371956	44.15595	45	0.84405	50	180	3.6
2056	1.291	0.83915	3.0615	33261.86	44.21861	70.28816481	15520.81	16479.19	20037.36	13828.52	604	1.7	0.057843	293.7635	0.804831607	44.21861	45	0.78139	50	180	3.6
2057	1.291	0.83915	3.0615	33319.68	44.27645	70.34922428	15547.78	16452.22	20072.19	13805.88	558	1.5	0.05341	272.0173	0.745252933	44.27645	45	0.723547	50	180	3.6
2058	1.291	0.83915	3.0615	33373.11	44.32986	70.40560373	15572.71	16427.29	20104.37	13784.96	516	1.4	0.049327	251.9379	0.690240774	44.32986	45	0.670137	50	180	3.6
2059	1.291	0.83915	3.0615	33422.49	44.37919	70.45767382	15595.76	16404.24	20134.12	13765.62	477	1.3	0.045567	233.3932	0.639433467	44.37919	45	0.620809	50	180	3.6
2060	1.291	0.83915	3.0615	33468.14	44.42476	70.50577409	15617.06	16382.94	20161.62	13747.75	441	1.2	0.042101	216.2624	0.592499706	44.42476	45	0.575242	50	180	3.6
2061	1.291	0.83915	3.0615	33510.34	44.46686	70.55021583	15636.75	16363.25	20187.05	13731.22	408	1.1	0.038906	200.4345	0.549135747	44.46686	45	0.533142	50	180	3.6
2062	1.291	0.83915	3.0615	33549.37	44.50576	70.59128466	15654.96	16345.04	20210.56	13715.94	377	1.0	0.035959	185.808	0.509062898	44.50576	45	0.494236	50	180	3.6
2063	1.291	0.83915	3.0615	33585.46	44.54172	70.62924284	15671.8	16328.2	20232.3	13701.81	349	1.0	0.03324	172.2892	0.472025271	44.54172	45	0.458277	50	180	3.6
2064	1.291	0.83915	3.0615	33618.84	44.57496	70.6643313	15687.38	16312.62	20252.41	13688.74	322	0.9	0.030732	159.7925	0.437787766	44.57496	45	0.425037	50	180	3.6
2065	1.291	0.83915	3.0615	33649.71	44.60569	70.69677154	15701.79	16298.21	20271	13676.65	298	0.8	0.028416	148.239	0.406134252	44.60569	45	0.394305	50	180	3.6
2066	1.291	0.83915	3.0615	33678.27	44.63411	70.72676731	15715.11	16284.89	20288.21	13665.46	275	0.8	0.026278	137.5561	0.376865923	44.63411	45	0.365889	50	180	3.6
2067	1.291	0.83915	3.0615	33704.69	44.66039	70.75450613	15727.44	16272.56	20304.13	13655.12	255	0.7	0.024303	127.6769	0.34979982	44.66039	45	0.339611	50	180	3.6
2068	1.291	0.83915	3.0615	33729.14	44.68469	70.78016062	15738.85	16261.15	20318.85	13645.55	235	0.6	0.022479	118.5401	0.324767486	44.68469	45	0.315308	50	180	3.6
2069	1.291	0.83915	3.0615	33751.76	44.70717	70.80388983	15749.4	16250.6	20332.48	13636.69	217	0.6	0.020794	110.089	0.301613747	44.70717	45	0.292829	50	180	3.6
2070	1.291	0.83915	3.0615	33772.69	44.72797	70.8258403	15759.17	16240.83	20345.09	13628.49	201	0.6	0.019237	102.2714	0.280195611	44.72797	45	0.272035	50	180	3.6
2071	1.291	0.83915	3.0615	33792.06	44.7472	70.84614713	15768.21	16231.79	20356.76	13620.91	186	0.5	0.017798	95.03916	0.26038126	44.7472	45	0.252797	50	180	3.6
2072	1.291	0.83915	3.0615	33809.98	44.765	70.86493489	15776.57	16223.43	20367.56	13613.89	171	0.5	0.016468	88.34793	0.242049133	44.765	45	0.234999	50	180	3.6
2073	1.291	0.83915	3.0615	33826.57	44.78147	70.8823185	15784.31	16215.69	20377.55	13607.39	158	0.4	0.015238	82.15679	0.225087098	44.78147	45	0.218531	50	180	3.6
2074	1.291	0.83915	3.0615	33841.93	44.79671	70.89840402	15791.48	16208.52	20386.8	13601.38	146	0.4	0.014101	76.42796	0.209391684	44.79671	45	0.203293	50	180	3.6
2075	1.291	0.83915	3.0615	33856.14	44.81081	70.9132893	15798.11	16201.89	20395.36	13595.82	135	0.4	0.01305	71.1266	0.194867389	44.81081	45	0.189192	50	180	3.6
2076	1.291	0.83915	3.0615	33869.29	44.82386	70.92706472	15804.25	16195.75	20403.28	13590.66	125	0.3	0.012077	66.22051	0.181426045	44.82386	45	0.176142	50	180	3.6
2077	1.291	0.83915	3.0615	33881.47	44.83594	70.93981372	15809.93	16190.07	20410.62	13585.9	115	0.3	0.011178	61.67998	0.168986233	44.83594	45	0.164064	50	180	3.6
2078	1.291	0.83915	3.0615	33892.74	44.84711	70.95161336	15815.19	16184.81	20417.41	13581.48	106	0.3	0.010346	57.47755	0.157472753	44.84711	45	0.152886	50	180	3.6
2079	1.291	0.83915	3.0615	33903.18	44.85746	70.96253484	15820.06	16179.94	20423.7	13577.4	98	0.3	0.009577	53.58789	0.146816133	44.85746	45	0.14254	50	180	3.6

	Equilibrium rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2080	1.291	0.83915	3.0615	33912.84	44.86704	70.97264396	15824.57	16175.43	20429.52	13573.61	90	0.2	0.008865	49.98755	0.136952182	44.86704	45	0.132963	50	180	3.6
2081	1.291	0.83915	3.0615	33921.78	44.8759	70.9820015	15828.74	16171.26	20434.9	13570.11	83	0.2	0.008206	46.65488	0.127821579	44.8759	45	0.124099	50	180	3.6
2082	1.291	0.83915	3.0615	33930.06	44.88411	70.99066365	15832.6	16167.4	20439.89	13566.87	77	0.2	0.007596	43.56986	0.119369492	44.88411	45	0.115893	50	180	3.6
2083	1.291	0.83915	3.0615	33937.73	44.8917	70.99868238	15836.18	16163.82	20444.51	13563.87	71	0.2	0.007032	40.71401	0.111545235	44.8917	45	0.108296	50	180	3.6
2084	1.291	0.83915	3.0615	33944.82	44.89874	71.0061057	15839.49	16160.51	20448.78	13561.09	65	0.2	0.00651	38.07021	0.104301946	44.89874	45	0.101264	50	180	3.6
2085	1.291	0.83915	3.0615	33951.4	44.90525	71.01297801	15842.56	16157.44	20452.74	13558.52	60	0.2	0.006027	35.62265	0.097596292	44.90525	45	0.094754	50	180	3.6
2086	1.291	0.83915	3.0615	33957.48	44.91127	71.0193404	15845.4	16154.6	20456.41	13556.13	55	0.2	0.00558	33.35669	0.0913882	44.91127	45	0.088726	50	180	3.6
2087	1.291	0.83915	3.0615	33963.11	44.91685	71.02523085	15848.03	16151.97	20459.8	13553.93	51	0.1	0.005166	31.25882	0.08564061	44.91685	45	0.083146	50	180	3.6
2088	1.291	0.83915	3.0615	33968.33	44.92202	71.03068448	15850.46	16149.54	20462.94	13551.89	47	0.1	0.004783	29.31652	0.08031924	44.92202	45	0.07798	50	180	3.6
2089	1.291	0.83915	3.0615	33973.16	44.9268	71.03573379	15852.71	16147.29	20465.85	13550	43	0.1	0.004429	27.51822	0.075392378	44.9268	45	0.073196	50	180	3.6
2090	1.291	0.83915	3.0615	33977.63	44.93123	71.04040886	15854.8	16145.2	20468.55	13548.24	39	0.1	0.004101	25.8532	0.070830688	44.93123	45	0.068768	50	180	3.6
2091	1.291	0.83915	3.0615	33981.77	44.93533	71.0447375	15856.73	16143.27	20471.04	13546.62	36	0.1	0.003797	24.31156	0.066607026	44.93533	45	0.064667	50	180	3.6
2092	1.291	0.83915	3.0615	33985.6	44.93913	71.04874545	15858.52	16141.48	20473.35	13545.12	33	0.1	0.003516	22.88414	0.062696278	44.93913	45	0.06087	50	180	3.6
2093	1.291	0.83915	3.0615	33989.16	44.94265	71.05245652	15860.18	16139.82	20475.49	13543.73	30	0.1	0.003255	21.56245	0.059075206	44.94265	45	0.057355	50	180	3.6
2094	1.291	0.83915	3.0615	33992.44	44.9459	71.05589275	15861.71	16138.29	20477.47	13542.44	27	0.1	0.003014	20.33864	0.055722304	44.9459	45	0.054099	50	180	3.6
2095	1.291	0.83915	3.0615	33995.49	44.94891	71.05907455	15863.13	16136.87	20479.3	13541.25	25	0.1	0.002791	19.20545	0.05261767	44.94891	45	0.051085	50	180	3.6
2096	1.291	0.83915	3.0615	33998.31	44.95171	71.06202079	15864.45	16135.55	20481	13540.15	23	0.1	0.002584	18.15615	0.049742886	44.95171	45	0.048294	50	180	3.6
2097	1.291	0.83915	3.0615	34000.92	44.95429	71.06474893	15865.67	16134.33	20482.58	13539.13	21	0.1	0.002393	17.18453	0.047080905	44.95429	45	0.04571	50	180	3.6
2098	1.291	0.83915	3.0615	34003.33	44.95668	71.06727515	15866.79	16133.21	20484.03	13538.18	19	0.1	0.002216	16.28482	0.044615948	44.95668	45	0.043316	50	180	3.6
2099	1.291	0.83915	3.0615	34005.57	44.9589	71.06961442	15867.84	16132.16	20485.38	13537.3	17	0.0	0.002052	15.45169	0.042333409	44.9589	45	0.0411	50	180	3.6
2100	1.291	0.83915	3.0615	34007.65	44.96095	71.07178059	15868.81	16131.19	20486.63	13536.49	15	0.0	0.0019	14.68022	0.04021977	44.96095	45	0.039048	50	180	3.6
2101	1.291	0.83915	3.0615	34009.57	44.96285	71.07378649	15869.7	16130.3	20487.79	13535.74	14	0.0	0.00176	13.96582	0.038262517	44.96285	45	0.037148	50	180	3.6
2102	1.291	0.83915	3.0615	34011.34	44.96461	71.07564399	15870.53	16129.47	20488.86	13535.04	13	0.0	0.001629	13.30427	0.036450065	44.96461	45	0.035388	50	180	3.6
2103	1.291	0.83915	3.0615	34012.99	44.96624	71.07736408	15871.3	16128.7	20489.85	13534.4	11	0.0	0.001509	12.69167	0.034771688	44.96624	45	0.033759	50	180	3.6
2104	1.291	0.83915	3.0615	34014.51	44.96775	71.07895694	15872.01	16127.99	20490.77	13533.8	10	0.0	0.001397	12.12437	0.033217458	44.96775	45	0.03225	50	180	3.6
2105	1.291	0.83915	3.0615	34015.93	44.96915	71.08043199	15872.67	16127.33	20491.62	13533.25	9	0.0	0.001294	11.59904	0.031778184	44.96915	45	0.030853	50	180	3.6
2106	1.291	0.83915	3.0615	34017.23	44.97044	71.08179794	15873.28	16126.72	20492.4	13532.74	8	0.0	0.001198	11.11255	0.030445355	44.97044	45	0.029559	50	180	3.6
2107	1.291	0.83915	3.0615	34018.44	44.97164	71.08306288	15873.85	16126.15	20493.13	13532.26	7	0.0	0.00111	10.66205	0.029211093	44.97164	45	0.02836	50	180	3.6
2108	1.291	0.83915	3.0615	34019.56	44.97275	71.08423428	15874.37	16125.63	20493.81	13531.82	6	0.0	0.001028	10.24486	0.028068102	44.97275	45	0.027251	50	180	3.6
2109	1.291	0.83915	3.0615	34020.6	44.97378	71.08531906	15874.85	16125.15	20494.43	13531.42	5	0.0	0.000952	9.858514	0.027009628	44.97378	45	0.026223	50	180	3.6
2110	1.291	0.83915	3.0615	34021.56	44.97473	71.08632364	15875.3	16124.7	20495.01	13531.04	4	0.0	0.000881	9.500738	0.026029418	44.97473	45	0.025271	50	180	3.6
2111	1.291	0.83915	3.0615	34022.46	44.97561	71.08725394	15875.72	16124.28	20495.55	13530.69	4	0.0	0.000816	9.169414	0.025121681	44.97561	45	0.02439	50	180	3.6
2112	1.291	0.83915	3.0615	34023.28	44.97643	71.08811545	15876.1	16123.9	20496.05	13530.37	3	0.0	0.000756	8.862586	0.024281056	44.97643	45	0.023574	50	180	3.6
2113	1.291	0.83915	3.0615	34024.04	44.97718	71.08891328	15876.46	16123.54	20496.51	13530.07	3	0.0	0.0007	8.578441	0.023502579	44.97718	45	0.022818	50	180	3.6
2114	1.291	0.83915	3.0615	34024.75	44.97788	71.08965212	15876.79	16123.21	20496.93	13529.79	2	0.0	0.000648	8.315303	0.022781652	44.97788	45	0.022118	50	180	3.6
2115	1.291	0.83915	3.0615	34025.41	44.97853	71.09033635	15877.09	16122.91	20497.33	13529.54	1	0.0	0.0006	8.071617	0.022114019	44.97853	45	0.02147	50	180	3.6
2116	1.291	0.83915	3.0615	34026.01	44.97913	71.09097	15877.38	16122.62	20497.69	13529.3	1	0.0	0.000556	7.845945	0.021495739	44.97913	45	0.02087	50	180	3.6
2117	1.291	0.83915	3.0615	34026.57	44.97969	71.09155681	15877.64	16122.36	20498.03	13529.08	1	0.0	0.000515	7.636954	0.020923162	44.97969	45	0.020314	50	180	3.6
2118	1.291	0.83915	3.0615	34027.09	44.9802	71.09210024	15877.88	16122.12	20498.35	13528.88	0	0.0	0.000477	7.443412	0.020392909	44.9802	45	0.019799	50	180	3.6
2119	1.291	0.83915	3.0615	34027.58	44.98068	71.0926035	15878.11	16121.89	20498.64	13528.69	0	0.0	0.000442	7.264175	0.01990185	44.98068	45	0.019322	50	180	3.6
2120	1.291	0.83915	3.0615	34028.02	44.98112	71.09306957	15878.31	16121.69	20498.9	13528.51	-1	0.0	0.000409	7.098187	0.019447087	44.98112	45	0.018881	50	180	3.6
2121	1.291	0.83915	3.0615	34028.44	44.98153	71.09350119	15878.51	16121.49	20499.15	13528.35	-1	0.0	0.000379	6.944467	0.019025936	44.98153	45	0.018472	50	180	3.6
2122	1.291	0.83915	3.0615	34028.82	44.98191	71.0939009	15878.69	16121.31	20499.38	13528.2	-1	0.0	0.000351	6.802108	0.018635913	44.98191	45	0.018093	50	180	3.6
2123	1.291	0.83915	3.0615	34029.17	44.98226	71.09427108	15878.85	16121.15	20499.6	13528.06	-2	0.0	0.000325	6.670272	0.018274717	44.98226	45	0.017742	50	180	3.6
2124	1.291	0.83915	3.0615	34029.5	44.98258	71.09461389	15879	16121	20499.79	13527.93	-2	0.0	0.000301	6.548179	0.017940215	44.98258	45	0.017418	50	180	3.6
2125	1.291	0.83915	3.0615	34029.8	44.98288	71.09493137	15879.15	16120.85	20499.98	13527.81	-2	0.0	0.000279	6.435109	0.017630436	44.98288	45	0.017117	50	180	3.6
2126	1.291	0.83915	3.0615	34030.09	44.98316	71.09522539	15879.28	16120.72	20500.15	13527.7	-2	0.0	0.000258	6.330396	0.017343551	44.98316	45	0.016838	50	180	3.6
2127	1.291	0.83915	3.0615	34030.35	44.98342	71.09549767	15879.4	16120.6	20500.3	13527.6	-2	0.0	0.000239	6.233422	0.017077868	44.98342	45	0.01658	50	180	3.6
2128	1.291	0.83915	3.0615	34030.59	44.98366	71.09574984	15879.51	16120.49	20500.45	13527.51	-3	0.0	0.000221	6.143614	0.01683182	44.98366	45	0.016342	50	180	3.6
2129	1.291	0.83915	3.0615	34030.81	44.98388	71.09598336	15879.62	16120.38	20500.58	13527.42	-3	0.0	0.000205	6.060444	0.016603955	44.98388	45	0.01612	50	180	3.6
2130	1.291	0.83915	3.0615	34031.02	44.98408	71.09619963	15879.71	16120.29	20500.71	13527.34	-3	0.0	0.00019	5.98342	0.01639293	44.98408	45	0.015915	50	180	3.6
2131	1.291	0.83915	3.0615	34031.21	44.98427	71.09639992	15879.8	16120.2	20500.82	13527.26	-3	0.0	0.000176	5.912088	0.0161975	44.98427	45	0.015726	50	180	3.6
2132	1.291	0.83915	3.0615	34031.39	44.98445	71.09658541	15879.89	16120.11	20500.93	13527.19	-3	0.0	0.000163	5.846027	0.016016513	44.98445	45	0.01555	50	180	3.6
2133	1.291	0.83915	3.0615	34031.55	44.98461	71.09675719	15879.96	16120.04	20501.03	13527.13	-3	0.0	0.000151	5.784849	0.0158489	44.98461	45	0.015387	50	180	3.6
2134	1.291	0.83915	3.0615	34031.7	44.98476	71.09691627	15880.03	16119.97	20501.12	13527.07	-4	0.0	0.00014	5.728191	0.015693674	44.98476	45	0.015237	50	180	3.6
2135	1.291	0.83915	3.0615	34031.85	44.9849	71.0970636	15880.1	16119.9	20501.21	13527.02	-4	0.0	0.000129	5.67572	0.015549919	44.9849	45	0.015097	50	180	3.6
2136	1.291	0.83915	3.0615	34031.98	44.98503	71.09720004	15880.16	16119.84	20501.29	13526.96	-4	0.0	0.00012	5.627127	0.015416787	44.98503	45	0.014968	50	180	3.6
2137	1.291	0.83915	3.0615	34032.1	44.98515	71.0973264	15880.22	16119.78	20501.36	13526.92	-4	0.0	0.000111	5.582125	0.015293493	44.98515	45	0.014848	50	180	3.6
2138	1.291	0.83915	3.0615	34032.21	44.98526	71.09744342	15880.27	16119.73	20501.43	13526.87	-4	0.0	0.000103	5.540448	0.01517931	44.98526	45	0.014737	50	180	3.6
2139	1.291	0.83915	3.0615	34032.31	44.98537	71.09755179	15880.32	16119.68	20501.49	13526.83	-4	0.0	9.51E-05	5.501851	0.015073565	44.98537	45	0.014635	50	180	3.6

	Equilibrium rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2140	1.291	0.83915	3.0615	34032.41	44.98546	71.09765216	15880.36	16119.64	20501.55	13526.79	-4	0.0	8.81E-05	5.466106	0.014975633	44.98546	45	0.014539	50	180	3.6
2141	1.291	0.83915	3.0615	34032.5	44.98555	71.09774511	15880.4	16119.6	20501.6	13526.76	-4	0.0	8.15E-05	5.433003	0.014884939	44.98555	45	0.014451	50	180	3.6
2142	1.291	0.83915	3.0615	34032.58	44.98563	71.09783119	15880.44	16119.56	20501.65	13526.73	-4	0.0	7.55E-05	5.402346	0.014800947	44.98563	45	0.01437	50	180	3.6
2143	1.291	0.83915	3.0615	34032.66	44.98571	71.0979109	15880.48	16119.52	20501.7	13526.7	-4	0.0	6.99E-05	5.373954	0.014723161	44.98571	45	0.014294	50	180	3.6
2144	1.291	0.83915	3.0615	34032.73	44.98578	71.09798473	15880.51	16119.49	20501.74	13526.67	-4	0.0	6.48E-05	5.34766	0.014651123	44.98578	45	0.014224	50	180	3.6
2145	1.291	0.83915	3.0615	34032.79	44.98584	71.09805311	15880.54	16119.46	20501.78	13526.64	-4	0.0	6E-05	5.323309	0.014584409	44.98584	45	0.01416	50	180	3.6
2146	1.291	0.83915	3.0615	34032.85	44.9859	71.09811643	15880.57	16119.43	20501.81	13526.62	-4	0.0	5.56E-05	5.300758	0.014522624	44.9859	45	0.0141	50	180	3.6
2147	1.291	0.83915	3.0615	34032.91	44.98596	71.09817507	15880.6	16119.4	20501.85	13526.6	-4	0.0	5.14E-05	5.279873	0.014465404	44.98596	45	0.014044	50	180	3.6
2148	1.291	0.83915	3.0615	34032.96	44.98601	71.09822938	15880.62	16119.38	20501.88	13526.58	-5	0.0	4.76E-05	5.260531	0.014412413	44.98601	45	0.013993	50	180	3.6
2149	1.291	0.83915	3.0615	34033.01	44.98606	71.09827967	15880.64	16119.36	20501.91	13526.56	-5	0.0	4.41E-05	5.242618	0.014363338	44.98606	45	0.013945	50	180	3.6
2150	1.291	0.83915	3.0615	34033.05	44.9861	71.09832625	15880.66	16119.34	20501.94	13526.54	-5	0.0	4.09E-05	5.226029	0.014317889	44.9861	45	0.013901	50	180	3.6
2151	1.291	0.83915	3.0615	34033.1	44.98614	71.09836939	15880.68	16119.32	20501.96	13526.53	-5	0.0	3.78E-05	5.210666	0.014275798	44.98614	45	0.01386	50	180	3.6
2152	1.291	0.83915	3.0615	34033.13	44.98618	71.09840933	15880.7	16119.3	20501.98	13526.51	-5	0.0	3.5E-05	5.196439	0.014236818	44.98618	45	0.013822	50	180	3.6
2153	1.291	0.83915	3.0615	34033.17	44.98621	71.09844633	15880.72	16119.28	20502.01	13526.5	-5	0.0	3.25E-05	5.183262	0.014200718	44.98621	45	0.013787	50	180	3.6
2154	1.291	0.83915	3.0615	34033.2	44.98625	71.0984806	15880.73	16119.27	20502.02	13526.48	-5	0.0	3.01E-05	5.171059	0.014167285	44.98625	45	0.013755	50	180	3.6
2155	1.291	0.83915	3.0615	34033.23	44.98628	71.09851233	15880.75	16119.25	20502.04	13526.47	-5	0.0	2.78E-05	5.159758	0.014136323	44.98628	45	0.013725	50	180	3.6
2156	1.291	0.83915	3.0615	34033.26	44.9863	71.09854171	15880.76	16119.24	20502.06	13526.46	-5	0.0	2.58E-05	5.149292	0.014107649	44.9863	45	0.013697	50	180	3.6
2157	1.291	0.83915	3.0615	34033.29	44.98633	71.09856893	15880.77	16119.23	20502.08	13526.45	-5	0.0	2.39E-05	5.139599	0.014081094	44.98633	45	0.013671	50	180	3.6
2158	1.291	0.83915	3.0615	34033.31	44.98635	71.09859413	15880.78	16119.22	20502.09	13526.44	-5	0.0	2.21E-05	5.130623	0.0140565	44.98635	45	0.013647	50	180	3.6
2159	1.291	0.83915	3.0615	34033.33	44.98638	71.09861748	15880.79	16119.21	20502.1	13526.43	-5	0.0	2.05E-05	5.122309	0.014033725	44.98638	45	0.013625	50	180	3.6
2160	1.291	0.83915	3.0615	34033.35	44.9864	71.09863909	15880.8	16119.2	20502.12	13526.42	-5	0.0	1.9E-05	5.114611	0.014012632	44.9864	45	0.013604	50	180	3.6
2161	1.291	0.83915	3.0615	34033.37	44.98641	71.09865911	15880.81	16119.19	20502.13	13526.42	-5	0.0	1.76E-05	5.107481	0.013993097	44.98641	45	0.013586	50	180	3.6
2162	1.291	0.83915	3.0615	34033.39	44.98643	71.09867765	15880.82	16119.18	20502.14	13526.41	-5	0.0	1.63E-05	5.100877	0.013975006	44.98643	45	0.013568	50	180	3.6
2163	1.291	0.83915	3.0615	34033.41	44.98645	71.09869482	15880.83	16119.17	20502.15	13526.4	-5	0.0	1.51E-05	5.094762	0.013958252	44.98645	45	0.013552	50	180	3.6
2164	1.291	0.83915	3.0615	34033.42	44.98646	71.09871073	15880.83	16119.17	20502.16	13526.4	-5	0.0	1.4E-05	5.089099	0.013942736	44.98646	45	0.013537	50	180	3.6
2165	1.291	0.83915	3.0615	34033.44	44.98648	71.09872545	15880.84	16119.16	20502.17	13526.39	-5	0.0	1.29E-05	5.083854	0.013928367	44.98648	45	0.013523	50	180	3.6
2166	1.291	0.83915	3.0615	34033.45	44.98649	71.09873909	15880.85	16119.15	20502.17	13526.39	-5	0.0	1.2E-05	5.078996	0.013915059	44.98649	45	0.01351	50	180	3.6
2167	1.291	0.83915	3.0615	34033.46	44.9865	71.09875172	15880.85	16119.15	20502.18	13526.38	-5	0.0	1.11E-05	5.074498	0.013902734	44.9865	45	0.013498	50	180	3.6
2168	1.291	0.83915	3.0615	34033.47	44.98651	71.09876342	15880.86	16119.14	20502.19	13526.38	-5	0.0	1.03E-05	5.070332	0.01389132	44.98651	45	0.013487	50	180	3.6
2169	1.291	0.83915	3.0615	34033.48	44.98652	71.09877425	15880.86	16119.14	20502.19	13526.37	-5	0.0	9.5E-06	5.066474	0.01388075	44.98652	45	0.013476	50	180	3.6
2170	1.291	0.83915	3.0615	34033.49	44.98653	71.09878429	15880.87	16119.13	20502.2	13526.37	-5	0.0	8.8E-06	5.062901	0.013870961	44.98653	45	0.013467	50	180	3.6
2171	1.291	0.83915	3.0615	34033.5	44.98654	71.09879358	15880.87	16119.13	20502.21	13526.37	-5	0.0	8.15E-06	5.059592	0.013861895	44.98654	45	0.013458	50	180	3.6
2172	1.291	0.83915	3.0615	34033.51	44.98655	71.09880218	15880.88	16119.12	20502.21	13526.36	-5	0.0	7.55E-06	5.056527	0.013853499	44.98655	45	0.01345	50	180	3.6
2173	1.291	0.83915	3.0615	34033.52	44.98656	71.09881015	15880.88	16119.12	20502.21	13526.36	-5	0.0	6.99E-06	5.053689	0.013845723	44.98656	45	0.013442	50	180	3.6
2174	1.291	0.83915	3.0615	34033.52	44.98656	71.09881753	15880.88	16119.12	20502.22	13526.36	-5	0.0	6.47E-06	5.05106	0.013838522	44.98656	45	0.013435	50	180	3.6
2175	1.291	0.83915	3.0615	34033.53	44.98657	71.09882437	15880.89	16119.11	20502.22	13526.36	-5	0.0	6E-06	5.048626	0.013831853	44.98657	45	0.013429	50	180	3.6
2176	1.291	0.83915	3.0615	34033.54	44.98658	71.0988307	15880.89	16119.11	20502.23	13526.35	-5	0.0	5.55E-06	5.046372	0.013825676	44.98658	45	0.013423	50	180	3.6
2177	1.291	0.83915	3.0615	34033.54	44.98658	71.09883656	15880.89	16119.11	20502.23	13526.35	-5	0.0	5.14E-06	5.044284	0.013819957	44.98658	45	0.013417	50	180	3.6
2178	1.291	0.83915	3.0615	34033.55	44.98659	71.09884199	15880.89	16119.11	20502.23	13526.35	-5	0.0	4.76E-06	5.042351	0.013814659	44.98659	45	0.013412	50	180	3.6
2179	1.291	0.83915	3.0615	34033.55	44.98659	71.09884701	15880.9	16119.1	20502.24	13526.35	-5	0.0	4.41E-06	5.04056	0.013809754	44.98659	45	0.013408	50	180	3.6
2180	1.291	0.83915	3.0615	34033.56	44.9866	71.09885167	15880.9	16119.1	20502.24	13526.34	-5	0.0	4.09E-06	5.038902	0.01380521	44.9866	45	0.013403	50	180	3.6
2181	1.291	0.83915	3.0615	34033.56	44.9866	71.09885598	15880.9	16119.1	20502.24	13526.34	-5	0.0	3.78E-06	5.037366	0.013801003	44.9866	45	0.013399	50	180	3.6
2182	1.291	0.83915	3.0615	34033.57	44.9866	71.09885998	15880.9	16119.1	20502.24	13526.34	-5	0.0	3.5E-06	5.035944	0.013797106	44.9866	45	0.013395	50	180	3.6
2183	1.291	0.83915	3.0615	34033.57	44.98661	71.09886367	15880.9	16119.1	20502.25	13526.34	-5	0.0	3.24E-06	5.034627	0.013793497	44.98661	45	0.013392	50	180	3.6
2184	1.291	0.83915	3.0615	34033.57	44.98661	71.0988671	15880.9	16119.1	20502.25	13526.34	-5	0.0	3E-06	5.033407	0.013790155	44.98661	45	0.013389	50	180	3.6
2185	1.291	0.83915	3.0615	34033.58	44.98661	71.09887027	15880.91	16119.09	20502.25	13526.34	-5	0.0	2.78E-06	5.032277	0.01378706	44.98661	45	0.013385	50	180	3.6
2186	1.291	0.83915	3.0615	34033.58	44.98662	71.09887321	15880.91	16119.09	20502.25	13526.34	-5	0.0	2.58E-06	5.031231	0.013784194	44.98662	45	0.013383	50	180	3.6
2187	1.291	0.83915	3.0615	34033.58	44.98662	71.09887593	15880.91	16119.09	20502.25	13526.34	-5	0.0	2.39E-06	5.030262	0.013781539	44.98662	45	0.01338	50	180	3.6
2188	1.291	0.83915	3.0615	34033.58	44.98662	71.09887845	15880.91	16119.09	20502.25	13526.33	-5	0.0	2.21E-06	5.029364	0.01377908	44.98662	45	0.013378	50	180	3.6
2189	1.291	0.83915	3.0615	34033.59	44.98662	71.09888078	15880.91	16119.09	20502.26	13526.33	-5	0.0	2.05E-06	5.028533	0.013776804	44.98662	45	0.013376	50	180	3.6
2190	1.291	0.83915	3.0615	34033.59	44.98663	71.09888294	15880.91	16119.09	20502.26	13526.33	-5	0.0	1.9E-06	5.027764	0.013774695	44.98663	45	0.013373	50	180	3.6
2191	1.291	0.83915	3.0615	34033.59	44.98663	71.09888494	15880.91	16119.09	20502.26	13526.33	-5	0.0	1.76E-06	5.027051	0.013772742	44.98663	45	0.013372	50	180	3.6
2192	1.291	0.83915	3.0615	34033.59	44.98663	71.0988868	15880.91	16119.09	20502.26	13526.33	-5	0.0	1.63E-06	5.026391	0.013770934	44.98663	45	0.01337	50	180	3.6
2193	1.291	0.83915	3.0615	34033.59	44.98663	71.09888851	15880.91	16119.09	20502.26	13526.33	-5	0.0	1.51E-06	5.02578	0.013769259	44.98663	45	0.013368	50	180	3.6
2194	1.291	0.83915	3.0615	34033.59	44.98663	71.0988901	15880.91	16119.09	20502.26	13526.33	-5	0.0	1.39E-06	5.025213	0.013767708	44.98663	45	0.013367	50	180	3.6
2195	1.291	0.83915	3.0615	34033.6	44.98663	71.09889158	15880.92	16119.08	20502.26	13526.33	-5	0.0	1.29E-06	5.024689	0.013766271	44.98663	45	0.013365	50	180	3.6
2196	1.291	0.83915	3.0615	34033.6	44.98664	71.09889294	15880.92	16119.08	20502.26	13526.33	-5	0.0	1.2E-06	5.024203	0.013764941	44.98664	45	0.013364	50	180	3.6
2197	1.291	0.83915	3.0615	34033.6	44.98664	71.0988942	15880.92	16119.08	20502.26	13526.33	-5	0.0	1.11E-06	5.023754	0.013763709	44.98664	45	0.013363	50	180	3.6
2198	1.291	0.83915	3.0615	34033.6	44.98664	71.09889537	15880.92	16119.08	20502.26	13526.33	-5	0.0	1.03E-06	5.023337	0.013762568	44.98664	45	0.013362	50	180	3.6
2199	1.291	0.83915	3.0615	34033.6	44.98664	71.09889646	15880.92	16119.08	20502.26	13526.33	-5	0.0	9.5E-07	5.022952	0.013761511	44.98664	45	0.013361	50	180	3.6

	Equilibrium rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2200	1.291	0.83915	3.0615	34033.6	44.98664	71.09889746	15880.92	16119.08	20502.27	13526.33	-5	0.0	8.8E-07	5.022594	0.013760533	44.98664	45	0.01336	50	180	3.6
2201	1.291	0.83915	3.0615	34033.6	44.98664	71.09889839	15880.92	16119.08	20502.27	13526.33	-5	0.0	8.15E-07	5.022264	0.013759626	44.98664	45	0.013359	50	180	3.6
2202	1.291	0.83915	3.0615	34033.6	44.98664	71.09889925	15880.92	16119.08	20502.27	13526.33	-5	0.0	7.55E-07	5.021957	0.013758787	44.98664	45	0.013358	50	180	3.6
2203	1.291	0.83915	3.0615	34033.6	44.98664	71.09890004	15880.92	16119.08	20502.27	13526.33	-5	0.0	6.99E-07	5.021674	0.01375801	44.98664	45	0.013357	50	180	3.6
2204	1.291	0.83915	3.0615	34033.6	44.98664	71.09890078	15880.92	16119.08	20502.27	13526.33	-5	0.0	6.47E-07	5.021411	0.01375729	44.98664	45	0.013357	50	180	3.6
2205	1.291	0.83915	3.0615	34033.61	44.98664	71.09890146	15880.92	16119.08	20502.27	13526.33	-5	0.0	5.99E-07	5.021167	0.013756623	44.98664	45	0.013356	50	180	3.6
2206	1.291	0.83915	3.0615	34033.61	44.98664	71.0989021	15880.92	16119.08	20502.27	13526.33	-5	0.0	5.55E-07	5.020942	0.013756006	44.98664	45	0.013355	50	180	3.6
2207	1.291	0.83915	3.0615	34033.61	44.98665	71.09890268	15880.92	16119.08	20502.27	13526.33	-5	0.0	5.14E-07	5.020733	0.013755434	44.98665	45	0.013355	50	180	3.6
2208	1.291	0.83915	3.0615	34033.61	44.98665	71.09890323	15880.92	16119.08	20502.27	13526.33	-5	0.0	4.76E-07	5.02054	0.013754904	44.98665	45	0.013354	50	180	3.6
2209	1.291	0.83915	3.0615	34033.61	44.98665	71.09890373	15880.92	16119.08	20502.27	13526.33	-5	0.0	4.41E-07	5.020361	0.013754414	44.98665	45	0.013354	50	180	3.6
2210	1.291	0.83915	3.0615	34033.61	44.98665	71.09890419	15880.92	16119.08	20502.27	13526.33	-5	0.0	4.08E-07	5.020195	0.01375396	44.98665	45	0.013353	50	180	3.6
2211	1.291	0.83915	3.0615	34033.61	44.98665	71.09890463	15880.92	16119.08	20502.27	13526.32	-5	0.0	3.78E-07	5.020042	0.013753539	44.98665	45	0.013353	50	180	3.6
2212	1.291	0.83915	3.0615	34033.61	44.98665	71.09890502	15880.92	16119.08	20502.27	13526.32	-5	0.0	3.5E-07	5.0199	0.01375315	44.98665	45	0.013353	50	180	3.6
2213	1.291	0.83915	3.0615	34033.61	44.98665	71.09890539	15880.92	16119.08	20502.27	13526.32	-5	0.0	3.24E-07	5.019768	0.013752789	44.98665	45	0.013352	50	180	3.6
2214	1.291	0.83915	3.0615	34033.61	44.98665	71.09890574	15880.92	16119.08	20502.27	13526.32	-5	0.0	3E-07	5.019646	0.013752455	44.98665	45	0.013352	50	180	3.6
2215	1.291	0.83915	3.0615	34033.61	44.98665	71.09890605	15880.92	16119.08	20502.27	13526.32	-5	0.0	2.78E-07	5.019533	0.013752145	44.98665	45	0.013352	50	180	3.6
2216	1.291	0.83915	3.0615	34033.61	44.98665	71.09890635	15880.92	16119.08	20502.27	13526.32	-5	0.0	2.58E-07	5.019428	0.013751859	44.98665	45	0.013351	50	180	3.6
2217	1.291	0.83915	3.0615	34033.61	44.98665	71.09890662	15880.92	16119.08	20502.27	13526.32	-5	0.0	2.39E-07	5.019332	0.013751593	44.98665	45	0.013351	50	180	3.6
2218	1.291	0.83915	3.0615	34033.61	44.98665	71.09890687	15880.92	16119.08	20502.27	13526.32	-5	0.0	2.21E-07	5.019242	0.013751348	44.98665	45	0.013351	50	180	3.6
2219	1.291	0.83915	3.0615	34033.61	44.98665	71.0989071	15880.92	16119.08	20502.27	13526.32	-5	0.0	2.05E-07	5.019159	0.01375112	44.98665	45	0.013351	50	180	3.6
2220	1.291	0.83915	3.0615	34033.61	44.98665	71.09890732	15880.92	16119.08	20502.27	13526.32	-5	0.0	1.9E-07	5.019082	0.013750909	44.98665	45	0.01335	50	180	3.6
2221	1.291	0.83915	3.0615	34033.61	44.98665	71.09890752	15880.92	16119.08	20502.27	13526.32	-5	0.0	1.76E-07	5.019011	0.013750714	44.98665	45	0.01335	50	180	3.6
2222	1.291	0.83915	3.0615	34033.61	44.98665	71.09890771	15880.92	16119.08	20502.27	13526.32	-5	0.0	1.63E-07	5.018945	0.013750533	44.98665	45	0.01335	50	180	3.6
2223	1.291	0.83915	3.0615	34033.61	44.98665	71.09890788	15880.92	16119.08	20502.27	13526.32	-5	0.0	1.51E-07	5.018884	0.013750366	44.98665	45	0.01335	50	180	3.6
2224	1.291	0.83915	3.0615	34033.61	44.98665	71.09890804	15880.92	16119.08	20502.27	13526.32	-5	0.0	1.39E-07	5.018827	0.013750211	44.98665	45	0.01335	50	180	3.6
2225	1.291	0.83915	3.0615	34033.61	44.98665	71.09890818	15880.92	16119.08	20502.27	13526.32	-5	0.0	1.29E-07	5.018775	0.013750067	44.98665	45	0.01335	50	180	3.6
2226	1.291	0.83915	3.0615	34033.61	44.98665	71.09890832	15880.92	16119.08	20502.27	13526.32	-5	0.0	1.2E-07	5.018726	0.013749934	44.98665	45	0.013349	50	180	3.6
2227	1.291	0.83915	3.0615	34033.61	44.98665	71.09890845	15880.92	16119.08	20502.27	13526.32	-5	0.0	1.11E-07	5.018681	0.013749811	44.98665	45	0.013349	50	180	3.6
2228	1.291	0.83915	3.0615	34033.61	44.98665	71.09890856	15880.92	16119.08	20502.27	13526.32	-5	0.0	1.03E-07	5.018639	0.013749697	44.98665	45	0.013349	50	180	3.6
2229	1.291	0.83915	3.0615	34033.61	44.98665	71.09890867	15880.92	16119.08	20502.27	13526.32	-5	0.0	9.5E-08	5.018601	0.013749591	44.98665	45	0.013349	50	180	3.6
2230	1.291	0.83915	3.0615	34033.61	44.98665	71.09890877	15880.92	16119.08	20502.27	13526.32	-5	0.0	8.8E-08	5.018565	0.013749494	44.98665	45	0.013349	50	180	3.6
2231	1.291	0.83915	3.0615	34033.61	44.98665	71.09890886	15880.92	16119.08	20502.27	13526.32	-5	0.0	8.15E-08	5.018532	0.013749403	44.98665	45	0.013349	50	180	3.6
2232	1.291	0.83915	3.0615	34033.61	44.98665	71.09890895	15880.92	16119.08	20502.27	13526.32	-5	0.0	7.54E-08	5.018501	0.013749319	44.98665	45	0.013349	50	180	3.6
2233	1.291	0.83915	3.0615	34033.61	44.98665	71.09890903	15880.92	16119.08	20502.27	13526.32	-5	0.0	6.99E-08	5.018473	0.013749241	44.98665	45	0.013349	50	180	3.6
2234	1.291	0.83915	3.0615	34033.61	44.98665	71.0989091	15880.92	16119.08	20502.27	13526.32	-5	0.0	6.47E-08	5.018447	0.013749169	44.98665	45	0.013349	50	180	3.6
2235	1.291	0.83915	3.0615	34033.61	44.98665	71.09890917	15880.92	16119.08	20502.27	13526.32	-5	0.0	5.99E-08	5.018422	0.013749103	44.98665	45	0.013349	50	180	3.6
2236	1.291	0.83915	3.0615	34033.61	44.98665	71.09890924	15880.92	16119.08	20502.27	13526.32	-5	0.0	5.55E-08	5.0184	0.013749041	44.98665	45	0.013349	50	180	3.6
2237	1.291	0.83915	3.0615	34033.61	44.98665	71.09890929	15880.92	16119.08	20502.27	13526.32	-5	0.0	5.14E-08	5.018379	0.013748984	44.98665	45	0.013349	50	180	3.6
2238	1.291	0.83915	3.0615	34033.61	44.98665	71.09890935	15880.92	16119.08	20502.27	13526.32	-5	0.0	4.76E-08	5.01836	0.013748931	44.98665	45	0.013348	50	180	3.6
2239	1.291	0.83915	3.0615	34033.61	44.98665	71.0989094	15880.92	16119.08	20502.27	13526.32	-5	0.0	4.41E-08	5.018342	0.013748882	44.98665	45	0.013348	50	180	3.6
2240	1.291	0.83915	3.0615	34033.61	44.98665	71.09890944	15880.92	16119.08	20502.27	13526.32	-5	0.0	4.08E-08	5.018325	0.013748836	44.98665	45	0.013348	50	180	3.6
2241	1.291	0.83915	3.0615	34033.61	44.98665	71.09890949	15880.92	16119.08	20502.27	13526.32	-5	0.0	3.78E-08	5.01831	0.013748794	44.98665	45	0.013348	50	180	3.6
2242	1.291	0.83915	3.0615	34033.61	44.98665	71.09890953	15880.92	16119.08	20502.27	13526.32	-5	0.0	3.5E-08	5.018296	0.013748755	44.98665	45	0.013348	50	180	3.6
2243	1.291	0.83915	3.0615	34033.61	44.98665	71.09890956	15880.92	16119.08	20502.27	13526.32	-5	0.0	3.24E-08	5.018283	0.013748719	44.98665	45	0.013348	50	180	3.6
2244	1.291	0.83915	3.0615	34033.61	44.98665	71.0989096	15880.92	16119.08	20502.27	13526.32	-5	0.0	3E-08	5.01827	0.013748686	44.98665	45	0.013348	50	180	3.6
2245	1.291	0.83915	3.0615	34033.61	44.98665	71.09890963	15880.92	16119.08	20502.27	13526.32	-5	0.0	2.78E-08	5.018259	0.013748655	44.98665	45	0.013348	50	180	3.6
2246	1.291	0.83915	3.0615	34033.61	44.98665	71.09890966	15880.92	16119.08	20502.27	13526.32	-5	0.0	2.58E-08	5.018249	0.013748626	44.98665	45	0.013348	50	180	3.6
2247	1.291	0.83915	3.0615	34033.61	44.98665	71.09890969	15880.92	16119.08	20502.27	13526.32	-5	0.0	2.39E-08	5.018239	0.0137486	44.98665	45	0.013348	50	180	3.6
2248	1.291	0.83915	3.0615	34033.61	44.98665	71.09890971	15880.92	16119.08	20502.27	13526.32	-5	0.0	2.21E-08	5.01823	0.013748575	44.98665	45	0.013348	50	180	3.6
2249	1.291	0.83915	3.0615	34033.61	44.98665	71.09890974	15880.92	16119.08	20502.27	13526.32	-5	0.0	2.05E-08	5.018222	0.013748553	44.98665	45	0.013348	50	180	3.6
2250	1.291	0.83915	3.0615	34033.61	44.98665	71.09890976	15880.92	16119.08	20502.27	13526.32	-5	0.0	1.89E-08	5.018214	0.013748531	44.98665	45	0.013348	50	180	3.6
2251	1.291	0.83915	3.0615	34033.61	44.98665	71.09890978	15880.92	16119.08	20502.27	13526.32	-5	0.0	1.75E-08	5.018207	0.013748512	44.98665	45	0.013348	50	180	3.6
2252	1.291	0.83915	3.0615	34033.61	44.98665	71.0989098	15880.92	16119.08	20502.27	13526.32	-5	0.0	1.63E-08	5.0182	0.013748494	44.98665	45	0.013348	50	180	3.6
2253	1.291	0.83915	3.0615	34033.61	44.98665	71.09890981	15880.92	16119.08	20502.27	13526.32	-5	0.0	1.5E-08	5.018194	0.013748477	44.98665	45	0.013348	50	180	3.6
2254	1.291	0.83915	3.0615	34033.61	44.98665	71.09890983	15880.92	16119.08	20502.27	13526.32	-5	0.0	1.39E-08	5.018189	0.013748462	44.98665	45	0.013348	50	180	3.6
2255	1.291	0.83915	3.0615	34033.61	44.98665	71.09890984	15880.92	16119.08	20502.27	13526.32	-5	0.0	1.29E-08	5.018183	0.013748447	44.98665	45	0.013348	50	180	3.6
2256	1.291	0.83915	3.0615	34033.61	44.98665	71.09890986	15880.92	16119.08	20502.27	13526.32	-5	0.0	1.2E-08	5.018178	0.013748434	44.98665	45	0.013348	50	180	3.6
2257	1.291	0.83915	3.0615	34033.61	44.98665	71.09890987	15880.92	16119.08	20502.27	13526.32	-5	0.0	1.11E-08	5.018174	0.013748422	44.98665	45	0.013348	50	180	3.6
2258	1.291	0.83915	3.0615	34033.61	44.98665	71.09890988	15880.92	16119.08	20502.27	13526.32	-5	0.0	1.03E-08	5.01817	0.01374841	44.98665	45	0.013348	50	180	3.6
2259	1.291	0.83915	3.0615	34033.61	44.98665	71.09890989	15880.92	16119.08	20502.27	13526.32	-5	0.0	9.49E-09	5.018166	0.0137484	44.98665	45	0.013348	50	180	3.6

	Equilibrium rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change lev	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2260	1.291	0.83915	3.0615	34033.61	44.98665	71.0989099	15880.92	16119.08	20502.27	13526.32	-5	0.0	8.79E-09	5.018162	0.01374839	44.98665	45	0.013348	50	180	3.6
2261	1.291	0.83915	3.0615	34033.61	44.98665	71.09890991	15880.92	16119.08	20502.27	13526.32	-5	0.0	8.14E-09	5.018159	0.013748381	44.98665	45	0.013348	50	180	3.6
2262	1.291	0.83915	3.0615	34033.61	44.98665	71.09890992	15880.92	16119.08	20502.27	13526.32	-5	0.0	7.54E-09	5.018156	0.013748372	44.98665	45	0.013348	50	180	3.6
2263	1.291	0.83915	3.0615	34033.61	44.98665	71.09890993	15880.92	16119.08	20502.27	13526.32	-5	0.0	6.98E-09	5.018153	0.013748365	44.98665	45	0.013348	50	180	3.6
2264	1.291	0.83915	3.0615	34033.61	44.98665	71.09890994	15880.92	16119.08	20502.27	13526.32	-5	0.0	6.47E-09	5.018151	0.013748358	44.98665	45	0.013348	50	180	3.6
2265	1.291	0.83915	3.0615	34033.61	44.98665	71.09890994	15880.92	16119.08	20502.27	13526.32	-5	0.0	5.99E-09	5.018148	0.013748351	44.98665	45	0.013348	50	180	3.6
2266	1.291	0.83915	3.0615	34033.61	44.98665	71.09890995	15880.92	16119.08	20502.27	13526.32	-5	0.0	5.55E-09	5.018146	0.013748345	44.98665	45	0.013348	50	180	3.6
2267	1.291	0.83915	3.0615	34033.61	44.98665	71.09890995	15880.92	16119.08	20502.27	13526.32	-5	0.0	5.14E-09	5.018144	0.013748339	44.98665	45	0.013348	50	180	3.6
2268	1.291	0.83915	3.0615	34033.61	44.98665	71.09890996	15880.92	16119.08	20502.27	13526.32	-5	0.0	4.76E-09	5.018142	0.013748334	44.98665	45	0.013348	50	180	3.6
2269	1.291	0.83915	3.0615	34033.61	44.98665	71.09890997	15880.92	16119.08	20502.27	13526.32	-5	0.0	4.41E-09	5.01814	0.013748329	44.98665	45	0.013348	50	180	3.6
2270	1.291	0.83915	3.0615	34033.61	44.98665	71.09890997	15880.92	16119.08	20502.27	13526.32	-5	0.0	4.08E-09	5.018138	0.013748324	44.98665	45	0.013348	50	180	3.6

	30 year rainfall 150%													2.404547		pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2020	0.5901	0.383565	3.0615	16832.15	25	50.001	7854.296	24145.7	4634.82	9261.447	-2936	-8.0	0.583517	7519	20.6	25	45	20	50	180	3.6
2021	0.620325	0.40321125	3.0615	17249.41	25.58352	50.61696098	8049.001	23951	4992.997	9657.312	-2599	-7.1	0.583988	7299.627	19.99897706	25.58352	45	19.41648	50	180	3.6
2022	0.986325	0.64111125	3.0615	17672.13	26.16751	51.23341907	8246.251	23753.75	8133.484	15228.8	5690	15.6	1.54861	7080.076	19.39746908	26.16751	45	18.83249	50	180	3.6
2023	0.7071	0.459615	3.0615	18817.85	27.71612	52.86813183	8780.875	23219.12	6208.957	10671.86	-1937	-5.3	0.519406	6497.876	17.80240074	27.71612	45	17.28388	50	180	3.6
2024	0.6972	0.45318	3.0615	19210.19	28.23552	53.4164165	8963.949	23036.05	6249.665	10439.48	-2521	-6.9	0.421863	6302.606	17.26741285	28.23552	45	16.76448	50	180	3.6
2025	0.478425	0.31097625	3.0615	19531.83	28.65738	53.86173502	9114.032	22885.97	4360.381	7116.992	-8054	-22.1	-0.20962	6144.006	16.83289403	28.65738	45	16.34262	50	180	3.6
2026	0.79665	0.5178225	3.0615	19371.68	28.44777	53.64046439	9039.303	22960.7	7201.161	11889.57	-281	-0.8	0.657336	6222.811	17.04879848	28.44777	45	16.55223	50	180	3.6
2027	0.277575	0.18042375	3.0615	19876.1	29.1051	54.33434837	9274.677	22725.32	2574.418	4100.188	-13201	-36.2	-0.77909	5975.686	16.37174231	29.1051	45	15.8949	50	180	3.6
2028	0.428925	0.27880125	3.0615	19278.96	28.32601	53.5119414	8996.038	23003.96	3858.626	6413.533	-9007	-24.7	-0.30438	6268.585	17.17420458	28.32601	45	16.67399	50	180	3.6
2029	0.9597	0.623805	3.0615	19048.14	28.02163	53.19063766	8888.332	23111.67	8530.132	14417.17	3899	10.7	1.156818	6383.016	17.48771619	28.02163	45	16.97837	50	180	3.6
2030	0.35535	0.2309775	3.0615	19932.78	29.17845	54.4117748	9301.129	22698.87	3305.156	5242.929	-11385	-31.2	-0.58451	5948.111	16.29619359	29.17845	45	15.82155	50	180	3.6
2031	0.2589	0.168285	3.0615	19483.29	28.59394	53.79476764	9091.383	22908.62	2353.759	3855.177	-13274	-36.4	-0.78167	6167.857	16.89823733	28.59394	45	16.40606	50	180	3.6
2032	0.5739	0.373035	3.0615	18890.18	27.81227	52.96963279	8814.624	23185.38	5058.713	8648.957	-5183	-14.2	0.145124	6461.727	17.70336134	27.81227	45	17.18773	50	180	3.6
2033	0.293475	0.19075875	3.0615	18999.6	27.95739	53.122826	8865.683	23134.32	2601.856	4413.073	-11985	-32.8	-0.62911	6407.167	17.55388331	27.95739	45	17.04261	50	180	3.6
2034	0.518175	0.33681375	3.0615	18527.54	27.32828	52.45873565	8645.408	23354.59	4479.834	7866.148	-6182	-16.9	0.053453	6643.682	18.2018684	27.32828	45	17.67172	50	180	3.6
2035	0.3768	0.24492	3.0615	18567.42	27.38174	52.51516047	8664.016	23335.98	3264.601	5715.449	-9587	-26.3	-0.34208	6623.586	18.14681197	27.38174	45	17.61826	50	180	3.6
2036	0.7167	0.465855	3.0615	18312.96	27.03966	52.15406122	8545.277	23454.72	6124.4	10926.5	-1262	-3.5	0.642476	6752.191	18.49915399	27.03966	45	17.96034	50	180	3.6
2037	0.45345	0.2947425	3.0615	18792.33	27.68213	52.83225892	8768.963	23231.04	3976.286	6847.174	-7969	-21.8	-0.16629	6510.652	17.83740367	27.68213	45	17.31787	50	180	3.6
2038	0.44985	0.2924025	3.0615	18667.66	27.51584	52.65672048	8710.789	23289.21	3918.548	6809.824	-7939	-21.8	-0.15683	6573.17	18.00868502	27.51584	45	17.48416	50	180	3.6
2039	0.4299	0.279435	3.0615	18550.46	27.35901	52.4911706	8656.102	23343.9	3721.258	6523.102	-8306	-22.8	-0.19339	6632.13	18.17022005	27.35901	45	17.64099	50	180	3.6
2040	0.5148	0.33462	3.0615	18406.46	27.16562	52.28703227	8588.906	23411.09	4421.569	7833.82	-6151	-16.9	0.064475	6704.834	18.3694077	27.16562	45	17.83438	50	180	3.6
2041	0.59235	0.3850275	3.0615	18454.4	27.2301	52.35509181	8611.28	23388.72	5100.892	9005.3	-4348	-11.9	0.270852	6680.595	18.30299871	27.2301	45	17.7699	50	180	3.6
2042	1.384275	0.89977875	3.0615	18656.51	27.50095	52.64100319	8705.59	23294.41	12050.93	20959.82	14354	39.3	2.404547	6578.768	18.02402114	27.50095	45	17.49905	50	180	3.6
2043	0.621825	0.40418625	3.0615	20499.05	29.9055	55.17924304	9565.361	22434.64	5947.98	9067.773	-5483	-15.0	0.020019	5674.778	15.54733769	29.9055	45	15.0945	50	180	3.6
2044	0.4641	0.301665	3.0615	20514.75	29.92552	55.20037469	9572.688	22427.31	4442.685	6765.535	-9307	-25.5	-0.38017	5667.252	15.52671852	29.92552	45	15.07448	50	180	3.6
2045	1.3227	0.859755	3.0615	20217.55	29.54534	54.79906403	9434.006	22565.99	12478.36	19401.23	11662	32.0	1.852046	5810.178	15.91829675	29.54534	45	15.45466	50	180	3.6
2046	0.368475	0.23950875	3.0615	21685.85	31.39739	56.75408425	10119.15	21880.85	3728.654	5240.655	-12717	-34.8	-0.75131	5113.901	14.01068892	31.39739	45	13.60261	50	180	3.6
2047	0.14295	0.0929175	3.0615	21084	30.64608	55.96099954	9838.317	22161.68	1406.387	2059.208	-17618	-48.3	-1.24229	5396.357	14.78454004	30.64608	45	14.35392	50	180	3.6
2048	0.701775	0.45615375	3.0615	20107.44	29.40379	54.6496372	9382.627	22617.37	6584.493	10317	-3206	-8.8	0.283231	5863.396	16.06409973	29.40379	45	15.59621	50	180	3.6
2049	0.748875	0.48676875	3.0615	20328.05	29.68702	54.94861584	9485.569	22514.43	7103.505	10959.32	-2265	-6.2	0.368106	5756.916	15.77237181	29.68702	45	15.31298	50	180	3.6
2050	0.547275	0.35572875	3.0615	20616.57	30.05512	55.33718844	9620.199	22379.8	5264.894	7961.139	-7391	-20.2	-0.1842	5618.526	15.39322272	30.05512	45	14.94488	50	180	3.6
2051	0.435675	0.28318875	3.0615	20471.94	29.87093	55.14275051	9552.713	22447.29	4161.878	6356.819	-9953	-27.3	-0.44652	5687.775	15.58294522	29.87093	45	15.12907	50	180	3.6
2052	0.5709	0.371085	3.0615	20123.46	29.42441	54.67140493	9390.103	22609.9	5360.81	8390.194	-6372	-17.5	-0.05504	5855.644	16.04285991	29.42441	45	15.57559	50	180	3.6
2053	0.15	0.0975	3.0615	20080.71	29.36937	54.61330683	9370.156	22629.84	1405.523	2206.41	-16469	-45.1	-1.13044	5876.335	16.09954904	29.36937	45	15.63063	50	180	3.6
2054	1.050525	0.68284125	3.0615	19212.77	28.23893	53.42000929	8965.155	23034.85	9418.119	15729.14	5934	16.3	1.364819	6301.326	17.26390719	28.23893	45	16.76107	50	180	3.6
2055	0.63465	0.4125225	3.0615	20263.06	29.60374	54.86071216	9455.244	22544.76	6000.771	9300.219	-4962	-13.6	0.087375	5788.222	15.85814369	29.60374	45	15.39626	50	180	3.6
2056	0.89175	0.5796375	3.0615	20331.25	29.69112	54.95294509	9487.064	22512.94	8460.089	13049.34	1178	3.2	0.730843	5755.374	15.76814756	29.69112	45	15.30888	50	180	3.6
2057	0.43545	0.2830425	3.0615	20906.11	30.42196	55.72442285	9755.309	22244.69	4247.949	6296.193	-10362	-28.4	-0.50038	5480.613	15.01537937	30.42196	45	14.57804	50	180	3.6
2058	0.208725	0.13567125	3.0615	20511.66	29.92158	55.19622197	9571.248	22428.75	1997.759	3042.937	-15471	-42.4	-1.02413	5668.731	15.53077053	29.92158	45	15.07842	50	180	3.6
2059	0.2967	0.192855	3.0615	19716.05	28.89745	54.11514657	9199.994	22800.01	2729.638	4397.095	-12589	-34.5	-0.71039	6053.754	16.58562811	28.89745	45	16.10255	50	180	3.6
2060	0.3951	0.256815	3.0615	19173.41	28.18706	53.36526164	8946.788	23053.21	3534.876	5920.411	-9718	-26.6	-0.37972	6320.824	17.31732712	28.18706	45	16.81294	50	180	3.6
2061	0.897225	0.58319625	3.0615	18886.47	27.80734	52.96442577	8812.891	23187.11	7907.146	13522.63	2543	7.0	1.022014	6463.581	17.70844207	27.80734	45	17.19266	50	180	3.6
2062	0.31215	0.2028975	3.0615	19663.7	28.82935	54.0432635	9175.569	22824.43	2864.154	4631.02	-12169	-33.3	-0.66363	6079.355	16.6557679	28.82935	45	16.17065	50	180	3.6
2063	0.47685	0.3099525	3.0615	19157.23	28.16572	53.34273668	8939.237	23060.76	4262.675	7147.741	-7747	-21.2	-0.15862	6328.847	17.33930581	28.16572	45	16.83428	50	180	3.6
2064	0.653775	0.42495375	3.0615	19037.15	28.0071	53.17529418	8883.205	23116.8	5807.617	9823.569	-3406	-9.3	0.335748	6388.481	17.50268757	28.0071	45	16.9929	50	180	3.6
2065	0.594225	0.38624625	3.0615	19291.76	28.34285	53.52970937	9002.013	22997.99	5349.221	8882.886	-5060	-13.9	0.133592	6262.257	17.15686751	28.34285	45	16.65715	50	180	3.6
2066	0.450375	0.29274375	3.0615	19393.54	28.47644	53.67072942	9049.506	22950.49	4075.671	6718.614	-8599	-23.6	-0.2638	6212.033	17.01926743	28.47644	45	16.52356	50	180	3.6
2067	0.818625	0.53210625	3.0615	19192.82	28.21264	53.39226605	8955.845	23044.15	7331.479	12261.94	401	1.1	0.749432	6311.207	17.29097761	28.21264	45	16.78736	50	180	3.6
2068	0.721875	0.46921875	3.0615	19765.79	28.96208	54.18336686	9223.205	22776.8	6658.001	10687.3	-2420	-6.6	0.391292	6029.458	16.51906227	28.96208	45	16.03792	50	180	3.6
2069	0.5901	0.383565	3.0615	20068.29	29.35337	54.59641503	9364.361	22635.64	5525.909	8682.239	-5860	-16.1	0.002371	5882.351	16.11603118	29.35337	45	15.64663	50	180	3.6
2070	0.620325	0.40321125	3.0615	20070.13	29.35574	54.5989183	9365.219	22634.78	5809.48	9126.598	-5134	-14.1	0.079806	5881.46	16.11358863	29.35574	45	15.64426	50	180	3.6
2071	0.986325	0.64111125	3.0615	20132.12	29.43555	54.68316195	9394.142	22605.86	9265.677	14492.87	3626	9.9	1.008915	5851.457	16.03138802	29.43555	45	15.56445	50	180	3.6
2072	0.7071	0.459615	3.0615	20923.94	30.44446	55.74817233	9763.626	22236.37	6903.86	10220.17	-3800	-10.4	0.171273	5472.155	14.99220585	30.44446	45	14.55554	50	180	3.6
2073	0.6972	0.45318	3.0615	21059.88	30.61573	55.92896829	9827.057	22172.94	6851.424	10048.33	-4160	-11.4	0.126961	5407.765	14.81579449	30.61573	45	14.38427	50	180	3.6
2074	0.478425	0.31097625	3.0615	21160.93	30.74269	56.06298782	9874.21	22125.79	4724.069	6880.595	-9556	-26.2	-0.42497	5360.034	14.68502515	30.74269	45	14.25731	50	180	3.6
2075	0.79665	0.5178225	3.0615	20823.64	30.31773	55.61439118	9716.822	22283.18	7740.906	11538.73	-1544	-4.2	0.409167	5519.801	15.12274259	30.31773	45	14.68227	50	180	3.6
2076	0.277575	0.18042375	3.0615	21148.34	30.72689	56.04630786	9868.335	22131.66	2739.203	3993.078	-14416	-39.5	-0.91708	5365.975	14.70130059	30.72689	45	14.27311	50	180	3.6
2077	0.428925	0.27880125	3.0615	20424.07	29.80981	55.07823533	9530.373	22469.63	4087.815	6264.56	-10072	-27.6	-0.45758	5710.752	15.64589581	29.80981	45	15.19019	50	180	3.6
2078	0.9597	0.623805	3.0615	20067.41	29.35223	54.59521047	9363.947	22636.05	8986.58	14120.48	3040	8.3	0.95285	5882.78	16.11720653	29.35223	45	15.64777	50	180	3.6
2079	0.35535	0.2309775	3.0615	20813.64	30.30508	55.60103881	9712.157	22287.84	3451.215	5147.99	-12214	-33.5	-0.68881	5524.556	15.13577115	30.30508	45	14.69492	50	180	3.6

	30 year rainfall 150%												2.404547			pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2080	0.2589	0.168285	3.0615	20272.82	29.61626	54.87392607	9459.8	22540.2	2449.142	3793.178	-14031	-38.4	-0.87179	5783.516	15.84525024	29.61626	45	15.38374	50	180	3.6
2081	0.5739	0.373035	3.0615	19598.55	28.74447	53.95366132	9145.169	22854.83	5248.412	8525.652	-5824	-16.0	0.031358	6111.267	16.74319708	28.74447	45	16.25553	50	180	3.6
2082	0.293475	0.19075875	3.0615	19622.61	28.77583	53.98676323	9156.394	22843.61	2687.173	4357.618	-12578	-34.5	-0.70752	6099.478	16.71089795	28.77583	45	16.22417	50	180	3.6
2083	0.518175	0.33681375	3.0615	19083.44	28.06831	53.23990402	8904.805	23095.2	4614.247	7778.779	-6690	-18.3	-0.03649	6365.47	17.43964462	28.06831	45	16.93169	50	180	3.6
2084	0.3768	0.24492	3.0615	19055.84	28.03182	53.20138415	8891.924	23108.08	3350.477	5659.63	-10046	-27.5	-0.41235	6379.189	17.47723032	28.03182	45	16.96818	50	180	3.6
2085	0.7167	0.465855	3.0615	18745.3	27.61947	52.76611263	8747.019	23252.98	6268.989	10832.52	-1644	-4.5	0.559095	6534.21	17.9019458	27.61947	45	17.38053	50	180	3.6
2086	0.45345	0.2947425	3.0615	19166.97	28.17857	53.3562936	8943.781	23056.22	4055.558	6795.647	-8316	-22.8	-0.2227	6324.018	17.32607767	28.17857	45	16.82143	50	180	3.6
2087	0.44985	0.2924025	3.0615	18998.45	27.95587	53.12121535	8865.146	23134.85	3987.986	6764.689	-8246	-22.6	-0.20733	6407.741	17.55545489	27.95587	45	17.04413	50	180	3.6
2088	0.4299	0.279435	3.0615	18842.23	27.74854	52.90235497	8792.247	23207.75	3779.787	6485.058	-8577	-23.5	-0.2379	6485.688	17.76900756	27.74854	45	17.25146	50	180	3.6
2089	0.5148	0.33462	3.0615	18663.76	27.51063	52.65122578	8708.971	23291.03	4483.378	7793.644	-6387	-17.5	0.021632	6575.127	18.01404646	27.51063	45	17.48937	50	180	3.6
2090	0.59235	0.3850275	3.0615	18679.95	27.53227	52.6740601	8716.527	23283.47	5163.235	8964.778	-4552	-12.5	0.231176	6566.995	17.99176591	27.53227	45	17.46773	50	180	3.6
2091	1.384275	0.89977875	3.0615	18853.44	27.76344	52.91808978	8797.478	23202.52	12178.13	20877.14	14202	38.9	2.350891	6480.084	17.75365434	27.76344	45	17.23656	50	180	3.6
2092	0.621825	0.40418625	3.0615	20663.17	30.11433	55.39969053	9641.943	22358.06	5995.601	9036.819	-5631	-15.4	-0.00358	5596.266	15.33223641	30.11433	45	14.88567	50	180	3.6
2093	0.4641	0.301665	3.0615	20660.35	30.11076	55.39591579	9640.629	22359.37	4474.216	6745.04	-9441	-25.9	-0.39868	5597.611	15.3359196	30.11076	45	14.88924	50	180	3.6
2094	1.3227	0.859755	3.0615	20347.63	29.71208	54.97507383	9494.706	22505.29	12558.65	19349.04	11560	31.7	1.822863	5747.493	15.74655548	29.71208	45	15.28792	50	180	3.6
2095	0.368475	0.23950875	3.0615	21796.96	31.53495	56.89928822	10171	21829	3747.758	5228.237	-12821	-35.1	-0.76283	5062.187	13.86900637	31.53495	45	13.46505	50	180	3.6
2096	0.14295	0.0929175	3.0615	21184.37	30.77211	56.09404164	9885.152	22114.85	1413.082	2054.856	-17716	-48.5	-1.25111	5348.974	14.65472444	30.77211	45	14.22789	50	180	3.6
2097	0.701775	0.45615375	3.0615	20198.59	29.521	54.7733647	9425.16	22574.84	6614.341	10297.6	-3287	-9.0	0.268715	5819.331	15.94337283	29.521	45	15.479	50	180	3.6
2098	0.748875	0.48676875	3.0615	20408.34	29.78971	55.05702031	9523.033	22476.97	7131.561	10941.09	-2336	-6.4	0.355204	5718.308	15.66659633	29.78971	45	15.21029	50	180	3.6
2099	0.547275	0.35572875	3.0615	20687.25	30.14492	55.43197357	9653.183	22346.82	5282.946	7949.405	-7455	-20.4	-0.19373	5584.769	15.30073628	30.14492	45	14.85508	50	180	3.6
2100	0.435675	0.28318875	3.0615	20534.89	29.95118	55.22746961	9582.088	22417.91	4174.676	6348.5	-10012	-27.4	-0.4544	5657.602	15.5002807	29.95118	45	15.04882	50	180	3.6
2101	0.5709	0.371085	3.0615	20179.74	29.49678	54.74780342	9416.365	22583.64	5375.803	8380.448	-6423	-17.6	-0.06319	5828.435	15.96831421	29.49678	45	15.50322	50	180	3.6
2102	0.15	0.0975	3.0615	20130.59	29.43359	54.68109617	9393.432	22606.57	1409.015	2204.14	-16517	-45.3	-1.13539	5852.192	16.0334037	29.43359	45	15.56641	50	180	3.6
2103	1.050525	0.68284125	3.0615	19257.8	28.29819	53.48257419	8986.167	23013.83	9440.193	15714.79	5897	16.2	1.354997	6279.044	17.20285959	28.29819	45	16.70181	50	180	3.6
2104	0.63465	0.4125225	3.0615	20301.64	29.65319	54.91290871	9473.245	22526.75	6012.195	9292.793	-4997	-13.7	0.081596	5769.633	15.80721299	29.65319	45	15.34681	50	180	3.6
2105	0.89175	0.5796375	3.0615	20365.38	29.73479	54.99904193	9502.987	22497.01	8474.288	13040.11	1149	3.1	0.724823	5738.957	15.72316863	29.73479	45	15.26521	50	180	3.6
2106	0.43545	0.2830425	3.0615	20935.95	30.45961	55.76416493	9769.229	22230.77	4254.011	6292.253	-10390	-28.5	-0.50395	5466.459	14.9766011	30.45961	45	14.54039	50	180	3.6
2107	0.208725	0.13567125	3.0615	20538.41	29.95566	55.23219318	9583.727	22416.27	2000.363	3041.244	-15497	-42.5	-1.02683	5655.92	15.49567168	29.95566	45	15.04434	50	180	3.6
2108	0.2967	0.192855	3.0615	19740.19	28.92883	54.14826914	9211.26	22788.74	2732.981	4394.922	-12612	-34.6	-0.71329	6041.958	16.55330881	28.92883	45	16.07117	50	180	3.6
2109	0.3951	0.256815	3.0615	19195.02	28.21553	53.39531681	8956.869	23043.13	3538.859	5917.822	-9738	-26.7	-0.38275	6310.12	17.28800084	28.21553	45	16.78447	50	180	3.6
2110	0.897225	0.58319625	3.0615	18905.63	27.83279	52.99128884	8821.833	23178.17	7915.169	13517.42	2527	6.9	1.018039	6454.014	17.68223048	27.83279	45	17.16721	50	180	3.6
2111	0.31215	0.2028975	3.0615	19680.2	28.85083	54.06593126	9183.268	22816.73	2866.557	4629.458	-12184	-33.4	-0.66566	6071.282	16.63364987	28.85083	45	16.14917	50	180	3.6
2112	0.47685	0.3099525	3.0615	19171.98	28.18517	53.36326392	8946.118	23053.88	4265.957	7145.608	-7760	-21.3	-0.16084	6321.536	17.3192764	28.18517	45	16.81483	50	180	3.6
2113	0.653775	0.42495375	3.0615	19050.18	28.02433	53.19348302	8889.283	23110.72	5811.591	9820.986	-3418	-9.4	0.33348	6382.003	17.48493984	28.02433	45	16.97567	50	180	3.6
2114	0.594225	0.38624625	3.0615	19303.15	28.35781	53.54550498	9007.327	22992.67	5352.379	8880.834	-5070	-13.9	0.131747	6256.631	17.14145497	28.35781	45	16.64219	50	180	3.6
2115	0.450375	0.29274375	3.0615	19403.55	28.48956	53.68457759	9054.176	22945.82	4077.775	6717.246	-8609	-23.6	-0.26523	6207.101	17.00575509	28.48956	45	16.51044	50	180	3.6
2116	0.818625	0.53210625	3.0615	19201.69	28.22433	53.40460176	8959.984	23040.02	7334.867	12259.74	393	1.1	0.747738	6306.813	17.27894107	28.22433	45	16.77567	50	180	3.6
2117	0.721875	0.46921875	3.0615	19773.48	28.97207	54.1939143	9226.796	22773.2	6660.593	10685.61	-2427	-6.7	0.389997	6025.701	16.50877062	28.97207	45	16.02793	50	180	3.6
2118	0.5901	0.383565	3.0615	20075.04	29.36206	54.60559529	9367.51	22632.49	5527.768	8681.031	-5866	-16.1	0.001371	5879.082	16.10707357	29.36206	45	15.63794	50	180	3.6
2119	0.620325	0.40321125	3.0615	20076.11	29.36344	54.60704199	9368.006	22631.99	5811.209	9125.474	-5139	-14.1	0.078901	5878.567	16.10566194	29.36344	45	15.63656	50	180	3.6
2120	0.986325	0.64111125	3.0615	20137.39	29.44234	54.69032972	9396.605	22603.4	9268.106	14491.29	3622	9.9	1.007907	5848.904	16.02439407	29.44234	45	15.55766	50	180	3.6
2121	0.7071	0.459615	3.0615	20928.52	30.45024	55.75427677	9765.764	22234.24	6905.372	10219.19	-3804	-10.4	0.170598	5469.981	14.98624946	30.45024	45	14.54976	50	180	3.6
2122	0.6972	0.45318	3.0615	21063.94	30.62084	55.93436	9828.952	22171.05	6852.745	10047.48	-4164	-11.4	0.126375	5405.845	14.81053354	30.62084	45	14.37916	50	180	3.6
2123	0.478425	0.31097625	3.0615	21164.53	30.74722	56.06776102	9875.891	22124.11	4724.873	6880.072	-9560	-26.2	-0.4254	5358.334	14.68036771	30.74722	45	14.25278	50	180	3.6
2124	0.79665	0.5178225	3.0615	20826.87	30.32181	55.61870399	9718.329	22281.67	7742.107	11537.95	-1547	-4.2	0.408656	5518.265	15.11853438	30.32181	45	14.67819	50	180	3.6
2125	0.277575	0.18042375	3.0615	21151.18	30.73047	56.05008167	9869.664	22130.34	2739.572	3992.838	-14419	-39.5	-0.91737	5364.631	14.6976183	30.73047	45	14.26953	50	180	3.6
2126	0.428925	0.27880125	3.0615	20426.64	29.8131	55.08170494	9531.574	22468.43	4088.33	6264.225	-10074	-27.6	-0.45791	5709.516	15.64251034	29.8131	45	15.1869	50	180	3.6
2127	0.9597	0.623805	3.0615	20069.71	29.35519	54.59833906	9365.021	22634.98	8987.61	14119.81	3038	8.3	0.952415	5881.666	16.11415382	29.35519	45	15.64481	50	180	3.6
2128	0.35535	0.2309775	3.0615	20815.64	30.30761	55.60370792	9713.089	22286.91	3451.546	5147.775	-12216	-33.5	-0.68904	5523.606	15.13316677	30.30761	45	14.69239	50	180	3.6
2129	0.2589	0.168285	3.0615	20274.62	29.61856	54.8763571	9460.638	22539.36	2449.359	3793.037	-14032	-38.4	-0.87199	5782.651	15.84287816	29.61856	45	15.38144	50	180	3.6
2130	0.5739	0.373035	3.0615	19600.17	28.74658	53.95588533	9145.923	22854.08	5248.845	8525.371	-5826	-16.0	0.031109	6110.475	16.74102701	28.74658	45	16.25342	50	180	3.6
2131	0.293475	0.19075875	3.0615	19624.03	28.77768	53.98872408	9157.059	22842.94	2687.368	4357.491	-12579	-34.5	-0.70769	6098.779	16.70898465	28.77768	45	16.22232	50	180	3.6
2132	0.518175	0.33681375	3.0615	19084.72	28.06999	53.24168217	8905.4	23094.6	4614.555	7778.579	-6692	-18.3	-0.03669	6364.837	17.43790959	28.06999	45	16.93001	50	180	3.6
2133	0.3768	0.24492	3.0615	19056.96	28.0333	53.20295149	8892.448	23107.55	3350.674	5659.502	-10047	-27.5	-0.4125	6378.631	17.47570099	28.0333	45	16.9667	50	180	3.6
2134	0.7167	0.465855	3.0615	18746.3	27.6208	52.76751428	8747.484	23252.52	6269.322	10832.3	-1645	-4.5	0.558908	6533.711	17.90057815	27.6208	45	17.3792	50	180	3.6
2135	0.45345	0.2947425	3.0615	19167.84	28.17971	53.35749754	8944.185	23055.81	4055.741	6795.529	-8317	-22.8	-0.22282	6323.59	17.32490293	28.17971	45	16.82029	50	180	3.6
2136	0.44985	0.2924025	3.0615	18999.22	27.95688	53.12228477	8865.503	23134.5	3988.146	6764.585	-8246	-22.6	-0.20745	6407.36	17.55441141	27.95688	45	17.04312	50	180	3.6
2137	0.4299	0.279435	3.0615	18842.9	27.74943	52.90330346	8792.562	23207.44	3779.923	6484.97	-8578	-23.5	-0.238	6485.35	17.76808207	27.74943	45	17.25057	50	180	3.6
2138	0.5148	0.33462	3.0615	18664.36	27.51143	52.6520673	8709.249	23290.75	4483.522	7793.551	-6387	-17.5	0.021534	6574.827	18.01322536	27.51143	45	17.48857	50	180	3.6
2139	0.59235	0.3850275	3.0615	18680.48	27.53297	52.67479833	8716.771	23283.23	5163.379	8964.683	-4552	-12.5	0.231085	6566.732	17.99104559	27.53297	45	17.46703	50	180	3.6

	30 year rainfall 150%												2.404547			pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2140	1.384275	0.89977875	3.0615	18853.89	27.76405	52.91873206	8797.692	23202.31	12178.42	20876.94	14201	38.9	2.350768	6479.855	17.75302765	27.76405	45	17.23595	50	180	3.6
2141	0.621825	0.40418625	3.0615	20663.55	30.11482	55.40020263	9642.121	22357.88	5995.712	9036.747	-5631	-15.4	-0.00363	5596.084	15.33173673	30.11482	45	14.88518	50	180	3.6
2142	0.4641	0.301665	3.0615	20660.69	30.11119	55.39637041	9640.787	22359.21	4474.289	6744.992	-9441	-25.9	-0.39872	5597.449	15.33547601	30.11119	45	14.88881	50	180	3.6
2143	1.3227	0.859755	3.0615	20347.93	29.71247	54.97548331	9494.847	22505.15	12558.83	19348.92	11560	31.7	1.822796	5747.347	15.74615592	29.71247	45	15.28753	50	180	3.6
2144	0.368475	0.23950875	3.0615	21797.21	31.53527	56.89962641	10171.12	21828.88	3747.803	5228.208	-12821	-35.1	-0.76286	5062.067	13.86867639	31.53527	45	13.46473	50	180	3.6
2145	0.14295	0.0929175	3.0615	21184.61	30.77241	56.09435162	9885.261	22114.74	1413.098	2054.846	-17717	-48.5	-1.25114	5348.864	14.65442197	30.77241	45	14.22759	50	180	3.6
2146	0.701775	0.45615375	3.0615	20198.8	29.52127	54.77365307	9425.259	22574.74	6614.411	10297.55	-3287	-9.0	0.268681	5819.228	15.94309145	29.52127	45	15.47873	50	180	3.6
2147	0.748875	0.48676875	3.0615	20408.52	29.78995	55.0572731	9523.12	22476.88	7131.627	10941.04	-2336	-6.4	0.355174	5718.218	15.66634966	29.78995	45	15.21005	50	180	3.6
2148	0.547275	0.35572875	3.0615	20687.42	30.14513	55.43219471	9653.26	22346.74	5282.988	7949.378	-7455	-20.4	-0.19375	5584.69	15.30052051	30.14513	45	14.85487	50	180	3.6
2149	0.435675	0.28318875	3.0615	20535.04	29.95137	55.22766733	9582.157	22417.84	4174.706	6348.481	-10012	-27.4	-0.45442	5657.532	15.50008777	29.95137	45	15.04863	50	180	3.6
2150	0.5709	0.371085	3.0615	20179.87	29.49695	54.74798177	9416.426	22583.57	5375.838	8380.426	-6424	-17.6	-0.06321	5828.371	15.96814018	29.49695	45	15.50305	50	180	3.6
2151	0.15	0.0975	3.0615	20130.71	29.43374	54.68125447	9393.486	22606.51	1409.023	2204.135	-16518	-45.3	-1.13541	5852.136	16.03324924	29.43374	45	15.56626	50	180	3.6
2152	1.050525	0.68284125	3.0615	19257.91	28.29833	53.48272032	8986.216	23013.78	9440.244	15714.76	5897	16.2	1.354974	6278.992	17.202717	28.29833	45	16.70167	50	180	3.6
2153	0.63465	0.4125225	3.0615	20301.73	29.65331	54.91303067	9473.287	22526.71	6012.222	9292.776	-4997	-13.7	0.081583	5769.589	15.80709398	29.65331	45	15.34669	50	180	3.6
2154	0.89175	0.5796375	3.0615	20365.46	29.73489	54.99914966	9503.024	22496.98	8474.322	13040.09	1149	3.1	0.724809	5738.918	15.72306352	29.73489	45	15.26511	50	180	3.6
2155	0.43545	0.2830425	3.0615	20936.02	30.4597	55.76425783	9769.261	22230.74	4254.025	6292.244	-10390	-28.5	-0.50396	5466.426	14.97651046	30.4597	45	14.5403	50	180	3.6
2156	0.208725	0.13567125	3.0615	20538.47	29.95574	55.23227727	9583.757	22416.24	2000.37	3041.24	-15497	-42.5	-1.02684	5655.89	15.49558963	29.95574	45	15.04426	50	180	3.6
2157	0.2967	0.192855	3.0615	19740.25	28.9289	54.14834659	9211.286	22788.71	2732.989	4394.917	-12612	-34.6	-0.7133	6041.93	16.55323325	28.9289	45	16.0711	50	180	3.6
2158	0.3951	0.256815	3.0615	19195.07	28.2156	53.39538708	8956.892	23043.11	3538.868	5917.816	-9738	-26.7	-0.38275	6310.095	17.28793227	28.2156	45	16.7844	50	180	3.6
2159	0.897225	0.58319625	3.0615	18905.67	27.83285	52.99135166	8821.854	23178.15	7915.188	13517.41	2527	6.9	1.01803	6453.992	17.68216918	27.83285	45	17.16715	50	180	3.6
2160	0.31215	0.2028975	3.0615	19680.24	28.85088	54.06598428	9183.286	22816.71	2866.563	4629.454	-12184	-33.4	-0.66566	6071.263	16.63359814	28.85088	45	16.14912	50	180	3.6
2161	0.47685	0.3099525	3.0615	19172.01	28.18521	53.36331193	8946.135	23053.87	4265.964	7145.603	-7760	-21.3	-0.16084	6321.519	17.31922955	28.18521	45	16.81479	50	180	3.6
2162	0.653775	0.42495375	3.0615	19050.21	28.02437	53.19352557	8889.297	23110.7	5811.6	9820.98	-3418	-9.4	0.333475	6381.988	17.48489832	28.02437	45	16.97563	50	180	3.6
2163	0.594225	0.38624625	3.0615	19303.18	28.35785	53.54554194	9007.339	22992.66	5352.386	8880.829	-5070	-13.9	0.131743	6256.618	17.14141891	28.35785	45	16.64215	50	180	3.6
2164	0.450375	0.29274375	3.0615	19403.58	28.48959	53.68460999	9054.187	22945.81	4077.78	6717.243	-8609	-23.6	-0.26523	6207.089	17.00572348	28.48959	45	16.51041	50	180	3.6
2165	0.818625	0.53210625	3.0615	19201.71	28.22436	53.40463062	8959.994	23040.01	7334.875	12259.73	393	1.1	0.747734	6306.803	17.2789129	28.22436	45	16.77564	50	180	3.6
2166	0.721875	0.46921875	3.0615	19773.5	28.97209	54.19393898	9226.804	22773.2	6660.599	10685.61	-2427	-6.7	0.389994	6025.692	16.50874654	28.97209	45	16.02791	50	180	3.6
2167	0.5901	0.383565	3.0615	20075.06	29.36208	54.60561677	9367.517	22632.48	5527.772	8681.028	-5866	-16.1	0.001368	5879.074	16.1070526	29.36208	45	15.63792	50	180	3.6
2168	0.620325	0.40321125	3.0615	20076.12	29.36345	54.60706101	9368.013	22631.99	5811.213	9125.472	-5139	-14.1	0.078899	5878.56	16.10564339	29.36345	45	15.63655	50	180	3.6
2169	0.986325	0.64111125	3.0615	20137.41	29.44235	54.6903465	9396.61	22603.39	9268.112	14491.29	3622	9.9	1.007905	5848.898	16.02437771	29.44235	45	15.55765	50	180	3.6
2170	0.7071	0.459615	3.0615	20928.53	30.45026	55.75429105	9765.769	22234.23	6905.376	10219.19	-3804	-10.4	0.170596	5469.976	14.98623552	30.45026	45	14.54974	50	180	3.6
2171	0.6972	0.45318	3.0615	21063.95	30.62085	55.93437262	9828.957	22171.04	6852.749	10047.47	-4164	-11.4	0.126373	5405.84	14.81052123	30.62085	45	14.37915	50	180	3.6
2172	0.478425	0.31097625	3.0615	21164.54	30.74723	56.06777219	9875.895	22124.1	4724.875	6880.071	-9560	-26.2	-0.42541	5358.33	14.68035681	30.74723	45	14.25277	50	180	3.6
2173	0.79665	0.5178225	3.0615	20826.87	30.32182	55.61871408	9718.333	22281.67	7742.11	11537.95	-1547	-4.2	0.408655	5518.261	15.11852453	30.32182	45	14.67818	50	180	3.6
2174	0.277575	0.18042375	3.0615	21151.19	30.73048	56.0500905	9869.667	22130.33	2739.573	3992.838	-14419	-39.5	-0.91737	5364.628	14.69760968	30.73048	45	14.26952	50	180	3.6
2175	0.428925	0.27880125	3.0615	20426.65	29.8131	55.08171306	9531.577	22468.42	4088.332	6264.224	-10074	-27.6	-0.45791	5709.513	15.64250242	29.8131	45	15.1869	50	180	3.6
2176	0.9597	0.623805	3.0615	20069.71	29.3552	54.59834638	9365.023	22634.98	8987.613	14119.81	3038	8.3	0.952414	5881.664	16.11414667	29.3552	45	15.6448	50	180	3.6
2177	0.35535	0.2309775	3.0615	20815.64	30.30761	55.60371417	9713.091	22286.91	3451.547	5147.774	-12216	-33.5	-0.68904	5523.604	15.13316067	30.30761	45	14.69239	50	180	3.6
2178	0.2589	0.168285	3.0615	20274.62	29.61857	54.87636279	9460.64	22539.36	2449.36	3793.036	-14032	-38.4	-0.87199	5782.649	15.84287261	29.61857	45	15.38143	50	180	3.6
2179	0.5739	0.373035	3.0615	19600.17	28.74658	53.95589053	9145.924	22854.08	5248.846	8525.37	-5826	-16.0	0.031109	6110.473	16.74102193	28.74658	45	16.25342	50	180	3.6
2180	0.293475	0.19075875	3.0615	19624.04	28.77769	53.98872867	9157.06	22842.94	2687.368	4357.491	-12579	-34.5	-0.70769	6098.778	16.70898017	28.77769	45	16.22231	50	180	3.6
2181	0.518175	0.33681375	3.0615	19084.72	28.06999	53.24168633	8905.401	23094.6	4614.556	7778.579	-6692	-18.3	-0.03669	6364.836	17.43790553	28.06999	45	16.93001	50	180	3.6
2182	0.3768	0.24492	3.0615	19056.96	28.0333	53.20295516	8892.449	23107.55	3350.675	5659.501	-10047	-27.5	-0.4125	6378.63	17.47569741	28.0333	45	16.9667	50	180	3.6
2183	0.7167	0.465855	3.0615	18746.3	27.6208	52.76751756	8747.485	23252.52	6269.322	10832.3	-1645	-4.5	0.558908	6533.71	17.90057495	27.6208	45	17.3792	50	180	3.6
2184	0.45345	0.2947425	3.0615	19167.84	28.17971	53.35750036	8944.186	23055.81	4055.741	6795.528	-8317	-22.8	-0.22282	6323.589	17.32490018	28.17971	45	16.82029	50	180	3.6
2185	0.44985	0.2924025	3.0615	18999.22	27.95688	53.12228727	8865.503	23134.5	3988.147	6764.585	-8246	-22.6	-0.20745	6407.359	17.55440897	27.95688	45	17.04312	50	180	3.6
2186	0.4299	0.279435	3.0615	18842.9	27.74944	52.90330568	8792.563	23207.44	3779.923	6484.97	-8578	-23.5	-0.238	6485.349	17.76807991	27.74944	45	17.25056	50	180	3.6
2187	0.5148	0.33462	3.0615	18664.36	27.51143	52.65206927	8709.25	23290.75	4483.522	7793.551	-6387	-17.5	0.021534	6574.827	18.01322343	27.51143	45	17.48857	50	180	3.6
2188	0.59235	0.3850275	3.0615	18680.48	27.53297	52.67480006	8716.772	23283.23	5163.38	8964.683	-4552	-12.5	0.231085	6566.731	17.9910439	27.53297	45	17.46703	50	180	3.6
2189	1.384275	0.89977875	3.0615	18853.89	27.76405	52.91873356	8797.692	23202.31	12178.43	20876.94	14201	38.9	2.350768	6479.855	17.75302618	27.76405	45	17.23595	50	180	3.6
2190	0.621825	0.40418625	3.0615	20663.55	30.11482	55.40020383	9642.121	22357.88	5995.712	9036.747	-5631	-15.4	-0.00363	5596.083	15.33173556	30.11482	45	14.88518	50	180	3.6
2191	0.4641	0.301665	3.0615	20660.69	30.11119	55.39637148	9640.788	22359.21	4474.289	6744.992	-9441	-25.9	-0.39872	5597.448	15.33547497	30.11119	45	14.88881	50	180	3.6
2192	1.3227	0.859755	3.0615	20347.93	29.71247	54.97548427	9494.848	22505.15	12558.83	19348.92	11560	31.7	1.822796	5747.347	15.74615499	29.71247	45	15.28753	50	180	3.6
2193	0.368475	0.23950875	3.0615	21797.22	31.53527	56.8996272	10171.12	21828.88	3747.803	5228.208	-12821	-35.1	-0.76286	5062.067	13.86867562	31.53527	45	13.46473	50	180	3.6
2194	0.14295	0.0929175	3.0615	21184.61	30.77241	56.09435235	9885.261	22114.74	1413.098	2054.846	-17717	-48.5	-1.25114	5348.864	14.65442126	30.77241	45	14.22759	50	180	3.6
2195	0.701775	0.45615375	3.0615	20198.8	29.52127	54.77365375	9425.259	22574.74	6614.411	10297.55	-3287	-9.0	0.268681	5819.228	15.94309079	29.52127	45	15.47873	50	180	3.6
2196	0.748875	0.48676875	3.0615	20408.52	29.78995	55.0572737	9523.12	22476.88	7131.627	10941.04	-2336	-6.4	0.355174	5718.217	15.66634908	29.78995	45	15.21005	50	180	3.6
2197	0.547275	0.35572875	3.0615	20687.42	30.14513	55.43219523	9653.261	22346.74	5282.988	7949.378	-7455	-20.4	-0.19375	5584.69	15.30052	30.14513	45	14.85487	50	180	3.6
2198	0.435675	0.28318875	3.0615	20535.04	29.95137	55.22766779	9582.157	22417.84	4174.706	6348.481	-10012	-27.4	-0.45442	5657.532	15.50008732	29.95137	45	15.04863	50	180	3.6
2199	0.5709	0.371085	3.0615	20179.87	29.49695	54.74798219	9416.426	22583.57	5375.838	8380.425	-6424	-17.6	-0.06321	5828.371	15.96813977	29.49695	45	15.50305	50	180	3.6

	30 year rainfall 150%												2.404547			pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2200	0.15	0.0975	3.0615	20130.71	29.43374	54.68125484	9393.487	22606.51	1409.023	2204.135	-16518	-45.3	-1.13541	5852.136	16.03324888	29.43374	45	15.56626	50	180	3.6
2201	1.050525	0.68284125	3.0615	19257.91	28.29833	53.48272066	8986.216	23013.78	9440.245	15714.76	5897	16.2	1.354974	6278.992	17.20271667	28.29833	45	16.70167	50	180	3.6
2202	0.63465	0.4125225	3.0615	20301.73	29.65331	54.91303096	9473.287	22526.71	6012.222	9292.776	-4997	-13.7	0.081583	5769.589	15.80709371	29.65331	45	15.34669	50	180	3.6
2203	0.89175	0.5796375	3.0615	20365.46	29.73489	54.99914991	9503.024	22496.98	8474.322	13040.09	1149	3.1	0.724809	5738.918	15.72306327	29.73489	45	15.26511	50	180	3.6
2204	0.43545	0.2830425	3.0615	20936.02	30.4597	55.76425804	9769.261	22230.74	4254.025	6292.244	-10390	-28.5	-0.50396	5466.426	14.97651025	30.4597	45	14.5403	50	180	3.6
2205	0.208725	0.13567125	3.0615	20538.47	29.95574	55.23227747	9583.757	22416.24	2000.37	3041.24	-15497	-42.5	-1.02684	5655.89	15.49558943	29.95574	45	15.04426	50	180	3.6
2206	0.2967	0.192855	3.0615	19740.25	28.9289	54.14834677	9211.286	22788.71	2732.989	4394.917	-12612	-34.6	-0.7133	6041.93	16.55323307	28.9289	45	16.0711	50	180	3.6
2207	0.3951	0.256815	3.0615	19195.07	28.2156	53.39538725	8956.892	23043.11	3538.868	5917.816	-9738	-26.7	-0.38275	6310.095	17.28793211	28.2156	45	16.7844	50	180	3.6
2208	0.897225	0.58319625	3.0615	18905.67	27.83285	52.99135181	8821.854	23178.15	7915.188	13517.41	2527	6.9	1.01803	6453.992	17.68216904	27.83285	45	17.16715	50	180	3.6
2209	0.31215	0.2028975	3.0615	19680.24	28.85088	54.0659844	9183.286	22816.71	2866.563	4629.454	-12184	-33.4	-0.66566	6071.263	16.63359802	28.85088	45	16.14912	50	180	3.6
2210	0.47685	0.3099525	3.0615	19172.01	28.18521	53.36331204	8946.135	23053.87	4265.964	7145.603	-7760	-21.3	-0.16084	6321.519	17.31922944	28.18521	45	16.81479	50	180	3.6
2211	0.653775	0.42495375	3.0615	19050.21	28.02437	53.19352567	8889.297	23110.7	5811.6	9820.98	-3418	-9.4	0.333475	6381.988	17.48489822	28.02437	45	16.97563	50	180	3.6
2212	0.594225	0.38624625	3.0615	19303.18	28.35785	53.54554202	9007.339	22992.66	5352.386	8880.829	-5070	-13.9	0.131743	6256.618	17.14141883	28.35785	45	16.64215	50	180	3.6
2213	0.450375	0.29274375	3.0615	19403.58	28.48959	53.68461007	9054.187	22945.81	4077.78	6717.243	-8609	-23.6	-0.26523	6207.089	17.00572341	28.48959	45	16.51041	50	180	3.6
2214	0.818625	0.53210625	3.0615	19201.71	28.22436	53.40463069	8959.994	23040.01	7334.875	12259.73	393	1.1	0.747734	6306.803	17.27891284	28.22436	45	16.77564	50	180	3.6
2215	0.721875	0.46921875	3.0615	19773.5	28.97209	54.19393904	9226.804	22773.2	6660.599	10685.61	-2427	-6.7	0.389994	6025.692	16.50874648	28.97209	45	16.02791	50	180	3.6
2216	0.5901	0.383565	3.0615	20075.06	29.36208	54.60561682	9367.517	22632.48	5527.772	8681.028	-5866	-16.1	0.001368	5879.074	16.10705256	29.36208	45	15.63792	50	180	3.6
2217	0.620325	0.40321125	3.0615	20076.12	29.36345	54.60706105	9368.013	22631.99	5811.213	9125.472	-5139	-14.1	0.078899	5878.56	16.10564335	29.36345	45	15.63655	50	180	3.6
2218	0.986325	0.64111125	3.0615	20137.41	29.44235	54.69034654	9396.61	22603.39	9268.112	14491.29	3622	9.9	1.007905	5848.898	16.02437767	29.44235	45	15.55765	50	180	3.6
2219	0.7071	0.459615	3.0615	20928.53	30.45026	55.75429109	9765.769	22234.23	6905.376	10219.19	-3804	-10.4	0.170596	5469.976	14.98623549	30.45026	45	14.54974	50	180	3.6
2220	0.6972	0.45318	3.0615	21063.95	30.62085	55.93437265	9828.957	22171.04	6852.749	10047.47	-4164	-11.4	0.126373	5405.84	14.8105212	30.62085	45	14.37915	50	180	3.6
2221	0.478425	0.31097625	3.0615	21164.54	30.74723	56.06777221	9875.895	22124.1	4724.875	6880.071	-9560	-26.2	-0.42541	5358.33	14.68035678	30.74723	45	14.25277	50	180	3.6
2222	0.79665	0.5178225	3.0615	20826.87	30.32182	55.61871411	9718.333	22281.67	7742.11	11537.95	-1547	-4.2	0.408655	5518.261	15.11852451	30.32182	45	14.67818	50	180	3.6
2223	0.277575	0.18042375	3.0615	21151.19	30.73048	56.05009053	9869.667	22130.33	2739.573	3992.838	-14419	-39.5	-0.91737	5364.628	14.69760966	30.73048	45	14.26952	50	180	3.6
2224	0.428925	0.27880125	3.0615	20426.65	29.8131	55.08171308	9531.577	22468.42	4088.332	6264.224	-10074	-27.6	-0.45791	5709.513	15.6425024	29.8131	45	15.1869	50	180	3.6
2225	0.9597	0.623805	3.0615	20069.71	29.3552	54.5983464	9365.023	22634.98	8987.613	14119.81	3038	8.3	0.952414	5881.664	16.11414666	29.3552	45	15.6448	50	180	3.6
2226	0.35535	0.2309775	3.0615	20815.64	30.30761	55.60371418	9713.091	22286.91	3451.547	5147.774	-12216	-33.5	-0.68904	5523.604	15.13316066	30.30761	45	14.69239	50	180	3.6
2227	0.2589	0.168285	3.0615	20274.62	29.61857	54.8763628	9460.64	22539.36	2449.36	3793.036	-14032	-38.4	-0.87199	5782.648	15.8428726	29.61857	45	15.38143	50	180	3.6
2228	0.5739	0.373035	3.0615	19600.17	28.74658	53.95589055	9145.924	22854.08	5248.846	8525.37	-5826	-16.0	0.031109	6110.473	16.74102192	28.74658	45	16.25342	50	180	3.6
2229	0.293475	0.19075875	3.0615	19624.04	28.77769	53.98872868	9157.06	22842.94	2687.368	4357.491	-12579	-34.5	-0.70769	6098.778	16.70898016	28.77769	45	16.22231	50	180	3.6
2230	0.518175	0.33681375	3.0615	19084.72	28.06999	53.24168634	8905.401	23094.6	4614.556	7778.579	-6692	-18.3	-0.03669	6364.836	17.43790552	28.06999	45	16.93001	50	180	3.6
2231	0.3768	0.24492	3.0615	19056.96	28.0333	53.20295517	8892.449	23107.55	3350.675	5659.501	-10047	-27.5	-0.4125	6378.63	17.4756974	28.0333	45	16.9667	50	180	3.6
2232	0.7167	0.465855	3.0615	18746.3	27.6208	52.76751756	8747.485	23252.52	6269.322	10832.3	-1645	-4.5	0.558908	6533.71	17.90057494	27.6208	45	17.3792	50	180	3.6
2233	0.45345	0.2947425	3.0615	19167.84	28.17971	53.35750037	8944.186	23055.81	4055.741	6795.528	-8317	-22.8	-0.22282	6323.589	17.32490017	28.17971	45	16.82029	50	180	3.6
2234	0.44985	0.2924025	3.0615	18999.22	27.95688	53.12228728	8865.503	23134.5	3988.147	6764.585	-8246	-22.6	-0.20745	6407.359	17.55440897	27.95688	45	17.04312	50	180	3.6
2235	0.4299	0.279435	3.0615	18842.9	27.74944	52.90330569	8792.563	23207.44	3779.923	6484.97	-8578	-23.5	-0.238	6485.349	17.7680799	27.74944	45	17.25056	50	180	3.6
2236	0.5148	0.33462	3.0615	18664.36	27.51143	52.65206927	8709.25	23290.75	4483.522	7793.551	-6387	-17.5	0.021534	6574.827	18.01322343	27.51143	45	17.48857	50	180	3.6
2237	0.59235	0.3850275	3.0615	18680.48	27.53297	52.67480006	8716.772	23283.23	5163.38	8964.683	-4552	-12.5	0.231085	6566.731	17.9910439	27.53297	45	17.46703	50	180	3.6
2238	1.384275	0.89977875	3.0615	18853.89	27.76405	52.91873356	8797.692	23202.31	12178.43	20876.94	14201	38.9	2.350768	6479.855	17.75302617	27.76405	45	17.23595	50	180	3.6
2239	0.621825	0.40418625	3.0615	20663.55	30.11482	55.40020383	9642.121	22357.88	5995.712	9036.747	-5631	-15.4	-0.00363	5596.083	15.33173556	30.11482	45	14.88518	50	180	3.6
2240	0.4641	0.301665	3.0615	20660.69	30.11119	55.39637148	9640.788	22359.21	4474.289	6744.992	-9441	-25.9	-0.39872	5597.448	15.33547497	30.11119	45	14.88881	50	180	3.6
2241	1.3227	0.859755	3.0615	20347.93	29.71247	54.97548427	9494.848	22505.15	12558.83	19348.92	11560	31.7	1.822796	5747.347	15.74615498	29.71247	45	15.28753	50	180	3.6
2242	0.368475	0.23950875	3.0615	21797.22	31.53527	56.8996272	10171.12	21828.88	3747.803	5228.208	-12821	-35.1	-0.76286	5062.067	13.86867561	31.53527	45	13.46473	50	180	3.6
2243	0.14295	0.0929175	3.0615	21184.61	30.77241	56.09435235	9885.261	22114.74	1413.098	2054.846	-17717	-48.5	-1.25114	5348.864	14.65442126	30.77241	45	14.22759	50	180	3.6
2244	0.701775	0.45615375	3.0615	20198.8	29.52127	54.77365375	9425.259	22574.74	6614.411	10297.55	-3287	-9.0	0.268681	5819.228	15.94309079	29.52127	45	15.47873	50	180	3.6
2245	0.748875	0.48676875	3.0615	20408.52	29.78995	55.0572737	9523.12	22476.88	7131.627	10941.04	-2336	-6.4	0.355174	5718.217	15.66634908	29.78995	45	15.21005	50	180	3.6
2246	0.547275	0.35572875	3.0615	20687.42	30.14513	55.43219523	9653.261	22346.74	5282.988	7949.378	-7455	-20.4	-0.19375	5584.69	15.30052	30.14513	45	14.85487	50	180	3.6
2247	0.435675	0.28318875	3.0615	20535.04	29.95137	55.2276678	9582.157	22417.84	4174.706	6348.481	-10012	-27.4	-0.45442	5657.532	15.50008732	29.95137	45	15.04863	50	180	3.6
2248	0.5709	0.371085	3.0615	20179.87	29.49695	54.74798219	9416.426	22583.57	5375.838	8380.425	-6424	-17.6	-0.06321	5828.371	15.96813977	29.49695	45	15.50305	50	180	3.6
2249	0.15	0.0975	3.0615	20130.71	29.43374	54.68125484	9393.487	22606.51	1409.023	2204.135	-16518	-45.3	-1.13541	5852.136	16.03324888	29.43374	45	15.56626	50	180	3.6
2250	1.050525	0.68284125	3.0615	19257.91	28.29833	53.48272066	8986.216	23013.78	9440.245	15714.76	5897	16.2	1.354974	6278.992	17.20271667	28.29833	45	16.70167	50	180	3.6
2251	0.63465	0.4125225	3.0615	20301.73	29.65331	54.91303096	9473.287	22526.71	6012.222	9292.776	-4997	-13.7	0.081583	5769.589	15.80709371	29.65331	45	15.34669	50	180	3.6
2252	0.89175	0.5796375	3.0615	20365.46	29.73489	54.99914991	9503.024	22496.98	8474.322	13040.09	1149	3.1	0.724809	5738.918	15.72306327	29.73489	45	15.26511	50	180	3.6
2253	0.43545	0.2830425	3.0615	20936.02	30.4597	55.76425804	9769.261	22230.74	4254.025	6292.244	-10390	-28.5	-0.50396	5466.426	14.97651025	30.4597	45	14.5403	50	180	3.6
2254	0.208725	0.13567125	3.0615	20538.47	29.95574	55.23227747	9583.757	22416.24	2000.37	3041.24	-15497	-42.5	-1.02684	5655.89	15.49558943	29.95574	45	15.04426	50	180	3.6
2255	0.2967	0.192855	3.0615	19740.25	28.9289	54.14834677	9211.286	22788.71	2732.989	4394.917	-12612	-34.6	-0.7133	6041.93	16.55323307	28.9289	45	16.0711	50	180	3.6
2256	0.3951	0.256815	3.0615	19195.07	28.2156	53.39538725	8956.892	23043.11	3538.868	5917.816	-9738	-26.7	-0.38275	6310.095	17.28793211	28.2156	45	16.7844	50	180	3.6
2257	0.897225	0.58319625	3.0615	18905.67	27.83285	52.99135181	8821.854	23178.15	7915.188	13517.41	2527	6.9	1.01803	6453.992	17.68216904	27.83285	45	17.16715	50	180	3.6
2258	0.31215	0.2028975	3.0615	19680.24	28.85088	54.0659844	9183.286	22816.71	2866.563	4629.454	-12184	-33.4	-0.66566	6071.263	16.63359802	28.85088	45	16.14912	50	180	3.6
2259	0.47685	0.3099525	3.0615	19172.01	28.18521	53.36331204	8946.135	23053.87	4265.964	7145.603	-7760	-21.3	-0.16084	6321.519	17.31922944	28.18521	45	16.81479	50	180	3.6

	30 year rainfall 150%												2.404547			pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2260	0.653775	0.42495375	3.0615	19050.21	28.02437	53.19352567	8889.297	23110.7	5811.6	9820.98	-3418	-9.4	0.333475	6381.988	17.48489822	28.02437	45	16.97563	50	180	3.6
2261	0.594225	0.38624625	3.0615	19303.18	28.35785	53.54554202	9007.339	22992.66	5352.386	8880.829	-5070	-13.9	0.131743	6256.618	17.14141883	28.35785	45	16.64215	50	180	3.6
2262	0.450375	0.29274375	3.0615	19403.58	28.48959	53.68461007	9054.187	22945.81	4077.78	6717.243	-8609	-23.6	-0.26523	6207.089	17.00572341	28.48959	45	16.51041	50	180	3.6
2263	0.818625	0.53210625	3.0615	19201.71	28.22436	53.40463069	8959.994	23040.01	7334.875	12259.73	393	1.1	0.747734	6306.803	17.27891284	28.22436	45	16.77564	50	180	3.6
2264	0.721875	0.46921875	3.0615	19773.5	28.97209	54.19393904	9226.804	22773.2	6660.599	10685.61	-2427	-6.7	0.389994	6025.692	16.50874648	28.97209	45	16.02791	50	180	3.6
2265	0.5901	0.383565	3.0615	20075.06	29.36208	54.60561682	9367.517	22632.48	5527.772	8681.028	-5866	-16.1	0.001368	5879.074	16.10705256	29.36208	45	15.63792	50	180	3.6
2266	0.620325	0.40321125	3.0615	20076.12	29.36345	54.60706105	9368.013	22631.99	5811.213	9125.472	-5139	-14.1	0.078899	5878.56	16.10564335	29.36345	45	15.63655	50	180	3.6
2267	0.986325	0.64111125	3.0615	20137.41	29.44235	54.69034654	9396.61	22603.39	9268.112	14491.29	3622	9.9	1.007905	5848.898	16.02437767	29.44235	45	15.55765	50	180	3.6
2268	0.7071	0.459615	3.0615	20928.53	30.45026	55.75429109	9765.769	22234.23	6905.376	10219.19	-3804	-10.4	0.170596	5469.976	14.98623549	30.45026	45	14.54974	50	180	3.6
2269	0.6972	0.45318	3.0615	21063.95	30.62085	55.93437265	9828.957	22171.04	6852.749	10047.47	-4164	-11.4	0.126373	5405.84	14.8105212	30.62085	45	14.37915	50	180	3.6
2270	0.478425	0.31097625	3.0615	21164.54	30.74723	56.06777221	9875.895	22124.1	4724.875	6880.071	-9560	-26.2	-0.42541	5358.33	14.68035678	30.74723	45	14.25277	50	180	3.6

	Max rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2020	0.923	0.59995	3.0615	16832.15	25	50.001	7854.296	24145.7	7249.515	14486.22	4904	13.4	1.581629	7519	20.6	25	45	20	50	180	3.6
2021	0.923	0.59995	3.0615	17974.99	26.58163	51.67056752	8387.573	23612.43	7741.73	14166.28	3933	10.8	1.294463	6924.387	18.97092218	26.58163	45	18.41837	50	180	3.6
2022	0.923	0.59995	3.0615	18938.26	27.87609	53.0370026	8837.06	23162.94	8156.607	13896.61	3115	8.5	1.08098	6437.733	17.63762535	27.87609	45	17.12391	50	180	3.6
2023	0.923	0.59995	3.0615	19761.94	28.95707	54.17808487	9221.407	22778.59	8511.358	13666.02	2415	6.6	0.915997	6031.339	16.52421617	28.95707	45	16.04293	50	180	3.6
2024	0.923	0.59995	3.0615	20473.62	29.87307	55.14501109	9553.496	22446.5	8817.877	13466.78	1811	5.0	0.784844	5686.97	15.58073946	29.87307	45	15.12693	50	180	3.6
2025	0.923	0.59995	3.0615	21093.42	30.65791	55.97349275	9842.71	22157.29	9084.821	13293.27	1285	3.5	0.678327	5391.908	14.77234982	30.65791	45	14.34209	50	180	3.6
2026	0.923	0.59995	3.0615	21636.55	31.33624	56.68953469	10096.15	21903.85	9318.744	13141.22	823	2.3	0.590354	5136.891	14.07367305	31.33624	45	13.66376	50	180	3.6
2027	0.923	0.59995	3.0615	22114.86	31.92659	57.31271266	10319.34	21680.66	9524.748	13007.31	417	1.1	0.516715	4914.947	13.46560815	31.92659	45	13.07341	50	180	3.6
2028	0.923	0.59995	3.0615	22537.79	32.44331	57.85815672	10516.69	21483.31	9706.905	12888.91	58	0.2	0.454393	4720.688	12.93339199	32.44331	45	12.55669	50	180	3.6
2029	0.923	0.59995	3.0615	22913.03	32.8977	58.33781423	10691.78	21308.22	9868.517	12783.86	-261	-0.7	0.401169	4549.859	12.46536694	32.8977	45	12.1023	50	180	3.6
2030	0.923	0.59995	3.0615	23246.89	33.29887	58.76128819	10847.57	21152.43	10012.31	12690.4	-544	-1.5	0.355366	4399.039	12.05216291	33.29887	45	11.70113	50	180	3.6
2031	0.923	0.59995	3.0615	23544.64	33.65424	59.13641283	10986.51	21013.49	10140.55	12607.04	-797	-2.2	0.315695	4265.44	11.68613564	33.65424	45	11.34576	50	180	3.6
2032	0.923	0.59995	3.0615	23810.75	33.96993	59.46966059	11110.68	20889.32	10255.16	12532.55	-1023	-2.8	0.281145	4146.754	11.36096968	33.96993	45	11.03007	50	180	3.6
2033	0.923	0.59995	3.0615	24048.99	34.25108	59.76643687	11221.85	20778.15	10357.77	12465.85	-1225	-3.4	0.250911	4041.058	11.0713907	34.25108	45	10.74892	50	180	3.6
2034	0.923	0.59995	3.0615	24262.62	34.50199	60.03129827	11321.54	20678.46	10449.78	12406.04	-1407	-3.9	0.224345	3946.728	10.81295262	34.50199	45	10.49801	50	180	3.6
2035	0.923	0.59995	3.0615	24454.42	34.72633	60.26811709	11411.04	20588.96	10532.39	12352.35	-1570	-4.3	0.200919	3862.385	10.58187703	34.72633	45	10.27367	50	180	3.6
2036	0.923	0.59995	3.0615	24626.84	34.92725	60.4802075	11491.49	20508.51	10606.65	12304.08	-1716	-4.7	0.180197	3786.85	10.37493016	34.92725	45	10.07275	50	180	3.6
2037	0.923	0.59995	3.0615	24781.99	35.10745	60.67042361	11563.89	20436.11	10673.47	12260.64	-1848	-5.1	0.161816	3719.104	10.18932709	35.10745	45	9.892551	50	180	3.6
2038	0.923	0.59995	3.0615	24921.73	35.26927	60.8412369	11629.1	20370.9	10733.66	12221.52	-1967	-5.4	0.145473	3658.27	10.0226563	35.26927	45	9.730734	50	180	3.6
2039	0.923	0.59995	3.0615	25047.7	35.41474	60.99479784	11687.87	20312.13	10787.91	12186.26	-2074	-5.7	0.130909	3603.579	9.872819462	35.41474	45	9.585262	50	180	3.6
2040	0.923	0.59995	3.0615	25161.32	35.54565	61.13298569	11740.89	20259.11	10836.84	12154.45	-2170	-5.9	0.117908	3554.364	9.737982887	35.54565	45	9.454352	50	180	3.6
2041	0.923	0.59995	3.0615	25263.88	35.66356	61.25744898	11788.75	20211.25	10881.01	12125.74	-2257	-6.2	0.106281	3510.036	9.616538036	35.66356	45	9.336445	50	180	3.6
2042	0.923	0.59995	3.0615	25356.5	35.76984	61.36963875	11831.97	20168.03	10920.91	12099.81	-2336	-6.4	0.095867	3470.08	9.507069046	35.76984	45	9.230164	50	180	3.6
2043	0.923	0.59995	3.0615	25440.19	35.8657	61.47083615	11871.02	20128.98	10956.95	12076.38	-2407	-6.6	0.086528	3434.039	9.408325851	35.8657	45	9.134297	50	180	3.6
2044	0.923	0.59995	3.0615	25515.85	35.95223	61.56217536	11906.33	20093.67	10989.54	12055.2	-2471	-6.8	0.078143	3401.509	9.31920176	35.95223	45	9.047769	50	180	3.6
2045	0.923	0.59995	3.0615	25584.28	36.03037	61.64466296	11938.25	20061.75	11019.01	12036.04	-2529	-6.9	0.070606	3372.131	9.238714615	36.03037	45	8.969626	50	180	3.6
2046	0.923	0.59995	3.0615	25646.18	36.10098	61.71919422	11967.14	20032.86	11045.67	12018.71	-2582	-7.1	0.063824	3345.587	9.165990866	36.10098	45	8.89902	50	180	3.6
2047	0.923	0.59995	3.0615	25702.2	36.1648	61.78656695	11993.28	20006.72	11069.8	12003.03	-2629	-7.2	0.057717	3321.592	9.10025203	36.1648	45	8.835196	50	180	3.6
2048	0.923	0.59995	3.0615	25752.91	36.22252	61.84749343	12016.95	19983.05	11091.64	11988.83	-2672	-7.3	0.052214	3299.893	9.040803117	36.22252	45	8.777479	50	180	3.6
2049	0.923	0.59995	3.0615	25798.84	36.27474	61.90261054	12038.37	19961.63	11111.42	11975.98	-2711	-7.4	0.047251	3280.263	8.987022681	36.27474	45	8.725265	50	180	3.6
2050	0.923	0.59995	3.0615	25840.43	36.32199	61.95248861	12057.78	19942.22	11129.33	11964.33	-2747	-7.5	0.042772	3262.499	8.938354241	36.32199	45	8.678014	50	180	3.6
2051	0.923	0.59995	3.0615	25878.11	36.36476	61.99763897	12075.36	19924.64	11145.56	11953.79	-2779	-7.6	0.038728	3246.419	8.894298843	36.36476	45	8.635242	50	180	3.6
2052	0.923	0.59995	3.0615	25912.25	36.40349	62.03852067	12091.29	19908.71	11160.26	11944.23	-2808	-7.7	0.035075	3231.859	8.854408591	36.40349	45	8.596513	50	180	3.6
2053	0.923	0.59995	3.0615	25943.18	36.43856	62.0755462	12105.73	19894.27	11173.59	11935.57	-2834	-7.8	0.031774	3218.673	8.818280994	36.43856	45	8.561438	50	180	3.6
2054	0.923	0.59995	3.0615	25971.23	36.47034	62.10908658	12118.82	19881.18	11185.67	11927.72	-2858	-7.8	0.028789	3206.727	8.785554021	36.47034	45	8.529664	50	180	3.6
2055	0.923	0.59995	3.0615	25996.65	36.49912	62.13947584	12130.68	19869.32	11196.61	11920.6	-2879	-7.9	0.026089	3195.904	8.755901752	36.49912	45	8.500875	50	180	3.6
2056	0.923	0.59995	3.0615	26019.7	36.52521	62.16701491	12141.43	19858.57	11206.54	11914.15	-2899	-7.9	0.023646	3186.096	8.729030547	36.52521	45	8.474787	50	180	3.6
2057	0.923	0.59995	3.0615	26040.59	36.54886	62.19197512	12151.18	19848.82	11215.54	11908.3	-2917	-8.0	0.021434	3177.207	8.704675662	36.54886	45	8.451141	50	180	3.6
2058	0.923	0.59995	3.0615	26059.54	36.57029	62.21460125	12160.03	19839.97	11223.7	11902.99	-2933	-8.0	0.019433	3169.148	8.682598255	36.57029	45	8.429707	50	180	3.6
2059	0.923	0.59995	3.0615	26076.73	36.58973	62.23511425	12168.05	19831.95	11231.11	11898.18	-2947	-8.1	0.01762	3161.843	8.662582723	36.58973	45	8.410274	50	180	3.6
2060	0.923	0.59995	3.0615	26092.32	36.60735	62.25371369	12175.32	19824.68	11237.82	11893.82	-2961	-8.1	0.015978	3155.219	8.644434345	36.60735	45	8.392655	50	180	3.6
2061	0.923	0.59995	3.0615	26106.46	36.62332	62.2705799	12181.92	19818.08	11243.91	11889.86	-2973	-8.1	0.01449	3149.212	8.627977171	36.62332	45	8.376677	50	180	3.6
2062	0.923	0.59995	3.0615	26119.29	36.63781	62.28587588	12187.9	19812.1	11249.44	11886.27	-2984	-8.2	0.013142	3143.764	8.613052148	36.63781	45	8.362187	50	180	3.6
2063	0.923	0.59995	3.0615	26130.92	36.65096	62.29974903	12193.33	19806.67	11254.45	11883.01	-2993	-8.2	0.011921	3138.823	8.599515438	36.65096	45	8.349044	50	180	3.6
2064	0.923	0.59995	3.0615	26141.48	36.66288	62.31233273	12198.26	19801.74	11258.99	11880.05	-3002	-8.2	0.010814	3134.341	8.587236919	36.66288	45	8.337123	50	180	3.6
2065	0.923	0.59995	3.0615	26151.06	36.67369	62.32374764	12202.73	19797.27	11263.12	11877.37	-3011	-8.2	0.00981	3130.276	8.57609884	36.67369	45	8.32631	50	180	3.6
2066	0.923	0.59995	3.0615	26159.75	36.6835	62.334103	12206.79	19793.21	11266.86	11874.94	-3018	-8.3	0.0089	3126.588	8.565994612	36.6835	45	8.3165	50	180	3.6
2067	0.923	0.59995	3.0615	26167.64	36.6924	62.34349772	12210.46	19789.54	11270.26	11872.73	-3025	-8.3	0.008075	3123.242	8.556827727	36.6924	45	8.3076	50	180	3.6
2068	0.923	0.59995	3.0615	26174.79	36.70047	62.35202138	12213.8	19786.2	11273.34	11870.73	-3031	-8.3	0.007326	3120.206	8.548510779	36.70047	45	8.299525	50	180	3.6
2069	0.923	0.59995	3.0615	26181.29	36.7078	62.35975512	12216.83	19783.17	11276.14	11868.91	-3036	-8.3	0.006648	3117.452	8.540964597	36.7078	45	8.292199	50	180	3.6
2070	0.923	0.59995	3.0615	26187.18	36.71445	62.36677245	12219.58	19780.42	11278.68	11867.26	-3041	-8.3	0.006032	3114.953	8.534117445	36.71445	45	8.285551	50	180	3.6
2071	0.923	0.59995	3.0615	26192.53	36.72048	62.37314	12222.08	19777.92	11280.98	11865.76	-3046	-8.3	0.005474	3112.685	8.527904321	36.72048	45	8.279519	50	180	3.6
2072	0.923	0.59995	3.0615	26197.38	36.72596	62.37891814	12224.34	19775.66	11283.07	11864.41	-3050	-8.4	0.004967	3110.627	8.522266308	36.72596	45	8.274045	50	180	3.6
2073	0.923	0.59995	3.0615	26201.78	36.73092	62.38416161	12226.4	19773.6	11284.97	11863.17	-3054	-8.4	0.004508	3108.76	8.517150005	36.73092	45	8.269078	50	180	3.6
2074	0.923	0.59995	3.0615	26205.78	36.73543	62.38892002	12228.26	19771.74	11286.69	11862.05	-3057	-8.4	0.004091	3107.065	8.512506994	36.73543	45	8.26457	50	180	3.6
2075	0.923	0.59995	3.0615	26209.41	36.73952	62.39323836	12229.96	19770.04	11288.25	11861.04	-3060	-8.4	0.003713	3105.527	8.508293379	36.73952	45	8.260479	50	180	3.6
2076	0.923	0.59995	3.0615	26212.7	36.74323	62.39715743	12231.49	19768.51	11289.67	11860.12	-3063	-8.4	0.003369	3104.131	8.504469353	36.74323	45	8.256766	50	180	3.6
2077	0.923	0.59995	3.0615	26215.69	36.7466	62.40071422	12232.89	19767.11	11290.96	11859.28	-3065	-8.4	0.003058	3102.865	8.500998818	36.7466	45	8.253397	50	180	3.6
2078	0.923	0.59995	3.0615	26218.4	36.74966	62.40394229	12234.15	19765.85	11292.12	11858.52	-3068	-8.4	0.002775	3101.715	8.497849033	36.74966	45	8.250339	50	180	3.6
2079	0.923	0.59995	3.0615	26220.86	36.75244	62.40687208	12235.3	19764.7	11293.18	11857.83	-3070	-8.4	0.002519	3100.671	8.494990302	36.75244	45	8.247563	50	180	3.6

	Max rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2080	0.923	0.59995	3.0615	26223.1	36.75496	62.40953118	12236.34	19763.66	11294.15	11857.2	-3072	-8.4	0.002286	3099.724	8.492395685	36.75496	45	8.245044	50	180	3.6
2081	0.923	0.59995	3.0615	26225.13	36.75724	62.41194465	12237.29	19762.71	11295.02	11856.64	-3073	-8.4	0.002075	3098.865	8.490040747	36.75724	45	8.242758	50	180	3.6
2082	0.923	0.59995	3.0615	26226.97	36.75932	62.4141352	12238.15	19761.85	11295.81	11856.12	-3075	-8.4	0.001884	3098.085	8.487903318	36.75932	45	8.240683	50	180	3.6
2083	0.923	0.59995	3.0615	26228.64	36.7612	62.41612346	12238.93	19761.07	11296.53	11855.65	-3076	-8.4	0.00171	3097.377	8.485963283	36.7612	45	8.238799	50	180	3.6
2084	0.923	0.59995	3.0615	26230.16	36.76291	62.41792811	12239.64	19760.36	11297.19	11855.23	-3078	-8.4	0.001552	3096.734	8.484202392	36.76291	45	8.23709	50	180	3.6
2085	0.923	0.59995	3.0615	26231.53	36.76446	62.41956614	12240.28	19759.72	11297.78	11854.84	-3079	-8.4	0.001408	3096.15	8.482604088	36.76446	45	8.235538	50	180	3.6
2086	0.923	0.59995	3.0615	26232.78	36.76587	62.42105294	12240.86	19759.14	11298.32	11854.49	-3080	-8.4	0.001278	3095.621	8.481153344	36.76587	45	8.234129	50	180	3.6
2087	0.923	0.59995	3.0615	26233.92	36.76715	62.42240249	12241.39	19758.61	11298.81	11854.18	-3081	-8.4	0.00116	3095.14	8.479836527	36.76715	45	8.232851	50	180	3.6
2088	0.923	0.59995	3.0615	26234.95	36.76831	62.42362746	12241.87	19758.13	11299.25	11853.89	-3082	-8.4	0.001053	3094.704	8.478641263	36.76831	45	8.231691	50	180	3.6
2089	0.923	0.59995	3.0615	26235.88	36.76936	62.42473936	12242.31	19757.69	11299.65	11853.63	-3083	-8.4	0.000956	3094.308	8.477556324	36.76936	45	8.230637	50	180	3.6
2090	0.923	0.59995	3.0615	26236.73	36.77032	62.42574864	12242.71	19757.29	11300.02	11853.39	-3083	-8.4	0.000868	3093.949	8.476571522	36.77032	45	8.229681	50	180	3.6
2091	0.923	0.59995	3.0615	26237.5	36.77119	62.42666477	12243.06	19756.94	11300.35	11853.17	-3084	-8.4	0.000788	3093.622	8.475677607	36.77119	45	8.228813	50	180	3.6
2092	0.923	0.59995	3.0615	26238.2	36.77197	62.42749636	12243.39	19756.61	11300.65	11852.98	-3085	-8.5	0.000715	3093.326	8.47486619	36.77197	45	8.228025	50	180	3.6
2093	0.923	0.59995	3.0615	26238.83	36.77269	62.4282512	12243.69	19756.31	11300.92	11852.8	-3085	-8.5	0.000649	3093.057	8.474129651	36.77269	45	8.22731	50	180	3.6
2094	0.923	0.59995	3.0615	26239.41	36.77334	62.42893639	12243.96	19756.04	11301.17	11852.64	-3086	-8.5	0.000589	3092.813	8.473461079	36.77334	45	8.226661	50	180	3.6
2095	0.923	0.59995	3.0615	26239.93	36.77393	62.42955836	12244.2	19755.8	11301.4	11852.49	-3086	-8.5	0.000535	3092.592	8.472854199	36.77393	45	8.226072	50	180	3.6
2096	0.923	0.59995	3.0615	26240.41	36.77446	62.43012293	12244.42	19755.58	11301.6	11852.36	-3086	-8.5	0.000485	3092.391	8.472303317	36.77446	45	8.225537	50	180	3.6
2097	0.923	0.59995	3.0615	26240.84	36.77495	62.43063541	12244.62	19755.38	11301.79	11852.24	-3087	-8.5	0.000441	3092.208	8.471803264	36.77495	45	8.225052	50	180	3.6
2098	0.923	0.59995	3.0615	26241.23	36.77539	62.43110061	12244.8	19755.2	11301.95	11852.13	-3087	-8.5	0.0004	3092.043	8.471349349	36.77539	45	8.224611	50	180	3.6
2099	0.923	0.59995	3.0615	26241.58	36.77579	62.43152289	12244.97	19755.03	11302.11	11852.03	-3087	-8.5	0.000363	3091.892	8.470937314	36.77579	45	8.224211	50	180	3.6
2100	0.923	0.59995	3.0615	26241.91	36.77615	62.4319062	12245.12	19754.88	11302.25	11851.94	-3088	-8.5	0.00033	3091.756	8.470563293	36.77615	45	8.223848	50	180	3.6
2101	0.923	0.59995	3.0615	26242.2	36.77648	62.43225415	12245.26	19754.74	11302.37	11851.86	-3088	-8.5	0.000299	3091.632	8.47022378	36.77648	45	8.223518	50	180	3.6
2102	0.923	0.59995	3.0615	26242.46	36.77678	62.43257	12245.38	19754.62	11302.49	11851.78	-3088	-8.5	0.000272	3091.519	8.469915589	36.77678	45	8.223219	50	180	3.6
2103	0.923	0.59995	3.0615	26242.7	36.77705	62.43285672	12245.49	19754.51	11302.59	11851.72	-3088	-8.5	0.000247	3091.417	8.46963583	36.77705	45	8.222947	50	180	3.6
2104	0.923	0.59995	3.0615	26242.92	36.7773	62.43311698	12245.6	19754.4	11302.68	11851.66	-3089	-8.5	0.000224	3091.324	8.469381881	36.7773	45	8.222701	50	180	3.6
2105	0.923	0.59995	3.0615	26243.12	36.77752	62.43335323	12245.69	19754.31	11302.77	11851.6	-3089	-8.5	0.000203	3091.24	8.469151359	36.77752	45	8.222477	50	180	3.6
2106	0.923	0.59995	3.0615	26243.3	36.77773	62.43356769	12245.77	19754.23	11302.85	11851.55	-3089	-8.5	0.000184	3091.164	8.468942103	36.77773	45	8.222274	50	180	3.6
2107	0.923	0.59995	3.0615	26243.47	36.77791	62.43376236	12245.85	19754.15	11302.92	11851.5	-3089	-8.5	0.000167	3091.095	8.468752151	36.77791	45	8.222089	50	180	3.6
2108	0.923	0.59995	3.0615	26243.61	36.77808	62.43393907	12245.92	19754.08	11302.98	11851.46	-3089	-8.5	0.000152	3091.032	8.468579722	36.77808	45	8.221922	50	180	3.6
2109	0.923	0.59995	3.0615	26243.75	36.77823	62.43409949	12245.98	19754.02	11303.04	11851.42	-3089	-8.5	0.000138	3090.974	8.4684232	36.77823	45	8.22177	50	180	3.6
2110	0.923	0.59995	3.0615	26243.87	36.77837	62.4342451	12246.04	19753.96	11303.09	11851.39	-3089	-8.5	0.000125	3090.923	8.468281116	36.77837	45	8.221632	50	180	3.6
2111	0.923	0.59995	3.0615	26243.98	36.77849	62.43437728	12246.09	19753.91	11303.14	11851.36	-3089	-8.5	0.000114	3090.876	8.468152139	36.77849	45	8.221507	50	180	3.6
2112	0.923	0.59995	3.0615	26244.08	36.77861	62.43449727	12246.14	19753.86	11303.18	11851.33	-3090	-8.5	0.000103	3090.833	8.46803506	36.77861	45	8.221393	50	180	3.6
2113	0.923	0.59995	3.0615	26244.18	36.77871	62.43460619	12246.18	19753.82	11303.22	11851.3	-3090	-8.5	9.37E-05	3090.794	8.467928781	36.77871	45	8.22129	50	180	3.6
2114	0.923	0.59995	3.0615	26244.26	36.7788	62.43470507	12246.22	19753.78	11303.26	11851.28	-3090	-8.5	8.5E-05	3090.759	8.467832306	36.7788	45	8.221196	50	180	3.6
2115	0.923	0.59995	3.0615	26244.33	36.77889	62.43479482	12246.25	19753.75	11303.29	11851.26	-3090	-8.5	7.72E-05	3090.727	8.46774473	36.77889	45	8.221111	50	180	3.6
2116	0.923	0.59995	3.0615	26244.4	36.77897	62.43487629	12246.29	19753.71	11303.32	11851.24	-3090	-8.5	7.01E-05	3090.698	8.467665232	36.77897	45	8.221034	50	180	3.6
2117	0.923	0.59995	3.0615	26244.46	36.77904	62.43495025	12246.31	19753.69	11303.35	11851.22	-3090	-8.5	6.36E-05	3090.671	8.467593068	36.77904	45	8.220964	50	180	3.6
2118	0.923	0.59995	3.0615	26244.52	36.7791	62.43501739	12246.34	19753.66	11303.37	11851.21	-3090	-8.5	5.77E-05	3090.648	8.46752756	36.7791	45	8.220901	50	180	3.6
2119	0.923	0.59995	3.0615	26244.57	36.77916	62.43507833	12246.36	19753.64	11303.39	11851.19	-3090	-8.5	5.24E-05	3090.626	8.467468095	36.77916	45	8.220843	50	180	3.6
2120	0.923	0.59995	3.0615	26244.62	36.77921	62.43513365	12246.39	19753.61	11303.41	11851.18	-3090	-8.5	4.76E-05	3090.606	8.467414115	36.77921	45	8.22079	50	180	3.6
2121	0.923	0.59995	3.0615	26244.66	36.77926	62.43518387	12246.41	19753.59	11303.43	11851.17	-3090	-8.5	4.32E-05	3090.588	8.467365115	36.77926	45	8.220743	50	180	3.6
2122	0.923	0.59995	3.0615	26244.7	36.7793	62.43522946	12246.42	19753.58	11303.45	11851.16	-3090	-8.5	3.92E-05	3090.572	8.467320634	36.7793	45	8.2207	50	180	3.6
2123	0.923	0.59995	3.0615	26244.73	36.77934	62.43527084	12246.44	19753.56	11303.46	11851.15	-3090	-8.5	3.56E-05	3090.557	8.467280256	36.77934	45	8.22066	50	180	3.6
2124	0.923	0.59995	3.0615	26244.77	36.77938	62.4353084	12246.46	19753.54	11303.48	11851.14	-3090	-8.5	3.23E-05	3090.544	8.467243603	36.77938	45	8.220625	50	180	3.6
2125	0.923	0.59995	3.0615	26244.79	36.77941	62.4353425	12246.47	19753.53	11303.49	11851.13	-3090	-8.5	2.93E-05	3090.532	8.467210331	36.77941	45	8.220593	50	180	3.6
2126	0.923	0.59995	3.0615	26244.82	36.77944	62.43537345	12246.48	19753.52	11303.5	11851.12	-3090	-8.5	2.66E-05	3090.521	8.467180128	36.77944	45	8.220563	50	180	3.6
2127	0.923	0.59995	3.0615	26244.84	36.77946	62.43540155	12246.49	19753.51	11303.51	11851.12	-3090	-8.5	2.42E-05	3090.511	8.467152711	36.77946	45	8.220537	50	180	3.6
2128	0.923	0.59995	3.0615	26244.87	36.77949	62.43542706	12246.5	19753.5	11303.52	11851.11	-3090	-8.5	2.19E-05	3090.502	8.467127822	36.77949	45	8.220512	50	180	3.6
2129	0.923	0.59995	3.0615	26244.88	36.77951	62.43545021	12246.51	19753.49	11303.53	11851.11	-3090	-8.5	1.99E-05	3090.493	8.46710523	36.77951	45	8.220491	50	180	3.6
2130	0.923	0.59995	3.0615	26244.9	36.77953	62.43547123	12246.52	19753.48	11303.54	11851.1	-3090	-8.5	1.81E-05	3090.486	8.467084722	36.77953	45	8.220471	50	180	3.6
2131	0.923	0.59995	3.0615	26244.92	36.77955	62.43549031	12246.53	19753.47	11303.54	11851.1	-3090	-8.5	1.64E-05	3090.479	8.467066105	36.77955	45	8.220453	50	180	3.6
2132	0.923	0.59995	3.0615	26244.93	36.77956	62.43550763	12246.53	19753.47	11303.55	11851.09	-3090	-8.5	1.49E-05	3090.473	8.467049205	36.77956	45	8.220436	50	180	3.6
2133	0.923	0.59995	3.0615	26244.95	36.77958	62.43552335	12246.54	19753.46	11303.56	11851.09	-3090	-8.5	1.35E-05	3090.467	8.467033864	36.77958	45	8.220421	50	180	3.6
2134	0.923	0.59995	3.0615	26244.96	36.77959	62.43553762	12246.55	19753.45	11303.56	11851.09	-3090	-8.5	1.23E-05	3090.462	8.467019939	36.77959	45	8.220408	50	180	3.6
2135	0.923	0.59995	3.0615	26244.97	36.7796	62.43555058	12246.55	19753.45	11303.57	11851.08	-3090	-8.5	1.11E-05	3090.458	8.467007298	36.7796	45	8.220395	50	180	3.6
2136	0.923	0.59995	3.0615	26244.98	36.77962	62.43556234	12246.55	19753.45	11303.57	11851.08	-3090	-8.5	1.01E-05	3090.453	8.466995822	36.77962	45	8.220384	50	180	3.6
2137	0.923	0.59995	3.0615	26244.99	36.77963	62.43557302	12246.56	19753.44	11303.57	11851.08	-3090	-8.5	9.18E-06	3090.45	8.466985406	36.77963	45	8.220374	50	180	3.6
2138	0.923	0.59995	3.0615	26245	36.77964	62.43558271	12246.56	19753.44	11303.58	11851.07	-3090	-8.5	8.33E-06	3090.446	8.46697595	36.77964	45	8.220365	50	180	3.6
2139	0.923	0.59995	3.0615	26245	36.77964	62.4355915	12246.57	19753.43	11303.58	11851.07	-3090	-8.5	7.56E-06	3090.443	8.466967366	36.77964	45	8.220357	50	180	3.6

	Max rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2140	0.923	0.59995	3.0615	26245.01	36.77965	62.43559949	12246.57	19753.43	11303.58	11851.07	-3090	-8.5	6.87E-06	3090.44	8.466959574	36.77965	45	8.220349	50	180	3.6
2141	0.923	0.59995	3.0615	26245.02	36.77966	62.43560674	12246.57	19753.43	11303.59	11851.07	-3090	-8.5	6.23E-06	3090.438	8.466952501	36.77966	45	8.220342	50	180	3.6
2142	0.923	0.59995	3.0615	26245.02	36.77966	62.43561332	12246.57	19753.43	11303.59	11851.07	-3090	-8.5	5.66E-06	3090.435	8.466946081	36.77966	45	8.220336	50	180	3.6
2143	0.923	0.59995	3.0615	26245.03	36.77967	62.43561929	12246.58	19753.42	11303.59	11851.07	-3090	-8.5	5.14E-06	3090.433	8.466940252	36.77967	45	8.22033	50	180	3.6
2144	0.923	0.59995	3.0615	26245.03	36.77967	62.43562471	12246.58	19753.42	11303.59	11851.06	-3090	-8.5	4.66E-06	3090.431	8.466934961	36.77967	45	8.220325	50	180	3.6
2145	0.923	0.59995	3.0615	26245.04	36.77968	62.43562964	12246.58	19753.42	11303.59	11851.06	-3090	-8.5	4.23E-06	3090.43	8.466930158	36.77968	45	8.220321	50	180	3.6
2146	0.923	0.59995	3.0615	26245.04	36.77968	62.4356341	12246.58	19753.42	11303.6	11851.06	-3090	-8.5	3.84E-06	3090.428	8.466925799	36.77968	45	8.220316	50	180	3.6
2147	0.923	0.59995	3.0615	26245.04	36.77969	62.43563816	12246.58	19753.42	11303.6	11851.06	-3090	-8.5	3.49E-06	3090.426	8.466921841	36.77969	45	8.220312	50	180	3.6
2148	0.923	0.59995	3.0615	26245.05	36.77969	62.43564184	12246.59	19753.41	11303.6	11851.06	-3090	-8.5	3.17E-06	3090.425	8.466918248	36.77969	45	8.220309	50	180	3.6
2149	0.923	0.59995	3.0615	26245.05	36.77969	62.43564518	12246.59	19753.41	11303.6	11851.06	-3090	-8.5	2.87E-06	3090.424	8.466914987	36.77969	45	8.220306	50	180	3.6
2150	0.923	0.59995	3.0615	26245.05	36.7797	62.43564822	12246.59	19753.41	11303.6	11851.06	-3090	-8.5	2.61E-06	3090.423	8.466912027	36.7797	45	8.220303	50	180	3.6
2151	0.923	0.59995	3.0615	26245.05	36.7797	62.43565097	12246.59	19753.41	11303.6	11851.06	-3090	-8.5	2.37E-06	3090.422	8.466909339	36.7797	45	8.2203	50	180	3.6
2152	0.923	0.59995	3.0615	26245.06	36.7797	62.43565347	12246.59	19753.41	11303.6	11851.06	-3090	-8.5	2.15E-06	3090.421	8.4669069	36.7797	45	8.220298	50	180	3.6
2153	0.923	0.59995	3.0615	26245.06	36.7797	62.43565574	12246.59	19753.41	11303.6	11851.06	-3090	-8.5	1.95E-06	3090.42	8.466904685	36.7797	45	8.220296	50	180	3.6
2154	0.923	0.59995	3.0615	26245.06	36.77971	62.4356578	12246.59	19753.41	11303.6	11851.06	-3090	-8.5	1.77E-06	3090.419	8.466902675	36.77971	45	8.220294	50	180	3.6
2155	0.923	0.59995	3.0615	26245.06	36.77971	62.43565967	12246.59	19753.41	11303.61	11851.06	-3090	-8.5	1.61E-06	3090.419	8.466900851	36.77971	45	8.220292	50	180	3.6
2156	0.923	0.59995	3.0615	26245.06	36.77971	62.43566137	12246.59	19753.41	11303.61	11851.06	-3090	-8.5	1.46E-06	3090.418	8.466899194	36.77971	45	8.22029	50	180	3.6
2157	0.923	0.59995	3.0615	26245.06	36.77971	62.43566291	12246.59	19753.41	11303.61	11851.06	-3090	-8.5	1.33E-06	3090.418	8.46689769	36.77971	45	8.220289	50	180	3.6
2158	0.923	0.59995	3.0615	26245.06	36.77971	62.43566431	12246.59	19753.41	11303.61	11851.06	-3090	-8.5	1.2E-06	3090.417	8.466896325	36.77971	45	8.220288	50	180	3.6
2159	0.923	0.59995	3.0615	26245.07	36.77971	62.43566558	12246.6	19753.4	11303.61	11851.06	-3090	-8.5	1.09E-06	3090.417	8.466895086	36.77971	45	8.220286	50	180	3.6
2160	0.923	0.59995	3.0615	26245.07	36.77971	62.43566673	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	9.91E-07	3090.416	8.466893962	36.77971	45	8.220285	50	180	3.6
2161	0.923	0.59995	3.0615	26245.07	36.77972	62.43566778	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	9E-07	3090.416	8.466892941	36.77972	45	8.220284	50	180	3.6
2162	0.923	0.59995	3.0615	26245.07	36.77972	62.43566873	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	8.17E-07	3090.416	8.466892014	36.77972	45	8.220284	50	180	3.6
2163	0.923	0.59995	3.0615	26245.07	36.77972	62.43566959	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	7.41E-07	3090.415	8.466891172	36.77972	45	8.220283	50	180	3.6
2164	0.923	0.59995	3.0615	26245.07	36.77972	62.43567037	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	6.73E-07	3090.415	8.466890409	36.77972	45	8.220282	50	180	3.6
2165	0.923	0.59995	3.0615	26245.07	36.77972	62.43567108	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	6.11E-07	3090.415	8.466889715	36.77972	45	8.220281	50	180	3.6
2166	0.923	0.59995	3.0615	26245.07	36.77972	62.43567173	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	5.55E-07	3090.415	8.466889086	36.77972	45	8.220281	50	180	3.6
2167	0.923	0.59995	3.0615	26245.07	36.77972	62.43567231	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	5.03E-07	3090.414	8.466888515	36.77972	45	8.22028	50	180	3.6
2168	0.923	0.59995	3.0615	26245.07	36.77972	62.43567285	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	4.57E-07	3090.414	8.466887996	36.77972	45	8.22028	50	180	3.6
2169	0.923	0.59995	3.0615	26245.07	36.77972	62.43567333	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	4.15E-07	3090.414	8.466887525	36.77972	45	8.220279	50	180	3.6
2170	0.923	0.59995	3.0615	26245.07	36.77972	62.43567377	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	3.77E-07	3090.414	8.466887098	36.77972	45	8.220279	50	180	3.6
2171	0.923	0.59995	3.0615	26245.07	36.77972	62.43567416	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	3.42E-07	3090.414	8.46688671	36.77972	45	8.220278	50	180	3.6
2172	0.923	0.59995	3.0615	26245.07	36.77972	62.43567452	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	3.1E-07	3090.414	8.466886358	36.77972	45	8.220278	50	180	3.6
2173	0.923	0.59995	3.0615	26245.07	36.77972	62.43567485	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.82E-07	3090.413	8.466886038	36.77972	45	8.220278	50	180	3.6
2174	0.923	0.59995	3.0615	26245.07	36.77972	62.43567515	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.56E-07	3090.413	8.466885748	36.77972	45	8.220277	50	180	3.6
2175	0.923	0.59995	3.0615	26245.07	36.77972	62.43567542	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.32E-07	3090.413	8.466885485	36.77972	45	8.220277	50	180	3.6
2176	0.923	0.59995	3.0615	26245.07	36.77972	62.43567566	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.11E-07	3090.413	8.466885246	36.77972	45	8.220277	50	180	3.6
2177	0.923	0.59995	3.0615	26245.07	36.77972	62.43567589	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.91E-07	3090.413	8.466885029	36.77972	45	8.220277	50	180	3.6
2178	0.923	0.59995	3.0615	26245.07	36.77972	62.43567609	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.74E-07	3090.413	8.466884832	36.77972	45	8.220277	50	180	3.6
2179	0.923	0.59995	3.0615	26245.07	36.77972	62.43567627	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.58E-07	3090.413	8.466884653	36.77972	45	8.220276	50	180	3.6
2180	0.923	0.59995	3.0615	26245.08	36.77972	62.43567644	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.43E-07	3090.413	8.46688449	36.77972	45	8.220276	50	180	3.6
2181	0.923	0.59995	3.0615	26245.08	36.77972	62.43567659	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.3E-07	3090.413	8.466884343	36.77972	45	8.220276	50	180	3.6
2182	0.923	0.59995	3.0615	26245.08	36.77972	62.43567673	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.18E-07	3090.413	8.466884209	36.77972	45	8.220276	50	180	3.6
2183	0.923	0.59995	3.0615	26245.08	36.77972	62.43567685	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.07E-07	3090.413	8.466884088	36.77972	45	8.220276	50	180	3.6
2184	0.923	0.59995	3.0615	26245.08	36.77972	62.43567696	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	9.72E-08	3090.413	8.466883977	36.77972	45	8.220276	50	180	3.6
2185	0.923	0.59995	3.0615	26245.08	36.77972	62.43567707	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	8.82E-08	3090.413	8.466883877	36.77972	45	8.220276	50	180	3.6
2186	0.923	0.59995	3.0615	26245.08	36.77972	62.43567716	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	8.01E-08	3090.413	8.466883786	36.77972	45	8.220276	50	180	3.6
2187	0.923	0.59995	3.0615	26245.08	36.77972	62.43567724	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	7.27E-08	3090.413	8.466883704	36.77972	45	8.220275	50	180	3.6
2188	0.923	0.59995	3.0615	26245.08	36.77972	62.43567732	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	6.6E-08	3090.413	8.466883629	36.77972	45	8.220275	50	180	3.6
2189	0.923	0.59995	3.0615	26245.08	36.77972	62.43567739	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	5.99E-08	3090.412	8.466883561	36.77972	45	8.220275	50	180	3.6
2190	0.923	0.59995	3.0615	26245.08	36.77972	62.43567745	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	5.44E-08	3090.412	8.4668835	36.77972	45	8.220275	50	180	3.6
2191	0.923	0.59995	3.0615	26245.08	36.77972	62.43567751	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	4.94E-08	3090.412	8.466883444	36.77972	45	8.220275	50	180	3.6
2192	0.923	0.59995	3.0615	26245.08	36.77972	62.43567756	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	4.48E-08	3090.412	8.466883393	36.77972	45	8.220275	50	180	3.6
2193	0.923	0.59995	3.0615	26245.08	36.77972	62.43567761	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	4.07E-08	3090.412	8.466883347	36.77972	45	8.220275	50	180	3.6
2194	0.923	0.59995	3.0615	26245.08	36.77972	62.43567765	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	3.69E-08	3090.412	8.466883305	36.77972	45	8.220275	50	180	3.6
2195	0.923	0.59995	3.0615	26245.08	36.77972	62.43567769	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	3.35E-08	3090.412	8.466883267	36.77972	45	8.220275	50	180	3.6
2196	0.923	0.59995	3.0615	26245.08	36.77973	62.43567773	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	3.04E-08	3090.412	8.466883232	36.77973	45	8.220275	50	180	3.6
2197	0.923	0.59995	3.0615	26245.08	36.77973	62.43567776	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.76E-08	3090.412	8.466883201	36.77973	45	8.220275	50	180	3.6
2198	0.923	0.59995	3.0615	26245.08	36.77973	62.43567779	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.51E-08	3090.412	8.466883172	36.77973	45	8.220275	50	180	3.6
2199	0.923	0.59995	3.0615	26245.08	36.77973	62.43567782	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.28E-08	3090.412	8.466883147	36.77973	45	8.220275	50	180	3.6

	Max rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2200	0.923	0.59995	3.0615	26245.08	36.77973	62.43567784	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.07E-08	3090.412	8.466883123	36.77973	45	8.220275	50	180	3.6
2201	0.923	0.59995	3.0615	26245.08	36.77973	62.43567786	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.88E-08	3090.412	8.466883102	36.77973	45	8.220275	50	180	3.6
2202	0.923	0.59995	3.0615	26245.08	36.77973	62.43567788	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.7E-08	3090.412	8.466883083	36.77973	45	8.220275	50	180	3.6
2203	0.923	0.59995	3.0615	26245.08	36.77973	62.4356779	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.55E-08	3090.412	8.466883065	36.77973	45	8.220275	50	180	3.6
2204	0.923	0.59995	3.0615	26245.08	36.77973	62.43567792	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.4E-08	3090.412	8.466883049	36.77973	45	8.220275	50	180	3.6
2205	0.923	0.59995	3.0615	26245.08	36.77973	62.43567793	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.27E-08	3090.412	8.466883035	36.77973	45	8.220275	50	180	3.6
2206	0.923	0.59995	3.0615	26245.08	36.77973	62.43567794	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.16E-08	3090.412	8.466883021	36.77973	45	8.220275	50	180	3.6
2207	0.923	0.59995	3.0615	26245.08	36.77973	62.43567796	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.05E-08	3090.412	8.46688301	36.77973	45	8.220275	50	180	3.6
2208	0.923	0.59995	3.0615	26245.08	36.77973	62.43567797	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	9.52E-09	3090.412	8.466882999	36.77973	45	8.220275	50	180	3.6
2209	0.923	0.59995	3.0615	26245.08	36.77973	62.43567798	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	8.65E-09	3090.412	8.466882989	36.77973	45	8.220275	50	180	3.6
2210	0.923	0.59995	3.0615	26245.08	36.77973	62.43567799	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	7.85E-09	3090.412	8.46688298	36.77973	45	8.220275	50	180	3.6
2211	0.923	0.59995	3.0615	26245.08	36.77973	62.43567799	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	7.12E-09	3090.412	8.466882972	36.77973	45	8.220275	50	180	3.6
2212	0.923	0.59995	3.0615	26245.08	36.77973	62.435678	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	6.47E-09	3090.412	8.466882965	36.77973	45	8.220275	50	180	3.6
2213	0.923	0.59995	3.0615	26245.08	36.77973	62.43567801	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	5.87E-09	3090.412	8.466882958	36.77973	45	8.220275	50	180	3.6
2214	0.923	0.59995	3.0615	26245.08	36.77973	62.43567802	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	5.33E-09	3090.412	8.466882952	36.77973	45	8.220275	50	180	3.6
2215	0.923	0.59995	3.0615	26245.08	36.77973	62.43567802	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	4.84E-09	3090.412	8.466882946	36.77973	45	8.220275	50	180	3.6
2216	0.923	0.59995	3.0615	26245.08	36.77973	62.43567803	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	4.39E-09	3090.412	8.466882941	36.77973	45	8.220275	50	180	3.6
2217	0.923	0.59995	3.0615	26245.08	36.77973	62.43567803	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	3.99E-09	3090.412	8.466882937	36.77973	45	8.220275	50	180	3.6
2218	0.923	0.59995	3.0615	26245.08	36.77973	62.43567804	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	3.62E-09	3090.412	8.466882933	36.77973	45	8.220275	50	180	3.6
2219	0.923	0.59995	3.0615	26245.08	36.77973	62.43567804	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	3.28E-09	3090.412	8.466882929	36.77973	45	8.220275	50	180	3.6
2220	0.923	0.59995	3.0615	26245.08	36.77973	62.43567804	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.98E-09	3090.412	8.466882926	36.77973	45	8.220275	50	180	3.6
2221	0.923	0.59995	3.0615	26245.08	36.77973	62.43567805	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.71E-09	3090.412	8.466882923	36.77973	45	8.220275	50	180	3.6
2222	0.923	0.59995	3.0615	26245.08	36.77973	62.43567805	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.46E-09	3090.412	8.46688292	36.77973	45	8.220275	50	180	3.6
2223	0.923	0.59995	3.0615	26245.08	36.77973	62.43567805	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.23E-09	3090.412	8.466882917	36.77973	45	8.220275	50	180	3.6
2224	0.923	0.59995	3.0615	26245.08	36.77973	62.43567805	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.02E-09	3090.412	8.466882915	36.77973	45	8.220275	50	180	3.6
2225	0.923	0.59995	3.0615	26245.08	36.77973	62.43567806	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.84E-09	3090.412	8.466882913	36.77973	45	8.220275	50	180	3.6
2226	0.923	0.59995	3.0615	26245.08	36.77973	62.43567806	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.67E-09	3090.412	8.466882911	36.77973	45	8.220275	50	180	3.6
2227	0.923	0.59995	3.0615	26245.08	36.77973	62.43567806	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.51E-09	3090.412	8.466882909	36.77973	45	8.220275	50	180	3.6
2228	0.923	0.59995	3.0615	26245.08	36.77973	62.43567806	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.37E-09	3090.412	8.466882908	36.77973	45	8.220275	50	180	3.6
2229	0.923	0.59995	3.0615	26245.08	36.77973	62.43567806	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.25E-09	3090.412	8.466882906	36.77973	45	8.220275	50	180	3.6
2230	0.923	0.59995	3.0615	26245.08	36.77973	62.43567806	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.13E-09	3090.412	8.466882905	36.77973	45	8.220275	50	180	3.6
2231	0.923	0.59995	3.0615	26245.08	36.77973	62.43567806	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.03E-09	3090.412	8.466882904	36.77973	45	8.220275	50	180	3.6
2232	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	9.34E-10	3090.412	8.466882903	36.77973	45	8.220275	50	180	3.6
2233	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	8.47E-10	3090.412	8.466882902	36.77973	45	8.220275	50	180	3.6
2234	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	7.69E-10	3090.412	8.466882901	36.77973	45	8.220275	50	180	3.6
2235	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	6.98E-10	3090.412	8.4668829	36.77973	45	8.220275	50	180	3.6
2236	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	6.34E-10	3090.412	8.4668829	36.77973	45	8.220275	50	180	3.6
2237	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	5.75E-10	3090.412	8.466882899	36.77973	45	8.220275	50	180	3.6
2238	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	5.22E-10	3090.412	8.466882898	36.77973	45	8.220275	50	180	3.6
2239	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	4.74E-10	3090.412	8.466882898	36.77973	45	8.220275	50	180	3.6
2240	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	4.3E-10	3090.412	8.466882897	36.77973	45	8.220275	50	180	3.6
2241	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	3.91E-10	3090.412	8.466882897	36.77973	45	8.220275	50	180	3.6
2242	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	3.55E-10	3090.412	8.466882896	36.77973	45	8.220275	50	180	3.6
2243	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	3.22E-10	3090.412	8.466882896	36.77973	45	8.220275	50	180	3.6
2244	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.92E-10	3090.412	8.466882896	36.77973	45	8.220275	50	180	3.6
2245	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.65E-10	3090.412	8.466882895	36.77973	45	8.220275	50	180	3.6
2246	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.41E-10	3090.412	8.466882895	36.77973	45	8.220275	50	180	3.6
2247	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.19E-10	3090.412	8.466882895	36.77973	45	8.220275	50	180	3.6
2248	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.98E-10	3090.412	8.466882895	36.77973	45	8.220275	50	180	3.6
2249	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.8E-10	3090.412	8.466882894	36.77973	45	8.220275	50	180	3.6
2250	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.64E-10	3090.412	8.466882894	36.77973	45	8.220275	50	180	3.6
2251	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.48E-10	3090.412	8.466882894	36.77973	45	8.220275	50	180	3.6
2252	0.923	0.59995	3.0615	26245.08	36.77973	62.43567807	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.35E-10	3090.412	8.466882894	36.77973	45	8.220275	50	180	3.6
2253	0.923	0.59995	3.0615	26245.08	36.77973	62.43567808	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.22E-10	3090.412	8.466882894	36.77973	45	8.220275	50	180	3.6
2254	0.923	0.59995	3.0615	26245.08	36.77973	62.43567808	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.11E-10	3090.412	8.466882894	36.77973	45	8.220275	50	180	3.6
2255	0.923	0.59995	3.0615	26245.08	36.77973	62.43567808	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	1.01E-10	3090.412	8.466882894	36.77973	45	8.220275	50	180	3.6
2256	0.923	0.59995	3.0615	26245.08	36.77973	62.43567808	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	9.15E-11	3090.412	8.466882893	36.77973	45	8.220275	50	180	3.6
2257	0.923	0.59995	3.0615	26245.08	36.77973	62.43567808	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	8.31E-11	3090.412	8.466882893	36.77973	45	8.220275	50	180	3.6
2258	0.923	0.59995	3.0615	26245.08	36.77973	62.43567808	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	7.54E-11	3090.412	8.466882893	36.77973	45	8.220275	50	180	3.6
2259	0.923	0.59995	3.0615	26245.08	36.77973	62.43567808	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	6.84E-11	3090.412	8.466882893	36.77973	45	8.220275	50	180	3.6

	Max rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change le\	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2260	0.923	0.59995	3.0615	26245.08	36.77973	62.43567808	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	6.21E-11	3090.412	8.466882893	36.77973	45	8.220275	50	180	3.6
2261	0.923	0.59995	3.0615	26245.08	36.77973	62.43567808	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	5.64E-11	3090.412	8.466882893	36.77973	45	8.220275	50	180	3.6
2262	0.923	0.59995	3.0615	26245.08	36.77973	62.43567808	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	5.12E-11	3090.412	8.466882893	36.77973	45	8.220275	50	180	3.6
2263	0.923	0.59995	3.0615	26245.08	36.77973	62.43567808	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	4.65E-11	3090.412	8.466882893	36.77973	45	8.220275	50	180	3.6
2264	0.923	0.59995	3.0615	26245.08	36.77973	62.43567808	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	4.22E-11	3090.412	8.466882893	36.77973	45	8.220275	50	180	3.6
2265	0.923	0.59995	3.0615	26245.08	36.77973	62.43567808	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	3.83E-11	3090.412	8.466882893	36.77973	45	8.220275	50	180	3.6
2266	0.923	0.59995	3.0615	26245.08	36.77973	62.43567808	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	3.48E-11	3090.412	8.466882893	36.77973	45	8.220275	50	180	3.6
2267	0.923	0.59995	3.0615	26245.08	36.77973	62.43567808	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	3.16E-11	3090.412	8.466882893	36.77973	45	8.220275	50	180	3.6
2268	0.923	0.59995	3.0615	26245.08	36.77973	62.43567808	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.86E-11	3090.412	8.466882893	36.77973	45	8.220275	50	180	3.6
2269	0.923	0.59995	3.0615	26245.08	36.77973	62.43567808	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.6E-11	3090.412	8.466882893	36.77973	45	8.220275	50	180	3.6
2270	0.923	0.59995	3.0615	26245.08	36.77973	62.43567808	12246.6	19753.4	11303.61	11851.05	-3090	-8.5	2.36E-11	3090.412	8.466882893	36.77973	45	8.220275	50	180	3.6

	Low rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change level	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2020	0.15	0.0975	3.0615	16832.15	25	50.001	7854.296	24145.7	1178.144	2354.206	-13300	-36.4	-0.736004631	7519	20.6	25	45	20	50	180	3.6
2021	0.15	0.0975	3.0615	16313.13	24.264	49.22407351	7612.109	24387.89	1141.816	2377.819	-12793	-35.1	-0.656558244	7795.701	21.35808477	24.264	45	20.736	50	180	3.6
2022	0.15	0.0975	3.0615	15856.99	23.60744	48.53101063	7399.264	24600.74	1109.89	2398.572	-12349	-33.8	-0.581949484	8042.534	22.03433976	23.60744	45	21.39256	50	180	3.6
2023	0.15	0.0975	3.0615	15458.1	23.02549	47.91670475	7213.13	24786.87	1081.97	2416.72	-11959	-32.8	-0.512688809	8261.318	22.63374773	23.02549	45	21.97451	50	180	3.6
2024	0.15	0.0975	3.0615	15110.89	22.5128	47.37551045	7051.113	24948.89	1057.667	2432.516	-11621	-31.8	-0.449098047	8454.063	23.1618172	22.5128	45	22.4872	50	180	3.6
2025	0.15	0.0975	3.0615	14809.98	22.0637	46.90144255	6910.704	25089.3	1036.606	2446.206	-11327	-31.0	-0.391316149	8622.902	23.62438819	22.0637	45	22.9363	50	180	3.6
2026	0.15	0.0975	3.0615	14550.26	21.67238	46.48836922	6789.511	25210.49	1018.427	2458.023	-11074	-30.3	-0.339316811	8770.017	24.02744382	21.67238	45	23.32762	50	180	3.6
2027	0.15	0.0975	3.0615	14326.91	21.33307	46.1301864	6685.291	25314.71	1002.794	2468.184	-10856	-29.7	-0.292934335	8897.583	24.37694014	21.33307	45	23.66693	50	180	3.6
2028	0.15	0.0975	3.0615	14135.48	21.04013	45.82096491	6595.965	25404.04	989.3947	2476.893	-10669	-29.2	-0.251893782	9007.712	24.6786625	21.04013	45	23.95987	50	180	3.6
2029	0.15	0.0975	3.0615	13971.9	20.78824	45.55506584	6519.634	25480.37	977.9451	2484.336	-10510	-28.8	-0.215841867	9102.411	24.9381131	20.78824	45	24.21176	50	180	3.6
2030	0.15	0.0975	3.0615	13832.49	20.5724	45.32722316	6454.582	25545.42	968.1873	2490.678	-10374	-28.4	-0.184375806	9183.557	25.16043022	20.5724	45	24.4276	50	180	3.6
2031	0.15	0.0975	3.0615	13713.96	20.38802	45.13259606	6399.271	25600.73	959.8907	2496.071	-10258	-28.1	-0.157068344	9252.873	25.3503373	20.38802	45	24.61198	50	180	3.6
2032	0.15	0.0975	3.0615	13613.38	20.23095	44.96679472	6352.34	25647.66	952.851	2500.647	-10160	-27.8	-0.133488047	9311.923	25.5121177	20.23095	45	24.76905	50	180	3.6
2033	0.15	0.0975	3.0615	13528.2	20.09747	44.82588474	6312.59	25687.41	946.8886	2504.522	-10077	-27.6	-0.113214717	9362.108	25.64961038	20.09747	45	24.90253	50	180	3.6
2034	0.15	0.0975	3.0615	13456.16	19.98425	44.70637528	6278.976	25721.02	941.8463	2507.8	-10007	-27.4	-0.095850264	9404.671	25.76622154	19.98425	45	25.01575	50	180	3.6
2035	0.15	0.0975	3.0615	13395.32	19.8884	44.60519574	6250.587	25749.41	937.588	2510.568	-9947	-27.3	-0.081025661	9440.706	25.86494731	19.8884	45	25.1116	50	180	3.6
2036	0.15	0.0975	3.0615	13344	19.80738	44.51966506	6226.638	25773.36	933.9958	2512.903	-9897	-27.1	-0.06840475	9471.167	25.94840374	19.80738	45	25.19262	50	180	3.6
2037	0.15	0.0975	3.0615	13300.75	19.73897	44.447457	6206.456	25793.54	930.9685	2514.87	-9855	-27.0	-0.057685625	9496.884	26.01886064	19.73897	45	25.26103	50	180	3.6
2038	0.15	0.0975	3.0615	13264.33	19.68128	44.38656406	6189.462	25810.54	928.4194	2516.527	-9819	-26.9	-0.048600272	9518.571	26.07827683	19.68128	45	25.31872	50	180	3.6
2039	0.15	0.0975	3.0615	13233.68	19.63268	44.33526161	6175.163	25824.84	926.2744	2517.922	-9789	-26.8	-0.04091303	9536.842	26.12833511	19.63268	45	25.36732	50	180	3.6
2040	0.15	0.0975	3.0615	13207.91	19.59177	44.29207381	6163.138	25836.86	924.4707	2519.094	-9764	-26.8	-0.034418324	9552.224	26.17047553	19.59177	45	25.40823	50	180	3.6
2041	0.15	0.0975	3.0615	13186.25	19.55735	44.25574183	6153.031	25846.97	922.9547	2520.079	-9743	-26.7	-0.028937996	9565.163	26.20592641	19.55735	45	25.44265	50	180	3.6
2042	0.15	0.0975	3.0615	13168.06	19.52842	44.22519488	6144.54	25855.46	921.681	2520.907	-9725	-26.6	-0.024318491	9576.042	26.23573254	19.52842	45	25.47158	50	180	3.6
2043	0.15	0.0975	3.0615	13152.77	19.5041	44.19952428	6137.409	25862.59	920.6113	2521.603	-9711	-26.6	-0.020428064	9585.185	26.26078059	19.5041	45	25.4959	50	180	3.6
2044	0.15	0.0975	3.0615	13139.94	19.48367	44.17796042	6131.422	25868.58	919.7133	2522.186	-9698	-26.6	-0.017154108	9592.865	26.28182149	19.48367	45	25.51633	50	180	3.6
2045	0.15	0.0975	3.0615	13129.17	19.46651	44.15985254	6126.397	25873.6	918.9595	2522.676	-9688	-26.5	-0.014400683	9599.314	26.29949023	19.46651	45	25.53349	50	180	3.6
2046	0.15	0.0975	3.0615	13120.14	19.45211	44.14465118	6122.179	25877.82	918.3269	2523.088	-9679	-26.5	-0.012086264	9604.728	26.31432293	19.45211	45	25.54789	50	180	3.6
2047	0.15	0.0975	3.0615	13112.55	19.44003	44.13189292	6118.641	25881.36	917.7962	2523.432	-9671	-26.5	-0.010141727	9609.272	26.32677178	19.44003	45	25.55997	50	180	3.6
2048	0.15	0.0975	3.0615	13106.19	19.42989	44.12118731	6115.673	25884.33	917.3509	2523.722	-9665	-26.5	-0.008508575	9613.084	26.33721776	19.42989	45	25.57011	50	180	3.6
2049	0.15	0.0975	3.0615	13100.86	19.42138	44.11220566	6113.183	25886.82	916.9775	2523.965	-9660	-26.5	-0.007137381	9616.283	26.34598159	19.42138	45	25.57862	50	180	3.6
2050	0.15	0.0975	3.0615	13096.38	19.41424	44.10467144	6111.095	25888.9	916.6643	2524.168	-9656	-26.5	-0.005986432	9618.967	26.35333309	19.41424	45	25.58576	50	180	3.6
2051	0.15	0.0975	3.0615	13092.63	19.40825	44.09835216	6109.344	25890.66	916.4016	2524.339	-9652	-26.4	-0.005020569	9621.217	26.35949912	19.40825	45	25.59175	50	180	3.6
2052	0.15	0.0975	3.0615	13089.48	19.40323	44.09305245	6107.876	25892.12	916.1814	2524.482	-9649	-26.4	-0.004210179	9623.105	26.36467031	19.40323	45	25.59677	50	180	3.6
2053	0.15	0.0975	3.0615	13086.84	19.39902	44.08860819	6106.645	25893.36	915.9967	2524.602	-9646	-26.4	-0.003530343	9624.687	26.36900679	19.39902	45	25.60098	50	180	3.6
2054	0.15	0.0975	3.0615	13084.63	19.39549	44.08488156	6105.612	25894.39	915.8419	2524.703	-9644	-26.4	-0.002960105	9626.015	26.37264304	19.39549	45	25.60451	50	180	3.6
2055	0.15	0.0975	3.0615	13082.78	19.39253	44.08175687	6104.747	25895.25	915.712	2524.787	-9642	-26.4	-0.002481848	9627.128	26.37569195	19.39253	45	25.60747	50	180	3.6
2056	0.15	0.0975	3.0615	13081.22	19.39005	44.07913703	6104.021	25895.98	915.6032	2524.858	-9641	-26.4	-0.002080774	9628.061	26.37824825	19.39005	45	25.60995	50	180	3.6
2057	0.15	0.0975	3.0615	13079.92	19.38797	44.07694057	6103.413	25896.59	915.5119	2524.917	-9639	-26.4	-0.001744453	9628.843	26.38039145	19.38797	45	25.61203	50	180	3.6
2058	0.15	0.0975	3.0615	13078.83	19.38623	44.07509912	6102.903	25897.1	915.4355	2524.967	-9638	-26.4	-0.001462448	9629.499	26.38218824	19.38623	45	25.61377	50	180	3.6
2059	0.15	0.0975	3.0615	13077.91	19.38476	44.07355536	6102.476	25897.52	915.3713	2525.009	-9638	-26.4	-0.001226002	9630.049	26.38369456	19.38476	45	25.61524	50	180	3.6
2060	0.15	0.0975	3.0615	13077.14	19.38354	44.07226119	6102.117	25897.88	915.3176	2525.044	-9637	-26.4	-0.001027761	9630.509	26.38495734	19.38354	45	25.61646	50	180	3.6
2061	0.15	0.0975	3.0615	13076.5	19.38251	44.07117629	6101.817	25898.18	915.2725	2525.073	-9636	-26.4	-0.000861561	9630.896	26.38601594	19.38251	45	25.61749	50	180	3.6
2062	0.15	0.0975	3.0615	13075.96	19.38165	44.07026683	6101.565	25898.44	915.2347	2525.097	-9636	-26.4	-0.000722226	9631.22	26.38690334	19.38165	45	25.61835	50	180	3.6
2063	0.15	0.0975	3.0615	13075.51	19.38093	44.06950444	6101.354	25898.65	915.2031	2525.118	-9635	-26.4	-0.000605418	9631.491	26.38764724	19.38093	45	25.61907	50	180	3.6
2064	0.15	0.0975	3.0615	13075.13	19.38032	44.06886536	6101.177	25898.82	915.1765	2525.135	-9635	-26.4	-0.000507496	9631.719	26.38827082	19.38032	45	25.61968	50	180	3.6
2065	0.15	0.0975	3.0615	13074.81	19.37981	44.06832965	6101.028	25898.97	915.1543	2525.15	-9635	-26.4	-0.000425408	9631.91	26.38879354	19.37981	45	25.62019	50	180	3.6
2066	0.15	0.0975	3.0615	13074.54	19.37939	44.06788059	6100.904	25899.1	915.1356	2525.162	-9634	-26.4	-0.000356596	9632.07	26.38923171	19.37939	45	25.62061	50	180	3.6
2067	0.15	0.0975	3.0615	13074.32	19.37903	44.06750417	6100.8	25899.2	915.12	2525.172	-9634	-26.4	-0.000298913	9632.204	26.389599	19.37903	45	25.62097	50	180	3.6
2068	0.15	0.0975	3.0615	13074.13	19.37873	44.06718864	6100.713	25899.29	915.1069	2525.181	-9634	-26.4	-0.000250559	9632.316	26.38990688	19.37873	45	25.62127	50	180	3.6
2069	0.15	0.0975	3.0615	13073.98	19.37848	44.06692415	6100.639	25899.36	915.0959	2525.188	-9634	-26.4	-0.000210026	9632.41	26.39016496	19.37848	45	25.62152	50	180	3.6
2070	0.15	0.0975	3.0615	13073.84	19.37827	44.06670244	6100.578	25899.42	915.0867	2525.194	-9634	-26.4	-0.00017605	9632.489	26.39038129	19.37827	45	25.62173	50	180	3.6
2071	0.15	0.0975	3.0615	13073.73	19.37809	44.0665166	6100.526	25899.47	915.079	2525.199	-9633	-26.4	-0.000147569	9632.555	26.39056262	19.37809	45	25.62191	50	180	3.6
2072	0.15	0.0975	3.0615	13073.64	19.37795	44.06636083	6100.483	25899.52	915.0725	2525.203	-9633	-26.4	-0.000123696	9632.611	26.39071461	19.37795	45	25.62205	50	180	3.6
2073	0.15	0.0975	3.0615	13073.56	19.37782	44.06623026	6100.447	25899.55	915.0671	2525.206	-9633	-26.4	-0.000103685	9632.657	26.39084202	19.37782	45	25.62218	50	180	3.6
2074	0.15	0.0975	3.0615	13073.5	19.37772	44.06612081	6100.417	25899.58	915.0625	2525.209	-9633	-26.4	-8.69107E-05	9632.696	26.39094882	19.37772	45	25.62228	50	180	3.6
2075	0.15	0.0975	3.0615	13073.44	19.37763	44.06602906	6100.391	25899.61	915.0587	2525.212	-9633	-26.4	-7.28502E-05	9632.729	26.39103833	19.37763	45	25.62237	50	180	3.6
2076	0.15	0.0975	3.0615	13073.4	19.37756	44.06595216	6100.37	25899.63	915.0555	2525.214	-9633	-26.4	-6.10643E-05	9632.756	26.39111337	19.37756	45	25.62244	50	180	3.6
2077	0.15	0.0975	3.0615	13073.36	19.3775	44.0658877	6100.352	25899.65	915.0529	2525.216	-9633	-26.4	-5.11851E-05	9632.779	26.39117627	19.3775	45	25.6225	50	180	3.6
2078	0.15	0.0975	3.0615	13073.33	19.37745	44.06583367	6100.337	25899.66	915.0506	2525.217	-9633	-26.4	-4.29042E-05	9632.799	26.39122899	19.37745	45	25.62255	50	180	3.6
2079	0.15	0.0975	3.0615	13073.3	19.3774	44.06578838	6100.325	25899.68	915.0487	2525.218	-9633	-26.4	-3.5963E-05	9632.815	26.39127318	19.3774	45	25.6226	50	180	3.6

	Low rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change level	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2080	0.15	0.0975	3.0615	13073.28	19.37737	44.06575042	6100.314	25899.69	915.0471	2525.219	-9633	-26.4	-3.01447E-05	9632.828	26.39131022	19.37737	45	25.62263	50	180	3.6
2081	0.15	0.0975	3.0615	13073.26	19.37734	44.0657186	6100.306	25899.69	915.0458	2525.22	-9633	-26.4	-2.52677E-05	9632.84	26.39134127	19.37734	45	25.62266	50	180	3.6
2082	0.15	0.0975	3.0615	13073.24	19.37731	44.06569193	6100.298	25899.7	915.0447	2525.221	-9633	-26.4	-2.11798E-05	9632.849	26.39136729	19.37731	45	25.62269	50	180	3.6
2083	0.15	0.0975	3.0615	13073.23	19.37729	44.06566957	6100.292	25899.71	915.0438	2525.222	-9633	-26.4	-1.77532E-05	9632.857	26.39138911	19.37729	45	25.62271	50	180	3.6
2084	0.15	0.0975	3.0615	13073.22	19.37727	44.06565083	6100.287	25899.71	915.043	2525.222	-9633	-26.4	-1.4881E-05	9632.864	26.3914074	19.37727	45	25.62273	50	180	3.6
2085	0.15	0.0975	3.0615	13073.21	19.37726	44.06563512	6100.282	25899.72	915.0424	2525.222	-9633	-26.4	-1.24734E-05	9632.869	26.39142272	19.37726	45	25.62274	50	180	3.6
2086	0.15	0.0975	3.0615	13073.2	19.37725	44.06562195	6100.279	25899.72	915.0418	2525.223	-9633	-26.4	-1.04554E-05	9632.874	26.39143557	19.37725	45	25.62275	50	180	3.6
2087	0.15	0.0975	3.0615	13073.2	19.37724	44.06561092	6100.276	25899.72	915.0414	2525.223	-9633	-26.4	-8.76384E-06	9632.878	26.39144634	19.37724	45	25.62276	50	180	3.6
2088	0.15	0.0975	3.0615	13073.19	19.37723	44.06560167	6100.273	25899.73	915.041	2525.223	-9633	-26.4	-7.34596E-06	9632.881	26.39145537	19.37723	45	25.62277	50	180	3.6
2089	0.15	0.0975	3.0615	13073.19	19.37722	44.06559391	6100.271	25899.73	915.0406	2525.224	-9633	-26.4	-6.15748E-06	9632.884	26.39146293	19.37722	45	25.62278	50	180	3.6
2090	0.15	0.0975	3.0615	13073.18	19.37721	44.06558741	6100.269	25899.73	915.0404	2525.224	-9633	-26.4	-5.16128E-06	9632.886	26.39146927	19.37721	45	25.62279	50	180	3.6
2091	0.15	0.0975	3.0615	13073.18	19.37721	44.06558196	6100.268	25899.73	915.0402	2525.224	-9633	-26.4	-4.32625E-06	9632.888	26.39147459	19.37721	45	25.62279	50	180	3.6
2092	0.15	0.0975	3.0615	13073.18	19.3772	44.0655774	6100.266	25899.73	915.04	2525.224	-9633	-26.4	-3.62632E-06	9632.89	26.39147905	19.3772	45	25.6228	50	180	3.6
2093	0.15	0.0975	3.0615	13073.17	19.3772	44.06557357	6100.265	25899.73	915.0398	2525.224	-9633	-26.4	-3.03962E-06	9632.891	26.39148278	19.3772	45	25.6228	50	180	3.6
2094	0.15	0.0975	3.0615	13073.17	19.3772	44.06557036	6100.264	25899.74	915.0397	2525.224	-9633	-26.4	-2.54785E-06	9632.892	26.39148591	19.3772	45	25.6228	50	180	3.6
2095	0.15	0.0975	3.0615	13073.17	19.3772	44.06556767	6100.264	25899.74	915.0396	2525.224	-9633	-26.4	-2.13564E-06	9632.893	26.39148854	19.3772	45	25.6228	50	180	3.6
2096	0.15	0.0975	3.0615	13073.17	19.37719	44.06556542	6100.263	25899.74	915.0395	2525.224	-9633	-26.4	-1.79012E-06	9632.894	26.39149074	19.37719	45	25.62281	50	180	3.6
2097	0.15	0.0975	3.0615	13073.17	19.37719	44.06556353	6100.263	25899.74	915.0394	2525.224	-9633	-26.4	-1.5005E-06	9632.895	26.39149258	19.37719	45	25.62281	50	180	3.6
2098	0.15	0.0975	3.0615	13073.17	19.37719	44.06556194	6100.262	25899.74	915.0393	2525.224	-9633	-26.4	-1.25774E-06	9632.895	26.39149413	19.37719	45	25.62281	50	180	3.6
2099	0.15	0.0975	3.0615	13073.17	19.37719	44.06556061	6100.262	25899.74	915.0393	2525.224	-9633	-26.4	-1.05425E-06	9632.896	26.39149542	19.37719	45	25.62281	50	180	3.6
2100	0.15	0.0975	3.0615	13073.17	19.37719	44.0655595	6100.261	25899.74	915.0392	2525.225	-9633	-26.4	-8.83687E-07	9632.896	26.39149651	19.37719	45	25.62281	50	180	3.6
2101	0.15	0.0975	3.0615	13073.16	19.37719	44.06555857	6100.261	25899.74	915.0392	2525.225	-9633	-26.4	-7.40718E-07	9632.897	26.39149742	19.37719	45	25.62281	50	180	3.6
2102	0.15	0.0975	3.0615	13073.16	19.37719	44.06555779	6100.261	25899.74	915.0391	2525.225	-9633	-26.4	-6.20879E-07	9632.897	26.39149818	19.37719	45	25.62281	50	180	3.6
2103	0.15	0.0975	3.0615	13073.16	19.37719	44.06555713	6100.261	25899.74	915.0391	2525.225	-9633	-26.4	-5.20428E-07	9632.897	26.39149882	19.37719	45	25.62281	50	180	3.6
2104	0.15	0.0975	3.0615	13073.16	19.37719	44.06555658	6100.261	25899.74	915.0391	2525.225	-9633	-26.4	-4.36229E-07	9632.897	26.39149936	19.37719	45	25.62281	50	180	3.6
2105	0.15	0.0975	3.0615	13073.16	19.37718	44.06555612	6100.261	25899.74	915.0391	2525.225	-9633	-26.4	-3.65653E-07	9632.897	26.39149981	19.37718	45	25.62282	50	180	3.6
2106	0.15	0.0975	3.0615	13073.16	19.37718	44.06555574	6100.26	25899.74	915.0391	2525.225	-9633	-26.4	-3.06495E-07	9632.898	26.39150018	19.37718	45	25.62282	50	180	3.6
2107	0.15	0.0975	3.0615	13073.16	19.37718	44.06555541	6100.26	25899.74	915.0391	2525.225	-9633	-26.4	-2.56908E-07	9632.898	26.3915005	19.37718	45	25.62282	50	180	3.6
2108	0.15	0.0975	3.0615	13073.16	19.37718	44.06555514	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-2.15343E-07	9632.898	26.39150076	19.37718	45	25.62282	50	180	3.6
2109	0.15	0.0975	3.0615	13073.16	19.37718	44.06555491	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.80503E-07	9632.898	26.39150098	19.37718	45	25.62282	50	180	3.6
2110	0.15	0.0975	3.0615	13073.16	19.37718	44.06555472	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.513E-07	9632.898	26.39150117	19.37718	45	25.62282	50	180	3.6
2111	0.15	0.0975	3.0615	13073.16	19.37718	44.06555456	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.26822E-07	9632.898	26.39150133	19.37718	45	25.62282	50	180	3.6
2112	0.15	0.0975	3.0615	13073.16	19.37718	44.06555443	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.06303E-07	9632.898	26.39150146	19.37718	45	25.62282	50	180	3.6
2113	0.15	0.0975	3.0615	13073.16	19.37718	44.06555432	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.91048E-08	9632.898	26.39150157	19.37718	45	25.62282	50	180	3.6
2114	0.15	0.0975	3.0615	13073.16	19.37718	44.06555422	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-7.46888E-08	9632.898	26.39150166	19.37718	45	25.62282	50	180	3.6
2115	0.15	0.0975	3.0615	13073.16	19.37718	44.06555414	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-6.2605E-08	9632.898	26.39150173	19.37718	45	25.62282	50	180	3.6
2116	0.15	0.0975	3.0615	13073.16	19.37718	44.06555408	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-5.24763E-08	9632.898	26.3915018	19.37718	45	25.62282	50	180	3.6
2117	0.15	0.0975	3.0615	13073.16	19.37718	44.06555402	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-4.39863E-08	9632.898	26.39150185	19.37718	45	25.62282	50	180	3.6
2118	0.15	0.0975	3.0615	13073.16	19.37718	44.06555398	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-3.68699E-08	9632.898	26.3915019	19.37718	45	25.62282	50	180	3.6
2119	0.15	0.0975	3.0615	13073.16	19.37718	44.06555394	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-3.09048E-08	9632.898	26.39150194	19.37718	45	25.62282	50	180	3.6
2120	0.15	0.0975	3.0615	13073.16	19.37718	44.0655539	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-2.59048E-08	9632.898	26.39150197	19.37718	45	25.62282	50	180	3.6
2121	0.15	0.0975	3.0615	13073.16	19.37718	44.06555388	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-2.17137E-08	9632.898	26.391502	19.37718	45	25.62282	50	180	3.6
2122	0.15	0.0975	3.0615	13073.16	19.37718	44.06555385	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.82007E-08	9632.898	26.39150202	19.37718	45	25.62282	50	180	3.6
2123	0.15	0.0975	3.0615	13073.16	19.37718	44.06555384	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.5256E-08	9632.898	26.39150204	19.37718	45	25.62282	50	180	3.6
2124	0.15	0.0975	3.0615	13073.16	19.37718	44.06555382	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.27878E-08	9632.898	26.39150205	19.37718	45	25.62282	50	180	3.6
2125	0.15	0.0975	3.0615	13073.16	19.37718	44.06555381	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.07189E-08	9632.898	26.39150207	19.37718	45	25.62282	50	180	3.6
2126	0.15	0.0975	3.0615	13073.16	19.37718	44.06555379	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.9847E-09	9632.898	26.39150208	19.37718	45	25.62282	50	180	3.6
2127	0.15	0.0975	3.0615	13073.16	19.37718	44.06555379	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-7.53109E-09	9632.898	26.39150209	19.37718	45	25.62282	50	180	3.6
2128	0.15	0.0975	3.0615	13073.16	19.37718	44.06555378	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-6.31265E-09	9632.898	26.39150209	19.37718	45	25.62282	50	180	3.6
2129	0.15	0.0975	3.0615	13073.16	19.37718	44.06555377	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-5.29134E-09	9632.898	26.3915021	19.37718	45	25.62282	50	180	3.6
2130	0.15	0.0975	3.0615	13073.16	19.37718	44.06555376	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-4.43527E-09	9632.898	26.39150211	19.37718	45	25.62282	50	180	3.6
2131	0.15	0.0975	3.0615	13073.16	19.37718	44.06555376	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-3.7177E-09	9632.898	26.39150211	19.37718	45	25.62282	50	180	3.6
2132	0.15	0.0975	3.0615	13073.16	19.37718	44.06555376	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-3.11622E-09	9632.898	26.39150211	19.37718	45	25.62282	50	180	3.6
2133	0.15	0.0975	3.0615	13073.16	19.37718	44.06555375	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-2.61205E-09	9632.898	26.39150212	19.37718	45	25.62282	50	180	3.6
2134	0.15	0.0975	3.0615	13073.16	19.37718	44.06555375	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-2.18946E-09	9632.898	26.39150212	19.37718	45	25.62282	50	180	3.6
2135	0.15	0.0975	3.0615	13073.16	19.37718	44.06555375	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.83523E-09	9632.898	26.39150212	19.37718	45	25.62282	50	180	3.6
2136	0.15	0.0975	3.0615	13073.16	19.37718	44.06555375	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.53831E-09	9632.898	26.39150212	19.37718	45	25.62282	50	180	3.6
2137	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.28943E-09	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2138	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.08082E-09	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2139	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-9.05955E-10	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6

	Low rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change level	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2140	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-7.59381E-10	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2141	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-6.36523E-10	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2142	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-5.33541E-10	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2143	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-4.47221E-10	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2144	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-3.74866E-10	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2145	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-3.14218E-10	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2146	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-2.63381E-10	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2147	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-2.20769E-10	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2148	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.85051E-10	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2149	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.55112E-10	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2150	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.30018E-10	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2151	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.08982E-10	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2152	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-9.13496E-11	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2153	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-7.65711E-11	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2154	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-6.41819E-11	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2155	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-5.37986E-11	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2156	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-4.50944E-11	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2157	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-3.77982E-11	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2158	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-3.16834E-11	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2159	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-2.65576E-11	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2160	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-2.22602E-11	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2161	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.86597E-11	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2162	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.56409E-11	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2163	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.31099E-11	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2164	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.09889E-11	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2165	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-9.21085E-12	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2166	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-7.72054E-12	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2167	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-6.47115E-12	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2168	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-5.42453E-12	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2169	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-4.54758E-12	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2170	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-3.81166E-12	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2171	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-3.19472E-12	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2172	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-2.67768E-12	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2173	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-2.24442E-12	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2174	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.88123E-12	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2175	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.57649E-12	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2176	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.32154E-12	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2177	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.10745E-12	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2178	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-9.28241E-13	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2179	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-7.78256E-13	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2180	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-6.52125E-13	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2181	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-5.46866E-13	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2182	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-4.58306E-13	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2183	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-3.84059E-13	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2184	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-3.22335E-13	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2185	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-2.69855E-13	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2186	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-2.25724E-13	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2187	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.89346E-13	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2188	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.58633E-13	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2189	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.33287E-13	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2190	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.1152E-13	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2191	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-9.30329E-14	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2192	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-7.84219E-14	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2193	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-6.58983E-14	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2194	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-5.48655E-14	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2195	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-4.59201E-14	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2196	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-3.87637E-14	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2197	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-3.19055E-14	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2198	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-2.68364E-14	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2199	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-2.20655E-14	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6

	Low rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change level	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2200	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.87855E-14	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2201	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.61018E-14	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2202	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.37164E-14	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2203	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.13309E-14	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2204	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-9.24365E-15	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2205	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-7.15637E-15	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2206	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-6.56001E-15	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2207	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-4.77092E-15	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2208	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-4.47273E-15	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2209	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-3.57819E-15	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2210	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-2.98182E-15	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2211	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-2.98182E-15	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2212	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-2.68364E-15	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2213	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-1.78909E-15	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2214	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2215	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2216	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2217	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2218	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2219	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2220	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2221	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2222	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2223	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2224	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2225	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2226	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2227	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2228	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2229	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2230	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2231	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2232	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2233	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2234	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2235	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2236	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2237	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2238	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2239	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2240	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2241	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2242	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2243	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2244	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2245	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2246	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2247	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2248	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2249	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2250	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2251	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2252	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2253	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2254	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2255	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2256	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2257	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2258	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2259	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6

	Low rainfall															pit level	Aquifer level				
year	Rainfall	catchment rai	evaporatio	evap loss	pit height	pit radius	pit area	catchment	rainfall pit	rainfall cat	balance 1(	inflow per	change level	GW inflow	GW inflow dai	Ha	Hb	dH	Ra	Rb	dR
	m	m	m	m3	m	m	m2	m2	m3	m3	m3	m3	m	m3	m3	m	m	m	m	m	m
2260	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2261	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2262	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2263	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2264	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2265	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2266	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2267	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2268	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2269	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6
2270	0.15	0.0975	3.0615	13073.16	19.37718	44.06555374	6100.26	25899.74	915.039	2525.225	-9633	-26.4	-8.94547E-16	9632.898	26.39150213	19.37718	45	25.62282	50	180	3.6

APPENDIX E: PHREEQC MODEL INPUT

Pit current model 20.6

mg/L

year	Na	K	Ca	Mg	Cl	SO4	F	NH4	Alk CaCO3	NO3	Ba	Cu	Fe	Mn	Zn		TDS	%
1993	248	6	12.25	60	397.5	122	0.6	0.03	83.5	0.875	0.02075	0.00065	0.0045	0.00075	0.00575		930.7874	0.25
2003	496	12	24.5	120	795	244	1.2	0.06	167	1.75	0.0415	0.0013	0.009	0.0015	0.0115		1861.5748	0.5
2013	744	18	36.75	180	1192.5	366	1.8	0.09	250.5	2.625	0.06225	0.00195	0.0135	0.00225	0.01725		2792.3622	0.75
2023	992	24	49	240	1590	488	2.4	0.12	334	3.5	0.083	0.0026	0.018	0.003	0.023		3723.1496	1
2032	1240	30	61.25	300	1987.5	610	3	0.15	417.5	4.375	0.10375	0.00325	0.0225	0.00375	0.02875		4653.937	1.25
2042	1488	36	73.5	360	2385	732	3.6	0.18	501	5.25	0.1245	0.0039	0.027	0.0045	0.0345		5584.7244	1.5
2051	1736	42	85.75	420	2782.5	854	4.2	0.21	584.5	6.125	0.14525	0.00455	0.0315	0.00525	0.04025		6515.5118	1.75
2061	1984	48	98	480	3180	976	4.8	0.24	668	7	0.166	0.0052	0.036	0.006	0.046		7446.2992	2
2071	2232	54	110.25	540	3577.5	1098	5.4	0.27	751.5	7.875	0.18675	0.00585	0.0405	0.00675	0.05175		8377.0866	2.25
2081	2480	60	122.5	600	3975	1220	6	0.3	835	8.75	0.2075	0.0065	0.045	0.0075	0.0575		9307.874	2.5
2090	2728	66	134.75	660	4372.5	1342	6.6	0.33	918.5	9.625	0.22825	0.00715	0.0495	0.00825	0.06325		10238.661	2.75
2100	2976	72	147	720	4770	1464	7.2	0.36	1002	10.5	0.249	0.0078	0.054	0.009	0.069		11169.449	3
2109	3224	78	159.25	780	5167.5	1586	7.8	0.39	1085.5	11.375	0.26975	0.00845	0.0585	0.00975	0.07475		12100.236	3.25
2119	3472	84	171.5	840	5565	1708	8.4	0.42	1169	12.25	0.2905	0.0091	0.063	0.0105	0.0805		13031.024	3.5
2129	3720	90	183.75	900	5962.5	1830	9	0.45	1252.5	13.125	0.31125	0.00975	0.0675	0.01125	0.08625		13961.811	3.75
2138	3968	96	196	960	6360	1952	9.6	0.48	1336	14	0.332	0.0104	0.072	0.012	0.092		14892.598	4
2148	4216	102	208.25	1020	6757.5	2074	10.2	0.51	1419.5	14.875	0.35275	0.01105	0.0765	0.01275	0.09775		15823.386	4.25
2158	4464	108	220.5	1080	7155	2196	10.8	0.54	1503	15.75	0.3735	0.0117	0.081	0.0135	0.1035		16754.173	4.5
2167	4712	114	232.75	1140	7552.5	2318	11.4	0.57	1586.5	16.625	0.39425	0.01235	0.0855	0.01425	0.10925		17684.961	4.75
2177	4960	120	245	1200	7950	2440	12	0.6	1670	17.5	0.415	0.013	0.09	0.015	0.115		18615.748	5
2186	5208	126	257.25	1260	8347.5	2562	12.6	0.63	1753.5	18.375	0.43575	0.01365	0.0945	0.01575	0.12075		19546.535	5.25
2196	5456	132	269.5	1320	8745	2684	13.2	0.66	1837	19.25	0.4565	0.0143	0.099	0.0165	0.1265		20477.323	5.5
2206	5704	138	281.75	1380	9142.5	2806	13.8	0.69	1920.5	20.125	0.47725	0.01495	0.1035	0.01725	0.13225		21408.11	5.75
2216	5952	144	294	1440	9540	2928	14.4	0.72	2004	21	0.498	0.0156	0.108	0.018	0.138		22338.898	6
2225	6200	150	306.25	1500	9937.5	3050	15	0.75	2087.5	21.875	0.51875	0.01625	0.1125	0.01875	0.14375		23269.685	6.25
2235	6448	156	318.5	1560	10335	3172	15.6	0.78	2171	22.75	0.5395	0.0169	0.117	0.0195	0.1495		24200.472	6.5
2244	6696	162	330.75	1620	10732.5	3294	16.2	0.81	2254.5	23.625	0.56025	0.01755	0.1215	0.02025	0.15525		25131.26	6.75
2254	6944	168	343	1680	11130	3416	16.8	0.84	2338	24.5	0.581	0.0182	0.126	0.021	0.161		26062.047	7
2264	7192	174	355.25	1740	11527.5	3538	17.4	0.87	2421.5	25.375	0.60175	0.01885	0.1305	0.02175	0.16675		26992.835	7.25
2273	7440	180	367.5	1800	11925	3660	18	0.9	2505	26.25	0.6225	0.0195	0.135	0.0225	0.1725		27923.622	7.5
2283	7688	186	379.75	1860	12322.5	3782	18.6	0.93	2588.5	27.125	0.64325	0.02015	0.1395	0.02325	0.17825		28854.409	7.75
2293	7936	192	392	1920	12720	3904	19.2	0.96	2672	28	0.664	0.0208	0.144	0.024	0.184		29785.197	8

Pit current model 20.6																		
	mmol/kg																	
year	**Na**	**K**	**Ca**	**Mg**	**Cl**	**S(6)**	**F**	**N(-3)**	**Alkalinity**	**N(5)**	**Ba**	**Cu**	**Fe**	**Mn**	**Zn**	**pH**		
	22.99	39.098	40.078	24.305	35.453	96.061	19	18.007	100.1	62.004	137.3	63.55	55.845	54.94	65.39			
1993	10.79	0.15	0.31	2.47	11.21	1.27	0.03	0.002	0.8341658	0.01	0.00015	0.00001	0.00008	0.00001	0.00009	8.46		
2003	21.57	0.31	0.61	4.94	22.42	2.54	0.06	0.003	1.6683317	0.03	0.00030	0.00002	0.00016	0.00003	0.00018	8.46		
2013	32.36	0.46	0.92	7.41	33.64	3.81	0.09	0.005	2.5024975	0.04	0.00045	0.00003	0.00024	0.00004	0.00026	8.46		
2023	43.15	0.61	1.22	9.87	44.85	5.08	0.13	0.007	3.3366633	0.06	0.00060	0.00004	0.00032	0.00005	0.00035	8.46		
2032	53.94	0.77	1.53	12.34	56.06	6.35	0.16	0.008	4.1708292	0.07	0.00076	0.00005	0.00040	0.00007	0.00044	8.46		
2042	64.72	0.92	1.83	14.81	67.27	7.62	0.19	0.010	5.004995	0.08	0.00091	0.00006	0.00048	0.00008	0.00053	8.46		
2051	75.51	1.07	2.14	17.28	78.48	8.89	0.22	0.012	5.8391608	0.10	0.00106	0.00007	0.00056	0.00010	0.00062	8.46		
2061	86.30	1.23	2.45	19.75	89.70	10.16	0.25	0.013	6.6733267	0.11	0.00121	0.00008	0.00064	0.00011	0.00070	8.46		
2071	97.09	1.38	2.75	22.22	100.91	11.43	0.28	0.015	7.5074925	0.13	0.00136	0.00009	0.00073	0.00012	0.00079	8.46		
2081	107.87	1.53	3.06	24.69	112.12	12.70	0.32	0.017	8.3416583	0.14	0.00151	0.00010	0.00081	0.00014	0.00088	8.46		
2090	118.66	1.69	3.36	27.15	123.33	13.97	0.35	0.018	9.1758242	0.16	0.00166	0.00011	0.00089	0.00015	0.00097	8.46		
2100	129.45	1.84	3.67	29.62	134.54	15.24	0.38	0.020	10.00999	0.17	0.00181	0.00012	0.00097	0.00016	0.00106	8.46		
2109	140.23	1.99	3.97	32.09	145.76	16.51	0.41	0.022	10.844156	0.18	0.00196	0.00013	0.00105	0.00018	0.00114	8.46		
2119	151.02	2.15	4.28	34.56	156.97	17.78	0.44	0.023	11.678322	0.20	0.00212	0.00014	0.00113	0.00019	0.00123	8.46		
2129	161.81	2.30	4.58	37.03	168.18	19.05	0.47	0.025	12.512488	0.21	0.00227	0.00015	0.00121	0.00020	0.00132	8.46		
2138	172.60	2.46	4.89	39.50	179.39	20.32	0.51	0.027	13.346653	0.23	0.00242	0.00016	0.00129	0.00022	0.00141	8.46		
2148	183.38	2.61	5.20	41.97	190.60	21.59	0.54	0.028	14.180819	0.24	0.00257	0.00017	0.00137	0.00023	0.00149	8.46		
2158	194.17	2.76	5.50	44.44	201.82	22.86	0.57	0.030	15.014985	0.25	0.00272	0.00018	0.00145	0.00025	0.00158	8.46		
2167	204.96	2.92	5.81	46.90	213.03	24.13	0.60	0.032	15.849151	0.27	0.00287	0.00019	0.00153	0.00026	0.00167	8.46		
2177	215.75	3.07	6.11	49.37	224.24	25.40	0.63	0.033	16.683317	0.28	0.00302	0.00020	0.00161	0.00027	0.00176	8.46		
2186	226.53	3.22	6.42	51.84	235.45	26.67	0.66	0.035	17.517483	0.30	0.00317	0.00021	0.00169	0.00029	0.00185	8.46		
2196	237.32	3.38	6.72	54.31	246.66	27.94	0.69	0.037	18.351648	0.31	0.00332	0.00023	0.00177	0.00030	0.00193	8.46		
2206	248.11	3.53	7.03	56.78	257.88	29.21	0.73	0.038	19.185814	0.32	0.00348	0.00024	0.00185	0.00031	0.00202	8.46		
2216	258.90	3.68	7.34	59.25	269.09	30.48	0.76	0.040	20.01998	0.34	0.00363	0.00025	0.00193	0.00033	0.00211	8.46		
2225	269.68	3.84	7.64	61.72	280.30	31.75	0.79	0.042	20.854146	0.35	0.00378	0.00026	0.00201	0.00034	0.00220	8.46		
2235	280.47	3.99	7.95	64.18	291.51	33.02	0.82	0.043	21.688312	0.37	0.00393	0.00027	0.00210	0.00035	0.00229	8.46		
2244	291.26	4.14	8.25	66.65	302.72	34.29	0.85	0.045	22.522478	0.38	0.00408	0.00028	0.00218	0.00037	0.00237	8.46		
2254	302.04	4.30	8.56	69.12	313.94	35.56	0.88	0.047	23.356643	0.40	0.00423	0.00029	0.00226	0.00038	0.00246	8.46		
2264	312.83	4.45	8.86	71.59	325.15	36.83	0.92	0.048	24.190809	0.41	0.00438	0.00030	0.00234	0.00040	0.00255	8.46		
2273	323.62	4.60	9.17	74.06	336.36	38.10	0.95	0.050	25.024975	0.42	0.00453	0.00031	0.00242	0.00041	0.00264	8.46		
2283	334.41	4.76	9.48	76.53	347.57	39.37	0.98	0.052	25.859141	0.44	0.00468	0.00032	0.00250	0.00042	0.00273	8.46		
2293	345.19	4.91	9.78	79.00	358.78	40.64	1.01	0.053	26.693307	0.45	0.00484	0.00033	0.00258	0.00044	0.00281	8.46		

Pit high inflow model 26.4

mg/L

year	Na	K	Ca	Mg	Cl	SO4	F	NH4	Alk CaCO3	NO3	Ba	Cu	Fe	Mn	Zn		TDS	%
1993	248	6	12.25	60	397.5	122	0.6	0.03	83.5	0.875	0.02075	0.00065	0.0045	0.00075	0.00575		1000	1
2003	527.31951	12.75773	26.047032	127.5773	845.19962	259.40718	1.275773	0.0637887	177.54508	1.8605023	0.1764819	0.0013821	0.0095683	0.0015947	0.0122262		2126.2883	2.1262883
2013	837.67452	20.266319	41.377068	202.66319	1342.6436	412.08182	2.0266319	0.1013316	282.03961	2.9555049	0.1764819	0.0021955	0.0151997	0.0025333	0.0194219		3377.7198	3.3777198
2023	1148.0295	27.774908	56.707104	277.74908	1840.0877	564.75646	2.7774908	0.1388745	386.53414	4.0505074	0.1764819	0.0030089	0.0208312	0.0034719	0.0266176		4629.1513	4.6291513
2032	1427.349	34.532638	70.504136	345.32638	2287.7873	702.16364	3.4532638	0.1726632	480.57921	5.0360097	0.1764819	0.003741	0.0258995	0.0043166	0.0330938		5755.4397	5.7554397
2042	1737.7041	42.041227	85.834172	420.41227	2785.2313	854.83829	4.2041227	0.2102061	585.07374	6.1310123	0.1764819	0.0045545	0.0315309	0.0052552	0.0402895		7006.8712	7.0068712
2051	2038.7484	49.324558	100.70431	493.24558	3267.752	1002.9327	4.9324558	0.2466228	686.43344	7.1931648	0.1764819	0.0053435	0.0369934	0.0061656	0.0472694		8220.7597	8.2207597
2061	2339.7928	56.60789	115.57444	566.0789	3750.2727	1151.0271	5.660789	0.2830394	787.79313	8.2553173	0.1764819	0.0061325	0.0424559	0.007076	0.0542492		9434.6483	9.4346483
2071	2640.8371	63.891221	130.44458	638.91221	4232.7934	1299.1215	6.3891221	0.3194561	889.15283	9.3174697	0.1764819	0.0069215	0.0479184	0.0079864	0.0612291		10648.537	10.648537
2081	2941.8815	71.174552	145.31471	711.74552	4715.3141	1447.2159	7.1174552	0.3558728	990.51252	10.379622	0.1764819	0.0077106	0.0533809	0.0088968	0.0682089		11862.425	11.862425
2090	3242.9259	78.457884	160.18485	784.57884	5197.8348	1595.3103	7.8457884	0.3922894	1091.8722	11.441775	0.1764819	0.0084996	0.0588434	0.0098072	0.0751888		13076.314	13.076314
2100	3543.9702	85.741215	175.05498	857.41215	5680.3555	1743.4047	8.5741215	0.4287061	1193.2319	12.503927	0.1764819	0.0092886	0.0643059	0.0107177	0.0821687		14290.203	14.290203
2109	3845.0146	93.024546	189.92512	930.24546	6162.8762	1891.4991	9.3024546	0.4651227	1294.5916	13.56608	0.1764819	0.0100777	0.0697684	0.0116281	0.0891485		15504.091	15.504091
2119	4146.0589	100.30788	204.79525	1003.0788	6645.3969	2039.5935	10.030788	0.5015394	1395.9513	14.628232	0.1764819	0.0108667	0.0752309	0.0125385	0.0961284		16717.98	16.71798
2129	4447.1033	107.59121	219.66539	1075.9121	7127.9176	2187.6879	10.759121	0.537956	1497.311	15.690385	0.1764819	0.0116557	0.0806934	0.0134489	0.1031082		17931.868	17.931868
2138	4748.1477	114.87454	234.53552	1148.7454	7610.4383	2335.7823	11.487454	0.5743727	1598.6707	16.752537	0.1764819	0.0124447	0.0861559	0.0143593	0.1100881		19145.757	19.145757
2148	5049.192	122.15787	249.40565	1221.5787	8092.959	2483.8767	12.215787	0.6107894	1700.0304	17.81469	0.1764819	0.0132338	0.0916184	0.0152697	0.117068		20359.645	20.359645
2158	5350.2364	129.4412	264.27579	1294.412	8575.4797	2631.9711	12.94412	0.647206	1801.3901	18.876842	0.1764819	0.0140228	0.0970809	0.0161802	0.1240478		21573.534	21.573534
2167	5651.2807	136.72453	279.14592	1367.2453	9058.0004	2780.0655	13.672453	0.6836227	1902.7498	19.938995	0.1764819	0.0148118	0.1025434	0.0170906	0.1310277		22787.422	22.787422
2177	5952.3251	144.00787	294.01606	1440.0787	9540.5211	2928.1599	14.400787	0.7200393	2004.1095	21.001147	0.1764819	0.0156009	0.1080059	0.018001	0.1380075		24001.311	24.001311
2186	6253.3695	151.2912	308.88619	1512.912	10023.042	3076.2543	15.12912	0.756456	2105.4692	22.0633	0.1764819	0.0163899	0.1134684	0.0189114	0.1449874		25215.199	25.215199
2196	6554.4138	158.57453	323.75633	1585.7453	10505.562	3224.3487	15.857453	0.7928726	2206.8289	23.125452	0.1764819	0.0171789	0.1189309	0.0198218	0.1519673		26429.088	26.429088
2206	6855.4582	165.85786	338.62646	1658.5786	10988.083	3372.4431	16.585786	0.8292893	2308.1885	24.187605	0.1764819	0.0179679	0.1243934	0.0207322	0.1589471		27642.977	27.642977
2216	7156.5026	173.14119	353.4966	1731.4119	11470.604	3520.5375	17.314119	0.865706	2409.5482	25.249757	0.1764819	0.018757	0.1298559	0.0216426	0.165927		28856.865	28.856865
2225	7457.5469	180.42452	368.36673	1804.2452	11953.125	3668.632	18.042452	0.9021226	2510.9079	26.311909	0.1764819	0.019546	0.1353184	0.0225531	0.1729068		30070.754	30.070754
2235	7758.5913	187.70785	383.23687	1877.0785	12435.645	3816.7264	18.770785	0.9385393	2612.2676	27.374062	0.1764819	0.020335	0.1407809	0.0234635	0.1798867		31284.642	31.284642
2244	8059.6356	194.99118	398.107	1949.9118	12918.166	3964.8208	19.499118	0.9749559	2713.6273	28.436214	0.1764819	0.021124	0.1462434	0.0243739	0.1868666		32498.531	32.498531
2254	8360.68	202.27452	412.97714	2022.7452	13400.687	4112.9152	20.227452	1.0113726	2814.987	29.498367	0.1764819	0.0219131	0.1517059	0.0252843	0.1938464		33712.419	33.712419
2264	8661.7244	209.55785	427.84727	2095.5785	13883.207	4261.0096	20.955785	1.0477892	2916.3467	30.560519	0.1764819	0.0227021	0.1571684	0.0261947	0.2008263		34926.308	34.926308
2273	8962.7687	216.84118	442.71741	2168.4118	14365.728	4409.104	21.684118	1.0842059	3017.7064	31.622672	0.1764819	0.0234911	0.1626309	0.0271051	0.2078061		36140.196	36.140196
2283	9263.8131	224.12451	457.58754	2241.2451	14848.249	4557.1984	22.412451	1.1206226	3119.0661	32.684824	0.1764819	0.0242802	0.1680934	0.0280156	0.214786		37354.085	37.354085
2293	9564.8574	231.40784	472.45768	2314.0784	15330.769	4705.2928	23.140784	1.1570392	3220.4258	33.746977	0.1764819	0.0250692	0.1735559	0.028926	0.2217658		38567.974	38.567974

Pit high inflow model 26.4																		
	mmol/kg																	
year	Na	K	Ca	Mg	Cl	S(6)	F	N(-3)	Alkalinity	N(5)	Ba	Cu	Fe	Mn	Zn	pH		
	22.99	39.098	40.078	24.305	35.453	96.061	19	18.007	100.1	62.004	137.3	63.55	55.845	54.94	65.39			
1993	10.79	0.15	0.31	2.47	11.21	1.27	0.03	0.002	0.8341658	0.01	0.00015	0.00001	0.00008	0.00001	0.00009	8.46		
2003	22.94	0.33	0.65	5.25	23.84	2.70	0.07	0.004	1.7736771	0.03	0.00129	0.00002	0.00017	0.00003	0.00019	8.46		
2013	36.44	0.52	1.03	8.34	37.87	4.29	0.11	0.006	2.8175785	0.05	0.00051	0.00003	0.00027	0.00005	0.00030	8.46		
2023	49.94	0.71	1.41	11.43	51.90	5.88	0.15	0.008	3.8614799	0.07	0.00060	0.00005	0.00037	0.00006	0.00041	8.46		
2032	62.09	0.88	1.76	14.21	64.53	7.31	0.18	0.010	4.8009912	0.08	0.00355	0.00006	0.00046	0.00008	0.00051	8.46		
2042	75.59	1.08	2.14	17.30	78.56	8.90	0.22	0.012	5.8448926	0.10	0.00431	0.00007	0.00056	0.00010	0.00062	8.46		
2051	88.68	1.26	2.51	20.29	92.17	10.44	0.26	0.014	6.8574769	0.12	0.00507	0.00008	0.00066	0.00011	0.00072	8.46		
2061	101.77	1.45	2.88	23.29	105.78	11.98	0.30	0.016	7.8700613	0.13	0.00582	0.00010	0.00076	0.00013	0.00083	8.46		
2071	114.87	1.63	3.25	26.29	119.39	13.52	0.34	0.018	8.8826456	0.15	0.00658	0.00011	0.00086	0.00015	0.00094	8.46		
2081	127.96	1.82	3.63	29.28	133.00	15.07	0.37	0.020	9.89523	0.17	0.00734	0.00012	0.00096	0.00016	0.00104	8.46		
2090	141.06	2.01	4.00	32.28	146.61	16.61	0.41	0.022	10.907814	0.18	0.00809	0.00013	0.00105	0.00018	0.00115	8.46		
2100	154.15	2.19	4.37	35.28	160.22	18.15	0.45	0.024	11.920399	0.20	0.00885	0.00015	0.00115	0.00020	0.00126	8.46		
2109	167.25	2.38	4.74	38.27	173.83	19.69	0.49	0.026	12.932983	0.22	0.00961	0.00016	0.00125	0.00021	0.00136	8.46		
2119	180.34	2.57	5.11	41.27	187.44	21.23	0.53	0.028	13.945567	0.24	0.01036	0.00017	0.00135	0.00023	0.00147	8.46		
2129	193.44	2.75	5.48	44.27	201.05	22.77	0.57	0.030	14.958152	0.25	0.01112	0.00018	0.00144	0.00024	0.00158	8.46		
2138	206.53	2.94	5.85	47.26	214.66	24.32	0.60	0.032	15.970736	0.27	0.01188	0.00020	0.00154	0.00026	0.00168	8.46		
2148	219.63	3.12	6.22	50.26	228.27	25.86	0.64	0.034	16.98332	0.29	0.01263	0.00021	0.00164	0.00028	0.00179	8.46		
2158	232.72	3.31	6.59	53.26	241.88	27.40	0.68	0.036	17.995905	0.30	0.01339	0.00022	0.00174	0.00029	0.00190	8.46		
2167	245.81	3.50	6.97	56.25	255.49	28.94	0.72	0.038	19.008489	0.32	0.01415	0.00023	0.00184	0.00031	0.00200	8.46		
2177	258.91	3.68	7.34	59.25	269.10	30.48	0.76	0.040	20.021074	0.34	0.01490	0.00025	0.00193	0.00033	0.00211	8.46		
2186	272.00	3.87	7.71	62.25	282.71	32.02	0.80	0.042	21.033658	0.36	0.01566	0.00026	0.00203	0.00034	0.00222	8.46		
2196	285.10	4.06	8.08	65.24	296.32	33.57	0.83	0.044	22.046242	0.37	0.01642	0.00027	0.00213	0.00036	0.00232	8.46		
2206	298.19	4.24	8.45	68.24	309.93	35.11	0.87	0.046	23.058827	0.39	0.01717	0.00028	0.00223	0.00038	0.00243	8.46		
2216	311.29	4.43	8.82	71.24	323.54	36.65	0.91	0.048	24.071411	0.41	0.01793	0.00030	0.00233	0.00039	0.00254	8.46		
2225	324.38	4.61	9.19	74.23	337.15	38.19	0.95	0.050	25.083995	0.42	0.01869	0.00031	0.00242	0.00041	0.00264	8.46		
2235	337.48	4.80	9.56	77.23	350.76	39.73	0.99	0.052	26.09658	0.44	0.01944	0.00032	0.00252	0.00043	0.00275	8.46		
2244	350.57	4.99	9.93	80.23	364.37	41.27	1.03	0.054	27.109164	0.46	0.02020	0.00033	0.00262	0.00044	0.00286	8.46		
2254	363.67	5.17	10.30	83.22	377.98	42.82	1.06	0.056	28.121748	0.48	0.02095	0.00034	0.00272	0.00046	0.00296	8.46		
2264	376.76	5.36	10.68	86.22	391.59	44.36	1.10	0.058	29.134333	0.49	0.02171	0.00036	0.00281	0.00048	0.00307	8.46		
2273	389.86	5.55	11.05	89.22	405.20	45.90	1.14	0.060	30.146917	0.51	0.02247	0.00037	0.00291	0.00049	0.00318	8.46		
2283	402.95	5.73	11.42	92.21	418.82	47.44	1.18	0.062	31.159501	0.53	0.02322	0.00038	0.00301	0.00051	0.00328	8.46		
2293	416.04	5.92	11.79	95.21	432.43	48.98	1.22	0.064	32.172086	0.54	0.02398	0.00039	0.00311	0.00053	0.00339	8.46		

Pit low inflow model 11.5																		
	mg/L																	
year	Na	K	Ca	Mg	Cl	SO4	F	NH4	Alk CaCO3	NO3	Ba	Cu	Fe	Mn	Zn		TDS	%
1993	248	6	12.25	60	397.5	122	0.6	0.03	83.5	0.875	0.02075	0.00065	0.0045	0.00075	0.00575		1000	1
2003	369.67327	8.9437082	18.260071	89.437082	592.52067	181.8554	0.8943708	0.0447185	124.46661	1.3042908	0.1764819	0.0009689	0.0067078	0.001118	0.0085711		1490.618	1.490618
2013	504.8658	12.214495	24.937927	122.14495	809.2103	248.3614	1.2214495	0.0610725	169.98506	1.7812805	0.1764819	0.0013232	0.0091609	0.0015268	0.0117056		2035.7492	2.0357492
2023	640.05832	15.485282	31.615784	154.85282	1025.8999	314.8674	1.5485282	0.0774264	215.50351	2.2582703	0.1764819	0.0016776	0.011614	0.0019357	0.0148401		2580.8803	2.5808803
2032	761.73159	18.42899	37.625855	184.2899	1220.9206	374.7228	1.842899	0.092145	256.47011	2.6875611	0.1764819	0.0019965	0.0138217	0.0023036	0.0176611		3071.4984	3.0714984
2042	896.92411	21.699777	44.303711	216.99777	1437.6102	441.2288	2.1699777	0.1084989	301.98856	3.1645508	0.1764819	0.0023508	0.0162748	0.0027125	0.0207956		3616.6295	3.6166295
2051	1028.0609	24.87244	50.781232	248.7244	1647.7992	505.73962	2.487244	0.1243622	346.14146	3.6272309	0.1764819	0.0026945	0.0186543	0.0031091	0.0238361		4145.4067	4.1454067
2061	1159.1976	28.045103	57.258753	280.45103	1857.9881	570.25044	2.8045103	0.1402255	390.29436	4.0899109	0.1764819	0.0030382	0.0210338	0.0035056	0.0268766		4674.1839	4.6741839
2071	1290.3344	31.217767	63.736274	312.17767	2068.177	634.76126	3.1217767	0.1560888	434.44725	4.552591	0.1764819	0.0033819	0.0234133	0.0039022	0.029917		5202.9611	5.2029611
2081	1421.4711	34.39043	70.213795	343.9043	2278.366	699.27208	3.439043	0.1719522	478.60015	5.015271	0.1764819	0.0037256	0.0257928	0.0042988	0.0329575		5731.7383	5.7317383
2090	1552.6079	37.563093	76.691315	375.63093	2488.5549	763.7829	3.7563093	0.1878155	522.75305	5.4779511	0.1764819	0.0040693	0.0281723	0.0046954	0.035998		6260.5155	6.2605155
2100	1683.7446	40.735757	83.168836	407.35757	2698.7439	828.29372	4.0735757	0.2036788	566.90595	5.9406312	0.1764819	0.004413	0.0305518	0.005092	0.0390384		6789.2928	6.7892928
2109	1814.8814	43.90842	89.646357	439.0842	2908.9328	892.80454	4.390842	0.2195421	611.05884	6.4033112	0.1764819	0.0047567	0.0329313	0.0054886	0.0420789		7318.07	7.31807
2119	1946.0181	47.081083	96.123878	470.81083	3119.1218	957.31536	4.7081083	0.2354054	655.21174	6.8659913	0.1764819	0.0051005	0.0353108	0.0058851	0.0451194		7846.8472	7.8468472
2129	2077.1548	50.253746	102.6014	502.53746	3329.3107	1021.8262	5.0253746	0.2512687	699.36464	7.3286713	0.1764819	0.0054442	0.0376903	0.0062817	0.0481598		8375.6244	8.3756244
2138	2208.2916	53.42641	109.07892	534.2641	3539.4996	1086.337	5.342641	0.267132	743.51753	7.7913514	0.1764819	0.0057879	0.0400698	0.0066783	0.0512003		8904.4016	8.9044016
2148	2339.4283	56.599073	115.55644	565.99073	3749.6886	1150.8478	5.6599073	0.2829954	787.67043	8.2540315	0.1764819	0.0061316	0.0424493	0.0070749	0.0542408		9433.1788	9.4331788
2158	2470.5651	59.771736	122.03396	597.71736	3959.8775	1215.3586	5.9771736	0.2988587	831.82333	8.7167115	0.1764819	0.0064753	0.0448288	0.0074715	0.0572812		9961.956	9.961956
2167	2601.7018	62.944399	128.51148	629.44399	4170.0665	1279.8695	6.2944399	0.314722	875.97622	9.1793916	0.1764819	0.006819	0.0472083	0.007868	0.0603217		10490.733	10.490733
2177	2732.8386	66.117063	134.989	661.17063	4380.2554	1344.3803	6.6117063	0.3305853	920.12912	9.6420716	0.1764819	0.0071627	0.0495878	0.0082646	0.0633622		11019.51	11.01951
2186	2863.9753	69.289726	141.46652	692.89726	4590.4443	1408.8911	6.9289726	0.3464486	964.28202	10.104752	0.1764819	0.0075064	0.0519673	0.0086612	0.0664027		11548.288	11.548288
2196	2995.1121	72.462389	147.94404	724.62389	4800.6333	1473.4019	7.2462389	0.3623119	1008.4349	10.567432	0.1764819	0.0078501	0.0543468	0.0090578	0.0694431		12077.065	12.077065
2206	3126.2488	75.635052	154.42157	756.35052	5010.8222	1537.9127	7.5635052	0.3781753	1052.5878	11.030112	0.1764819	0.0081938	0.0567263	0.0094544	0.0724836		12605.842	12.605842
2216	3257.3856	78.807716	160.89909	788.07716	5221.0112	1602.4236	7.8807716	0.3940386	1096.7407	11.492792	0.1764819	0.0085375	0.0591058	0.009851	0.0755241		13134.619	13.134619
2225	3388.5223	81.980379	167.37661	819.80379	5431.2001	1666.9344	8.1980379	0.4099019	1140.8936	11.955472	0.1764819	0.0088812	0.0614853	0.0102475	0.0785645		13663.396	13.663396
2235	3519.6591	85.153042	173.85413	851.53042	5641.389	1731.4452	8.5153042	0.4257652	1185.0465	12.418152	0.1764819	0.0092249	0.0638648	0.0106441	0.081605		14192.174	14.192174
2244	3650.7958	88.325705	180.33165	883.25705	5851.578	1795.956	8.8325705	0.4416285	1229.1994	12.880832	0.1764819	0.0095686	0.0662443	0.0110407	0.0846455		14720.951	14.720951
2254	3781.9326	91.498369	186.80917	914.98369	6061.7669	1860.4668	9.1498369	0.4574918	1273.3523	13.343512	0.1764819	0.0099123	0.0686238	0.0114373	0.0876859		15249.728	15.249728
2264	3913.0693	94.671032	193.28669	946.71032	6271.9559	1924.9777	9.4671032	0.4733552	1317.5052	13.806192	0.1764819	0.010256	0.0710033	0.0118339	0.0907264		15778.505	15.778505
2273	4044.2061	97.843695	199.76421	978.43695	6482.1448	1989.4885	9.7843695	0.4892185	1361.6581	14.268872	0.1764819	0.0105997	0.0733828	0.0122305	0.0937669		16307.283	16.307283
2283	4175.3428	101.01636	206.24173	1010.1636	6692.3338	2053.9993	10.101636	0.5050818	1405.811	14.731552	0.1764819	0.0109434	0.0757623	0.012627	0.0968073		16836.06	16.83606
2293	4306.4796	104.18902	212.71925	1041.8902	6902.5227	2118.5101	10.418902	0.5209451	1449.9639	15.194232	0.1764819	0.0112871	0.0781418	0.0130236	0.0998478		17364.837	17.364837

Pit low inflow model 11.5																		
	mmol/kg																	
Year	**Na**	**K**	**Ca**	**Mg**	**Cl**	**S(6)**	**F**	**N(-3)**	**Alkalinity**	**N(5)**	**Ba**	**Cu**	**Fe**	**Mn**	**Zn**	**pH**		
	22.99	39.098	40.078	24.305	35.453	96.061	19	18.007	100.1	62.004	137.3	63.55	55.845	54.94	65.39			
1993	10.79	0.15	0.31	2.47	11.21	1.27	0.03	0.002	0.8341658	0.01	0.00015	0.00001	0.00008	0.00001	0.00009	8.46		
2003	16.08	0.23	0.46	3.68	16.71	1.89	0.05	0.002	1.2434226	0.02	0.00129	0.00002	0.00012	0.00002	0.00013	8.46		
2013	21.96	0.31	0.62	5.03	22.82	2.59	0.06	0.003	1.6981524	0.03	0.00051	0.00002	0.00016	0.00003	0.00018	8.46		
2023	27.84	0.40	0.79	6.37	28.94	3.28	0.08	0.004	2.1528822	0.04	0.00060	0.00003	0.00021	0.00004	0.00023	8.46		
2032	33.13	0.47	0.94	7.58	34.44	3.90	0.10	0.005	2.562139	0.04	0.00355	0.00003	0.00025	0.00004	0.00027	8.46		
2042	39.01	0.56	1.11	8.93	40.55	4.59	0.11	0.006	3.0168688	0.05	0.00431	0.00004	0.00029	0.00005	0.00032	8.46		
2051	44.72	0.64	1.27	10.23	46.48	5.26	0.13	0.007	3.4579566	0.06	0.00507	0.00004	0.00033	0.00006	0.00036	8.46		
2061	50.42	0.72	1.43	11.54	52.41	5.94	0.15	0.008	3.8990445	0.07	0.00582	0.00005	0.00038	0.00006	0.00041	8.46		
2071	56.13	0.80	1.59	12.84	58.34	6.61	0.16	0.009	4.3401324	0.07	0.00658	0.00005	0.00042	0.00007	0.00046	8.46		
2081	61.83	0.88	1.75	14.15	64.26	7.28	0.18	0.010	4.7812203	0.08	0.00734	0.00006	0.00046	0.00008	0.00050	8.46		
2090	67.53	0.96	1.91	15.45	70.19	7.95	0.20	0.010	5.2223082	0.09	0.00809	0.00006	0.00050	0.00009	0.00055	8.46		
2100	73.24	1.04	2.08	16.76	76.12	8.62	0.21	0.011	5.6633961	0.10	0.00885	0.00007	0.00055	0.00009	0.00060	8.46		
2109	78.94	1.12	2.24	18.07	82.05	9.29	0.23	0.012	6.1044839	0.10	0.00961	0.00007	0.00059	0.00010	0.00064	8.46		
2119	84.65	1.20	2.40	19.37	87.98	9.97	0.25	0.013	6.5455718	0.11	0.01036	0.00008	0.00063	0.00011	0.00069	8.46		
2129	90.35	1.29	2.56	20.68	93.91	10.64	0.26	0.014	6.9866597	0.12	0.01112	0.00009	0.00067	0.00011	0.00074	8.46		
2138	96.05	1.37	2.72	21.98	99.84	11.31	0.28	0.015	7.4277476	0.13	0.01188	0.00009	0.00072	0.00012	0.00078	8.46		
2148	101.76	1.45	2.88	23.29	105.77	11.98	0.30	0.016	7.8688355	0.13	0.01263	0.00010	0.00076	0.00013	0.00083	8.46		
2158	107.46	1.53	3.04	24.59	111.69	12.65	0.31	0.017	8.3099234	0.14	0.01339	0.00010	0.00080	0.00014	0.00088	8.46		
2167	113.17	1.61	3.21	25.90	117.62	13.32	0.33	0.017	8.7510112	0.15	0.01415	0.00011	0.00085	0.00014	0.00092	8.46		
2177	118.87	1.69	3.37	27.20	123.55	14.00	0.35	0.018	9.1920991	0.16	0.01490	0.00011	0.00089	0.00015	0.00097	8.46		
2186	124.57	1.77	3.53	28.51	129.48	14.67	0.36	0.019	9.633187	0.16	0.01566	0.00012	0.00093	0.00016	0.00102	8.46		
2196	130.28	1.85	3.69	29.81	135.41	15.34	0.38	0.020	10.074275	0.17	0.01642	0.00012	0.00097	0.00016	0.00106	8.46		
2206	135.98	1.93	3.85	31.12	141.34	16.01	0.40	0.021	10.515363	0.18	0.01717	0.00013	0.00102	0.00017	0.00111	8.46		
2216	141.69	2.02	4.01	32.42	147.27	16.68	0.41	0.022	10.956451	0.19	0.01793	0.00013	0.00106	0.00018	0.00115	8.46		
2225	147.39	2.10	4.18	33.73	153.19	17.35	0.43	0.023	11.397539	0.19	0.01869	0.00014	0.00110	0.00019	0.00120	8.46		
2235	153.10	2.18	4.34	35.04	159.12	18.02	0.45	0.024	11.838626	0.20	0.01944	0.00015	0.00114	0.00019	0.00125	8.46		
2244	158.80	2.26	4.50	36.34	165.05	18.70	0.46	0.025	12.279714	0.21	0.02020	0.00015	0.00119	0.00020	0.00129	8.46		
2254	164.50	2.34	4.66	37.65	170.98	19.37	0.48	0.025	12.720802	0.22	0.02095	0.00016	0.00123	0.00021	0.00134	8.46		
2264	170.21	2.42	4.82	38.95	176.91	20.04	0.50	0.026	13.16189	0.22	0.02171	0.00016	0.00127	0.00022	0.00139	8.46		
2273	175.91	2.50	4.98	40.26	182.84	20.71	0.51	0.027	13.602978	0.23	0.02247	0.00017	0.00131	0.00022	0.00143	8.46		
2283	181.62	2.58	5.15	41.56	188.77	21.38	0.53	0.028	14.044066	0.24	0.02322	0.00017	0.00136	0.00023	0.00148	8.46		
2293	187.32	2.66	5.31	42.87	194.70	22.05	0.55	0.029	14.485154	0.25	0.02398	0.00018	0.00140	0.00024	0.00153	8.46		

APPENDIX F: PHREEQC MODEL OUTPUT

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        Input   file:   C:\Users\a Group   Pty   Ltd\EESI   Group   -   2024 -   QLD\7240! Tick   hill   model   update\4.  Laboratory Conc1.pqi
        Output  file:   C:\Users\a Group   Pty   Ltd\EESI   Group   -   2024 -   QLD\7240! Tick   hill   model   update\4.  Laboratory Conc1.pqo
Database file:  C:\Prograr Files   (x86)\USG: Interactive 3.7.3-15968\database\phreeqc.dat

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Reading data    base.
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        SOLUTION_MASTER_SPECIES
        SOLUTION_SPECIES
        PHASES
        EXCHANGE_MASTER_SPECIES
        EXCHANGE_SPECIES
        SURFACE_MASTER_SPECIES
        SURFACE_SPECIES
        RATES
        END
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Reading input   data    for     simulation      1
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        DATABASE C:\Prograr Files   (x86)\USG: Interactive 3.7.3-15968\database\phreeqc.dat
        SOLUTION_SPREAD
        Na      K       Ca      Mg      Cl      S(6)    F       N(-3)   Alkalinity  N(5)    Ba      Cu      Fe      Mn      Zn      pH
            10.79   0.15    0.31    2.47    11.21   1.27    0.03    0.002   0.834166    0.01    0.00015 0.00001 0.00008 0.00001 0.00009     8.46
            21.57   0.31    0.61    4.94    22.42   2.54    0.06    0.003   1.668332    0.03    0.0003  0.00002 0.00016 0.00003 0.00018     8.46
            32.36   0.46    0.92    7.41    33.64   3.81    0.09    0.005   2.502498    0.04    0.00045 0.00003 0.00024 0.00004 0.00026     8.46
            43.15   0.61    1.22    9.87    44.85   5.08    0.13    0.007   3.336663    0.06    0.0006  0.00004 0.00032 0.00005 0.00035     8.46
            53.94   0.77    1.53    12.34   56.06   6.35    0.16    0.008   4.170829    0.07    0.00076 0.00005 0.0004  0.00007 0.00044     8.46
            64.72   0.92    1.83    14.81   67.27   7.62    0.19    0.01    5.004995    0.08    0.00091 0.00006 0.00048 0.00008 0.00053     8.46
            75.51   1.07    2.14    17.28   78.48   8.89    0.22    0.012   5.839161    0.1     0.00106 0.00007 0.00056 0.0001  0.00062     8.46
            86.3    1.23    2.45    19.75   89.7    10.16   0.25    0.013   6.673327    0.11    0.00121 0.00008 0.00064 0.00011 0.0007      8.46
            97.09   1.38    2.75    22.22   100.91  11.43   0.28    0.015   7.507493    0.13    0.00136 0.00009 0.00073 0.00012 0.00079     8.46
           107.87   1.53    3.06    24.69   112.12  12.7    0.32    0.017   8.341658    0.14    0.00151 0.0001  0.00081 0.00014 0.00088     8.46
           118.66   1.69    3.36    27.15   123.33  13.97   0.35    0.018   9.175824    0.16    0.00166 0.00011 0.00089 0.00015 0.00097     8.46
           129.45   1.84    3.67    29.62   134.54  15.24   0.38    0.02    10.00999    0.17    0.00181 0.00012 0.00097 0.00016 0.00106     8.46
           140.23   1.99    3.97    32.09   145.76  16.51   0.41    0.022   10.84416    0.18    0.00196 0.00013 0.00105 0.00018 0.00114     8.46
           151.02   2.15    4.28    34.56   156.97  17.78   0.44    0.023   11.67832    0.2     0.00212 0.00014 0.00113 0.00019 0.00123     8.46
           161.81   2.3     4.58    37.03   168.18  19.05   0.47    0.025   12.51249    0.21    0.00227 0.00015 0.00121 0.0002  0.00132     8.46
           172.6    2.46    4.89    39.5    179.39  20.32   0.51    0.027   13.34665    0.23    0.00242 0.00016 0.00129 0.00022 0.00141     8.46
           183.38   2.61    5.2     41.97   190.6   21.59   0.54    0.028   14.18082    0.24    0.00257 0.00017 0.00137 0.00023 0.00149     8.46
           194.17   2.76    5.5     44.44   201.82  22.86   0.57    0.03    15.01499    0.25    0.00272 0.00018 0.00145 0.00025 0.00158     8.46
           204.96   2.92    5.81    46.9    213.03  24.13   0.6     0.032   15.84915    0.27    0.00287 0.00019 0.00153 0.00026 0.00167     8.46
           215.75   3.07    6.11    49.37   224.24  25.4    0.63    0.033   16.68332    0.28    0.00302 0.0002  0.00161 0.00027 0.00176     8.46
           226.53   3.22    6.42    51.84   235.45  26.67   0.66    0.035   17.51748    0.3     0.00317 0.00021 0.00169 0.00029 0.00185     8.46
           237.32   3.38    6.72    54.31   246.66  27.94   0.69    0.037   18.35165    0.31    0.00332 0.00023 0.00177 0.0003  0.00193     8.46
           248.11   3.53    7.03    56.78   257.88  29.21   0.73    0.038   19.18581    0.32    0.00348 0.00024 0.00185 0.00031 0.00202     8.46
           258.9    3.68    7.34    59.25   269.09  30.48   0.76    0.04    20.01998    0.34    0.00363 0.00025 0.00193 0.00033 0.00211     8.46
           269.68   3.84    7.64    61.72   280.3   31.75   0.79    0.042   20.85415    0.35    0.00378 0.00026 0.00201 0.00034 0.0022      8.46
           280.47   3.99    7.95    64.18   291.51  33.02   0.82    0.043   21.68831    0.37    0.00393 0.00027 0.0021  0.00035 0.00229     8.46
           291.26   4.14    8.25    66.65   302.72  34.29   0.85    0.045   22.52248    0.38    0.00408 0.00028 0.00218 0.00037 0.00237     8.46
           302.04   4.3     8.56    69.12   313.94  35.56   0.88    0.047   23.35664    0.4     0.00423 0.00029 0.00226 0.00038 0.00246     8.46
           312.83   4.45    8.86    71.59   325.15  36.83   0.92    0.048   24.19081    0.41    0.00438 0.0003  0.00234 0.0004  0.00255     8.46
           323.62   4.6     9.17    74.06   336.36  38.1    0.95    0.05    25.02498    0.42    0.00453 0.00031 0.00242 0.00041 0.00264     8.46
           334.41   4.76    9.48    76.53   347.57  39.37   0.98    0.052   25.85914    0.44    0.00468 0.00032 0.0025  0.00042 0.00273     8.46
           345.19   4.91    9.78    79      358.78  40.64   1.01    0.053   26.69331    0.45    0.00484 0.00033 0.00258 0.00044 0.00281     8.46
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Beginning of initial solution calculations.
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Initial solution 1

 #NAME? composition-----------------------------

        Elements   Molality   Moles

        Alkalinity  8.34E-04  8.34E-04
        Ba          1.50E-07  1.50E-07
        Ca          3.10E-04  3.10E-04
        Cl          1.12E-02  1.12E-02
        Cu          1.00E-08  1.00E-08
        F           3.00E-05  3.00E-05
        Fe          8.00E-08  8.00E-08
        K           1.50E-04  1.50E-04
        Mg          2.47E-03  2.47E-03
        Mn          1.00E-08  1.00E-08
        N(-3)       2.00E-06  2.00E-06
        N(5)        1.00E-05  1.00E-05
        Na          1.08E-02  1.08E-02
        S(6)        1.27E-03  1.27E-03
        Zn          9.00E-08  9.00E-08

 #NAME? of solution----------------------------

        pH          =                8.46
        pe          =                   4
        Specific    Conductan (µS/cm,  25°C)     =              1678
        Density     (g/cm³)   =          0.99776
        Volume      (L)       =          1.00314
        Activity    of        water    =                   1
        Ionic       strength  (mol/kgw) =          1.86E-02
        Mass        of        water    (kg)       =          1.00E+00
        Total       carbon    (mol/kg) =          8.03E-04
        Total       CO2       (mol/kg) =          8.03E-04
        Temperatu   (°C)      =                  25
        Electrical  balance   (eq)     =          1.88E-03
        Percent     error,    100*(Cat-|=                6.24
        Iterations  =                 7
        Total       H         =          1.11E+02
        Total       O         =          5.55E+01

 #NAME? couples--------------------------------

        Redox       couple    pe       Eh        (volts)

        N(-3)/N(5)    4.4048    0.2606
```

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	3.35E-06	2.92E-06	-5.475	-5.535	-0.06	-3.99
	H+	3.89E-09	3.47E-09	-8.41	-8.46	-0.05	0
	H2O	5.55E+01	1.00E+00	1.744	0	0	18.07
Ba	1.50E-07						
	Ba+2	1.27E-07	7.41E-08	-6.897	-7.13	-0.233	-12.43
	BaSO4	2.24E-08	2.25E-08	-7.649	-7.648	0.002	0
	BaHCO3+	5.35E-10	4.68E-10	-9.271	-9.33	-0.058	0
	BaCO3	3.40E-10	3.41E-10	-9.469	-9.467	0.002	-10.7
	BaOH+	8.25E-13	7.23E-13	-12.084	-12.141	-0.057	0
C(4)	8.03E-04						
	HCO3-	7.50E-04	6.59E-04	-3.125	-3.181	-0.056	24.82
	CO3-2	1.49E-05	8.92E-06	-4.826	-5.05	-0.224	-4.87
	MgHCO3+	1.20E-05	1.05E-05	-4.921	-4.98	-0.059	5.56
	MgCO3	1.15E-05	1.16E-05	-4.939	-4.938	0.002	-17.09
	CO2	5.12E-06	5.14E-06	-5.291	-5.289	0.002	34.43
	NaHCO3	3.48E-06	3.49E-06	-5.459	-5.457	0.002	1.8
	CaCO3	2.56E-06	2.57E-06	-5.592	-5.591	0.002	-14.6
	NaCO3-	1.79E-06	1.56E-06	-5.747	-5.806	-0.058	-0.85
	CaHCO3+	1.64E-06	1.44E-06	-5.786	-5.841	-0.055	9.75
	ZnCO3	2.75E-08	2.76E-08	-7.561	-7.559	0.002	0
	Zn(CO3)2-2	9.00E-09	5.26E-09	-8.046	-8.279	-0.234	0
	MnCO3	2.72E-09	2.73E-09	-8.565	-8.563	0.002	0
	ZnHCO3+	1.47E-09	1.29E-09	-8.832	-8.891	-0.058	0
	BaHCO3+	5.35E-10	4.68E-10	-9.271	-9.33	-0.058	0
	BaCO3	3.40E-10	3.41E-10	-9.469	-9.467	0.002	-10.7
	CuCO3	2.67E-10	2.68E-10	-9.573	-9.571	0.002	0
	MnHCO3+	2.59E-10	2.27E-10	-9.588	-9.644	-0.057	0
	Cu(CO3)2-	5.16E-12	3.01E-12	-11.288	-11.521	-0.234	0
	CuHCO3+	2.12E-12	1.85E-12	-11.674	-11.733	-0.058	0
	FeCO3	2.04E-12	2.05E-12	-11.69	-11.689	0.002	0
	FeHCO3+	7.22E-13	6.31E-13	-12.141	-12.2	-0.058	0
	(CO2)2	4.83E-13	4.85E-13	-12.316	-12.314	0.002	68.87
Ca	3.10E-04						
	Ca+2	2.87E-04	1.71E-04	-3.542	-3.766	-0.224	-17.83
	CaSO4	1.84E-05	1.85E-05	-4.735	-4.733	0.002	7.5
	CaCO3	2.56E-06	2.57E-06	-5.592	-5.591	0.002	-14.6
	CaHCO3+	1.64E-06	1.44E-06	-5.786	-5.841	-0.055	9.75
	CaOH+	9.38E-09	8.20E-09	-8.028	-8.086	-0.058	0
	CaHSO4+	4.82E-13	4.22E-13	-12.317	-12.375	-0.058	0
Cl	1.12E-02						
	Cl-	1.12E-02	9.77E-03	-1.95	-2.01	-0.06	18.17
	ZnOHCl	1.44E-09	1.45E-09	-8.842	-8.84	0.002	0
	ZnCl+	4.67E-10	4.08E-10	-9.331	-9.39	-0.059	-13.89
	MnCl+	1.75E-10	1.54E-10	-9.757	-9.813	-0.057	-3.01

	CuCl2-	1.02E-11	8.88E-12	-10.992	-11.052	-0.059	0
	ZnCl2	4.16E-12	4.17E-12	-11.381	-11.38	0.002	102.03
	MnCl2	6.53E-13	6.56E-13	-12.185	-12.183	0.002	85.89
	CuCl3-2	2.32E-13	1.38E-13	-12.634	-12.861	-0.227	0
	CuCl+	1.69E-13	1.47E-13	-12.773	-12.832	-0.059	0.74
	FeCl+	1.48E-13	1.29E-13	-12.83	-12.889	-0.058	0
	ZnCl3-	5.24E-14	4.58E-14	-13.28	-13.34	-0.059	16.94
	MnCl3-	2.01E-15	1.76E-15	-14.697	-14.753	-0.057	43.49
	CuCl2	7.70E-16	7.74E-16	-15.113	-15.112	0.002	31.02
	ZnCl4-2	3.78E-16	2.24E-16	-15.422	-15.649	-0.227	145.62
	CuCl3-	3.07E-20	2.68E-20	-19.512	-19.571	-0.059	0
	FeCl+2	4.56E-21	2.70E-21	-20.341	-20.569	-0.227	0
	FeCl2+	1.34E-22	1.18E-22	-21.872	-21.929	-0.057	0
	CuCl4-2	2.22E-24	1.31E-24	-23.654	-23.881	-0.227	0
	FeCl3	1.15E-25	1.15E-25	-24.941	-24.939	0.002	0
Cu(1)	1.08E-11						
	CuCl2-	1.02E-11	8.88E-12	-10.992	-11.052	-0.059	0
	Cu+	3.40E-13	2.94E-13	-12.469	-12.532	-0.063	0
	CuCl3-2	2.32E-13	1.38E-13	-12.634	-12.861	-0.227	0
Cu(2)	9.99E-09						
	Cu(OH)2	9.69E-09	9.73E-09	-8.014	-8.012	0.002	0
	CuCO3	2.67E-10	2.68E-10	-9.573	-9.571	0.002	0
	CuOH+	1.85E-11	1.62E-11	-10.733	-10.792	-0.059	0
	Cu+2	9.29E-12	5.60E-12	-11.032	-11.252	-0.219	-26.31
	Cu(CO3)2-	5.16E-12	3.01E-12	-11.288	-11.521	-0.234	0
	CuHCO3+	2.12E-12	1.85E-12	-11.674	-11.733	-0.058	0
	CuSO4	6.91E-13	6.94E-13	-12.16	-12.159	0.002	13.09
	Cu(OH)3-	1.93E-13	1.69E-13	-12.714	-12.772	-0.058	0
	CuCl+	1.69E-13	1.47E-13	-12.773	-12.832	-0.059	0.74
	CuF+	2.79E-15	2.43E-15	-14.555	-14.614	-0.058	0
	CuCl2	7.70E-16	7.74E-16	-15.113	-15.112	0.002	31.02
	Cu2(OH)2+	1.96E-16	1.14E-16	-15.709	-15.943	-0.234	0
	Cu(OH)4-2	1.66E-17	9.72E-18	-16.779	-17.012	-0.234	0
	CuCl3-	3.07E-20	2.68E-20	-19.512	-19.571	-0.059	0
	CuCl4-2	2.22E-24	1.31E-24	-23.654	-23.881	-0.227	0
F	3.00E-05						
	F-	2.74E-05	2.39E-05	-4.562	-4.622	-0.06	-1.22
	MgF+	2.45E-06	2.14E-06	-5.612	-5.669	-0.058	-10.49
	NaF	1.29E-07	1.30E-07	-6.89	-6.888	0.002	7.26
	HF	1.24E-10	1.24E-10	-9.908	-9.906	0.002	12.5
	ZnF+	5.98E-12	5.23E-12	-11.223	-11.282	-0.058	0
	MnF+	7.27E-13	6.38E-13	-12.139	-12.196	-0.057	0
	HF2-	1.30E-14	1.14E-14	-13.886	-13.944	-0.058	22.16
	CuF+	2.79E-15	2.43E-15	-14.555	-14.614	-0.058	0
	FeF+	2.62E-15	2.29E-15	-14.582	-14.641	-0.058	0
	FeF+2	5.84E-19	3.46E-19	-18.233	-18.461	-0.227	0
	FeF2+	3.75E-19	3.29E-19	-18.426	-18.483	-0.057	0
	FeF3	1.24E-20	1.25E-20	-19.907	-19.905	0.002	0
Fe(2)	2.08E-11						
	Fe+2	1.59E-11	9.58E-12	-10.799	-11.019	-0.219	-21.83

	FeCO3	2.04E-12	2.05E-12	-11.69	-11.689	0.002	0
	FeSO4	1.03E-12	1.03E-12	-11.988	-11.986	0.002	18.97
	FeOH+	9.95E-13	8.73E-13	-12.002	-12.059	-0.057	0
	FeHCO3+	7.22E-13	6.31E-13	-12.141	-12.2	-0.058	0
	FeCl+	1.48E-13	1.29E-13	-12.83	-12.889	-0.058	0
	FeF+	2.62E-15	2.29E-15	-14.582	-14.641	-0.058	0
	Fe(OH)2	2.13E-15	2.14E-15	-14.671	-14.669	0.002	0
	Fe(OH)3-	2.62E-17	2.29E-17	-16.583	-16.639	-0.057	0
	FeHSO4+	2.69E-20	2.36E-20	-19.57	-19.628	-0.058	0
Fe(3)	8.00E-08						
	Fe(OH)3	6.01E-08	6.03E-08	-7.221	-7.219	0.002	0
	Fe(OH)4-	1.81E-08	1.59E-08	-7.744	-7.8	-0.056	0
	Fe(OH)2+	1.85E-09	1.63E-09	-8.733	-8.789	-0.056	0
	FeOH+2	2.87E-14	1.70E-14	-13.542	-13.769	-0.227	0
	FeF+2	5.84E-19	3.46E-19	-18.233	-18.461	-0.227	0
	FeF2+	3.75E-19	3.29E-19	-18.426	-18.483	-0.057	0
	FeSO4+	6.94E-20	6.08E-20	-19.159	-19.216	-0.057	0
	Fe+3	2.56E-20	9.15E-21	-19.592	-20.039	-0.446	0
	FeF3	1.24E-20	1.25E-20	-19.907	-19.905	0.002	0
	FeCl+2	4.56E-21	2.70E-21	-20.341	-20.569	-0.227	0
	Fe(SO4)2-	9.24E-22	8.08E-22	-21.034	-21.093	-0.058	0
	FeCl2+	1.34E-22	1.18E-22	-21.872	-21.929	-0.057	0
	FeCl3	1.15E-25	1.15E-25	-24.941	-24.939	0.002	0
	Fe2(OH)2+	6.71E-26	7.80E-27	-25.173	-26.108	-0.935	0
	FeHSO4+2	9.67E-28	5.65E-28	-27.014	-27.248	-0.234	0
	Fe3(OH)4+	7.64E-32	2.65E-33	-31.117	-32.577	-1.46	0
H(0)	1.70E-28						
	H2	8.48E-29	8.51E-29	-28.072	-28.07	0.002	28.61
K	1.50E-04						
	K+	1.49E-04	1.30E-04	-3.826	-3.886	-0.06	9.1
	KSO4-	6.31E-07	5.55E-07	-6.2	-6.256	-0.056	34.2
Mg	2.47E-03						
	Mg+2	2.25E-03	1.36E-03	-2.648	-2.867	-0.22	-21.52
	MgSO4	1.92E-04	1.93E-04	-3.716	-3.714	0.002	5.84
	MgHCO3+	1.20E-05	1.05E-05	-4.921	-4.98	-0.059	5.56
	MgCO3	1.15E-05	1.16E-05	-4.939	-4.938	0.002	-17.09
	MgF+	2.45E-06	2.14E-06	-5.612	-5.669	-0.058	-10.49
	MgOH+	1.61E-06	1.42E-06	-5.794	-5.848	-0.054	0
Mn(2)	1.00E-08						
	Mn+2	6.40E-09	3.86E-09	-8.194	-8.414	-0.219	-19.45
	MnCO3	2.72E-09	2.73E-09	-8.565	-8.563	0.002	0
	MnSO4	4.15E-10	4.16E-10	-9.382	-9.381	0.002	22.54
	MnHCO3+	2.59E-10	2.27E-10	-9.588	-9.644	-0.057	0
	MnCl+	1.75E-10	1.54E-10	-9.757	-9.813	-0.057	-3.01
	MnOH+	3.26E-11	2.86E-11	-10.487	-10.544	-0.057	0
	MnF+	7.27E-13	6.38E-13	-12.139	-12.196	-0.057	0
	MnCl2	6.53E-13	6.56E-13	-12.185	-12.183	0.002	85.89
	MnCl3-	2.01E-15	1.76E-15	-14.697	-14.753	-0.057	43.49
	Mn(OH)3-	1.67E-18	1.47E-18	-17.777	-17.834	-0.057	0
	Mn(NO3)2	1.15E-18	1.16E-18	-17.938	-17.936	0.002	41.04

Mn(3)	3.33E-30						
	Mn+3	3.33E-30	1.19E-30	-29.477	-29.924	-0.446	0
N(-3)	2.00E-06						
	NH4+	1.74E-06	1.51E-06	-5.759	-5.822	-0.063	18.05
	NH3	2.47E-07	2.48E-07	-6.608	-6.606	0.002	24.42
	NH4SO4-	1.35E-08	1.18E-08	-7.871	-7.929	-0.058	37.76
N(5)	1.00E-05						
	NO3-	1.00E-05	8.68E-06	-5	-5.061	-0.061	29.59
	Mn(NO3)2	1.15E-18	1.16E-18	-17.938	-17.936	0.002	41.04
Na	1.08E-02						
	Na+	1.08E-02	9.42E-03	-1.969	-2.026	-0.057	-1.33
	NaSO4-	3.26E-05	2.87E-05	-4.487	-4.543	-0.056	14.65
	NaHCO3	3.48E-06	3.49E-06	-5.459	-5.457	0.002	1.8
	NaCO3-	1.79E-06	1.56E-06	-5.747	-5.806	-0.058	-0.85
	NaF	1.29E-07	1.30E-07	-6.89	-6.888	0.002	7.26
	NaOH	2.74E-18	2.75E-18	-17.563	-17.561	0.002	0
O(0)	1.15E-36						
	O2	5.73E-37	5.75E-37	-36.242	-36.24	0.002	30.4
S(6)	1.27E-03						
	SO4-2	1.03E-03	6.07E-04	-2.989	-3.217	-0.228	14.91
	MgSO4	1.92E-04	1.93E-04	-3.716	-3.714	0.002	5.84
	NaSO4-	3.26E-05	2.87E-05	-4.487	-4.543	-0.056	14.65
	CaSO4	1.84E-05	1.85E-05	-4.735	-4.733	0.002	7.5
	KSO4-	6.31E-07	5.55E-07	-6.2	-6.256	-0.056	34.2
	BaSO4	2.24E-08	2.25E-08	-7.649	-7.648	0.002	0
	NH4SO4-	1.35E-08	1.18E-08	-7.871	-7.929	-0.058	37.76
	ZnSO4	2.20E-09	2.20E-09	-8.659	-8.657	0.002	21.71
	MnSO4	4.15E-10	4.16E-10	-9.382	-9.381	0.002	22.54
	HSO4-	2.34E-10	2.05E-10	-9.631	-9.689	-0.058	40.37
	Zn(SO4)2-2	1.86E-11	1.09E-11	-10.73	-10.964	-0.234	-12.61
	FeSO4	1.03E-12	1.03E-12	-11.988	-11.986	0.002	18.97
	CuSO4	6.91E-13	6.94E-13	-12.16	-12.159	0.002	13.09
	CaHSO4+	4.82E-13	4.22E-13	-12.317	-12.375	-0.058	0
	FeSO4+	6.94E-20	6.08E-20	-19.159	-19.216	-0.057	0
	FeHSO4+	2.69E-20	2.36E-20	-19.57	-19.628	-0.058	0
	Fe(SO4)2-	9.24E-22	8.08E-22	-21.034	-21.093	-0.058	0
	FeHSO4+2	9.67E-28	5.65E-28	-27.014	-27.248	-0.234	0
Zn	9.00E-08						
	ZnCO3	2.75E-08	2.76E-08	-7.561	-7.559	0.002	0
	Zn+2	2.62E-08	1.55E-08	-7.582	-7.81	-0.227	-25.05
	Zn(OH)2	1.62E-08	1.62E-08	-7.792	-7.79	0.002	0
	Zn(CO3)2-2	9.00E-09	5.26E-09	-8.046	-8.279	-0.234	0
	ZnOH+	5.61E-09	4.90E-09	-8.251	-8.31	-0.058	0
	ZnSO4	2.20E-09	2.20E-09	-8.659	-8.657	0.002	21.71
	ZnHCO3+	1.47E-09	1.29E-09	-8.832	-8.891	-0.058	0
	ZnOHCl	1.44E-09	1.45E-09	-8.842	-8.84	0.002	0
	ZnCl+	4.67E-10	4.08E-10	-9.331	-9.39	-0.059	-13.89
	Zn(SO4)2-2	1.86E-11	1.09E-11	-10.73	-10.964	-0.234	-12.61
	Zn(OH)3-	1.69E-11	1.48E-11	-10.772	-10.83	-0.058	0
	ZnF+	5.98E-12	5.23E-12	-11.223	-11.282	-0.058	0

ZnCl2	4.16E-12	4.17E-12	-11.381	-11.38	0.002	102.03
ZnCl3-	5.24E-14	4.58E-14	-13.28	-13.34	-0.059	16.94
Zn(OH)4-2	1.16E-15	6.75E-16	-14.937	-15.17	-0.234	0
ZnCl4-2	3.78E-16	2.24E-16	-15.422	-15.649	-0.227	145.62

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-2.71	-6.98	-4.28	CaSO4
Aragonite	-0.48	-8.82	-8.34	CaCO3
Barite	-0.5	-10.35	-9.84	BaSO4
Calcite	-0.34	-8.82	-8.48	CaCO3
CO2(g)	-3.82	-5.29	-1.47	CO2
Dolomite	0.35	-16.73	-17.08	CaMg(CO3)2
Fe(OH)3(a	0.45	5.34	4.89	Fe(OH)3
Fluorite	-2.41	-13.01	-10.6	CaF2
Goethite	6.34	5.34	-1	FeOOH
Gypsum	-2.4	-6.98	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-5.61	-4.04	1.57	NaCl
Hausmann	-10.59	50.44	61.03	Mn3O4
Hematite	14.69	10.68	-4.01	Fe2O3
Jarosite-K	-10.47	-19.68	-9.21	KFe3(SO4)2(OH)6
Manganite	-4.37	20.97	25.34	MnOOH
Melanterit	-12.03	-14.24	-2.21	FeSO4:7H2O
NH3(g)	-8.4	-6.61	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.69	8.51	15.2	Mn(OH)2
Pyrolusite	-7.95	33.43	41.38	MnO2:H2O
Rhodochro	-2.33	-13.46	-11.13	MnCO3
Siderite	-5.18	-16.07	-10.89	FeCO3
Smithsonit	-2.86	-12.86	-10	ZnCO3
Sylvite	-6.8	-5.9	0.9	KCl
Witherite	-3.62	-12.18	-8.56	BaCO3
Zn(OH)2(e	-2.39	9.11	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 2

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.67E-03	1.67E-03
Ba	3.00E-07	3.00E-07
Ca	6.10E-04	6.10E-04

Cl	2.24E-02	2.24E-02
Cu	2.00E-08	2.00E-08
F	6.00E-05	6.00E-05
Fe	1.60E-07	1.60E-07
K	3.10E-04	3.10E-04
Mg	4.94E-03	4.94E-03
Mn	3.00E-08	3.00E-08
N(-3)	3.00E-06	3.00E-06
N(5)	3.00E-05	3.00E-05
Na	2.16E-02	2.16E-02
S(6)	2.54E-03	2.54E-03
Zn	1.80E-07	1.80E-07

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 3214
Density (g/cm³) = 0.99848
Volume (L) = 1.00332
Activity of water = 0.999
Ionic strength (mol/kgw) = 3.66E-02
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 1.59E-03
Total CO2 (mol/kg) = 1.59E-03
Temperatu (°C) = 25
Electrical balance (eq) = 3.73E-03
Percent error, 100*(Cat-| = 6.26
Iterations = 7 (14 overall)
Total H = 1.11E+02
Total O = 5.55E+01

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4425	0.2628		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	3.51E-06	2.92E-06	-5.455	-5.535	-0.08	-3.92
H+	4.00E-09	3.47E-09	-8.398	-8.46	-0.062	0
H2O	5.55E+01	9.99E-01	1.744	0	0	18.07
Ba	3.00E-07					
Ba+2	2.41E-07	1.19E-07	-6.618	-6.924	-0.306	-12.28
BaSO4	5.62E-08	5.67E-08	-7.25	-7.246	0.004	0
BaHCO3+	1.66E-09	1.39E-09	-8.78	-8.857	-0.076	0

	BaCO3	1.01E-09	1.01E-09	-8.998	-8.994	0.004	-10.7
	BaOH+	1.38E-12	1.16E-12	-11.86	-11.934	-0.074	0
C(4)	1.59E-03						
	HCO3-	1.44E-03	1.22E-03	-2.841	-2.914	-0.073	24.92
	MgHCO3+	3.87E-05	3.24E-05	-4.412	-4.49	-0.078	5.59
	MgCO3	3.54E-05	3.57E-05	-4.451	-4.447	0.004	-17.09
	CO3-2	3.22E-05	1.65E-05	-4.492	-4.783	-0.291	-4.65
	NaHCO3	1.23E-05	1.24E-05	-4.911	-4.907	0.004	1.8
	CO2	9.43E-06	9.51E-06	-5.026	-5.022	0.004	34.43
	CaCO3	7.73E-06	7.79E-06	-5.112	-5.108	0.004	-14.6
	NaCO3-	6.61E-06	5.54E-06	-5.18	-5.256	-0.076	-0.71
	CaHCO3+	5.15E-06	4.38E-06	-5.288	-5.359	-0.071	9.78
	ZnCO3	6.09E-08	6.14E-08	-7.216	-7.212	0.004	0
	Zn(CO3)2-2	4.37E-08	2.16E-08	-7.36	-7.665	-0.305	0
	MnCO3	1.08E-08	1.09E-08	-7.968	-7.964	0.004	0
	ZnHCO3+	3.41E-09	2.86E-09	-8.467	-8.543	-0.076	0
	BaHCO3+	1.66E-09	1.39E-09	-8.78	-8.857	-0.076	0
	MnHCO3+	1.07E-09	9.01E-10	-8.971	-9.045	-0.074	0
	BaCO3	1.01E-09	1.01E-09	-8.998	-8.994	0.004	-10.7
	CuCO3	9.62E-10	9.70E-10	-9.017	-9.013	0.004	0
	Cu(CO3)2-	4.06E-11	2.01E-11	-10.391	-10.696	-0.305	0
	CuHCO3+	7.98E-12	6.69E-12	-11.098	-11.174	-0.076	0
	FeCO3	7.47E-12	7.53E-12	-11.127	-11.123	0.004	0
	FeHCO3+	2.77E-12	2.32E-12	-11.558	-11.634	-0.076	0
	(CO2)2	1.65E-12	1.66E-12	-11.784	-11.78	0.004	68.87
Ca	6.10E-04						
	Ca+2	5.50E-04	2.82E-04	-3.26	-3.551	-0.291	-17.69
	CaSO4	4.71E-05	4.75E-05	-4.327	-4.323	0.004	7.5
	CaCO3	7.73E-06	7.79E-06	-5.112	-5.108	0.004	-14.6
	CaHCO3+	5.15E-06	4.38E-06	-5.288	-5.359	-0.071	9.78
	CaOH+	1.61E-08	1.35E-08	-7.795	-7.871	-0.076	0
	CaHSO4+	1.29E-12	1.08E-12	-11.889	-11.965	-0.076	0
Cl	2.24E-02						
	Cl-	2.24E-02	1.87E-02	-1.649	-1.728	-0.079	18.22
	ZnOHCl	3.30E-09	3.33E-09	-8.481	-8.477	0.004	0
	ZnCl+	1.12E-09	9.40E-10	-8.949	-9.027	-0.078	-13.92
	MnCl+	7.50E-10	6.32E-10	-9.125	-9.199	-0.074	-2.98
	CuCl2-	7.61E-11	6.36E-11	-10.119	-10.197	-0.078	0
	ZnCl2	1.82E-11	1.84E-11	-10.739	-10.735	0.004	102.03
	MnCl2	5.12E-12	5.16E-12	-11.291	-11.287	0.004	85.89
	CuCl3-2	3.73E-12	1.88E-12	-11.428	-11.725	-0.297	0
	CuCl+	6.60E-13	5.52E-13	-12.181	-12.258	-0.078	0.79
	FeCl+	5.86E-13	4.92E-13	-12.232	-12.308	-0.076	0
	ZnCl3-	4.62E-13	3.86E-13	-12.335	-12.413	-0.078	16.85
	MnCl3-	3.15E-14	2.66E-14	-13.501	-13.576	-0.074	43.59
	ZnCl4-2	7.17E-15	3.62E-15	-14.145	-14.442	-0.297	145.88
	CuCl2	5.49E-15	5.54E-15	-14.26	-14.257	0.004	31.02
	CuCl3-	4.40E-19	3.67E-19	-18.357	-18.435	-0.078	0
	FeCl+2	2.04E-20	1.03E-20	-19.691	-19.988	-0.297	0
	FeCl2+	1.02E-21	8.58E-22	-20.992	-21.066	-0.074	0

	CuCl4-2	6.82E-23	3.44E-23	-22.166	-22.463	-0.297	0
	FeCl3	1.59E-24	1.61E-24	-23.798	-23.795	0.004	0
Cu(1)	8.05E-11						
	CuCl2-	7.61E-11	6.36E-11	-10.119	-10.197	-0.078	0
	CuCl3-2	3.73E-12	1.88E-12	-11.428	-11.725	-0.297	0
	Cu+	6.98E-13	5.75E-13	-12.156	-12.24	-0.084	0
Cu(2)	1.99E-08						
	Cu(OH)2	1.89E-08	1.90E-08	-7.725	-7.721	0.004	0
	CuCO3	9.62E-10	9.70E-10	-9.017	-9.013	0.004	0
	Cu(CO3)2-	4.06E-11	2.01E-11	-10.391	-10.696	-0.305	0
	CuOH+	3.78E-11	3.16E-11	-10.423	-10.501	-0.078	0
	Cu+2	2.10E-11	1.10E-11	-10.677	-10.96	-0.283	-26.19
	CuHCO3+	7.98E-12	6.69E-12	-11.098	-11.174	-0.076	0
	CuSO4	2.11E-12	2.12E-12	-11.676	-11.673	0.004	13.09
	CuCl+	6.60E-13	5.52E-13	-12.181	-12.258	-0.078	0.79
	Cu(OH)3-	3.93E-13	3.30E-13	-12.405	-12.481	-0.076	0
	CuF+	1.03E-14	8.60E-15	-13.989	-14.066	-0.076	0
	CuCl2	5.49E-15	5.54E-15	-14.26	-14.257	0.004	31.02
	Cu2(OH)2+	8.81E-16	4.36E-16	-15.055	-15.36	-0.305	0
	Cu(OH)4-2	3.83E-17	1.90E-17	-16.417	-16.722	-0.305	0
	CuCl3-	4.40E-19	3.67E-19	-18.357	-18.435	-0.078	0
	CuCl4-2	6.82E-23	3.44E-23	-22.166	-22.463	-0.297	0
F	6.00E-05						
	F-	5.19E-05	4.31E-05	-4.285	-4.365	-0.08	-1.16
	MgF+	7.71E-06	6.47E-06	-5.113	-5.189	-0.076	-10.46
	NaF	4.45E-07	4.48E-07	-6.352	-6.348	0.004	7.26
	HF	2.22E-10	2.24E-10	-9.653	-9.649	0.004	12.5
	ZnF+	1.36E-11	1.14E-11	-10.868	-10.944	-0.076	0
	MnF+	2.94E-12	2.48E-12	-11.532	-11.606	-0.074	0
	HF2-	4.42E-14	3.71E-14	-13.354	-13.431	-0.076	22.21
	CuF+	1.03E-14	8.60E-15	-13.989	-14.066	-0.076	0
	FeF+	9.79E-15	8.22E-15	-14.009	-14.085	-0.076	0
	FeF2+	2.53E-18	2.14E-18	-17.596	-17.671	-0.074	0
	FeF+2	2.46E-18	1.24E-18	-17.608	-17.905	-0.297	0
	FeF3	1.45E-19	1.46E-19	-18.839	-18.836	0.004	0
Fe(2)	5.27E-11						
	Fe+2	3.66E-11	1.91E-11	-10.437	-10.72	-0.283	-21.71
	FeCO3	7.47E-12	7.53E-12	-11.127	-11.123	0.004	0
	FeSO4	3.19E-12	3.22E-12	-11.496	-11.493	0.004	18.97
	FeHCO3+	2.77E-12	2.32E-12	-11.558	-11.634	-0.076	0
	FeOH+	2.06E-12	1.74E-12	-11.686	-11.76	-0.074	0
	FeCl+	5.86E-13	4.92E-13	-12.232	-12.308	-0.076	0
	FeF+	9.79E-15	8.22E-15	-14.009	-14.085	-0.076	0
	Fe(OH)2	4.22E-15	4.26E-15	-14.375	-14.371	0.004	0
	Fe(OH)3-	5.41E-17	4.56E-17	-16.267	-16.341	-0.074	0
	FeHSO4+	8.74E-20	7.33E-20	-19.058	-19.135	-0.076	0
Fe(3)	1.60E-07						
	Fe(OH)3	1.19E-07	1.20E-07	-6.925	-6.921	0.004	0
	Fe(OH)4-	3.73E-08	3.15E-08	-7.429	-7.502	-0.073	0
	Fe(OH)2+	3.82E-09	3.23E-09	-8.418	-8.491	-0.073	0

	FeOH+2	6.71E-14	3.39E-14	-13.174	-13.47	-0.297	0
	FeF2+	2.53E-18	2.14E-18	-17.596	-17.671	-0.074	0
	FeF+2	2.46E-18	1.24E-18	-17.608	-17.905	-0.297	0
	FeSO4+	2.25E-19	1.89E-19	-18.648	-18.723	-0.074	0
	FeF3	1.45E-19	1.46E-19	-18.839	-18.836	0.004	0
	Fe+3	6.62E-20	1.82E-20	-19.179	-19.74	-0.561	0
	FeCl+2	2.04E-20	1.03E-20	-19.691	-19.988	-0.297	0
	Fe(SO4)2-	4.69E-21	3.94E-21	-20.329	-20.405	-0.076	0
	FeCl2+	1.02E-21	8.58E-22	-20.992	-21.066	-0.074	0
	FeCl3	1.59E-24	1.61E-24	-23.798	-23.795	0.004	0
	Fe2(OH)2+	5.13E-25	3.08E-26	-24.29	-25.511	-1.221	0
	FeHSO4+2	3.55E-27	1.76E-27	-26.45	-26.755	-0.305	0
	Fe3(OH)4+	1.68E-30	2.08E-32	-29.775	-31.682	-1.907	0
H(0)	1.69E-28						
	H2	8.44E-29	8.51E-29	-28.074	-28.07	0.004	28.61
K	3.10E-04						
	K+	3.08E-04	2.57E-04	-3.511	-3.591	-0.079	9.14
	KSO4-	2.02E-06	1.71E-06	-5.694	-5.767	-0.073	34.26
Mg	4.94E-03						
	Mg+2	4.35E-03	2.27E-03	-2.361	-2.644	-0.283	-21.39
	MgSO4	5.01E-04	5.06E-04	-3.3	-3.296	0.004	5.84
	MgHCO3+	3.87E-05	3.24E-05	-4.412	-4.49	-0.078	5.59
	MgCO3	3.54E-05	3.57E-05	-4.451	-4.447	0.004	-17.09
	MgF+	7.71E-06	6.47E-06	-5.113	-5.189	-0.076	-10.46
	MgOH+	2.79E-06	2.38E-06	-5.555	-5.624	-0.069	0
Mn(2)	3.00E-08						
	Mn+2	1.59E-08	8.30E-09	-7.798	-8.081	-0.283	-18.97
	MnCO3	1.08E-08	1.09E-08	-7.968	-7.964	0.004	0
	MnSO4	1.39E-09	1.40E-09	-8.857	-8.853	0.004	22.54
	MnHCO3+	1.07E-09	9.01E-10	-8.971	-9.045	-0.074	0
	MnCl+	7.50E-10	6.32E-10	-9.125	-9.199	-0.074	-2.98
	MnOH+	7.29E-11	6.15E-11	-10.137	-10.211	-0.074	0
	MnCl2	5.12E-12	5.16E-12	-11.291	-11.287	0.004	85.89
	MnF+	2.94E-12	2.48E-12	-11.532	-11.606	-0.074	0
	MnCl3-	3.15E-14	2.66E-14	-13.501	-13.576	-0.074	43.59
	Mn(NO3)2	2.02E-17	2.04E-17	-16.695	-16.691	0.004	41.04
	Mn(OH)3-	3.73E-18	3.15E-18	-17.428	-17.502	-0.074	0
Mn(3)	9.33E-30						
	Mn+3	9.33E-30	2.57E-30	-29.03	-29.591	-0.561	0
N(-3)	3.00E-06						
	NH4+	2.62E-06	2.16E-06	-5.582	-5.666	-0.084	18.09
	NH3	3.51E-07	3.54E-07	-6.454	-6.451	0.004	24.42
	NH4SO4-	3.14E-08	2.64E-08	-7.503	-7.579	-0.076	37.85
N(5)	3.00E-05						
	NO3-	3.00E-05	2.48E-05	-4.523	-4.605	-0.082	29.64
	Mn(NO3)2	2.02E-17	2.04E-17	-16.695	-16.691	0.004	41.04
Na	2.16E-02						
	Na+	2.15E-02	1.81E-02	-1.669	-1.743	-0.075	-1.25
	NaSO4-	1.02E-04	8.60E-05	-3.993	-4.066	-0.073	15.15
	NaHCO3	1.23E-05	1.24E-05	-4.911	-4.907	0.004	1.8

	NaCO3-	6.61E-06	5.54E-06	-5.18	-5.256	-0.076	-0.71
	NaF	4.45E-07	4.48E-07	-6.352	-6.348	0.004	7.26
	NaOH	5.22E-18	5.27E-18	-17.282	-17.278	0.004	0
O(0)	1.14E-36						
	O2	5.70E-37	5.74E-37	-36.244	-36.241	0.004	30.4
S(6)	2.54E-03						
	SO4-2	1.89E-03	9.50E-04	-2.724	-3.022	-0.298	15.11
	MgSO4	5.01E-04	5.06E-04	-3.3	-3.296	0.004	5.84
	NaSO4-	1.02E-04	8.60E-05	-3.993	-4.066	-0.073	15.15
	CaSO4	4.71E-05	4.75E-05	-4.327	-4.323	0.004	7.5
	KSO4-	2.02E-06	1.71E-06	-5.694	-5.767	-0.073	34.26
	BaSO4	5.62E-08	5.67E-08	-7.25	-7.246	0.004	0
	NH4SO4-	3.14E-08	2.64E-08	-7.503	-7.579	-0.076	37.85
	ZnSO4	4.12E-09	4.16E-09	-8.385	-8.381	0.004	21.71
	MnSO4	1.39E-09	1.40E-09	-8.857	-8.853	0.004	22.54
	HSO4-	3.82E-10	3.20E-10	-9.418	-9.495	-0.076	40.42
	Zn(SO4)2-2	6.48E-11	3.21E-11	-10.189	-10.494	-0.305	-12.27
	FeSO4	3.19E-12	3.22E-12	-11.496	-11.493	0.004	18.97
	CuSO4	2.11E-12	2.12E-12	-11.676	-11.673	0.004	13.09
	CaHSO4+	1.29E-12	1.08E-12	-11.889	-11.965	-0.076	0
	FeSO4+	2.25E-19	1.89E-19	-18.648	-18.723	-0.074	0
	FeHSO4+	8.74E-20	7.33E-20	-19.058	-19.135	-0.076	0
	Fe(SO4)2-	4.69E-21	3.94E-21	-20.329	-20.405	-0.076	0
	FeHSO4+2	3.55E-27	1.76E-27	-26.45	-26.755	-0.305	0
Zn	1.80E-07						
	ZnCO3	6.09E-08	6.14E-08	-7.216	-7.212	0.004	0
	Zn(CO3)2-2	4.37E-08	2.16E-08	-7.36	-7.665	-0.305	0
	Zn+2	3.70E-08	1.87E-08	-7.432	-7.729	-0.297	-24.92
	Zn(OH)2	1.94E-08	1.95E-08	-7.713	-7.71	0.004	0
	ZnOH+	7.03E-09	5.90E-09	-8.153	-8.229	-0.076	0
	ZnSO4	4.12E-09	4.16E-09	-8.385	-8.381	0.004	21.71
	ZnHCO3+	3.41E-09	2.86E-09	-8.467	-8.543	-0.076	0
	ZnOHCl	3.30E-09	3.33E-09	-8.481	-8.477	0.004	0
	ZnCl+	1.12E-09	9.40E-10	-8.949	-9.027	-0.078	-13.92
	Zn(SO4)2-2	6.48E-11	3.21E-11	-10.189	-10.494	-0.305	-12.27
	Zn(OH)3-	2.12E-11	1.78E-11	-10.674	-10.75	-0.076	0
	ZnCl2	1.82E-11	1.84E-11	-10.739	-10.735	0.004	102.03
	ZnF+	1.36E-11	1.14E-11	-10.868	-10.944	-0.076	0
	ZnCl3-	4.62E-13	3.86E-13	-12.335	-12.413	-0.078	16.85
	ZnCl4-2	7.17E-15	3.62E-15	-14.145	-14.442	-0.297	145.88
	Zn(OH)4-2	1.64E-15	8.12E-16	-14.785	-15.09	-0.305	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-2.3	-6.57	-4.28	CaSO4			
Aragonite	0	-8.33	-8.34	CaCO3			
Barite	-0.1	-9.95	-9.84	BaSO4			
Calcite	0.15	-8.33	-8.48	CaCO3			

CO2(g)	-3.55	-5.02	-1.47	CO2
Dolomite	1.32	-15.76	-17.08	CaMg(CO3)2
Fe(OH)3(a)	0.75	5.64	4.89	Fe(OH)3
Fluorite	-1.68	-12.28	-10.6	CaF2
Goethite	6.64	5.64	-1	FeOOH
Gypsum	-1.99	-6.57	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-5.04	-3.47	1.57	NaCl
Hausmann	-9.59	51.44	61.03	Mn3O4
Hematite	15.29	11.28	-4.01	Fe2O3
Jarosite-K	-8.89	-18.1	-9.21	KFe3(SO4)2(OH)6
Manganite	-4.04	21.3	25.34	MnOOH
Melanterit	-11.54	-13.75	-2.21	FeSO4:7H2O
NH3(g)	-8.25	-6.45	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.36	8.84	15.2	Mn(OH)2
Pyrolusite	-7.62	33.76	41.38	MnO2:H2O
Rhodochrc	-1.73	-12.86	-11.13	MnCO3
Siderite	-4.61	-15.5	-10.89	FeCO3
Smithsonit	-2.51	-12.51	-10	ZnCO3
Sylvite	-6.22	-5.32	0.9	KCl
Witherite	-3.15	-11.71	-8.56	BaCO3
Zn(OH)2(e	-2.31	9.19	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 3

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	2.50E-03	2.50E-03
Ba	4.50E-07	4.50E-07
Ca	9.20E-04	9.20E-04
Cl	3.36E-02	3.36E-02
Cu	3.00E-08	3.00E-08
F	9.00E-05	9.00E-05
Fe	2.40E-07	2.40E-07
K	4.60E-04	4.60E-04
Mg	7.41E-03	7.41E-03
Mn	4.00E-08	4.00E-08
N(-3)	5.00E-06	5.00E-06
N(5)	4.00E-05	4.00E-05
Na	3.24E-02	3.24E-02
S(6)	3.81E-03	3.81E-03
Zn	2.60E-07	2.60E-07

#NAME? of solution----------

pH	=	8.46		
pe	=	4		
Specific	Conductan	(µS/cm,	25°C)	= 4686
Density	(g/cm³)	=	0.99919	
Volume	(L)	=	1.0035	
Activity	of	water	=	0.999
Ionic	strength	(mol/kgw)	=	5.43E-02
Mass	of	water	(kg)	= 1.00E+00
Total	carbon	(mol/kg)	=	2.36E-03
Total	CO2	(mol/kg)	=	2.36E-03
Temperatu	(°C)	=	25	
Electrical	balance	(eq)	=	5.59E-03
Percent	error,	100*(Cat-|	=	6.31
Iterations	=	8	(22	overall)
Total	H	=	1.11E+02	
Total	O	=	5.55E+01	

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4304	0.2621		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	3.62E-06	2.92E-06	-5.442	-5.535	-0.094	-3.86
H+	4.08E-09	3.47E-09	-8.39	-8.46	-0.07	0
H2O	5.55E+01	9.99E-01	1.744	-0.001	0	18.07
Ba	4.50E-07					
Ba+2	3.52E-07	1.55E-07	-6.453	-6.809	-0.356	-12.18
BaSO4	9.29E-08	9.41E-08	-7.032	-7.026	0.005	0
BaHCO3+	3.14E-09	2.56E-09	-8.503	-8.591	-0.088	0
BaCO3	1.85E-09	1.87E-09	-8.734	-8.728	0.005	-10.7
BaOH+	1.85E-12	1.52E-12	-11.734	-11.82	-0.086	0
C(4)	2.36E-03					
HCO3-	2.09E-03	1.72E-03	-2.68	-2.764	-0.084	25
MgHCO3+	7.55E-05	6.12E-05	-4.122	-4.213	-0.091	5.62
MgCO3	6.67E-05	6.75E-05	-4.176	-4.17	0.005	-17.09
CO3-2	5.06E-05	2.33E-05	-4.296	-4.633	-0.336	-4.49
NaHCO3	2.52E-05	2.55E-05	-4.598	-4.593	0.005	1.8
CaCO3	1.46E-05	1.48E-05	-4.836	-4.831	0.005	-14.6
NaCO3-	1.40E-05	1.14E-05	-4.854	-4.942	-0.088	-0.59
CO2	1.33E-05	1.35E-05	-4.877	-4.871	0.005	34.43
CaHCO3+	1.00E-05	8.29E-06	-5	-5.081	-0.081	9.8
Zn(CO3)2-2	9.46E-08	4.20E-08	-7.024	-7.376	-0.352	0

	ZnCO3	8.33E-08	8.44E-08	-7.079	-7.074	0.005	0
	MnCO3	1.63E-08	1.65E-08	-7.788	-7.783	0.005	0
	ZnHCO3+	4.82E-09	3.94E-09	-8.317	-8.405	-0.088	0
	BaHCO3+	3.14E-09	2.56E-09	-8.503	-8.591	-0.088	0
	CuCO3	1.99E-09	2.01E-09	-8.702	-8.697	0.005	0
	BaCO3	1.85E-09	1.87E-09	-8.734	-8.728	0.005	-10.7
	MnHCO3+	1.67E-09	1.37E-09	-8.778	-8.864	-0.086	0
	Cu(CO3)2-	1.33E-10	5.90E-11	-9.877	-10.229	-0.352	0
	CuHCO3+	1.70E-11	1.39E-11	-10.77	-10.858	-0.088	0
	FeCO3	1.57E-11	1.59E-11	-10.803	-10.798	0.005	0
	FeHCO3+	6.02E-12	4.91E-12	-11.221	-11.309	-0.088	0
	(CO2)2	3.28E-12	3.32E-12	-11.484	-11.479	0.005	68.87
Ca	9.20E-04						
	Ca+2	8.15E-04	3.77E-04	-3.089	-3.423	-0.335	-17.6
	CaSO4	8.01E-05	8.11E-05	-4.096	-4.091	0.005	7.5
	CaCO3	1.46E-05	1.48E-05	-4.836	-4.831	0.005	-14.6
	CaHCO3+	1.00E-05	8.29E-06	-5	-5.081	-0.081	9.8
	CaOH+	2.21E-08	1.80E-08	-7.656	-7.744	-0.088	0
	CaHSO4+	2.26E-12	1.85E-12	-11.645	-11.733	-0.088	0
Cl	3.36E-02						
	Cl-	3.36E-02	2.72E-02	-1.473	-1.565	-0.092	18.26
	ZnOHCl	4.65E-09	4.71E-09	-8.333	-8.327	0.005	0
	ZnCl+	1.64E-09	1.33E-09	-8.786	-8.877	-0.091	-13.95
	MnCl+	1.20E-09	9.88E-10	-8.92	-9.005	-0.086	-2.96
	CuCl2-	2.44E-10	1.98E-10	-9.613	-9.704	-0.091	0
	ZnCl2	3.74E-11	3.79E-11	-10.427	-10.422	0.005	102.03
	CuCl3-2	1.88E-11	8.52E-12	-10.726	-11.07	-0.344	0
	MnCl2	1.16E-11	1.17E-11	-10.936	-10.931	0.005	85.89
	CuCl+	1.45E-12	1.18E-12	-11.838	-11.929	-0.091	0.84
	ZnCl3-	1.43E-12	1.16E-12	-11.846	-11.937	-0.091	16.76
	FeCl+	1.31E-12	1.07E-12	-11.882	-11.97	-0.088	0
	MnCl3-	1.07E-13	8.79E-14	-12.97	-13.056	-0.086	43.67
	ZnCl4-2	3.48E-14	1.58E-14	-13.458	-13.802	-0.344	146.1
	CuCl2	1.70E-14	1.72E-14	-13.77	-13.764	0.005	31.02
	CuCl3-	2.05E-18	1.66E-18	-17.689	-17.78	-0.091	0
	FeCl+2	4.94E-20	2.24E-20	-19.306	-19.65	-0.344	0
	FeCl2+	3.32E-21	2.72E-21	-20.479	-20.565	-0.086	0
	CuCl4-2	5.00E-22	2.27E-22	-21.301	-21.645	-0.344	0
	FeCl3	7.31E-24	7.40E-24	-23.136	-23.131	0.005	0
Cu(1)	2.63E-10						
	CuCl2-	2.44E-10	1.98E-10	-9.613	-9.704	-0.091	0
	CuCl3-2	1.88E-11	8.52E-12	-10.726	-11.07	-0.344	0
	Cu+	1.06E-12	8.43E-13	-11.974	-12.074	-0.1	0
Cu(2)	2.97E-08						
	Cu(OH)2	2.75E-08	2.79E-08	-7.561	-7.555	0.005	0
	CuCO3	1.99E-09	2.01E-09	-8.702	-8.697	0.005	0
	Cu(CO3)2-	1.33E-10	5.90E-11	-9.877	-10.229	-0.352	0
	CuOH+	5.71E-11	4.63E-11	-10.244	-10.335	-0.091	0
	Cu+2	3.40E-11	1.61E-11	-10.468	-10.794	-0.326	-26.1
	CuHCO3+	1.70E-11	1.39E-11	-10.77	-10.858	-0.088	0

	CuSO4	3.92E-12	3.97E-12	-11.407	-11.401	0.005	13.09
	CuCl+	1.45E-12	1.18E-12	-11.838	-11.929	-0.091	0.84
	Cu(OH)3-	5.92E-13	4.83E-13	-12.228	-12.316	-0.088	0
	CuF+	2.15E-14	1.75E-14	-13.668	-13.756	-0.088	0
	CuCl2	1.70E-14	1.72E-14	-13.77	-13.764	0.005	31.02
	Cu2(OH)2+	2.11E-15	9.37E-16	-14.676	-15.028	-0.352	0
	Cu(OH)4-2	6.25E-17	2.78E-17	-16.204	-16.556	-0.352	0
	CuCl3-	2.05E-18	1.66E-18	-17.689	-17.78	-0.091	0
	CuCl4-2	5.00E-22	2.27E-22	-21.301	-21.645	-0.344	0
F	9.00E-05						
	F-	7.44E-05	5.99E-05	-4.129	-4.222	-0.094	-1.13
	MgF+	1.47E-05	1.20E-05	-4.832	-4.92	-0.088	-10.44
	NaF	8.97E-07	9.09E-07	-6.047	-6.042	0.005	7.26
	HF	3.08E-10	3.12E-10	-9.512	-9.506	0.005	12.5
	ZnF+	1.88E-11	1.54E-11	-10.726	-10.814	-0.088	0
	MnF+	4.50E-12	3.69E-12	-11.347	-11.433	-0.086	0
	HF2-	8.78E-14	7.17E-14	-13.057	-13.145	-0.088	22.25
	CuF+	2.15E-14	1.75E-14	-13.668	-13.756	-0.088	0
	FeF+	2.09E-14	1.71E-14	-13.679	-13.767	-0.088	0
	FeF2+	7.52E-18	6.17E-18	-17.124	-17.21	-0.086	0
	FeF+2	5.71E-18	2.59E-18	-17.244	-17.587	-0.344	0
	FeF3	5.79E-19	5.86E-19	-18.238	-18.232	0.005	0
Fe(2)	9.27E-11						
	Fe+2	6.04E-11	2.85E-11	-10.219	-10.545	-0.326	-21.62
	FeCO3	1.57E-11	1.59E-11	-10.803	-10.798	0.005	0
	FeSO4	6.06E-12	6.13E-12	-11.218	-11.212	0.005	18.97
	FeHCO3+	6.02E-12	4.91E-12	-11.221	-11.309	-0.088	0
	FeOH+	3.17E-12	2.60E-12	-11.5	-11.586	-0.086	0
	FeCl+	1.31E-12	1.07E-12	-11.882	-11.97	-0.088	0
	FeF+	2.09E-14	1.71E-14	-13.679	-13.767	-0.088	0
	Fe(OH)2	6.29E-15	6.37E-15	-14.202	-14.196	0.005	0
	Fe(OH)3-	8.30E-17	6.81E-17	-16.081	-16.167	-0.086	0
	FeHSO4+	1.71E-19	1.40E-19	-18.767	-18.855	-0.088	0
Fe(3)	2.40E-07						
	Fe(OH)3	1.77E-07	1.79E-07	-6.752	-6.747	0.005	0
	Fe(OH)4-	5.71E-08	4.71E-08	-7.243	-7.327	-0.084	0
	Fe(OH)2+	5.86E-09	4.83E-09	-8.232	-8.316	-0.084	0
	FeOH+2	1.12E-13	5.06E-14	-12.952	-13.296	-0.344	0
	FeF2+	7.52E-18	6.17E-18	-17.124	-17.21	-0.086	0
	FeF+2	5.71E-18	2.59E-18	-17.244	-17.587	-0.344	0
	FeF3	5.79E-19	5.86E-19	-18.238	-18.232	0.005	0
	FeSO4+	4.40E-19	3.61E-19	-18.357	-18.442	-0.086	0
	Fe+3	1.17E-19	2.72E-20	-18.932	-19.565	-0.633	0
	FeCl+2	4.94E-20	2.24E-20	-19.306	-19.65	-0.344	0
	Fe(SO4)2-	1.17E-20	9.55E-21	-19.932	-20.02	-0.088	0
	FeCl2+	3.32E-21	2.72E-21	-20.479	-20.565	-0.086	0
	FeCl3	7.31E-24	7.40E-24	-23.136	-23.131	0.005	0
	Fe2(OH)2+	1.77E-24	6.90E-26	-23.752	-25.161	-1.409	0
	FeHSO4+2	7.54E-27	3.35E-27	-26.122	-26.475	-0.352	0
	Fe3(OH)4+	1.11E-29	6.96E-32	-28.956	-31.157	-2.202	0

H(0)	1.68E-28						
	H2	8.41E-29	8.51E-29	-28.075	-28.07	0.005	28.61
K	4.60E-04						
	K+	4.56E-04	3.68E-04	-3.341	-3.434	-0.093	9.18
	KSO4-	3.80E-06	3.13E-06	-5.42	-5.504	-0.084	34.29
Mg	7.41E-03						
	Mg+2	6.40E-03	3.04E-03	-2.194	-2.518	-0.324	-21.3
	MgSO4	8.50E-04	8.61E-04	-3.07	-3.065	0.005	5.84
	MgHCO3+	7.55E-05	6.12E-05	-4.122	-4.213	-0.091	5.62
	MgCO3	6.67E-05	6.75E-05	-4.176	-4.17	0.005	-17.09
	MgF+	1.47E-05	1.20E-05	-4.832	-4.92	-0.088	-10.44
	MgOH+	3.81E-06	3.18E-06	-5.419	-5.498	-0.079	0
Mn(2)	4.00E-08						
	Mn+2	1.89E-08	8.91E-09	-7.725	-8.05	-0.326	-18.66
	MnCO3	1.63E-08	1.65E-08	-7.788	-7.783	0.005	0
	MnSO4	1.89E-09	1.92E-09	-8.723	-8.718	0.005	22.54
	MnHCO3+	1.67E-09	1.37E-09	-8.778	-8.864	-0.086	0
	MnCl+	1.20E-09	9.88E-10	-8.92	-9.005	-0.086	-2.96
	MnOH+	8.04E-11	6.59E-11	-10.095	-10.181	-0.086	0
	MnCl2	1.16E-11	1.17E-11	-10.936	-10.931	0.005	85.89
	MnF+	4.50E-12	3.69E-12	-11.347	-11.433	-0.086	0
	MnCl3-	1.07E-13	8.79E-14	-12.97	-13.056	-0.086	43.67
	Mn(NO3)2	3.59E-17	3.64E-17	-16.445	-16.439	0.005	41.04
	Mn(OH)3-	4.11E-18	3.37E-18	-17.386	-17.472	-0.086	0
Mn(3)	1.18E-29						
	Mn+3	1.18E-29	2.75E-30	-28.927	-29.56	-0.633	0
N(-3)	5.00E-06						
	NH4+	4.37E-06	3.47E-06	-5.36	-5.459	-0.1	18.12
	NH3	5.64E-07	5.71E-07	-6.249	-6.243	0.005	24.42
	NH4SO4-	6.63E-08	5.41E-08	-7.179	-7.267	-0.088	37.93
N(5)	4.00E-05						
	NO3-	4.00E-05	3.20E-05	-4.398	-4.495	-0.097	29.68
	Mn(NO3)2	3.59E-17	3.64E-17	-16.445	-16.439	0.005	41.04
Na	3.24E-02						
	Na+	3.21E-02	2.64E-02	-1.493	-1.579	-0.086	-1.2
	NaSO4-	1.94E-04	1.60E-04	-3.713	-3.797	-0.084	15.53
	NaHCO3	2.52E-05	2.55E-05	-4.598	-4.593	0.005	1.8
	NaCO3-	1.40E-05	1.14E-05	-4.854	-4.942	-0.088	-0.59
	NaF	8.97E-07	9.09E-07	-6.047	-6.042	0.005	7.26
	NaOH	7.59E-18	7.68E-18	-17.12	-17.115	0.005	0
O(0)	1.13E-36						
	O2	5.67E-37	5.74E-37	-36.247	-36.241	0.005	30.4
S(6)	3.81E-03						
	SO4-2	2.68E-03	1.21E-03	-2.572	-2.917	-0.346	15.27
	MgSO4	8.50E-04	8.61E-04	-3.07	-3.065	0.005	5.84
	NaSO4-	1.94E-04	1.60E-04	-3.713	-3.797	-0.084	15.53
	CaSO4	8.01E-05	8.11E-05	-4.096	-4.091	0.005	7.5
	KSO4-	3.80E-06	3.13E-06	-5.42	-5.504	-0.084	34.29
	BaSO4	9.29E-08	9.41E-08	-7.032	-7.026	0.005	0
	NH4SO4-	6.63E-08	5.41E-08	-7.179	-7.267	-0.088	37.93

	ZnSO4	5.08E-09	5.14E-09	-8.294	-8.289	0.005	21.71
	MnSO4	1.89E-09	1.92E-09	-8.723	-8.718	0.005	22.54
	HSO4-	4.99E-10	4.08E-10	-9.302	-9.39	-0.088	40.46
	Zn(SO4)2-2	1.14E-10	5.05E-11	-9.944	-10.296	-0.352	-11.98
	FeSO4	6.06E-12	6.13E-12	-11.218	-11.212	0.005	18.97
	CuSO4	3.92E-12	3.97E-12	-11.407	-11.401	0.005	13.09
	CaHSO4+	2.26E-12	1.85E-12	-11.645	-11.733	-0.088	0
	FeSO4+	4.40E-19	3.61E-19	-18.357	-18.442	-0.086	0
	FeHSO4+	1.71E-19	1.40E-19	-18.767	-18.855	-0.088	0
	Fe(SO4)2-	1.17E-20	9.55E-21	-19.932	-20.02	-0.088	0
	FeHSO4+2	7.54E-27	3.35E-27	-26.122	-26.475	-0.352	0
Zn	2.60E-07						
	Zn(CO3)2-2	9.46E-08	4.20E-08	-7.024	-7.376	-0.352	0
	ZnCO3	8.33E-08	8.44E-08	-7.079	-7.074	0.005	0
	Zn+2	4.00E-08	1.81E-08	-7.398	-7.741	-0.344	-24.83
	Zn(OH)2	1.87E-08	1.89E-08	-7.728	-7.723	0.005	0
	ZnOH+	7.02E-09	5.73E-09	-8.154	-8.242	-0.088	0
	ZnSO4	5.08E-09	5.14E-09	-8.294	-8.289	0.005	21.71
	ZnHCO3+	4.82E-09	3.94E-09	-8.317	-8.405	-0.088	0
	ZnOHCl	4.65E-09	4.71E-09	-8.333	-8.327	0.005	0
	ZnCl+	1.64E-09	1.33E-09	-8.786	-8.877	-0.091	-13.95
	Zn(SO4)2-2	1.14E-10	5.05E-11	-9.944	-10.296	-0.352	-11.98
	ZnCl2	3.74E-11	3.79E-11	-10.427	-10.422	0.005	102.03
	Zn(OH)3-	2.11E-11	1.73E-11	-10.675	-10.763	-0.088	0
	ZnF+	1.88E-11	1.54E-11	-10.726	-10.814	-0.088	0
	ZnCl3-	1.43E-12	1.16E-12	-11.846	-11.937	-0.091	16.76
	ZnCl4-2	3.48E-14	1.58E-14	-13.458	-13.802	-0.344	146.1
	Zn(OH)4-2	1.77E-15	7.88E-16	-14.751	-15.104	-0.352	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-2.06	-6.34	-4.28	CaSO4			
Aragonite	0.28	-8.06	-8.34	CaCO3			
Barite	0.12	-9.73	-9.84	BaSO4			
Calcite	0.42	-8.06	-8.48	CaCO3			
CO2(g)	-3.4	-4.87	-1.47	CO2			
Dolomite	1.88	-15.21	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	0.92	5.81	4.89	Fe(OH)3			
Fluorite	-1.27	-11.87	-10.6	CaF2			
Goethite	6.81	5.81	-1	FeOOH			
Gypsum	-1.76	-6.34	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-4.71	-3.14	1.57	NaCl			
Hausmann	-9.5	51.53	61.03	Mn3O4			
Hematite	15.64	11.63	-4.01	Fe2O3			
Jarosite-K	-8	-17.21	-9.21	KFe3(SO4)2(OH)6			
Manganite	-4.01	21.33	25.34	MnOOH			

Melanterit	-11.26	-13.47	-2.21	FeSO4:7H2O
NH3(g)	-8.04	-6.24	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.33	8.87	15.2	Mn(OH)2
Pyrolusite	-7.59	33.79	41.38	MnO2:H2O
Rhodochrc	-1.55	-12.68	-11.13	MnCO3
Siderite	-4.29	-15.18	-10.89	FeCO3
Smithsonit	-2.37	-12.37	-10	ZnCO3
Sylvite	-5.9	-5	0.9	KCl
Witherite	-2.88	-11.44	-8.56	BaCO3
Zn(OH)2(e	-2.32	9.18	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 4

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	3.34E-03	3.34E-03
Ba	6.00E-07	6.00E-07
Ca	1.22E-03	1.22E-03
Cl	4.49E-02	4.49E-02
Cu	4.00E-08	4.00E-08
F	1.30E-04	1.30E-04
Fe	3.20E-07	3.20E-07
K	6.10E-04	6.10E-04
Mg	9.87E-03	9.87E-03
Mn	5.00E-08	5.00E-08
N(-3)	7.00E-06	7.00E-06
N(5)	6.00E-05	6.00E-05
Na	4.32E-02	4.32E-02
S(6)	5.08E-03	5.08E-03
Zn	3.50E-07	3.50E-07

#NAME? of solution----------

pH	=	8.46		
pe	=	4		
Specific	Conductan	(µS/cm,	25°C)	= 6112
Density	(g/cm³)	=	0.9999	
Volume	(L)	=	1.00368	
Activity	of	water	=	0.998
Ionic	strength	(mol/kgw)	=	7.18E-02
Mass	of	water	(kg)	= 1.00E+00
Total	carbon	(mol/kg)	=	3.12E-03
Total	CO2	(mol/kg)	=	3.12E-03
Temperatu	(°C)	=	25	

```
Electrical balance (eq) = 7.41E-03
Percent error, 100*(Cat-|= 6.31
Iterations = 9 (31 overall)
Total H = 1.11E+02
Total O = 5.55E+01

#NAME? couples---------------------------------

Redox couple pe Eh (volts)

N(-3)/N(5) 4.4343 0.2623

#NAME? of species----------------------------
```

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	3.71E-06	2.91E-06	-5.431	-5.536	-0.104	-3.81
	H+	4.13E-09	3.47E-09	-8.384	-8.46	-0.076	0
	H2O	5.55E+01	9.98E-01	1.744	-0.001	0	18.07
Ba	6.00E-07						
	Ba+2	4.61E-07	1.87E-07	-6.336	-6.729	-0.393	-12.1
	BaSO4	1.31E-07	1.33E-07	-6.883	-6.876	0.007	0
	BaHCO3+	4.89E-09	3.92E-09	-8.31	-8.407	-0.097	0
	BaCO3	2.81E-09	2.86E-09	-8.552	-8.544	0.007	-10.7
	BaOH+	2.26E-12	1.82E-12	-11.645	-11.74	-0.095	0
C(4)	3.12E-03						
	HCO3-	2.71E-03	2.19E-03	-2.567	-2.66	-0.093	25.07
	MgHCO3+	1.20E-04	9.52E-05	-3.92	-4.021	-0.101	5.63
	MgCO3	1.03E-04	1.05E-04	-3.986	-3.979	0.007	-17.09
	CO3-2	6.95E-05	2.96E-05	-4.158	-4.528	-0.37	-4.35
	NaHCO3	4.17E-05	4.24E-05	-4.38	-4.373	0.007	1.8
	NaCO3-	2.37E-05	1.90E-05	-4.625	-4.722	-0.097	-0.47
	CaCO3	2.24E-05	2.28E-05	-4.649	-4.642	0.007	-14.6
	CO2	1.68E-05	1.71E-05	-4.774	-4.767	0.007	34.43
	CaHCO3+	1.57E-05	1.28E-05	-4.804	-4.893	-0.089	9.82
	Zn(CO3)2-2	1.61E-07	6.58E-08	-6.794	-7.182	-0.387	0
	ZnCO3	1.02E-07	1.04E-07	-6.99	-6.983	0.007	0
	MnCO3	2.19E-08	2.23E-08	-7.659	-7.652	0.007	0
	ZnHCO3+	6.06E-09	4.85E-09	-8.218	-8.314	-0.097	0
	BaHCO3+	4.89E-09	3.92E-09	-8.31	-8.407	-0.097	0
	CuCO3	3.28E-09	3.33E-09	-8.485	-8.478	0.007	0
	BaCO3	2.81E-09	2.86E-09	-8.552	-8.544	0.007	-10.7
	MnHCO3+	2.30E-09	1.85E-09	-8.638	-8.733	-0.095	0
	Cu(CO3)2-	3.03E-10	1.24E-10	-9.519	-9.906	-0.387	0
	CuHCO3+	2.87E-11	2.30E-11	-10.542	-10.639	-0.097	0
	FeCO3	2.66E-11	2.70E-11	-10.576	-10.569	0.007	0
	FeHCO3+	1.04E-11	8.32E-12	-10.983	-11.08	-0.097	0
	(CO2)2	5.28E-12	5.37E-12	-11.277	-11.27	0.007	68.87
Ca	1.22E-03						

	Ca+2	1.07E-03	4.58E-04	-2.972	-3.339	-0.368	-17.53
	CaSO4	1.14E-04	1.16E-04	-3.943	-3.936	0.007	7.5
	CaCO3	2.24E-05	2.28E-05	-4.649	-4.642	0.007	-14.6
	CaHCO3+	1.57E-05	1.28E-05	-4.804	-4.893	-0.089	9.82
	CaOH+	2.73E-08	2.19E-08	-7.563	-7.66	-0.097	0
	CaHSO4+	3.30E-12	2.64E-12	-11.481	-11.578	-0.097	0
Cl	4.49E-02						
	Cl-	4.49E-02	3.54E-02	-1.348	-1.451	-0.102	18.29
	ZnOHCl	5.85E-09	5.94E-09	-8.233	-8.226	0.007	0
	ZnCl+	2.12E-09	1.68E-09	-8.674	-8.775	-0.101	-14
	MnCl+	1.70E-09	1.37E-09	-8.769	-8.864	-0.095	-2.94
	CuCl2-	5.51E-10	4.36E-10	-9.259	-9.36	-0.101	0
	ZnCl2	6.12E-11	6.23E-11	-10.213	-10.206	0.007	102.03
	CuCl3-2	5.87E-11	2.45E-11	-10.231	-10.611	-0.379	0
	MnCl2	2.08E-11	2.12E-11	-10.682	-10.674	0.007	85.89
	ZnCl3-	3.12E-12	2.48E-12	-11.505	-11.606	-0.101	16.65
	CuCl+	2.52E-12	2.00E-12	-11.599	-11.7	-0.101	0.89
	FeCl+	2.32E-12	1.86E-12	-11.634	-11.731	-0.097	0
	MnCl3-	2.57E-13	2.07E-13	-12.59	-12.685	-0.095	43.75
	ZnCl4-2	1.05E-13	4.40E-14	-12.977	-13.357	-0.379	146.28
	CuCl2	3.74E-14	3.80E-14	-13.427	-13.42	0.007	31.02
	CuCl3-	6.03E-18	4.78E-18	-17.22	-17.321	-0.101	0
	FeCl+2	9.30E-20	3.88E-20	-19.031	-19.411	-0.379	0
	FeCl2+	7.64E-21	6.14E-21	-20.117	-20.212	-0.095	0
	CuCl4-2	2.03E-21	8.48E-22	-20.692	-21.071	-0.379	0
	FeCl3	2.14E-23	2.18E-23	-22.669	-22.662	0.007	0
Cu(1)	6.11E-10						
	CuCl2-	5.51E-10	4.36E-10	-9.259	-9.36	-0.101	0
	CuCl3-2	5.87E-11	2.45E-11	-10.231	-10.611	-0.379	0
	Cu+	1.42E-12	1.10E-12	-11.847	-11.959	-0.112	0
Cu(2)	3.94E-08						
	Cu(OH)2	3.57E-08	3.62E-08	-7.448	-7.441	0.007	0
	CuCO3	3.28E-09	3.33E-09	-8.485	-8.478	0.007	0
	Cu(CO3)2-	3.03E-10	1.24E-10	-9.519	-9.906	-0.387	0
	CuOH+	7.60E-11	6.03E-11	-10.119	-10.22	-0.101	0
	Cu+2	4.77E-11	2.09E-11	-10.322	-10.679	-0.358	-26.04
	CuHCO3+	2.87E-11	2.30E-11	-10.542	-10.639	-0.097	0
	CuSO4	5.99E-12	6.09E-12	-11.223	-11.216	0.007	13.09
	CuCl+	2.52E-12	2.00E-12	-11.599	-11.7	-0.101	0.89
	Cu(OH)3-	7.86E-13	6.29E-13	-12.105	-12.202	-0.097	0
	CuF+	3.87E-14	3.10E-14	-13.412	-13.509	-0.097	0
	CuCl2	3.74E-14	3.80E-14	-13.427	-13.42	0.007	31.02
	Cu2(OH)2+	3.87E-15	1.59E-15	-14.412	-14.799	-0.387	0
	Cu(OH)4-2	8.81E-17	3.61E-17	-16.055	-16.442	-0.387	0
	CuCl3-	6.03E-18	4.78E-18	-17.22	-17.321	-0.101	0
	CuCl4-2	2.03E-21	8.48E-22	-20.692	-21.071	-0.379	0
F	1.30E-04						
	F-	1.03E-04	8.13E-05	-3.985	-4.09	-0.104	-1.09
	MgF+	2.50E-05	2.00E-05	-4.602	-4.7	-0.098	-10.42
	NaF	1.58E-06	1.61E-06	-5.8	-5.793	0.007	7.26

	HF	4.16E-10	4.23E-10	-9.381	-9.374	0.007	12.5
	ZnF+	2.52E-11	2.02E-11	-10.598	-10.695	-0.097	0
	MnF+	6.63E-12	5.33E-12	-11.178	-11.273	-0.095	0
	HF2-	1.65E-13	1.32E-13	-12.783	-12.88	-0.097	22.28
	CuF+	3.87E-14	3.10E-14	-13.412	-13.509	-0.097	0
	FeF+	3.86E-14	3.09E-14	-13.414	-13.51	-0.097	0
	FeF2+	1.88E-17	1.51E-17	-16.725	-16.82	-0.095	0
	FeF+2	1.12E-17	4.67E-18	-16.951	-17.33	-0.379	0
	FeF3	1.92E-18	1.95E-18	-17.717	-17.71	0.007	0
Fe(2)	1.40E-10						
	Fe+2	8.65E-11	3.80E-11	-10.063	-10.42	-0.358	-21.55
	FeCO3	2.66E-11	2.70E-11	-10.576	-10.569	0.007	0
	FeHCO3+	1.04E-11	8.32E-12	-10.983	-11.08	-0.097	0
	FeSO4	9.46E-12	9.62E-12	-11.024	-11.017	0.007	18.97
	FeOH+	4.30E-12	3.46E-12	-11.366	-11.461	-0.095	0
	FeCl+	2.32E-12	1.86E-12	-11.634	-11.731	-0.097	0
	FeF+	3.86E-14	3.09E-14	-13.414	-13.51	-0.097	0
	Fe(OH)2	8.33E-15	8.47E-15	-14.079	-14.072	0.007	0
	Fe(OH)3-	1.13E-16	9.06E-17	-15.948	-16.043	-0.095	0
	FeHSO4+	2.74E-19	2.19E-19	-18.562	-18.659	-0.097	0
Fe(3)	3.20E-07						
	Fe(OH)3	2.35E-07	2.38E-07	-6.63	-6.623	0.007	0
	Fe(OH)4-	7.75E-08	6.26E-08	-7.111	-7.204	-0.093	0
	Fe(OH)2+	7.96E-09	6.43E-09	-8.099	-8.192	-0.093	0
	FeOH+2	1.62E-13	6.74E-14	-12.792	-13.171	-0.379	0
	FeF2+	1.88E-17	1.51E-17	-16.725	-16.82	-0.095	0
	FeF+2	1.12E-17	4.67E-18	-16.951	-17.33	-0.379	0
	FeF3	1.92E-18	1.95E-18	-17.717	-17.71	0.007	0
	FeSO4+	7.05E-19	5.67E-19	-18.152	-18.247	-0.095	0
	Fe+3	1.76E-19	3.63E-20	-18.754	-19.44	-0.686	0
	FeCl+2	9.30E-20	3.88E-20	-19.031	-19.411	-0.379	0
	Fe(SO4)2-	2.21E-20	1.77E-20	-19.656	-19.753	-0.097	0
	FeCl2+	7.64E-21	6.14E-21	-20.117	-20.212	-0.095	0
	FeCl3	2.14E-23	2.18E-23	-22.669	-22.662	0.007	0
	Fe2(OH)2+	4.33E-24	1.22E-25	-23.364	-24.912	-1.548	0
	FeHSO4+2	1.28E-26	5.26E-27	-25.892	-26.279	-0.387	0
	Fe3(OH)4+	4.32E-29	1.64E-31	-28.365	-30.784	-2.419	0
H(0)	1.67E-28						
	H2	8.37E-29	8.51E-29	-28.077	-28.07	0.007	28.61
K	6.10E-04						
	K+	6.04E-04	4.76E-04	-3.219	-3.322	-0.103	9.2
	KSO4-	5.90E-06	4.77E-06	-5.229	-5.322	-0.093	34.33
Mg	9.87E-03						
	Mg+2	8.40E-03	3.72E-03	-2.076	-2.43	-0.354	-21.23
	MgSO4	1.22E-03	1.24E-03	-2.913	-2.906	0.007	5.84
	MgHCO3+	1.20E-04	9.52E-05	-3.92	-4.021	-0.101	5.63
	MgCO3	1.03E-04	1.05E-04	-3.986	-3.979	0.007	-17.09
	MgF+	2.50E-05	2.00E-05	-4.602	-4.7	-0.098	-10.42
	MgOH+	4.75E-06	3.89E-06	-5.324	-5.411	-0.087	0
Mn(2)	5.00E-08						

	MnCO3	2.19E-08	2.23E-08	-7.659	-7.652	0.007	0
	Mn+2	2.16E-08	9.48E-09	-7.666	-8.023	-0.358	-18.44
	MnSO4	2.36E-09	2.40E-09	-8.627	-8.62	0.007	22.54
	MnHCO3+	2.30E-09	1.85E-09	-8.638	-8.733	-0.095	0
	MnCl+	1.70E-09	1.37E-09	-8.769	-8.864	-0.095	-2.94
	MnOH+	8.72E-11	7.01E-11	-10.059	-10.154	-0.095	0
	MnCl2	2.08E-11	2.12E-11	-10.682	-10.674	0.007	85.89
	MnF+	6.63E-12	5.33E-12	-11.178	-11.273	-0.095	0
	MnCl3-	2.57E-13	2.07E-13	-12.59	-12.685	-0.095	43.75
	Mn(NO3)2	8.12E-17	8.26E-17	-16.09	-16.083	0.007	41.04
	Mn(OH)3-	4.46E-18	3.58E-18	-17.351	-17.446	-0.095	0
Mn(3)	1.42E-29						
	Mn+3	1.42E-29	2.93E-30	-28.847	-29.533	-0.686	0
N(-3)	7.00E-06						
	NH4+	6.13E-06	4.73E-06	-5.213	-5.325	-0.112	18.14
	NH3	7.65E-07	7.78E-07	-6.116	-6.109	0.007	24.42
	NH4SO4-	1.09E-07	8.69E-08	-6.964	-7.061	-0.097	38.01
N(5)	6.00E-05						
	NO3-	6.00E-05	4.68E-05	-4.222	-4.33	-0.108	29.72
	Mn(NO3)2	8.12E-17	8.26E-17	-16.09	-16.083	0.007	41.04
Na	4.32E-02						
	Na+	4.28E-02	3.44E-02	-1.369	-1.463	-0.095	-1.15
	NaSO4-	3.04E-04	2.46E-04	-3.517	-3.61	-0.093	15.86
	NaHCO3	4.17E-05	4.24E-05	-4.38	-4.373	0.007	1.8
	NaCO3-	2.37E-05	1.90E-05	-4.625	-4.722	-0.097	-0.47
	NaF	1.58E-06	1.61E-06	-5.8	-5.793	0.007	7.26
	NaOH	9.86E-18	1.00E-17	-17.006	-16.999	0.007	0
O(0)	1.13E-36						
	O2	5.64E-37	5.73E-37	-36.249	-36.242	0.007	30.4
S(6)	5.08E-03						
	SO4-2	3.44E-03	1.42E-03	-2.464	-2.846	-0.382	15.4
	MgSO4	1.22E-03	1.24E-03	-2.913	-2.906	0.007	5.84
	NaSO4-	3.04E-04	2.46E-04	-3.517	-3.61	-0.093	15.86
	CaSO4	1.14E-04	1.16E-04	-3.943	-3.936	0.007	7.5
	KSO4-	5.90E-06	4.77E-06	-5.229	-5.322	-0.093	34.33
	BaSO4	1.31E-07	1.33E-07	-6.883	-6.876	0.007	0
	NH4SO4-	1.09E-07	8.69E-08	-6.964	-7.061	-0.097	38.01
	ZnSO4	5.78E-09	5.87E-09	-8.238	-8.231	0.007	21.71
	MnSO4	2.36E-09	2.40E-09	-8.627	-8.62	0.007	22.54
	HSO4-	6.00E-10	4.80E-10	-9.222	-9.319	-0.097	40.49
	Zn(SO4)2-2	1.66E-10	6.80E-11	-9.78	-10.168	-0.387	-11.72
	FeSO4	9.46E-12	9.62E-12	-11.024	-11.017	0.007	18.97
	CuSO4	5.99E-12	6.09E-12	-11.223	-11.216	0.007	13.09
	CaHSO4+	3.30E-12	2.64E-12	-11.481	-11.578	-0.097	0
	FeSO4+	7.05E-19	5.67E-19	-18.152	-18.247	-0.095	0
	FeHSO4+	2.74E-19	2.19E-19	-18.562	-18.659	-0.097	0
	Fe(SO4)2-	2.21E-20	1.77E-20	-19.656	-19.753	-0.097	0
	FeHSO4+2	1.28E-26	5.26E-27	-25.892	-26.279	-0.387	0
Zn	3.50E-07						
	Zn(CO3)2-2	1.61E-07	6.58E-08	-6.794	-7.182	-0.387	0

ZnCO3	1.02E-07	1.04E-07	-6.99	-6.983	0.007	0
Zn+2	4.22E-08	1.76E-08	-7.375	-7.755	-0.379	-24.77
Zn(OH)2	1.81E-08	1.84E-08	-7.743	-7.736	0.007	0
ZnOH+	6.94E-09	5.55E-09	-8.159	-8.255	-0.097	0
ZnHCO3+	6.06E-09	4.85E-09	-8.218	-8.314	-0.097	0
ZnOHCl	5.85E-09	5.94E-09	-8.233	-8.226	0.007	0
ZnSO4	5.78E-09	5.87E-09	-8.238	-8.231	0.007	21.71
ZnCl+	2.12E-09	1.68E-09	-8.674	-8.775	-0.101	-14
Zn(SO4)2-2	1.66E-10	6.80E-11	-9.78	-10.168	-0.387	-11.72
ZnCl2	6.12E-11	6.23E-11	-10.213	-10.206	0.007	102.03
ZnF+	2.52E-11	2.02E-11	-10.598	-10.695	-0.097	0
Zn(OH)3-	2.09E-11	1.67E-11	-10.68	-10.777	-0.097	0
ZnCl3-	3.12E-12	2.48E-12	-11.505	-11.606	-0.101	16.65
ZnCl4-2	1.05E-13	4.40E-14	-12.977	-13.357	-0.379	146.28
Zn(OH)4-2	1.86E-15	7.62E-16	-14.731	-15.118	-0.387	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-1.91	-6.19	-4.28	CaSO4
Aragonite	0.47	-7.87	-8.34	CaCO3
Barite	0.27	-9.58	-9.84	BaSO4
Calcite	0.61	-7.87	-8.48	CaCO3
CO2(g)	-3.3	-4.77	-1.47	CO2
Dolomite	2.26	-14.83	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.05	5.94	4.89	Fe(OH)3
Fluorite	-0.92	-11.52	-10.6	CaF2
Goethite	6.94	5.94	-1	FeOOH
Gypsum	-1.6	-6.19	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-4.48	-2.91	1.57	NaCl
Hausmann	-9.42	51.61	61.03	Mn3O4
Hematite	15.88	11.88	-4.01	Fe2O3
Jarosite-K	-7.37	-16.58	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.98	21.36	25.34	MnOOH
Melanterit	-11.06	-13.27	-2.21	FeSO4:7H2O
NH3(g)	-7.91	-6.11	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.3	8.9	15.2	Mn(OH)2
Pyrolusite	-7.57	33.81	41.38	MnO2:H2O
Rhodochro	-1.42	-12.55	-11.13	MnCO3
Siderite	-4.06	-14.95	-10.89	FeCO3
Smithsonit	-2.28	-12.28	-10	ZnCO3
Sylvite	-5.67	-4.77	0.9	KCl
Witherite	-2.7	-11.26	-8.56	BaCO3
Zn(OH)2(e	-2.34	9.16	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *

```
        For     ideal   gases,  phi     =               1

Initial solution        5

 #NAME? composition-----------------------------

        Elements Molality  Moles

        Alkalinity  4.17E-03  4.17E-03
        Ba          7.60E-07  7.60E-07
        Ca          1.53E-03  1.53E-03
        Cl          5.61E-02  5.61E-02
        Cu          5.00E-08  5.00E-08
        F           1.60E-04  1.60E-04
        Fe          4.00E-07  4.00E-07
        K           7.70E-04  7.70E-04
        Mg          1.23E-02  1.23E-02
        Mn          7.00E-08  7.00E-08
        N(-3)       8.00E-06  8.00E-06
        N(5)        7.00E-05  7.00E-05
        Na          5.39E-02  5.39E-02
        S(6)        6.35E-03  6.35E-03
        Zn          4.40E-07  4.40E-07

 #NAME? of      solution----------------------------

        pH      =           8.46
        pe      =              4
        Specific Conductan (µS/cm,  25°C)   =          7504
        Density (g/cm³)  =        1.00061
        Volume  (L)      =        1.00386
        Activity of      water   =          0.998
        Ionic   strength (mol/kgw) =        8.91E-02
        Mass    of       water   (kg)   =        1.00E+00
        Total   carbon   (mol/kg) =        3.88E-03
        Total   CO2      (mol/kg) =        3.88E-03
        Temperatu (°C)   =             25
        Electrical balance (eq)   =        9.30E-03
        Percent error,   100*(Cat-|=          6.35
        Iterations =          10 (41     overall)
        Total   H        =        1.11E+02
        Total   O        =        5.55E+01

 #NAME? couples--------------------------------

        Redox   couple   pe      Eh      (volts)

        N(-3)/N(5)  4.4355   0.2624

 #NAME? of      species----------------------------
```

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	3.78E-06	2.91E-06	-5.422	-5.536	-0.113	-3.76
	H+	4.18E-09	3.47E-09	-8.379	-8.46	-0.081	0
	H2O	5.55E+01	9.98E-01	1.744	-0.001	0	18.07
Ba	7.60E-07						
	Ba+2	5.77E-07	2.18E-07	-6.239	-6.662	-0.424	-12.03
	BaSO4	1.72E-07	1.75E-07	-6.765	-6.756	0.009	0
	BaHCO3+	6.95E-09	5.48E-09	-8.158	-8.261	-0.104	0
	BaCO3	3.91E-09	3.99E-09	-8.408	-8.399	0.009	-10.7
	BaOH+	2.68E-12	2.12E-12	-11.571	-11.673	-0.102	0
C(4)	3.88E-03						
	HCO3-	3.30E-03	2.63E-03	-2.481	-2.581	-0.1	25.14
	MgHCO3+	1.72E-04	1.34E-04	-3.765	-3.874	-0.109	5.65
	MgCO3	1.44E-04	1.47E-04	-3.84	-3.832	0.009	-17.09
	CO3-2	8.89E-05	3.55E-05	-4.051	-4.449	-0.398	-4.22
	NaHCO3	6.12E-05	6.25E-05	-4.213	-4.204	0.009	1.8
	NaCO3-	3.55E-05	2.80E-05	-4.45	-4.553	-0.104	-0.36
	CaCO3	3.13E-05	3.20E-05	-4.504	-4.496	0.009	-14.6
	CaHCO3+	2.24E-05	1.79E-05	-4.65	-4.746	-0.096	9.83
	CO2	2.01E-05	2.05E-05	-4.697	-4.688	0.009	34.43
	Zn(CO3)2-2	2.34E-07	9.02E-08	-6.631	-7.045	-0.414	0
	ZnCO3	1.16E-07	1.19E-07	-6.934	-6.926	0.009	0
	MnCO3	3.23E-08	3.29E-08	-7.491	-7.482	0.009	0
	ZnHCO3+	7.03E-09	5.54E-09	-8.153	-8.257	-0.104	0
	BaHCO3+	6.95E-09	5.48E-09	-8.158	-8.261	-0.104	0
	CuCO3	4.77E-09	4.87E-09	-8.321	-8.312	0.009	0
	BaCO3	3.91E-09	3.99E-09	-8.408	-8.399	0.009	-10.7
	MnHCO3+	3.46E-09	2.73E-09	-8.461	-8.563	-0.102	0
	Cu(CO3)2-	5.66E-10	2.18E-10	-9.247	-9.662	-0.414	0
	CuHCO3+	4.27E-11	3.36E-11	-10.37	-10.473	-0.104	0
	FeCO3	3.96E-11	4.05E-11	-10.402	-10.393	0.009	0
	FeHCO3+	1.58E-11	1.25E-11	-10.801	-10.904	-0.104	0
	(CO2)2	7.57E-12	7.73E-12	-11.121	-11.112	0.009	68.87
Ca	1.53E-03						
	Ca+2	1.33E-03	5.35E-04	-2.877	-3.271	-0.394	-17.47
	CaSO4	1.50E-04	1.53E-04	-3.824	-3.815	0.009	7.5
	CaCO3	3.13E-05	3.20E-05	-4.504	-4.496	0.009	-14.6
	CaHCO3+	2.24E-05	1.79E-05	-4.65	-4.746	-0.096	9.83
	CaOH+	3.25E-08	2.56E-08	-7.489	-7.592	-0.104	0
	CaHSO4+	4.43E-12	3.49E-12	-11.353	-11.457	-0.104	0
Cl	5.61E-02						
	Cl-	5.61E-02	4.34E-02	-1.251	-1.362	-0.111	18.32
	ZnOHCl	6.79E-09	6.93E-09	-8.168	-8.159	0.009	0
	MnCl+	2.61E-09	2.07E-09	-8.583	-8.685	-0.102	-2.93
	ZnCl+	2.52E-09	1.96E-09	-8.599	-8.708	-0.109	-14.04
	CuCl2-	1.03E-09	8.00E-10	-8.988	-9.097	-0.109	0
	CuCl3-2	1.41E-10	5.51E-11	-9.851	-10.259	-0.409	0

	ZnCl2	8.73E-11	8.91E-11	-10.059	-10.05	0.009	102.03
	MnCl2	3.84E-11	3.92E-11	-10.416	-10.407	0.009	85.89
	ZnCl3-	5.58E-12	4.34E-12	-11.253	-11.362	-0.109	16.55
	CuCl+	3.84E-12	2.99E-12	-11.416	-11.525	-0.109	0.92
	FeCl+	3.61E-12	2.85E-12	-11.442	-11.546	-0.104	0
	MnCl3-	5.93E-13	4.69E-13	-12.227	-12.329	-0.102	43.82
	ZnCl4-2	2.42E-13	9.45E-14	-12.616	-13.025	-0.409	146.46
	CuCl2	6.82E-14	6.97E-14	-13.166	-13.157	0.009	31.02
	CuCl3-	1.38E-17	1.07E-17	-16.86	-16.969	-0.109	0
	FeCl+2	1.52E-19	5.95E-20	-18.817	-19.226	-0.409	0
	FeCl2+	1.46E-20	1.15E-20	-19.836	-19.938	-0.102	0
	CuCl4-2	5.99E-21	2.34E-21	-20.223	-20.631	-0.409	0
	FeCl3	4.91E-23	5.01E-23	-22.309	-22.3	0.009	0
Cu(1)	1.17E-09						
	CuCl2-	1.03E-09	8.00E-10	-8.988	-9.097	-0.109	0
	CuCl3-2	1.41E-10	5.51E-11	-9.851	-10.259	-0.409	0
	Cu+	1.78E-12	1.34E-12	-11.751	-11.873	-0.122	0
Cu(2)	4.88E-08						
	Cu(OH)2	4.33E-08	4.42E-08	-7.364	-7.355	0.009	0
	CuCO3	4.77E-09	4.87E-09	-8.321	-8.312	0.009	0
	Cu(CO3)2-	5.66E-10	2.18E-10	-9.247	-9.662	-0.414	0
	CuOH+	9.45E-11	7.35E-11	-10.024	-10.134	-0.109	0
	Cu+2	6.17E-11	2.55E-11	-10.209	-10.593	-0.383	-25.98
	CuHCO3+	4.27E-11	3.36E-11	-10.37	-10.473	-0.104	0
	CuSO4	8.22E-12	8.39E-12	-11.085	-11.076	0.009	13.09
	CuCl+	3.84E-12	2.99E-12	-11.416	-11.525	-0.109	0.92
	Cu(OH)3-	9.72E-13	7.66E-13	-12.012	-12.116	-0.104	0
	CuCl2	6.82E-14	6.97E-14	-13.166	-13.157	0.009	31.02
	CuF+	5.59E-14	4.40E-14	-13.253	-13.356	-0.104	0
	Cu2(OH)2+	6.14E-15	2.36E-15	-14.212	-14.627	-0.414	0
	Cu(OH)4-2	1.14E-16	4.40E-17	-15.942	-16.357	-0.414	0
	CuCl3-	1.38E-17	1.07E-17	-16.86	-16.969	-0.109	0
	CuCl4-2	5.99E-21	2.34E-21	-20.223	-20.631	-0.409	0
F	1.60E-04						
	F-	1.23E-04	9.48E-05	-3.91	-4.023	-0.113	-1.06
	MgF+	3.47E-05	2.72E-05	-4.459	-4.565	-0.106	-10.41
	NaF	2.26E-06	2.31E-06	-5.646	-5.637	0.009	7.26
	HF	4.83E-10	4.93E-10	-9.316	-9.307	0.009	12.5
	ZnF+	2.85E-11	2.24E-11	-10.546	-10.649	-0.104	0
	MnF+	9.68E-12	7.65E-12	-11.014	-11.116	-0.102	0
	HF2-	2.28E-13	1.79E-13	-12.643	-12.747	-0.104	22.31
	FeF+	5.71E-14	4.50E-14	-13.243	-13.347	-0.104	0
	CuF+	5.59E-14	4.40E-14	-13.253	-13.356	-0.104	0
	FeF2+	3.25E-17	2.57E-17	-16.488	-16.59	-0.102	0
	FeF+2	1.75E-17	6.81E-18	-16.758	-17.167	-0.409	0
	FeF3	3.78E-18	3.86E-18	-17.423	-17.414	0.009	0
Fe(2)	1.93E-10						
	Fe+2	1.15E-10	4.75E-11	-9.94	-10.324	-0.383	-21.49
	FeCO3	3.96E-11	4.05E-11	-10.402	-10.393	0.009	0
	FeHCO3+	1.58E-11	1.25E-11	-10.801	-10.904	-0.104	0

	FeSO4	1.33E-11	1.36E-11	-10.876	-10.867	0.009	18.97
	FeOH+	5.47E-12	4.32E-12	-11.262	-11.364	-0.102	0
	FeCl+	3.61E-12	2.85E-12	-11.442	-11.546	-0.104	0
	FeF+	5.71E-14	4.50E-14	-13.243	-13.347	-0.104	0
	Fe(OH)2	1.04E-14	1.06E-14	-13.984	-13.975	0.009	0
	Fe(OH)3-	1.43E-16	1.13E-16	-15.844	-15.946	-0.102	0
	FeHSO4+	3.93E-19	3.10E-19	-18.406	-18.509	-0.104	0
Fe(3)	4.00E-07						
	Fe(OH)3	2.92E-07	2.98E-07	-6.535	-6.526	0.009	0
	Fe(OH)4-	9.82E-08	7.81E-08	-7.008	-7.107	-0.1	0
	Fe(OH)2+	1.01E-08	8.03E-09	-7.996	-8.095	-0.1	0
	FeOH+2	2.16E-13	8.42E-14	-12.666	-13.074	-0.409	0
	FeF2+	3.25E-17	2.57E-17	-16.488	-16.59	-0.102	0
	FeF+2	1.75E-17	6.81E-18	-16.758	-17.167	-0.409	0
	FeF3	3.78E-18	3.86E-18	-17.423	-17.414	0.009	0
	FeSO4+	1.01E-18	8.00E-19	-17.995	-18.097	-0.102	0
	Fe+3	2.42E-19	4.53E-20	-18.616	-19.344	-0.728	0
	FeCl+2	1.52E-19	5.95E-20	-18.817	-19.226	-0.409	0
	Fe(SO4)2-	3.57E-20	2.82E-20	-19.447	-19.551	-0.104	0
	FeCl2+	1.46E-20	1.15E-20	-19.836	-19.938	-0.102	0
	FeCl3	4.91E-23	5.01E-23	-22.309	-22.3	0.009	0
	Fe2(OH)2+	8.69E-24	1.91E-25	-23.061	-24.719	-1.658	0
	FeHSO4+2	1.93E-26	7.43E-27	-25.715	-26.129	-0.414	0
	Fe3(OH)4+	1.25E-28	3.20E-31	-27.904	-30.494	-2.59	0
H(0)	1.67E-28						
	H2	8.34E-29	8.51E-29	-28.079	-28.07	0.009	28.61
K	7.70E-04						
	K+	7.62E-04	5.89E-04	-3.118	-3.23	-0.112	9.23
	KSO4-	8.37E-06	6.65E-06	-5.078	-5.177	-0.1	34.36
Mg	1.23E-02						
	Mg+2	1.04E-02	4.35E-03	-1.984	-2.362	-0.378	-21.17
	MgSO4	1.61E-03	1.64E-03	-2.794	-2.785	0.009	5.84
	MgHCO3+	1.72E-04	1.34E-04	-3.765	-3.874	-0.109	5.65
	MgCO3	1.44E-04	1.47E-04	-3.84	-3.832	0.009	-17.09
	MgF+	3.47E-05	2.72E-05	-4.459	-4.565	-0.106	-10.41
	MgOH+	5.63E-06	4.54E-06	-5.25	-5.343	-0.093	0
Mn(2)	7.00E-08						
	MnCO3	3.23E-08	3.29E-08	-7.491	-7.482	0.009	0
	Mn+2	2.82E-08	1.17E-08	-7.549	-7.933	-0.383	-18.26
	MnHCO3+	3.46E-09	2.73E-09	-8.461	-8.563	-0.102	0
	MnSO4	3.27E-09	3.34E-09	-8.485	-8.476	0.009	22.54
	MnCl+	2.61E-09	2.07E-09	-8.583	-8.685	-0.102	-2.93
	MnOH+	1.09E-10	8.64E-11	-9.962	-10.064	-0.102	0
	MnCl2	3.84E-11	3.92E-11	-10.416	-10.407	0.009	85.89
	MnF+	9.68E-12	7.65E-12	-11.014	-11.116	-0.102	0
	MnCl3-	5.93E-13	4.69E-13	-12.227	-12.329	-0.102	43.82
	Mn(NO3)2	1.30E-16	1.33E-16	-15.887	-15.878	0.009	41.04
	Mn(OH)3-	5.58E-18	4.41E-18	-17.254	-17.356	-0.102	0
Mn(3)	1.93E-29						
	Mn+3	1.93E-29	3.61E-30	-28.715	-29.443	-0.728	0

N(-3)	8.00E-06						
	NH4+	7.01E-06	5.29E-06	-5.154	-5.277	-0.122	18.16
	NH3	8.52E-07	8.69E-07	-6.07	-6.061	0.009	24.42
	NH4SO4-	1.39E-07	1.10E-07	-6.857	-6.96	-0.104	38.08
N(5)	7.00E-05						
	NO3-	7.00E-05	5.34E-05	-4.155	-4.273	-0.118	29.75
	Mn(NO3)2	1.30E-16	1.33E-16	-15.887	-15.878	0.009	41.04
Na	5.39E-02						
	Na+	5.34E-02	4.23E-02	-1.272	-1.374	-0.101	-1.11
	NaSO4-	4.29E-04	3.41E-04	-3.368	-3.467	-0.1	16.14
	NaHCO3	6.12E-05	6.25E-05	-4.213	-4.204	0.009	1.8
	NaCO3-	3.55E-05	2.80E-05	-4.45	-4.553	-0.104	-0.36
	NaF	2.26E-06	2.31E-06	-5.646	-5.637	0.009	7.26
	NaOH	1.21E-17	1.23E-17	-16.918	-16.91	0.009	0
O(0)	1.12E-36						
	O2	5.61E-37	5.73E-37	-36.251	-36.242	0.009	30.4
S(6)	6.35E-03						
	SO4-2	4.16E-03	1.61E-03	-2.381	-2.794	-0.412	15.52
	MgSO4	1.61E-03	1.64E-03	-2.794	-2.785	0.009	5.84
	NaSO4-	4.29E-04	3.41E-04	-3.368	-3.467	-0.1	16.14
	CaSO4	1.50E-04	1.53E-04	-3.824	-3.815	0.009	7.5
	KSO4-	8.37E-06	6.65E-06	-5.078	-5.177	-0.1	34.36
	BaSO4	1.72E-07	1.75E-07	-6.765	-6.756	0.009	0
	NH4SO4-	1.39E-07	1.10E-07	-6.857	-6.96	-0.104	38.08
	ZnSO4	6.19E-09	6.32E-09	-8.209	-8.2	0.009	21.71
	MnSO4	3.27E-09	3.34E-09	-8.485	-8.476	0.009	22.54
	HSO4-	6.88E-10	5.42E-10	-9.162	-9.266	-0.104	40.52
	Zn(SO4)2-2	2.15E-10	8.26E-11	-9.669	-10.083	-0.414	-11.47
	FeSO4	1.33E-11	1.36E-11	-10.876	-10.867	0.009	18.97
	CuSO4	8.22E-12	8.39E-12	-11.085	-11.076	0.009	13.09
	CaHSO4+	4.43E-12	3.49E-12	-11.353	-11.457	-0.104	0
	FeSO4+	1.01E-18	8.00E-19	-17.995	-18.097	-0.102	0
	FeHSO4+	3.93E-19	3.10E-19	-18.406	-18.509	-0.104	0
	Fe(SO4)2-	3.57E-20	2.82E-20	-19.447	-19.551	-0.104	0
	FeHSO4+2	1.93E-26	7.43E-27	-25.715	-26.129	-0.414	0
Zn	4.40E-07						
	Zn(CO3)2-2	2.34E-07	9.02E-08	-6.631	-7.045	-0.414	0
	ZnCO3	1.16E-07	1.19E-07	-6.934	-6.926	0.009	0
	Zn+2	4.29E-08	1.68E-08	-7.367	-7.776	-0.409	-24.71
	Zn(OH)2	1.71E-08	1.75E-08	-7.767	-7.758	0.009	0
	ZnHCO3+	7.03E-09	5.54E-09	-8.153	-8.257	-0.104	0
	ZnOHCl	6.79E-09	6.93E-09	-8.168	-8.159	0.009	0
	ZnOH+	6.71E-09	5.28E-09	-8.173	-8.277	-0.104	0
	ZnSO4	6.19E-09	6.32E-09	-8.209	-8.2	0.009	21.71
	ZnCl+	2.52E-09	1.96E-09	-8.599	-8.708	-0.109	-14.04
	Zn(SO4)2-2	2.15E-10	8.26E-11	-9.669	-10.083	-0.414	-11.47
	ZnCl2	8.73E-11	8.91E-11	-10.059	-10.05	0.009	102.03
	ZnF+	2.85E-11	2.24E-11	-10.546	-10.649	-0.104	0
	Zn(OH)3-	2.02E-11	1.59E-11	-10.695	-10.799	-0.104	0
	ZnCl3-	5.58E-12	4.34E-12	-11.253	-11.362	-0.109	16.55

ZnCl4-2	2.42E-13	9.45E-14	-12.616	-13.025	-0.409	146.46
Zn(OH)4-2	1.88E-15	7.24E-16	-14.726	-15.14	-0.414	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-1.79	-6.06	-4.28	CaSO4
Aragonite	0.62	-7.72	-8.34	CaCO3
Barite	0.39	-9.46	-9.84	BaSO4
Calcite	0.76	-7.72	-8.48	CaCO3
CO2(g)	-3.22	-4.69	-1.47	CO2
Dolomite	2.55	-14.53	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.14	6.03	4.89	Fe(OH)3
Fluorite	-0.72	-11.32	-10.6	CaF2
Goethite	7.03	6.03	-1	FeOOH
Gypsum	-1.48	-6.07	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-4.31	-2.74	1.57	NaCl
Hausmann	-9.15	51.88	61.03	Mn3O4
Hematite	16.08	12.07	-4.01	Fe2O3
Jarosite-K	-6.88	-16.09	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.89	21.45	25.34	MnOOH
Melanterit	-10.91	-13.12	-2.21	FeSO4:7H2O
NH3(g)	-7.86	-6.06	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.21	8.99	15.2	Mn(OH)2
Pyrolusite	-7.48	33.9	41.38	MnO2:H2O
Rhodochro	-1.25	-12.38	-11.13	MnCO3
Siderite	-3.88	-14.77	-10.89	FeCO3
Smithsonit	-2.23	-12.23	-10	ZnCO3
Sylvite	-5.49	-4.59	0.9	KCl
Witherite	-2.55	-11.11	-8.56	BaCO3
Zn(OH)2(e	-2.36	9.14	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 6

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	5.01E-03	5.01E-03
Ba	9.10E-07	9.10E-07
Ca	1.83E-03	1.83E-03
Cl	6.73E-02	6.73E-02
Cu	6.00E-08	6.00E-08

F	1.90E-04	1.90E-04
Fe	4.80E-07	4.80E-07
K	9.20E-04	9.20E-04
Mg	1.48E-02	1.48E-02
Mn	8.00E-08	8.00E-08
N(-3)	1.00E-05	1.00E-05
N(5)	8.00E-05	8.00E-05
Na	6.47E-02	6.47E-02
S(6)	7.62E-03	7.62E-03
Zn	5.30E-07	5.30E-07

#NAME? of solution----------

pH	=	8.46		
pe	=	4		
Specific	Conductan	(µS/cm,	25°C)	= 8865
Density	(g/cm³)	=	1.00131	
Volume	(L)	=	1.00405	
Activity	of	water	=	0.997
Ionic	strength	(mol/kgw)	=	1.06E-01
Mass	of	water	(kg)	= 1.00E+00
Total	carbon	(mol/kg)	=	4.63E-03
Total	CO2	(mol/kg)	=	4.63E-03
Temperatu	(°C)	=	25	
Electrical	balance	(eq)	=	1.12E-02
Percent	error,	100*(Cat-|	=	6.37
Iterations	=	9	(50	overall)
Total	H	=	1.11E+02	
Total	O	=	5.56E+01	

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4307	0.2621		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	3.85E-06	2.91E-06	-5.415	-5.536	-0.121	-3.71
H+	4.21E-09	3.47E-09	-8.375	-8.46	-0.085	0
H2O	5.55E+01	9.97E-01	1.744	-0.001	0	18.07
Ba	9.10E-07					
Ba+2	6.85E-07	2.43E-07	-6.164	-6.614	-0.449	-11.97
BaSO4	2.11E-07	2.16E-07	-6.676	-6.665	0.011	0
BaHCO3+	9.11E-09	7.09E-09	-8.04	-8.149	-0.109	0
BaCO3	5.04E-09	5.17E-09	-8.297	-8.287	0.011	-10.7
BaOH+	3.04E-12	2.37E-12	-11.517	-11.625	-0.108	0

C(4)	4.63E-03						
	HCO3-	3.87E-03	3.04E-03	-2.412	-2.517	-0.105	25.2
	MgHCO3+	2.30E-04	1.76E-04	-3.639	-3.755	-0.116	5.66
	MgCO3	1.89E-04	1.94E-04	-3.723	-3.713	0.011	-17.09
	CO3-2	1.09E-04	4.11E-05	-3.965	-4.386	-0.422	-4.11
	NaHCO3	8.34E-05	8.55E-05	-4.079	-4.068	0.011	1.8
	NaCO3-	4.92E-05	3.83E-05	-4.308	-4.417	-0.109	-0.26
	CaCO3	4.07E-05	4.17E-05	-4.39	-4.38	0.011	-14.6
	CaHCO3+	2.96E-05	2.34E-05	-4.529	-4.63	-0.101	9.84
	CO2	2.32E-05	2.38E-05	-4.635	-4.624	0.011	34.43
	Zn(CO3)2-2	3.12E-07	1.14E-07	-6.505	-6.942	-0.437	0
	ZnCO3	1.27E-07	1.30E-07	-6.896	-6.886	0.011	0
	MnCO3	3.82E-08	3.92E-08	-7.417	-7.407	0.011	0
	BaHCO3+	9.11E-09	7.09E-09	-8.04	-8.149	-0.109	0
	ZnHCO3+	7.80E-09	6.07E-09	-8.108	-8.217	-0.109	0
	CuCO3	6.43E-09	6.59E-09	-8.192	-8.181	0.011	0
	BaCO3	5.04E-09	5.17E-09	-8.297	-8.287	0.011	-10.7
	MnHCO3+	4.17E-09	3.25E-09	-8.38	-8.488	-0.108	0
	Cu(CO3)2-	9.32E-10	3.41E-10	-9.03	-9.467	-0.437	0
	CuHCO3+	5.85E-11	4.55E-11	-10.233	-10.342	-0.109	0
	FeCO3	5.49E-11	5.62E-11	-10.261	-10.25	0.011	0
	FeHCO3+	2.23E-11	1.73E-11	-10.652	-10.761	-0.109	0
	(CO2)2	1.01E-11	1.04E-11	-10.995	-10.985	0.011	68.87
Ca	1.83E-03						
	Ca+2	1.57E-03	6.04E-04	-2.803	-3.219	-0.416	-17.42
	CaSO4	1.86E-04	1.90E-04	-3.731	-3.72	0.011	7.5
	CaCO3	4.07E-05	4.17E-05	-4.39	-4.38	0.011	-14.6
	CaHCO3+	2.96E-05	2.34E-05	-4.529	-4.63	-0.101	9.84
	CaOH+	3.71E-08	2.88E-08	-7.431	-7.54	-0.109	0
	CaHSO4+	5.58E-12	4.34E-12	-11.253	-11.362	-0.109	0
Cl	6.73E-02						
	Cl-	6.73E-02	5.13E-02	-1.172	-1.29	-0.118	18.35
	ZnOHCl	7.56E-09	7.75E-09	-8.122	-8.111	0.011	0
	MnCl+	3.22E-09	2.51E-09	-8.493	-8.601	-0.108	-2.92
	ZnCl+	2.86E-09	2.19E-09	-8.543	-8.66	-0.116	-14.09
	CuCl2-	1.70E-09	1.30E-09	-8.769	-8.885	-0.116	0
	CuCl3-2	2.87E-10	1.06E-10	-9.542	-9.975	-0.433	0
	ZnCl2	1.15E-10	1.18E-10	-9.941	-9.93	0.011	102.03
	MnCl2	5.48E-11	5.61E-11	-10.262	-10.251	0.011	85.89
	ZnCl3-	8.84E-12	6.76E-12	-11.054	-11.17	-0.116	16.44
	CuCl+	5.39E-12	4.12E-12	-11.268	-11.385	-0.116	0.96
	FeCl+	5.19E-12	4.04E-12	-11.285	-11.394	-0.109	0
	MnCl3-	1.02E-12	7.92E-13	-11.993	-12.101	-0.108	43.89
	ZnCl4-2	4.71E-13	1.74E-13	-12.327	-12.76	-0.433	146.62
	CuCl2	1.11E-13	1.14E-13	-12.956	-12.945	0.011	31.02
	CuCl3-	2.70E-17	2.06E-17	-16.569	-16.685	-0.116	0
	FeCl+2	2.29E-19	8.43E-20	-18.641	-19.074	-0.433	0
	FeCl2+	2.48E-20	1.93E-20	-19.606	-19.714	-0.108	0
	CuCl4-2	1.44E-20	5.31E-21	-19.842	-20.275	-0.433	0
	FeCl3	9.66E-23	9.90E-23	-22.015	-22.004	0.011	0

Cu(1)	1.99E-09						
	CuCl2-	1.70E-09	1.30E-09	-8.769	-8.885	-0.116	0
	CuCl3-2	2.87E-10	1.06E-10	-9.542	-9.975	-0.433	0
	Cu+	2.12E-12	1.57E-12	-11.674	-11.805	-0.131	0
Cu(2)	5.80E-08						
	Cu(OH)2	5.04E-08	5.16E-08	-7.298	-7.287	0.011	0
	CuCO3	6.43E-09	6.59E-09	-8.192	-8.181	0.011	0
	Cu(CO3)2-	9.32E-10	3.41E-10	-9.03	-9.467	-0.437	0
	CuOH+	1.12E-10	8.59E-11	-9.95	-10.066	-0.116	0
	Cu+2	7.59E-11	2.99E-11	-10.12	-10.525	-0.405	-25.94
	CuHCO3+	5.85E-11	4.55E-11	-10.233	-10.342	-0.109	0
	CuSO4	1.06E-11	1.08E-11	-10.977	-10.966	0.011	13.09
	CuCl+	5.39E-12	4.12E-12	-11.268	-11.385	-0.116	0.96
	Cu(OH)3-	1.15E-12	8.95E-13	-11.939	-12.048	-0.109	0
	CuCl2	1.11E-13	1.14E-13	-12.956	-12.945	0.011	31.02
	CuF+	7.49E-14	5.83E-14	-13.125	-13.234	-0.109	0
	Cu2(OH)2+	8.83E-15	3.23E-15	-14.054	-14.491	-0.437	0
	Cu(OH)4-2	1.40E-16	5.14E-17	-15.853	-16.289	-0.437	0
	CuCl3-	2.70E-17	2.06E-17	-16.569	-16.685	-0.116	0
	CuCl4-2	1.44E-20	5.31E-21	-19.842	-20.275	-0.433	0
F	1.90E-04						
	F-	1.42E-04	1.07E-04	-3.849	-3.97	-0.121	-1.04
	MgF+	4.53E-05	3.50E-05	-4.344	-4.456	-0.112	-10.39
	NaF	3.01E-06	3.09E-06	-5.521	-5.51	0.011	7.26
	HF	5.44E-10	5.58E-10	-9.264	-9.254	0.011	12.5
	ZnF+	3.09E-11	2.40E-11	-10.51	-10.619	-0.109	0
	MnF+	1.14E-11	8.90E-12	-10.942	-11.05	-0.108	0
	HF2-	2.95E-13	2.29E-13	-12.53	-12.639	-0.109	22.34
	FeF+	7.86E-14	6.11E-14	-13.105	-13.214	-0.109	0
	CuF+	7.49E-14	5.83E-14	-13.125	-13.234	-0.109	0
	FeF2+	5.07E-17	3.95E-17	-16.295	-16.403	-0.108	0
	FeF+2	2.51E-17	9.25E-18	-16.6	-17.034	-0.433	0
	FeF3	6.55E-18	6.71E-18	-17.184	-17.173	0.011	0
Fe(2)	2.52E-10						
	Fe+2	1.45E-10	5.70E-11	-9.839	-10.244	-0.405	-21.44
	FeCO3	5.49E-11	5.62E-11	-10.261	-10.25	0.011	0
	FeHCO3+	2.23E-11	1.73E-11	-10.652	-10.761	-0.109	0
	FeSO4	1.75E-11	1.80E-11	-10.756	-10.746	0.011	18.97
	FeOH+	6.65E-12	5.19E-12	-11.177	-11.285	-0.108	0
	FeCl+	5.19E-12	4.04E-12	-11.285	-11.394	-0.109	0
	FeF+	7.86E-14	6.11E-14	-13.105	-13.214	-0.109	0
	Fe(OH)2	1.24E-14	1.27E-14	-13.907	-13.896	0.011	0
	Fe(OH)3-	1.74E-16	1.36E-16	-15.759	-15.868	-0.108	0
	FeHSO4+	5.27E-19	4.10E-19	-18.279	-18.388	-0.109	0
Fe(3)	4.80E-07						
	Fe(OH)3	3.48E-07	3.57E-07	-6.458	-6.448	0.011	0
	Fe(OH)4-	1.19E-07	9.36E-08	-6.923	-7.029	-0.105	0
	Fe(OH)2+	1.23E-08	9.63E-09	-7.911	-8.016	-0.105	0
	FeOH+2	2.74E-13	1.01E-13	-12.562	-12.995	-0.433	0
	FeF2+	5.07E-17	3.95E-17	-16.295	-16.403	-0.108	0

	FeF+2	2.51E-17	9.25E-18	-16.6	-17.034	-0.433	0
	FeF3	6.55E-18	6.71E-18	-17.184	-17.173	0.011	0
	FeSO4+	1.36E-18	1.06E-18	-17.867	-17.976	-0.108	0
	Fe+3	3.15E-19	5.44E-20	-18.502	-19.264	-0.762	0
	FeCl+2	2.29E-19	8.43E-20	-18.641	-19.074	-0.433	0
	Fe(SO4)2-	5.27E-20	4.10E-20	-19.278	-19.387	-0.109	0
	FeCl2+	2.48E-20	1.93E-20	-19.606	-19.714	-0.108	0
	FeCl3	9.66E-23	9.90E-23	-22.015	-22.004	0.011	0
	Fe2(OH)2+	1.54E-23	2.75E-25	-22.814	-24.56	-1.747	0
	FeHSO4+2	2.69E-26	9.82E-27	-25.571	-26.008	-0.437	0
	Fe3(OH)4+	2.97E-28	5.54E-31	-27.528	-30.257	-2.729	0
H(0)	1.66E-28						
	H2	8.31E-29	8.51E-29	-28.081	-28.07	0.011	28.61
K	9.20E-04						
	K+	9.09E-04	6.91E-04	-3.041	-3.161	-0.119	9.25
	KSO4-	1.10E-05	8.60E-06	-4.96	-5.066	-0.105	34.38
Mg	1.48E-02						
	Mg+2	1.23E-02	4.94E-03	-1.909	-2.306	-0.397	-21.12
	MgSO4	2.00E-03	2.05E-03	-2.698	-2.688	0.011	5.84
	MgHCO3+	2.30E-04	1.76E-04	-3.639	-3.755	-0.116	5.66
	MgCO3	1.89E-04	1.94E-04	-3.723	-3.713	0.011	-17.09
	MgF+	4.53E-05	3.50E-05	-4.344	-4.456	-0.112	-10.39
	MgOH+	6.47E-06	5.16E-06	-5.189	-5.287	-0.098	0
Mn(2)	8.00E-08						
	MnCO3	3.82E-08	3.92E-08	-7.417	-7.407	0.011	0
	Mn+2	3.05E-08	1.20E-08	-7.516	-7.921	-0.405	-18.11
	MnHCO3+	4.17E-09	3.25E-09	-8.38	-8.488	-0.108	0
	MnSO4	3.69E-09	3.78E-09	-8.433	-8.422	0.011	22.54
	MnCl+	3.22E-09	2.51E-09	-8.493	-8.601	-0.108	-2.92
	MnOH+	1.14E-10	8.87E-11	-9.944	-10.052	-0.108	0
	MnCl2	5.48E-11	5.61E-11	-10.262	-10.251	0.011	85.89
	MnF+	1.14E-11	8.90E-12	-10.942	-11.05	-0.108	0
	MnCl3-	1.02E-12	7.92E-13	-11.993	-12.101	-0.108	43.89
	Mn(NO3)2	1.67E-16	1.71E-16	-15.777	-15.766	0.011	41.04
	Mn(OH)3-	5.81E-18	4.53E-18	-17.236	-17.344	-0.108	0
Mn(3)	2.15E-29						
	Mn+3	2.15E-29	3.71E-30	-28.669	-29.431	-0.762	0
N(-3)	1.00E-05						
	NH4+	8.77E-06	6.48E-06	-5.057	-5.188	-0.131	18.18
	NH3	1.04E-06	1.07E-06	-5.983	-5.972	0.011	24.42
	NH4SO4-	1.90E-07	1.48E-07	-6.721	-6.83	-0.109	38.15
N(5)	8.00E-05						
	NO3-	8.00E-05	5.99E-05	-4.097	-4.223	-0.126	29.78
	Mn(NO3)2	1.67E-16	1.71E-16	-15.777	-15.766	0.011	41.04
Na	6.47E-02						
	Na+	6.40E-02	5.00E-02	-1.194	-1.301	-0.107	-1.08
	NaSO4-	5.67E-04	4.44E-04	-3.247	-3.352	-0.105	16.4
	NaHCO3	8.34E-05	8.55E-05	-4.079	-4.068	0.011	1.8
	NaCO3-	4.92E-05	3.83E-05	-4.308	-4.417	-0.109	-0.26
	NaF	3.01E-06	3.09E-06	-5.521	-5.51	0.011	7.26

	NaOH	1.42E-17	1.46E-17	-16.847	-16.837	0.011	0
O(0)	1.12E-36						
	O2	5.59E-37	5.72E-37	-36.253	-36.242	0.011	30.4
S(6)	7.62E-03						
	SO4-2	4.85E-03	1.77E-03	-2.314	-2.751	-0.438	15.62
	MgSO4	2.00E-03	2.05E-03	-2.698	-2.688	0.011	5.84
	NaSO4-	5.67E-04	4.44E-04	-3.247	-3.352	-0.105	16.4
	CaSO4	1.86E-04	1.90E-04	-3.731	-3.72	0.011	7.5
	KSO4-	1.10E-05	8.60E-06	-4.96	-5.066	-0.105	34.38
	BaSO4	2.11E-07	2.16E-07	-6.676	-6.665	0.011	0
	NH4SO4-	1.90E-07	1.48E-07	-6.721	-6.83	-0.109	38.15
	ZnSO4	6.43E-09	6.59E-09	-8.192	-8.181	0.011	21.71
	MnSO4	3.69E-09	3.78E-09	-8.433	-8.422	0.011	22.54
	HSO4-	7.68E-10	5.97E-10	-9.115	-9.224	-0.109	40.55
	Zn(SO4)2-2	2.59E-10	9.49E-11	-9.586	-10.023	-0.437	-11.24
	FeSO4	1.75E-11	1.80E-11	-10.756	-10.746	0.011	18.97
	CuSO4	1.06E-11	1.08E-11	-10.977	-10.966	0.011	13.09
	CaHSO4+	5.58E-12	4.34E-12	-11.253	-11.362	-0.109	0
	FeSO4+	1.36E-18	1.06E-18	-17.867	-17.976	-0.108	0
	FeHSO4+	5.27E-19	4.10E-19	-18.279	-18.388	-0.109	0
	Fe(SO4)2-	5.27E-20	4.10E-20	-19.278	-19.387	-0.109	0
	FeHSO4+2	2.69E-26	9.82E-27	-25.571	-26.008	-0.437	0
Zn	5.30E-07						
	Zn(CO3)2-2	3.12E-07	1.14E-07	-6.505	-6.942	-0.437	0
	ZnCO3	1.27E-07	1.30E-07	-6.896	-6.886	0.011	0
	Zn+2	4.30E-08	1.59E-08	-7.366	-7.8	-0.433	-24.67
	Zn(OH)2	1.61E-08	1.65E-08	-7.793	-7.782	0.011	0
	ZnHCO3+	7.80E-09	6.07E-09	-8.108	-8.217	-0.109	0
	ZnOHCl	7.56E-09	7.75E-09	-8.122	-8.111	0.011	0
	ZnOH+	6.43E-09	5.00E-09	-8.192	-8.301	-0.109	0
	ZnSO4	6.43E-09	6.59E-09	-8.192	-8.181	0.011	21.71
	ZnCl+	2.86E-09	2.19E-09	-8.543	-8.66	-0.116	-14.09
	Zn(SO4)2-2	2.59E-10	9.49E-11	-9.586	-10.023	-0.437	-11.24
	ZnCl2	1.15E-10	1.18E-10	-9.941	-9.93	0.011	102.03
	ZnF+	3.09E-11	2.40E-11	-10.51	-10.619	-0.109	0
	Zn(OH)3-	1.93E-11	1.50E-11	-10.714	-10.823	-0.109	0
	ZnCl3-	8.84E-12	6.76E-12	-11.054	-11.17	-0.116	16.44
	ZnCl4-2	4.71E-13	1.74E-13	-12.327	-12.76	-0.433	146.62
	Zn(OH)4-2	1.87E-15	6.85E-16	-14.728	-15.164	-0.437	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-1.69	-5.97	-4.28	CaSO4			
Aragonite	0.73	-7.6	-8.34	CaCO3			
Barite	0.48	-9.37	-9.84	BaSO4			
Calcite	0.88	-7.6	-8.48	CaCO3			
CO2(g)	-3.16	-4.62	-1.47	CO2			
Dolomite	2.79	-14.3	-17.08	CaMg(CO3)2			

Fe(OH)3(a)	1.22	6.11	4.89	Fe(OH)3
Fluorite	-0.56	-11.16	-10.6	CaF2
Goethite	7.11	6.11	-1	FeOOH
Gypsum	-1.39	-5.97	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-4.16	-2.59	1.57	NaCl
Hausmann	-9.12	51.91	61.03	Mn3O4
Hematite	16.24	12.23	-4.01	Fe2O3
Jarosite-K	-6.49	-15.7	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.88	21.46	25.34	MnOOH
Melanterit	-10.79	-13	-2.21	FeSO4:7H2O
NH3(g)	-7.77	-5.97	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.2	9	15.2	Mn(OH)2
Pyrolusite	-7.46	33.92	41.38	MnO2:H2O
Rhodochrc	-1.18	-12.31	-11.13	MnCO3
Siderite	-3.74	-14.63	-10.89	FeCO3
Smithsonit	-2.19	-12.19	-10	ZnCO3
Sylvite	-5.35	-4.45	0.9	KCl
Witherite	-2.44	-11	-8.56	BaCO3
Zn(OH)2(e	-2.38	9.12	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 7

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	5.84E-03	5.84E-03
Ba	1.06E-06	1.06E-06
Ca	2.14E-03	2.14E-03
Cl	7.85E-02	7.85E-02
Cu	7.00E-08	7.00E-08
F	2.20E-04	2.20E-04
Fe	5.60E-07	5.60E-07
K	1.07E-03	1.07E-03
Mg	1.73E-02	1.73E-02
Mn	1.00E-07	1.00E-07
N(-3)	1.20E-05	1.20E-05
N(5)	1.00E-04	1.00E-04
Na	7.55E-02	7.55E-02
S(6)	8.89E-03	8.89E-03
Zn	6.20E-07	6.20E-07

#NAME? of solution----------

pH	=	8.46			
pe	=	4			
Specific	Conductan	(µS/cm,	25°C)	=	10202
Density	(g/cm³)	=	1.00202		
Volume	(L)	=	1.00423		
Activity	of	water	=	0.997	
Ionic	strength	(mol/kgw)	=	1.24E-01	
Mass	of	water	(kg)	=	1.00E+00
Total	carbon	(mol/kg)	=	5.37E-03	
Total	CO2	(mol/kg)	=	5.37E-03	
Temperatu	(°C)	=	25		
Electrical	balance	(eq)	=	1.30E-02	
Percent	error,	100*(Cat-|	=	6.39	
Iterations	=	9	(59	overall)	
Total	H	=	1.11E+02		
Total	O	=	5.56E+01		

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4331	0.2622		

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	3.90E-06	2.91E-06	-5.408	-5.536	-0.128	-3.67
	H+	4.25E-09	3.47E-09	-8.372	-8.46	-0.088	0
	H2O	5.55E+01	9.97E-01	1.744	-0.001	0	18.07
Ba	1.06E-06						
	Ba+2	7.92E-07	2.68E-07	-6.101	-6.573	-0.472	-11.92
	BaSO4	2.50E-07	2.57E-07	-6.602	-6.59	0.012	0
	BaHCO3+	1.14E-08	8.79E-09	-7.942	-8.056	-0.114	0
	BaCO3	6.23E-09	6.41E-09	-8.205	-8.193	0.012	-10.7
	BaOH+	3.39E-12	2.61E-12	-11.47	-11.584	-0.114	0
C(4)	5.37E-03						
	HCO3-	4.42E-03	3.43E-03	-2.354	-2.465	-0.11	25.27
	MgHCO3+	2.93E-04	2.21E-04	-3.533	-3.656	-0.123	5.67
	MgCO3	2.37E-04	2.44E-04	-3.625	-3.613	0.012	-17.09
	CO3-2	1.28E-04	4.64E-05	-3.892	-4.334	-0.442	-4.01
	NaHCO3	1.08E-04	1.11E-04	-3.966	-3.954	0.012	1.8
	NaCO3-	6.48E-05	4.98E-05	-4.189	-4.302	-0.114	-0.15
	CaCO3	5.10E-05	5.24E-05	-4.293	-4.28	0.012	-14.6
	CaHCO3+	3.76E-05	2.94E-05	-4.425	-4.531	-0.106	9.85
	CO2	2.61E-05	2.68E-05	-4.584	-4.571	0.012	34.43
	Zn(CO3)2-2	3.94E-07	1.38E-07	-6.405	-6.86	-0.455	0
	ZnCO3	1.35E-07	1.39E-07	-6.869	-6.856	0.012	0
	MnCO3	4.91E-08	5.05E-08	-7.309	-7.296	0.012	0

	BaHCO3+	1.14E-08	8.79E-09	-7.942	-8.056	-0.114	0
	ZnHCO3+	8.44E-09	6.49E-09	-8.074	-8.188	-0.114	0
	CuCO3	8.22E-09	8.45E-09	-8.085	-8.073	0.012	0
	BaCO3	6.23E-09	6.41E-09	-8.205	-8.193	0.012	-10.7
	MnHCO3+	5.45E-09	4.19E-09	-8.264	-8.378	-0.114	0
	Cu(CO3)2-	1.41E-09	4.94E-10	-8.852	-9.307	-0.455	0
	CuHCO3+	7.58E-11	5.83E-11	-10.12	-10.234	-0.114	0
	FeCO3	7.20E-11	7.41E-11	-10.143	-10.13	0.012	0
	FeHCO3+	2.97E-11	2.28E-11	-10.528	-10.641	-0.114	0
	(CO2)2	1.28E-11	1.32E-11	-10.891	-10.879	0.012	68.87
Ca	2.14E-03						
	Ca+2	1.83E-03	6.73E-04	-2.738	-3.172	-0.434	-17.37
	CaSO4	2.23E-04	2.30E-04	-3.651	-3.639	0.012	7.5
	CaCO3	5.10E-05	5.24E-05	-4.293	-4.28	0.012	-14.6
	CaHCO3+	3.76E-05	2.94E-05	-4.425	-4.531	-0.106	9.85
	CaOH+	4.17E-08	3.21E-08	-7.38	-7.494	-0.114	0
	CaHSO4+	6.80E-12	5.23E-12	-11.168	-11.281	-0.114	0
Cl	7.85E-02						
	Cl-	7.85E-02	5.90E-02	-1.105	-1.229	-0.124	18.37
	ZnOHCl	8.20E-09	8.44E-09	-8.086	-8.074	0.012	0
	MnCl+	4.28E-09	3.29E-09	-8.369	-8.482	-0.114	-2.91
	ZnCl+	3.17E-09	2.39E-09	-8.5	-8.622	-0.123	-14.14
	CuCl2-	2.60E-09	1.96E-09	-8.586	-8.708	-0.123	0
	CuCl3-2	5.21E-10	1.83E-10	-9.283	-9.738	-0.455	0
	ZnCl2	1.43E-10	1.47E-10	-9.844	-9.832	0.012	102.03
	MnCl2	8.24E-11	8.48E-11	-10.084	-10.072	0.012	85.89
	ZnCl3-	1.29E-11	9.75E-12	-10.889	-11.011	-0.123	16.33
	CuCl+	7.14E-12	5.38E-12	-11.146	-11.269	-0.123	1
	FeCl+	7.04E-12	5.42E-12	-11.152	-11.266	-0.114	0
	MnCl3-	1.79E-12	1.38E-12	-11.748	-11.861	-0.114	43.96
	ZnCl4-2	8.20E-13	2.88E-13	-12.086	-12.541	-0.455	146.77
	CuCl2	1.66E-13	1.70E-13	-12.781	-12.768	0.012	31.02
	CuCl3-	4.73E-17	3.57E-17	-16.325	-16.448	-0.123	0
	FeCl+2	3.23E-19	1.13E-19	-18.491	-18.946	-0.455	0
	FeCl2+	3.87E-20	2.98E-20	-19.412	-19.526	-0.114	0
	CuCl4-2	3.00E-20	1.05E-20	-19.523	-19.977	-0.455	0
	FeCl3	1.71E-22	1.76E-22	-21.767	-21.755	0.012	0
Cu(1)	3.12E-09						
	CuCl2-	2.60E-09	1.96E-09	-8.586	-8.708	-0.123	0
	CuCl3-2	5.21E-10	1.83E-10	-9.283	-9.738	-0.455	0
	Cu+	2.45E-12	1.78E-12	-11.61	-11.749	-0.139	0
Cu(2)	6.69E-08						
	Cu(OH)2	5.69E-08	5.86E-08	-7.245	-7.232	0.012	0
	CuCO3	8.22E-09	8.45E-09	-8.085	-8.073	0.012	0
	Cu(CO3)2-	1.41E-09	4.94E-10	-8.852	-9.307	-0.455	0
	CuOH+	1.29E-10	9.75E-11	-9.888	-10.011	-0.123	0
	Cu+2	9.00E-11	3.39E-11	-10.046	-10.469	-0.424	-25.9
	CuHCO3+	7.58E-11	5.83E-11	-10.12	-10.234	-0.114	0
	CuSO4	1.29E-11	1.33E-11	-10.889	-10.876	0.012	13.09
	CuCl+	7.14E-12	5.38E-12	-11.146	-11.269	-0.123	1

	Cu(OH)3-	1.32E-12	1.02E-12	-11.88	-11.994	-0.114	0
	CuCl2	1.66E-13	1.70E-13	-12.781	-12.768	0.012	31.02
	CuF+	9.53E-14	7.34E-14	-13.021	-13.135	-0.114	0
	Cu2(OH)2+	1.19E-14	4.16E-15	-13.926	-14.381	-0.455	0
	Cu(OH)4-2	1.66E-16	5.82E-17	-15.78	-16.235	-0.455	0
	CuCl3-	4.73E-17	3.57E-17	-16.325	-16.448	-0.123	0
	CuCl4-2	3.00E-20	1.05E-20	-19.523	-19.977	-0.455	0
F	2.20E-04						
	F-	1.59E-04	1.19E-04	-3.797	-3.925	-0.128	-1.01
	MgF+	5.67E-05	4.32E-05	-4.246	-4.364	-0.118	-10.38
	NaF	3.83E-06	3.95E-06	-5.416	-5.404	0.012	7.26
	HF	6.01E-10	6.18E-10	-9.221	-9.209	0.012	12.5
	ZnF+	3.28E-11	2.52E-11	-10.484	-10.598	-0.114	0
	MnF+	1.47E-11	1.13E-11	-10.834	-10.948	-0.114	0
	HF2-	3.66E-13	2.82E-13	-12.436	-12.55	-0.114	22.36
	FeF+	1.03E-13	7.91E-14	-12.988	-13.102	-0.114	0
	CuF+	9.53E-14	7.34E-14	-13.021	-13.135	-0.114	0
	FeF2+	7.36E-17	5.67E-17	-16.133	-16.247	-0.114	0
	FeF+2	3.41E-17	1.20E-17	-16.467	-16.922	-0.455	0
	FeF3	1.04E-17	1.07E-17	-16.984	-16.972	0.012	0
Fe(2)	3.15E-10						
	Fe+2	1.77E-10	6.66E-11	-9.753	-10.177	-0.424	-21.4
	FeCO3	7.20E-11	7.41E-11	-10.143	-10.13	0.012	0
	FeHCO3+	2.97E-11	2.28E-11	-10.528	-10.641	-0.114	0
	FeSO4	2.21E-11	2.27E-11	-10.656	-10.644	0.012	18.97
	FeOH+	7.86E-12	6.05E-12	-11.104	-11.218	-0.114	0
	FeCl+	7.04E-12	5.42E-12	-11.152	-11.266	-0.114	0
	FeF+	1.03E-13	7.91E-14	-12.988	-13.102	-0.114	0
	Fe(OH)2	1.44E-14	1.48E-14	-13.842	-13.829	0.012	0
	Fe(OH)3-	2.06E-16	1.58E-16	-15.687	-15.801	-0.114	0
	FeHSO4+	6.73E-19	5.18E-19	-18.172	-18.286	-0.114	0
Fe(3)	5.60E-07						
	Fe(OH)3	4.05E-07	4.16E-07	-6.393	-6.381	0.012	0
	Fe(OH)4-	1.41E-07	1.09E-07	-6.852	-6.962	-0.11	0
	Fe(OH)2+	1.45E-08	1.12E-08	-7.839	-7.949	-0.11	0
	FeOH+2	3.36E-13	1.18E-13	-12.473	-12.928	-0.455	0
	FeF2+	7.36E-17	5.67E-17	-16.133	-16.247	-0.114	0
	FeF+2	3.41E-17	1.20E-17	-16.467	-16.922	-0.455	0
	FeF3	1.04E-17	1.07E-17	-16.984	-16.972	0.012	0
	FeSO4+	1.74E-18	1.34E-18	-17.76	-17.874	-0.114	0
	Fe+3	3.93E-19	6.36E-20	-18.405	-19.197	-0.791	0
	FeCl+2	3.23E-19	1.13E-19	-18.491	-18.946	-0.455	0
	Fe(SO4)2-	7.30E-20	5.62E-20	-19.137	-19.25	-0.114	0
	FeCl2+	3.87E-20	2.98E-20	-19.412	-19.526	-0.114	0
	FeCl3	1.71E-22	1.76E-22	-21.767	-21.755	0.012	0
	Fe2(OH)2+	2.48E-23	3.75E-25	-22.606	-24.426	-1.82	0
	FeHSO4+2	3.54E-26	1.24E-26	-25.451	-25.906	-0.455	0
	Fe3(OH)4+	6.14E-28	8.80E-31	-27.212	-30.055	-2.844	0
H(0)	1.66E-28						
	H2	8.27E-29	8.51E-29	-28.082	-28.07	0.012	28.61

K	1.07E-03						
	K+	1.06E-03	7.91E-04	-2.976	-3.102	-0.126	9.27
	KSO4-	1.38E-05	1.07E-05	-4.862	-4.972	-0.11	34.41
Mg	1.73E-02						
	Mg+2	1.43E-02	5.51E-03	-1.845	-2.259	-0.414	-21.07
	MgSO4	2.41E-03	2.48E-03	-2.618	-2.606	0.012	5.84
	MgHCO3+	2.93E-04	2.21E-04	-3.533	-3.656	-0.123	5.67
	MgCO3	2.37E-04	2.44E-04	-3.625	-3.613	0.012	-17.09
	MgF+	5.67E-05	4.32E-05	-4.246	-4.364	-0.118	-10.38
	MgOH+	7.28E-06	5.75E-06	-5.138	-5.241	-0.102	0
Mn(2)	1.00E-07						
	MnCO3	4.91E-08	5.05E-08	-7.309	-7.296	0.012	0
	Mn+2	3.64E-08	1.37E-08	-7.439	-7.863	-0.424	-17.98
	MnHCO3+	5.45E-09	4.19E-09	-8.264	-8.378	-0.114	0
	MnSO4	4.55E-09	4.68E-09	-8.342	-8.33	0.012	22.54
	MnCl+	4.28E-09	3.29E-09	-8.369	-8.482	-0.114	-2.91
	MnOH+	1.32E-10	1.01E-10	-9.881	-9.994	-0.114	0
	MnCl2	8.24E-11	8.48E-11	-10.084	-10.072	0.012	85.89
	MnF+	1.47E-11	1.13E-11	-10.834	-10.948	-0.114	0
	MnCl3-	1.79E-12	1.38E-12	-11.748	-11.861	-0.114	43.96
	Mn(NO3)2	2.87E-16	2.96E-16	-15.541	-15.529	0.012	41.04
	Mn(OH)3-	6.71E-18	5.17E-18	-17.173	-17.287	-0.114	0
Mn(3)	2.62E-29						
	Mn+3	2.62E-29	4.24E-30	-28.582	-29.373	-0.791	0
N(-3)	1.20E-05						
	NH4+	1.05E-05	7.65E-06	-4.977	-5.117	-0.139	18.19
	NH3	1.22E-06	1.26E-06	-5.913	-5.901	0.012	24.42
	NH4SO4-	2.46E-07	1.89E-07	-6.61	-6.723	-0.114	38.21
N(5)	1.00E-04						
	NO3-	1.00E-04	7.36E-05	-4	-4.133	-0.133	29.8
	Mn(NO3)2	2.87E-16	2.96E-16	-15.541	-15.529	0.012	41.04
Na	7.55E-02						
	Na+	7.46E-02	5.77E-02	-1.127	-1.239	-0.112	-1.05
	NaSO4-	7.16E-04	5.55E-04	-3.145	-3.256	-0.11	16.64
	NaHCO3	1.08E-04	1.11E-04	-3.966	-3.954	0.012	1.8
	NaCO3-	6.48E-05	4.98E-05	-4.189	-4.302	-0.114	-0.15
	NaF	3.83E-06	3.95E-06	-5.416	-5.404	0.012	7.26
	NaOH	1.63E-17	1.68E-17	-16.787	-16.775	0.012	0
O(0)	1.11E-36						
	O2	5.56E-37	5.72E-37	-36.255	-36.243	0.012	30.4
S(6)	8.89E-03						
	SO4-2	5.53E-03	1.92E-03	-2.257	-2.717	-0.46	15.72
	MgSO4	2.41E-03	2.48E-03	-2.618	-2.606	0.012	5.84
	NaSO4-	7.16E-04	5.55E-04	-3.145	-3.256	-0.11	16.64
	CaSO4	2.23E-04	2.30E-04	-3.651	-3.639	0.012	7.5
	KSO4-	1.38E-05	1.07E-05	-4.862	-4.972	-0.11	34.41
	BaSO4	2.50E-07	2.57E-07	-6.602	-6.59	0.012	0
	NH4SO4-	2.46E-07	1.89E-07	-6.61	-6.723	-0.114	38.21
	ZnSO4	6.58E-09	6.77E-09	-8.182	-8.17	0.012	21.71
	MnSO4	4.55E-09	4.68E-09	-8.342	-8.33	0.012	22.54

HSO4-	8.41E-10	6.47E-10	-9.075	-9.189	-0.114	40.57
Zn(SO4)2-2	3.01E-10	1.06E-10	-9.522	-9.977	-0.455	-11.02
FeSO4	2.21E-11	2.27E-11	-10.656	-10.644	0.012	18.97
CuSO4	1.29E-11	1.33E-11	-10.889	-10.876	0.012	13.09
CaHSO4+	6.80E-12	5.23E-12	-11.168	-11.281	-0.114	0
FeSO4+	1.74E-18	1.34E-18	-17.76	-17.874	-0.114	0
FeHSO4+	6.73E-19	5.18E-19	-18.172	-18.286	-0.114	0
Fe(SO4)2-	7.30E-20	5.62E-20	-19.137	-19.25	-0.114	0
FeHSO4+2	3.54E-26	1.24E-26	-25.451	-25.906	-0.455	0
Zn	6.20E-07					
Zn(CO3)2-2	3.94E-07	1.38E-07	-6.405	-6.86	-0.455	0
ZnCO3	1.35E-07	1.39E-07	-6.869	-6.856	0.012	0
Zn+2	4.28E-08	1.50E-08	-7.368	-7.823	-0.455	-24.62
Zn(OH)2	1.52E-08	1.57E-08	-7.818	-7.806	0.012	0
ZnHCO3+	8.44E-09	6.49E-09	-8.074	-8.188	-0.114	0
ZnOHCl	8.20E-09	8.44E-09	-8.086	-8.074	0.012	0
ZnSO4	6.58E-09	6.77E-09	-8.182	-8.17	0.012	21.71
ZnOH+	6.16E-09	4.74E-09	-8.21	-8.324	-0.114	0
ZnCl+	3.17E-09	2.39E-09	-8.5	-8.622	-0.123	-14.14
Zn(SO4)2-2	3.01E-10	1.06E-10	-9.522	-9.977	-0.455	-11.02
ZnCl2	1.43E-10	1.47E-10	-9.844	-9.832	0.012	102.03
ZnF+	3.28E-11	2.52E-11	-10.484	-10.598	-0.114	0
Zn(OH)3-	1.85E-11	1.42E-11	-10.733	-10.847	-0.114	0
ZnCl3-	1.29E-11	9.75E-12	-10.889	-11.011	-0.123	16.33
ZnCl4-2	8.20E-13	2.88E-13	-12.086	-12.541	-0.455	146.77
Zn(OH)4-2	1.85E-15	6.48E-16	-14.733	-15.188	-0.455	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-1.61	-5.89	-4.28	CaSO4
Aragonite	0.83	-7.51	-8.34	CaCO3
Barite	0.55	-9.29	-9.84	BaSO4
Calcite	0.97	-7.51	-8.48	CaCO3
CO2(g)	-3.1	-4.57	-1.47	CO2
Dolomite	2.99	-14.1	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.29	6.18	4.89	Fe(OH)3
Fluorite	-0.42	-11.02	-10.6	CaF2
Goethite	7.18	6.18	-1	FeOOH
Gypsum	-1.31	-5.89	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-4.04	-2.47	1.57	NaCl
Hausmann	-8.94	52.09	61.03	Mn3O4
Hematite	16.37	12.36	-4.01	Fe2O3
Jarosite-K	-6.16	-15.37	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.83	21.51	25.34	MnOOH
Melanterit	-10.69	-12.9	-2.21	FeSO4:7H2O
NH3(g)	-7.7	-5.9	1.8	NH3

O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.15	9.05	15.2	Mn(OH)2
Pyrolusite	-7.41	33.97	41.38	MnO2:H2O
Rhodochrc	-1.07	-12.2	-11.13	MnCO3
Siderite	-3.62	-14.51	-10.89	FeCO3
Smithsonit	-2.16	-12.16	-10	ZnCO3
Sylvite	-5.23	-4.33	0.9	KCl
Witherite	-2.34	-10.91	-8.56	BaCO3
Zn(OH)2(e	-2.41	9.09	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 8

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	6.67E-03	6.67E-03
Ba	1.21E-06	1.21E-06
Ca	2.45E-03	2.45E-03
Cl	8.97E-02	8.97E-02
Cu	8.00E-08	8.00E-08
F	2.50E-04	2.50E-04
Fe	6.40E-07	6.40E-07
K	1.23E-03	1.23E-03
Mg	1.98E-02	1.98E-02
Mn	1.10E-07	1.10E-07
N(-3)	1.30E-05	1.30E-05
N(5)	1.10E-04	1.10E-04
Na	8.63E-02	8.63E-02
S(6)	1.02E-02	1.02E-02
Zn	7.00E-07	7.00E-07

#NAME? of solution----------

pH	=	8.46		
pe	=	4		
Specific	Conductan	(µS/cm,	25°C)	= 11518
Density	(g/cm³)	=	1.00272	
Volume	(L)	=	1.00442	
Activity	of	water	=	0.996
Ionic	strength	(mol/kgw)	=	1.41E-01
Mass	of	water	(kg)	= 1.00E+00
Total	carbon	(mol/kg)	=	6.11E-03
Total	CO2	(mol/kg)	=	6.11E-03
Temperatu	(°C)	=	25	
Electrical	balance	(eq)	=	1.49E-02
Percent	error,	100*(Cat-|	=	6.42

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        Iterations  =                  9 (68        overall)
        Total       H          =          1.11E+02
        Total       O          =          5.56E+01

#NAME?  couples--------------------------------

        Redox       couple     pe         Eh         (volts)

        N(-3)/N(5)     4.434     0.2623

#NAME?  of          species----------------------------

        Log         Log        Log        mole       V
        Species     Molality   Activity   Molality   Activity   Gamma    cm³/mol

        OH-          3.96E-06  2.91E-06     -5.403     -5.536   -0.134     -3.63
        H+           4.27E-09  3.47E-09     -8.369      -8.46   -0.091         0
        H2O          5.55E+01  9.96E-01      1.744     -0.002        0      18.07
Ba        1.21E-06
        Ba+2         8.99E-07  2.90E-07     -6.046     -6.537   -0.491    -11.87
        BaSO4        2.89E-07  2.99E-07     -6.539     -6.525    0.014         0
        BaHCO3+      1.39E-08  1.06E-08     -7.858     -7.975   -0.118         0
        BaCO3        7.47E-09  7.72E-09     -8.127     -8.113    0.014      -10.7
        BaOH+        3.71E-12  2.83E-12     -11.43    -11.549   -0.118         0
C(4)      6.11E-03
        HCO3-        4.96E-03  3.80E-03     -2.305      -2.42   -0.115     25.33
        MgHCO3+      3.62E-04  2.69E-04     -3.442      -3.57   -0.128      5.68
        MgCO3        2.88E-04  2.97E-04     -3.541     -3.527    0.014    -17.09
        CO3-2        1.48E-04  5.14E-05     -3.829     -4.289   -0.459     -3.91
        NaHCO3       1.35E-04  1.40E-04     -3.869     -3.855    0.014       1.8
        NaCO3-       8.20E-05  6.25E-05     -4.086     -4.204   -0.118     -0.05
        CaCO3        6.17E-05  6.38E-05     -4.209     -4.195    0.014     -14.6
        CaHCO3+      4.61E-05  3.58E-05     -4.336     -4.446    -0.11      9.86
        CO2          2.88E-05  2.98E-05      -4.54     -4.526    0.014     34.43
        Zn(CO3)2-:   4.70E-07  1.59E-07     -6.328     -6.798    -0.47         0
        ZnCO3        1.40E-07  1.45E-07     -6.854      -6.84    0.014         0
        MnCO3        5.52E-08  5.70E-08     -7.258     -7.244    0.014         0
        BaHCO3+      1.39E-08  1.06E-08     -7.858     -7.975   -0.118         0
        CuCO3        1.01E-08  1.04E-08     -7.996     -7.982    0.014         0
        ZnHCO3+      8.85E-09  6.75E-09     -8.053     -8.171   -0.118         0
        BaCO3        7.47E-09  7.72E-09     -8.127     -8.113    0.014      -10.7
        MnHCO3+      6.21E-09  4.73E-09     -8.207     -8.325   -0.118         0
        Cu(CO3)2-    1.99E-09  6.74E-10     -8.701     -9.171    -0.47         0
        CuHCO3+      9.42E-11  7.19E-11    -10.026    -10.144   -0.118         0
        FeCO3        9.10E-11  9.40E-11    -10.041    -10.027    0.014         0
        FeHCO3+      3.80E-11  2.90E-11     -10.42    -10.538   -0.118         0
        (CO2)2       1.57E-11  1.63E-11    -10.803    -10.789    0.014     68.87
Ca        2.45E-03
        Ca+2         2.08E-03  7.38E-04     -2.682     -3.132    -0.45    -17.33
        CaSO4        2.61E-04  2.70E-04     -3.584      -3.57    0.014       7.5
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	CaCO3	6.17E-05	6.38E-05	-4.209	-4.195	0.014	-14.6
	CaHCO3+	4.61E-05	3.58E-05	-4.336	-4.446	-0.11	9.86
	CaOH+	4.61E-08	3.52E-08	-7.336	-7.454	-0.118	0
	CaHSO4+	8.05E-12	6.14E-12	-11.094	-11.212	-0.118	0
Cl	8.97E-02						
	Cl-	8.97E-02	6.65E-02	-1.047	-1.177	-0.13	18.39
	ZnOHCl	8.64E-09	8.92E-09	-8.064	-8.049	0.014	0
	MnCl+	4.97E-09	3.78E-09	-8.304	-8.422	-0.118	-2.9
	CuCl2-	3.72E-09	2.77E-09	-8.43	-8.558	-0.128	0
	ZnCl+	3.39E-09	2.52E-09	-8.47	-8.598	-0.128	-14.19
	CuCl3-2	8.69E-10	2.92E-10	-9.061	-9.535	-0.473	0
	ZnCl2	1.70E-10	1.76E-10	-9.769	-9.755	0.014	102.03
	MnCl2	1.06E-10	1.10E-10	-9.973	-9.959	0.014	85.89
	ZnCl3-	1.76E-11	1.31E-11	-10.754	-10.882	-0.128	16.22
	FeCl+	9.17E-12	7.00E-12	-11.037	-11.155	-0.118	0
	CuCl+	9.07E-12	6.75E-12	-11.043	-11.171	-0.128	1.03
	MnCl3-	2.64E-12	2.01E-12	-11.578	-11.696	-0.118	44.02
	ZnCl4-2	1.30E-12	4.38E-13	-11.885	-12.359	-0.473	146.91
	CuCl2	2.34E-13	2.41E-13	-12.632	-12.618	0.014	31.02
	CuCl3-	7.65E-17	5.69E-17	-16.117	-16.245	-0.128	0
	FeCl+2	4.35E-19	1.46E-19	-18.362	-18.835	-0.473	0
	FeCl2+	5.71E-20	4.35E-20	-19.244	-19.362	-0.118	0
	CuCl4-2	5.65E-20	1.90E-20	-19.248	-19.722	-0.473	0
	FeCl3	2.80E-22	2.89E-22	-21.553	-21.539	0.014	0
Cu(1)	4.59E-09						
	CuCl2-	3.72E-09	2.77E-09	-8.43	-8.558	-0.128	0
	CuCl3-2	8.69E-10	2.92E-10	-9.061	-9.535	-0.473	0
	Cu+	2.77E-12	1.98E-12	-11.557	-11.704	-0.146	0
Cu(2)	7.54E-08						
	Cu(OH)2	6.30E-08	6.50E-08	-7.201	-7.187	0.014	0
	CuCO3	1.01E-08	1.04E-08	-7.996	-7.982	0.014	0
	Cu(CO3)2-	1.99E-09	6.74E-10	-8.701	-9.171	-0.47	0
	CuOH+	1.46E-10	1.08E-10	-9.837	-9.965	-0.128	0
	Cu+2	1.04E-10	3.77E-11	-9.984	-10.424	-0.44	-25.86
	CuHCO3+	9.42E-11	7.19E-11	-10.026	-10.144	-0.118	0
	CuSO4	1.53E-11	1.58E-11	-10.815	-10.801	0.014	13.09
	CuCl+	9.07E-12	6.75E-12	-11.043	-11.171	-0.128	1.03
	Cu(OH)3-	1.48E-12	1.13E-12	-11.831	-11.948	-0.118	0
	CuCl2	2.34E-13	2.41E-13	-12.632	-12.618	0.014	31.02
	CuF+	1.17E-13	8.90E-14	-12.933	-13.051	-0.118	0
	Cu2(OH)2+	1.52E-14	5.14E-15	-13.819	-14.289	-0.47	0
	Cu(OH)4-2	1.91E-16	6.46E-17	-15.72	-16.19	-0.47	0
	CuCl3-	7.65E-17	5.69E-17	-16.117	-16.245	-0.128	0
	CuCl4-2	5.65E-20	1.90E-20	-19.248	-19.722	-0.473	0
F	2.50E-04						
	F-	1.77E-04	1.30E-04	-3.753	-3.887	-0.134	-0.99
	MgF+	6.88E-05	5.18E-05	-4.162	-4.285	-0.123	-10.37
	NaF	4.72E-06	4.87E-06	-5.326	-5.312	0.014	7.26
	HF	6.53E-10	6.75E-10	-9.185	-9.171	0.014	12.5
	ZnF+	3.39E-11	2.58E-11	-10.47	-10.588	-0.118	0

	MnF+	1.65E-11	1.25E-11	-10.784	-10.902	-0.118	0
	HF2-	4.40E-13	3.36E-13	-12.356	-12.474	-0.118	22.38
	FeF+	1.30E-13	9.88E-14	-12.887	-13.005	-0.118	0
	CuF+	1.17E-13	8.90E-14	-12.933	-13.051	-0.118	0
	FeF2+	1.02E-16	7.73E-17	-15.994	-16.112	-0.118	0
	FeF+2	4.45E-17	1.50E-17	-16.352	-16.825	-0.473	0
	FeF3	1.54E-17	1.59E-17	-16.813	-16.799	0.014	0
Fe(2)	3.84E-10						
	Fe+2	2.10E-10	7.62E-11	-9.678	-10.118	-0.44	-21.36
	FeCO3	9.10E-11	9.40E-11	-10.041	-10.027	0.014	0
	FeHCO3+	3.80E-11	2.90E-11	-10.42	-10.538	-0.118	0
	FeSO4	2.69E-11	2.78E-11	-10.57	-10.556	0.014	18.97
	FeCl+	9.17E-12	7.00E-12	-11.037	-11.155	-0.118	0
	FeOH+	9.09E-12	6.93E-12	-11.041	-11.16	-0.118	0
	FeF+	1.30E-13	9.88E-14	-12.887	-13.005	-0.118	0
	Fe(OH)2	1.64E-14	1.69E-14	-13.785	-13.771	0.014	0
	Fe(OH)3-	2.38E-16	1.81E-16	-15.624	-15.743	-0.118	0
	FeHSO4+	8.31E-19	6.34E-19	-18.08	-18.198	-0.118	0
Fe(3)	6.40E-07						
	Fe(OH)3	4.61E-07	4.76E-07	-6.337	-6.323	0.014	0
	Fe(OH)4-	1.62E-07	1.25E-07	-6.789	-6.904	-0.115	0
	Fe(OH)2+	1.67E-08	1.29E-08	-7.776	-7.891	-0.115	0
	FeOH+2	4.02E-13	1.35E-13	-12.396	-12.87	-0.473	0
	FeF2+	1.02E-16	7.73E-17	-15.994	-16.112	-0.118	0
	FeF+2	4.45E-17	1.50E-17	-16.352	-16.825	-0.473	0
	FeF3	1.54E-17	1.59E-17	-16.813	-16.799	0.014	0
	FeSO4+	2.15E-18	1.64E-18	-17.667	-17.786	-0.118	0
	Fe+3	4.77E-19	7.28E-20	-18.322	-19.138	-0.816	0
	FeCl+2	4.35E-19	1.46E-19	-18.362	-18.835	-0.473	0
	Fe(SO4)2-	9.65E-20	7.36E-20	-19.016	-19.133	-0.118	0
	FeCl2+	5.71E-20	4.35E-20	-19.244	-19.362	-0.118	0
	FeCl3	2.80E-22	2.89E-22	-21.553	-21.539	0.014	0
	Fe2(OH)2+	3.73E-23	4.91E-25	-22.428	-24.309	-1.881	0
	FeHSO4+2	4.49E-26	1.52E-26	-25.347	-25.818	-0.47	0
	Fe3(OH)4+	1.15E-27	1.32E-30	-26.941	-29.88	-2.94	0
H(0)	1.65E-28						
	H2	8.24E-29	8.51E-29	-28.084	-28.07	0.014	28.61
K	1.23E-03						
	K+	1.21E-03	8.96E-04	-2.916	-3.048	-0.132	9.29
	KSO4-	1.68E-05	1.29E-05	-4.774	-4.888	-0.115	34.43
Mg	1.98E-02						
	Mg+2	1.62E-02	6.05E-03	-1.79	-2.218	-0.428	-21.04
	MgSO4	2.82E-03	2.91E-03	-2.55	-2.536	0.014	5.84
	MgHCO3+	3.62E-04	2.69E-04	-3.442	-3.57	-0.128	5.68
	MgCO3	2.88E-04	2.97E-04	-3.541	-3.527	0.014	-17.09
	MgF+	6.88E-05	5.18E-05	-4.162	-4.285	-0.123	-10.37
	MgOH+	8.06E-06	6.31E-06	-5.094	-5.2	-0.106	0
Mn(2)	1.10E-07						
	MnCO3	5.52E-08	5.70E-08	-7.258	-7.244	0.014	0
	Mn+2	3.84E-08	1.40E-08	-7.415	-7.855	-0.44	-17.86

	MnHCO3+	6.21E-09	4.73E-09	-8.207	-8.325	-0.118	0
	MnCl+	4.97E-09	3.78E-09	-8.304	-8.422	-0.118	-2.9
	MnSO4	4.93E-09	5.10E-09	-8.307	-8.293	0.014	22.54
	MnOH+	1.35E-10	1.03E-10	-9.869	-9.987	-0.118	0
	MnCl2	1.06E-10	1.10E-10	-9.973	-9.959	0.014	85.89
	MnF+	1.65E-11	1.25E-11	-10.784	-10.902	-0.118	0
	MnCl3-	2.64E-12	2.01E-12	-11.578	-11.696	-0.118	44.02
	Mn(NO3)2	3.42E-16	3.53E-16	-15.466	-15.452	0.014	41.04
	Mn(OH)3-	6.89E-18	5.25E-18	-17.162	-17.28	-0.118	0
Mn(3)	2.83E-29						
	Mn+3	2.83E-29	4.31E-30	-28.549	-29.365	-0.816	0
N(-3)	1.30E-05						
	NH4+	1.14E-05	8.16E-06	-4.942	-5.089	-0.146	18.21
	NH3	1.30E-06	1.34E-06	-5.887	-5.873	0.014	24.42
	NH4SO4-	2.83E-07	2.16E-07	-6.549	-6.666	-0.118	38.27
N(5)	1.10E-04						
	NO3-	1.10E-04	7.98E-05	-3.959	-4.098	-0.14	29.83
	Mn(NO3)2	3.42E-16	3.53E-16	-15.466	-15.452	0.014	41.04
Na	8.63E-02						
	Na+	8.52E-02	6.53E-02	-1.07	-1.185	-0.116	-1.02
	NaSO4-	8.75E-04	6.72E-04	-3.058	-3.173	-0.115	16.87
	NaHCO3	1.35E-04	1.40E-04	-3.869	-3.855	0.014	1.8
	NaCO3-	8.20E-05	6.25E-05	-4.086	-4.204	-0.118	-0.05
	NaF	4.72E-06	4.87E-06	-5.326	-5.312	0.014	7.26
	NaOH	1.84E-17	1.90E-17	-16.736	-16.722	0.014	0
O(0)	1.11E-36						
	O2	5.53E-37	5.71E-37	-36.257	-36.243	0.014	30.4
S(6)	1.02E-02						
	SO4-2	6.19E-03	2.05E-03	-2.208	-2.688	-0.479	15.81
	MgSO4	2.82E-03	2.91E-03	-2.55	-2.536	0.014	5.84
	NaSO4-	8.75E-04	6.72E-04	-3.058	-3.173	-0.115	16.87
	CaSO4	2.61E-04	2.70E-04	-3.584	-3.57	0.014	7.5
	KSO4-	1.68E-05	1.29E-05	-4.774	-4.888	-0.115	34.43
	BaSO4	2.89E-07	2.99E-07	-6.539	-6.525	0.014	0
	NH4SO4-	2.83E-07	2.16E-07	-6.549	-6.666	-0.118	38.27
	ZnSO4	6.57E-09	6.78E-09	-8.183	-8.168	0.014	21.71
	MnSO4	4.93E-09	5.10E-09	-8.307	-8.293	0.014	22.54
	HSO4-	9.07E-10	6.92E-10	-9.042	-9.16	-0.118	40.59
	Zn(SO4)2-2	3.34E-10	1.13E-10	-9.476	-9.946	-0.47	-10.8
	FeSO4	2.69E-11	2.78E-11	-10.57	-10.556	0.014	18.97
	CuSO4	1.53E-11	1.58E-11	-10.815	-10.801	0.014	13.09
	CaHSO4+	8.05E-12	6.14E-12	-11.094	-11.212	-0.118	0
	FeSO4+	2.15E-18	1.64E-18	-17.667	-17.786	-0.118	0
	FeHSO4+	8.31E-19	6.34E-19	-18.08	-18.198	-0.118	0
	Fe(SO4)2-	9.65E-20	7.36E-20	-19.016	-19.133	-0.118	0
	FeHSO4+2	4.49E-26	1.52E-26	-25.347	-25.818	-0.47	0
Zn	7.00E-07						
	Zn(CO3)2-2	4.70E-07	1.59E-07	-6.328	-6.798	-0.47	0
	ZnCO3	1.40E-07	1.45E-07	-6.854	-6.84	0.014	0
	Zn+2	4.19E-08	1.41E-08	-7.377	-7.851	-0.473	-24.59

Zn(OH)2	1.42E-08	1.47E-08	-7.848	-7.834	0.014	0
ZnHCO3+	8.85E-09	6.75E-09	-8.053	-8.171	-0.118	0
ZnOHCl	8.64E-09	8.92E-09	-8.064	-8.049	0.014	0
ZnSO4	6.57E-09	6.78E-09	-8.183	-8.168	0.014	21.71
ZnOH+	5.82E-09	4.44E-09	-8.235	-8.352	-0.118	0
ZnCl+	3.39E-09	2.52E-09	-8.47	-8.598	-0.128	-14.19
Zn(SO4)2-2	3.34E-10	1.13E-10	-9.476	-9.946	-0.47	-10.8
ZnCl2	1.70E-10	1.76E-10	-9.769	-9.755	0.014	102.03
ZnF+	3.39E-11	2.58E-11	-10.47	-10.588	-0.118	0
ZnCl3-	1.76E-11	1.31E-11	-10.754	-10.882	-0.128	16.22
Zn(OH)3-	1.75E-11	1.33E-11	-10.758	-10.876	-0.118	0
ZnCl4-2	1.30E-12	4.38E-13	-11.885	-12.359	-0.473	146.91
Zn(OH)4-2	1.79E-15	6.07E-16	-14.747	-15.217	-0.47	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-1.54	-5.82	-4.28	CaSO4			
Aragonite	0.92	-7.42	-8.34	CaCO3			
Barite	0.62	-9.22	-9.84	BaSO4			
Calcite	1.06	-7.42	-8.48	CaCO3			
CO2(g)	-3.06	-4.53	-1.47	CO2			
Dolomite	3.16	-13.93	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.35	6.24	4.89	Fe(OH)3			
Fluorite	-0.31	-10.91	-10.6	CaF2			
Goethite	7.24	6.24	-1	FeOOH			
Gypsum	-1.24	-5.82	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-3.93	-2.36	1.57	NaCl			
Hausmann	-8.92	52.11	61.03	Mn3O4			
Hematite	16.49	12.48	-4.01	Fe2O3			
Jarosite-K	-5.88	-15.09	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.82	21.52	25.34	MnOOH			
Melanterit	-10.61	-12.82	-2.21	FeSO4:7H2O			
NH3(g)	-7.67	-5.87	1.8	NH3			
O2(g)	-33.35	-36.24	-2.89	O2			
Pyrochroit	-6.14	9.06	15.2	Mn(OH)2			
Pyrolusite	-7.4	33.98	41.38	MnO2:H2O			
Rhodochro	-1.01	-12.14	-11.13	MnCO3			
Siderite	-3.52	-14.41	-10.89	FeCO3			
Smithsonit	-2.14	-12.14	-10	ZnCO3			
Sylvite	-5.12	-4.22	0.9	KCl			
Witherite	-2.26	-10.83	-8.56	BaCO3			
Zn(OH)2(e	-2.43	9.07	11.5	Zn(OH)2			

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

```
Initial     solution          9

 #NAME?  composition------------------------------

         Elements  Molality   Moles

         Alkalinity  7.51E-03  7.51E-03
         Ba          1.36E-06  1.36E-06
         Ca          2.75E-03  2.75E-03
         Cl          1.01E-01  1.01E-01
         Cu          9.00E-08  9.00E-08
         F           2.80E-04  2.80E-04
         Fe          7.30E-07  7.30E-07
         K           1.38E-03  1.38E-03
         Mg          2.22E-02  2.22E-02
         Mn          1.20E-07  1.20E-07
         N(-3)       1.50E-05  1.50E-05
         N(5)        1.30E-04  1.30E-04
         Na          9.71E-02  9.71E-02
         S(6)        1.14E-02  1.14E-02
         Zn          7.90E-07  7.90E-07

 #NAME?  of        solution----------------------------

         pH        =              8.46
         pe        =                 4
         Specific  Conductan (µS/cm,  25°C)     =            12811
         Density   (g/cm³)   =          1.00342
         Volume    (L)       =          1.00461
         Activity  of        water    =            0.996
         Ionic     strength  (mol/kgw) =          1.58E-01
         Mass      of        water    (kg)      =          1.00E+00
         Total     carbon    (mol/kg) =          6.84E-03
         Total     CO2       (mol/kg) =          6.84E-03
         Temperatu (°C)      =                25
         Electrical balance  (eq)     =          1.67E-02
         Percent   error,    100*(Cat-|=            6.43
         Iterations =                10 (78       overall)
         Total     H         =          1.11E+02
         Total     O         =          5.56E+01

 #NAME?  couples--------------------------------

         Redox     couple    pe        Eh        (volts)

         N(-3)/N(5)   4.4354    0.2624

 #NAME?  of        species----------------------------

         Log       Log       Log       mole      V
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	Species	Molality	Activity	Molality	Activity	Gamma	cm³/mol
	OH-	4.00E-06	2.91E-06	-5.397	-5.537	-0.139	-3.59
	H+	4.30E-09	3.47E-09	-8.367	-8.46	-0.093	0
	H2O	5.55E+01	9.96E-01	1.744	-0.002	0	18.07
Ba	1.36E-06						
	Ba+2	1.01E-06	3.12E-07	-5.997	-6.506	-0.508	-11.82
	BaSO4	3.29E-07	3.41E-07	-6.483	-6.468	0.016	0
	BaHCO3+	1.65E-08	1.25E-08	-7.784	-7.905	-0.121	0
	BaCO3	8.76E-09	9.08E-09	-8.058	-8.042	0.016	-10.7
	BaOH+	4.03E-12	3.04E-12	-11.395	-11.517	-0.123	0
C(4)	6.84E-03						
	HCO3-	5.47E-03	4.16E-03	-2.262	-2.381	-0.119	25.39
	MgHCO3+	4.35E-04	3.20E-04	-3.362	-3.495	-0.133	5.69
	MgCO3	3.41E-04	3.53E-04	-3.468	-3.452	0.016	-17.09
	CO3-2	1.68E-04	5.63E-05	-3.774	-4.25	-0.475	-3.82
	NaHCO3	1.64E-04	1.70E-04	-3.785	-3.769	0.016	1.8
	NaCO3-	1.01E-04	7.63E-05	-3.997	-4.118	-0.121	0.05
	CaCO3	7.28E-05	7.54E-05	-4.138	-4.122	0.016	-14.6
	CaHCO3+	5.50E-05	4.24E-05	-4.259	-4.373	-0.114	9.86
	CO2	3.14E-05	3.26E-05	-4.503	-4.487	0.016	34.43
	Zn(CO3)2-2	5.54E-07	1.82E-07	-6.257	-6.74	-0.483	0
	ZnCO3	1.46E-07	1.51E-07	-6.836	-6.82	0.016	0
	MnCO3	6.13E-08	6.35E-08	-7.213	-7.197	0.016	0
	BaHCO3+	1.65E-08	1.25E-08	-7.784	-7.905	-0.121	0
	CuCO3	1.20E-08	1.25E-08	-7.921	-7.905	0.016	0
	ZnHCO3+	9.32E-09	7.06E-09	-8.031	-8.151	-0.121	0
	BaCO3	8.76E-09	9.08E-09	-8.058	-8.042	0.016	-10.7
	MnHCO3+	6.99E-09	5.27E-09	-8.156	-8.278	-0.123	0
	Cu(CO3)2-	2.68E-09	8.82E-10	-8.571	-9.055	-0.483	0
	CuHCO3+	1.13E-10	8.59E-11	-9.945	-10.066	-0.121	0
	FeCO3	1.13E-10	1.18E-10	-9.946	-9.93	0.016	0
	FeHCO3+	4.79E-11	3.62E-11	-10.32	-10.441	-0.121	0
	(CO2)2	1.88E-11	1.95E-11	-10.726	-10.711	0.016	68.87
Ca	2.75E-03						
	Ca+2	2.32E-03	7.98E-04	-2.634	-3.098	-0.464	-17.29
	CaSO4	2.98E-04	3.09E-04	-3.526	-3.51	0.016	7.5
	CaCO3	7.28E-05	7.54E-05	-4.138	-4.122	0.016	-14.6
	CaHCO3+	5.50E-05	4.24E-05	-4.259	-4.373	-0.114	9.86
	CaOH+	5.02E-08	3.80E-08	-7.299	-7.42	-0.121	0
	CaHSO4+	9.30E-12	7.04E-12	-11.032	-11.152	-0.121	0
Cl	1.01E-01						
	Cl-	1.01E-01	7.40E-02	-0.996	-1.131	-0.135	18.41
	ZnOHCl	9.14E-09	9.48E-09	-8.039	-8.023	0.016	0
	MnCl+	5.68E-09	4.28E-09	-8.246	-8.368	-0.123	-2.89
	CuCl2-	5.08E-09	3.74E-09	-8.294	-8.427	-0.133	0
	ZnCl+	3.65E-09	2.68E-09	-8.438	-8.571	-0.133	-14.24
	CuCl3-2	1.36E-09	4.39E-10	-8.868	-9.358	-0.49	0
	ZnCl2	2.00E-10	2.08E-10	-9.698	-9.682	0.016	102.03
	MnCl2	1.33E-10	1.38E-10	-9.875	-9.859	0.016	85.89

	ZnCl3-	2.34E-11	1.73E-11	-10.63	-10.763	-0.133	16.11
	FeCl+	1.17E-11	8.89E-12	-10.93	-11.051	-0.121	0
	CuCl+	1.11E-11	8.20E-12	-10.953	-11.086	-0.133	1.06
	MnCl3-	3.74E-12	2.82E-12	-11.427	-11.55	-0.123	44.09
	ZnCl4-2	1.98E-12	6.40E-13	-11.704	-12.194	-0.49	147.05
	CuCl2	3.14E-13	3.26E-13	-12.503	-12.487	0.016	31.02
	CuCl3-	1.16E-16	8.55E-17	-15.935	-16.068	-0.133	0
	FeCl+2	5.75E-19	1.86E-19	-18.241	-18.731	-0.49	0
	CuCl4-2	9.81E-20	3.17E-20	-19.008	-19.499	-0.49	0
	FeCl2+	8.14E-20	6.14E-20	-19.089	-19.212	-0.123	0
	FeCl3	4.38E-22	4.54E-22	-21.358	-21.343	0.016	0
Cu(1)	6.44E-09						
	CuCl2-	5.08E-09	3.74E-09	-8.294	-8.427	-0.133	0
	CuCl3-2	1.36E-09	4.39E-10	-8.868	-9.358	-0.49	0
	Cu+	3.07E-12	2.16E-12	-11.513	-11.665	-0.153	0
Cu(2)	8.36E-08						
	Cu(OH)2	6.85E-08	7.10E-08	-7.165	-7.149	0.016	0
	CuCO3	1.20E-08	1.25E-08	-7.921	-7.905	0.016	0
	Cu(CO3)2-	2.68E-09	8.82E-10	-8.571	-9.055	-0.483	0
	CuOH+	1.61E-10	1.18E-10	-9.794	-9.927	-0.133	0
	Cu+2	1.17E-10	4.12E-11	-9.931	-10.385	-0.454	-25.83
	CuHCO3+	1.13E-10	8.59E-11	-9.945	-10.066	-0.121	0
	CuSO4	1.77E-11	1.83E-11	-10.753	-10.737	0.016	13.09
	CuCl+	1.11E-11	8.20E-12	-10.953	-11.086	-0.133	1.06
	Cu(OH)3-	1.62E-12	1.23E-12	-11.79	-11.911	-0.121	0
	CuCl2	3.14E-13	3.26E-13	-12.503	-12.487	0.016	31.02
	CuF+	1.39E-13	1.05E-13	-12.859	-12.979	-0.121	0
	Cu2(OH)2+	1.86E-14	6.12E-15	-13.73	-14.213	-0.483	0
	Cu(OH)4-2	2.14E-16	7.04E-17	-15.669	-16.152	-0.483	0
	CuCl3-	1.16E-16	8.55E-17	-15.935	-16.068	-0.133	0
	CuCl4-2	9.81E-20	3.17E-20	-19.008	-19.499	-0.49	0
F	2.80E-04						
	F-	1.93E-04	1.40E-04	-3.715	-3.854	-0.139	-0.97
	MgF+	8.16E-05	6.08E-05	-4.088	-4.216	-0.128	-10.37
	NaF	5.65E-06	5.86E-06	-5.248	-5.232	0.016	7.26
	HF	7.02E-10	7.28E-10	-9.154	-9.138	0.016	12.5
	ZnF+	3.52E-11	2.66E-11	-10.454	-10.575	-0.121	0
	MnF+	1.83E-11	1.38E-11	-10.739	-10.861	-0.123	0
	HF2-	5.16E-13	3.91E-13	-12.287	-12.408	-0.121	22.41
	FeF+	1.61E-13	1.22E-13	-12.793	-12.914	-0.121	0
	CuF+	1.39E-13	1.05E-13	-12.859	-12.979	-0.121	0
	FeF2+	1.36E-16	1.03E-16	-15.866	-15.988	-0.123	0
	FeF+2	5.70E-17	1.84E-17	-16.244	-16.734	-0.49	0
	FeF3	2.20E-17	2.28E-17	-16.658	-16.642	0.016	0
Fe(2)	4.64E-10						
	Fe+2	2.48E-10	8.71E-11	-9.606	-10.06	-0.454	-21.33
	FeCO3	1.13E-10	1.18E-10	-9.946	-9.93	0.016	0
	FeHCO3+	4.79E-11	3.62E-11	-10.32	-10.441	-0.121	0
	FeSO4	3.25E-11	3.37E-11	-10.488	-10.472	0.016	18.97
	FeCl+	1.17E-11	8.89E-12	-10.93	-11.051	-0.121	0

	FeOH+	1.05E-11	7.91E-12	-10.979	-11.102	-0.123	0
	FeF+	1.61E-13	1.22E-13	-12.793	-12.914	-0.121	0
	Fe(OH)2	1.86E-14	1.93E-14	-13.729	-13.714	0.016	0
	Fe(OH)3-	2.74E-16	2.06E-16	-15.563	-15.685	-0.123	0
	FeHSO4+	1.02E-18	7.68E-19	-17.994	-18.115	-0.121	0
Fe(3)	7.30E-07						
	Fe(OH)3	5.23E-07	5.43E-07	-6.281	-6.265	0.016	0
	Fe(OH)4-	1.87E-07	1.42E-07	-6.728	-6.847	-0.119	0
	Fe(OH)2+	1.93E-08	1.47E-08	-7.715	-7.834	-0.119	0
	FeOH+2	4.77E-13	1.54E-13	-12.322	-12.812	-0.49	0
	FeF2+	1.36E-16	1.03E-16	-15.866	-15.988	-0.123	0
	FeF+2	5.70E-17	1.84E-17	-16.244	-16.734	-0.49	0
	FeF3	2.20E-17	2.28E-17	-16.658	-16.642	0.016	0
	FeSO4+	2.63E-18	1.99E-18	-17.58	-17.702	-0.123	0
	FeCl+2	5.75E-19	1.86E-19	-18.241	-18.731	-0.49	0
	Fe+3	5.73E-19	8.31E-20	-18.242	-19.08	-0.838	0
	Fe(SO4)2-	1.25E-19	9.45E-20	-18.904	-19.024	-0.121	0
	FeCl2+	8.14E-20	6.14E-20	-19.089	-19.212	-0.123	0
	FeCl3	4.38E-22	4.54E-22	-21.358	-21.343	0.016	0
	Fe2(OH)2+	5.49E-23	6.40E-25	-22.26	-24.194	-1.933	0
	FeHSO4+2	5.61E-26	1.84E-26	-25.251	-25.735	-0.483	0
	Fe3(OH)4+	2.06E-27	1.96E-30	-26.687	-29.708	-3.021	0
H(0)	1.64E-28						
	H2	8.21E-29	8.51E-29	-28.086	-28.07	0.016	28.61
K	1.38E-03						
	K+	1.36E-03	9.93E-04	-2.866	-3.003	-0.137	9.3
	KSO4-	2.00E-05	1.52E-05	-4.7	-4.819	-0.119	34.45
Mg	2.22E-02						
	Mg+2	1.81E-02	6.58E-03	-1.742	-2.182	-0.44	-21
	MgSO4	3.24E-03	3.36E-03	-2.49	-2.474	0.016	5.84
	MgHCO3+	4.35E-04	3.20E-04	-3.362	-3.495	-0.133	5.69
	MgCO3	3.41E-04	3.53E-04	-3.468	-3.452	0.016	-17.09
	MgF+	8.16E-05	6.08E-05	-4.088	-4.216	-0.128	-10.37
	MgOH+	8.83E-06	6.86E-06	-5.054	-5.164	-0.11	0
Mn(2)	1.20E-07						
	MnCO3	6.13E-08	6.35E-08	-7.213	-7.197	0.016	0
	Mn+2	4.05E-08	1.42E-08	-7.393	-7.847	-0.454	-17.76
	MnHCO3+	6.99E-09	5.27E-09	-8.156	-8.278	-0.123	0
	MnCl+	5.68E-09	4.28E-09	-8.246	-8.368	-0.123	-2.89
	MnSO4	5.31E-09	5.50E-09	-8.275	-8.26	0.016	22.54
	MnOH+	1.39E-10	1.05E-10	-9.857	-9.979	-0.123	0
	MnCl2	1.33E-10	1.38E-10	-9.875	-9.859	0.016	85.89
	MnF+	1.83E-11	1.38E-11	-10.739	-10.861	-0.123	0
	MnCl3-	3.74E-12	2.82E-12	-11.427	-11.55	-0.123	44.09
	Mn(NO3)2	4.72E-16	4.89E-16	-15.326	-15.311	0.016	41.04
	Mn(OH)3-	7.08E-18	5.34E-18	-17.15	-17.273	-0.123	0
Mn(3)	3.03E-29						
	Mn+3	3.03E-29	4.39E-30	-28.519	-29.357	-0.838	0
N(-3)	1.50E-05						
	NH4+	1.32E-05	9.28E-06	-4.88	-5.033	-0.153	18.22

	NH3	1.47E-06	1.53E-06	-5.833	-5.817	0.016	24.42
	NH4SO4-	3.44E-07	2.60E-07	-6.464	-6.585	-0.121	38.34
N(5)	1.30E-04						
	NO3-	1.30E-04	9.30E-05	-3.886	-4.032	-0.146	29.85
	Mn(NO3)2	4.72E-16	4.89E-16	-15.326	-15.311	0.016	41.04
Na	9.71E-02						
	Na+	9.58E-02	7.28E-02	-1.019	-1.138	-0.119	-0.99
	NaSO4-	1.04E-03	7.94E-04	-2.981	-3.1	-0.119	17.08
	NaHCO3	1.64E-04	1.70E-04	-3.785	-3.769	0.016	1.8
	NaCO3-	1.01E-04	7.63E-05	-3.997	-4.118	-0.121	0.05
	NaF	5.65E-06	5.86E-06	-5.248	-5.232	0.016	7.26
	NaOH	2.04E-17	2.12E-17	-16.69	-16.675	0.016	0
O(0)	1.10E-36						
	O2	5.51E-37	5.71E-37	-36.259	-36.244	0.016	30.4
S(6)	1.14E-02						
	SO4-2	6.83E-03	2.18E-03	-2.166	-2.662	-0.497	15.89
	MgSO4	3.24E-03	3.36E-03	-2.49	-2.474	0.016	5.84
	NaSO4-	1.04E-03	7.94E-04	-2.981	-3.1	-0.119	17.08
	CaSO4	2.98E-04	3.09E-04	-3.526	-3.51	0.016	7.5
	KSO4-	2.00E-05	1.52E-05	-4.7	-4.819	-0.119	34.45
	NH4SO4-	3.44E-07	2.60E-07	-6.464	-6.585	-0.121	38.34
	BaSO4	3.29E-07	3.41E-07	-6.483	-6.468	0.016	0
	ZnSO4	6.63E-09	6.88E-09	-8.178	-8.163	0.016	21.71
	MnSO4	5.31E-09	5.50E-09	-8.275	-8.26	0.016	22.54
	HSO4-	9.69E-10	7.34E-10	-9.014	-9.134	-0.121	40.61
	Zn(SO4)2-2	3.70E-10	1.22E-10	-9.432	-9.915	-0.483	-10.59
	FeSO4	3.25E-11	3.37E-11	-10.488	-10.472	0.016	18.97
	CuSO4	1.77E-11	1.83E-11	-10.753	-10.737	0.016	13.09
	CaHSO4+	9.30E-12	7.04E-12	-11.032	-11.152	-0.121	0
	FeSO4+	2.63E-18	1.99E-18	-17.58	-17.702	-0.123	0
	FeHSO4+	1.02E-18	7.68E-19	-17.994	-18.115	-0.121	0
	Fe(SO4)2-	1.25E-19	9.45E-20	-18.904	-19.024	-0.121	0
	FeHSO4+2	5.61E-26	1.84E-26	-25.251	-25.735	-0.483	0
Zn	7.90E-07						
	Zn(CO3)2-2	5.54E-07	1.82E-07	-6.257	-6.74	-0.483	0
	ZnCO3	1.46E-07	1.51E-07	-6.836	-6.82	0.016	0
	Zn+2	4.17E-08	1.35E-08	-7.38	-7.871	-0.49	-24.56
	Zn(OH)2	1.35E-08	1.40E-08	-7.87	-7.854	0.016	0
	ZnHCO3+	9.32E-09	7.06E-09	-8.031	-8.151	-0.121	0
	ZnOHCl	9.14E-09	9.48E-09	-8.039	-8.023	0.016	0
	ZnSO4	6.63E-09	6.88E-09	-8.178	-8.163	0.016	21.71
	ZnOH+	5.60E-09	4.24E-09	-8.252	-8.372	-0.121	0
	ZnCl+	3.65E-09	2.68E-09	-8.438	-8.571	-0.133	-14.24
	Zn(SO4)2-2	3.70E-10	1.22E-10	-9.432	-9.915	-0.483	-10.59
	ZnCl2	2.00E-10	2.08E-10	-9.698	-9.682	0.016	102.03
	ZnF+	3.52E-11	2.66E-11	-10.454	-10.575	-0.121	0
	ZnCl3-	2.34E-11	1.73E-11	-10.63	-10.763	-0.133	16.11
	Zn(OH)3-	1.68E-11	1.27E-11	-10.775	-10.896	-0.121	0
	ZnCl4-2	1.98E-12	6.40E-13	-11.704	-12.194	-0.49	147.05
	Zn(OH)4-2	1.76E-15	5.79E-16	-14.754	-15.238	-0.483	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-1.48	-5.76	-4.28	CaSO4
Aragonite	0.99	-7.35	-8.34	CaCO3
Barite	0.68	-9.17	-9.84	BaSO4
Calcite	1.13	-7.35	-8.48	CaCO3
CO2(g)	-3.02	-4.49	-1.47	CO2
Dolomite	3.3	-13.78	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.4	6.29	4.89	Fe(OH)3
Fluorite	-0.21	-10.81	-10.6	CaF2
Goethite	7.3	6.3	-1	FeOOH
Gypsum	-1.18	-5.76	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-3.84	-2.27	1.57	NaCl
Hausmann	-8.9	52.13	61.03	Mn3O4
Hematite	16.6	12.59	-4.01	Fe2O3
Jarosite-K	-5.61	-14.82	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.81	21.53	25.34	MnOOH
Melanterit	-10.53	-12.73	-2.21	FeSO4:7H2O
NH3(g)	-7.61	-5.82	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.13	9.07	15.2	Mn(OH)2
Pyrolusite	-7.39	33.99	41.38	MnO2:H2O
Rhodochro	-0.97	-12.1	-11.13	MnCO3
Siderite	-3.42	-14.31	-10.89	FeCO3
Smithsonit	-2.12	-12.12	-10	ZnCO3
Sylvite	-5.03	-4.13	0.9	KCl
Witherite	-2.19	-10.76	-8.56	BaCO3
Zn(OH)2(e	-2.45	9.05	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 10

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	8.34E-03	8.34E-03
Ba	1.51E-06	1.51E-06
Ca	3.06E-03	3.06E-03
Cl	1.12E-01	1.12E-01
Cu	1.00E-07	1.00E-07
F	3.20E-04	3.20E-04
Fe	8.10E-07	8.10E-07

K	1.53E-03	1.53E-03
Mg	2.47E-02	2.47E-02
Mn	1.40E-07	1.40E-07
N(-3)	1.70E-05	1.70E-05
N(5)	1.40E-04	1.40E-04
Na	1.08E-01	1.08E-01
S(6)	1.27E-02	1.27E-02
Zn	8.80E-07	8.80E-07

#NAME? of solution----------

pH	=	8.46			
pe	=	4			
Specific	Conductan	(µS/cm,	25°C)	=	14086
Density	(g/cm³)	=	1.00412		
Volume	(L)	=	1.0048		
Activity	of	water	=	0.996	
Ionic	strength	(mol/kgw)	=	1.75E-01	
Mass	of	water	(kg)	=	1.00E+00
Total	carbon	(mol/kg)	=	7.57E-03	
Total	CO2	(mol/kg)	=	7.57E-03	
Temperatu	(°C)	=	25		
Electrical	balance	(eq)	=	1.86E-02	
Percent	error,	100*(Cat-|	=	6.44	
Iterations	=	11	(89	overall)	
Total	H	=	1.11E+02		
Total	O	=	5.56E+01		

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4327	0.2622		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.05E-06	2.91E-06	-5.393	-5.537	-0.144	-3.55
H+	4.32E-09	3.47E-09	-8.365	-8.46	-0.095	0
H2O	5.55E+01	9.96E-01	1.744	-0.002	0	18.07
Ba	1.51E-06					
Ba+2	1.11E-06	3.33E-07	-5.953	-6.477	-0.524	-11.78
BaSO4	3.68E-07	3.83E-07	-6.434	-6.417	0.017	0
BaHCO3+	1.91E-08	1.44E-08	-7.718	-7.842	-0.124	0
BaCO3	1.01E-08	1.05E-08	-7.997	-7.979	0.017	-10.7
BaOH+	4.34E-12	3.24E-12	-11.363	-11.489	-0.126	0
C(4)	7.57E-03					
HCO3-	5.97E-03	4.50E-03	-2.224	-2.346	-0.122	25.45

	MgHCO3+	5.13E-04	3.74E-04	-3.29	-3.428	-0.138	5.7
	MgCO3	3.96E-04	4.12E-04	-3.403	-3.385	0.017	-17.09
	NaHCO3	1.95E-04	2.03E-04	-3.71	-3.692	0.017	1.8
	CO3-2	1.88E-04	6.09E-05	-3.726	-4.215	-0.49	-3.73
	NaCO3-	1.21E-04	9.10E-05	-3.917	-4.041	-0.124	0.15
	CaCO3	8.44E-05	8.79E-05	-4.073	-4.056	0.017	-14.6
	CaHCO3+	6.46E-05	4.94E-05	-4.19	-4.307	-0.117	9.87
	CO2	3.39E-05	3.53E-05	-4.47	-4.453	0.017	34.43
	Zn(CO3)2-2	6.39E-07	2.05E-07	-6.195	-6.689	-0.494	0
	ZnCO3	1.51E-07	1.57E-07	-6.821	-6.804	0.017	0
	MnCO3	7.25E-08	7.55E-08	-7.14	-7.122	0.017	0
	BaHCO3+	1.91E-08	1.44E-08	-7.718	-7.842	-0.124	0
	CuCO3	1.39E-08	1.45E-08	-7.856	-7.838	0.017	0
	BaCO3	1.01E-08	1.05E-08	-7.997	-7.979	0.017	-10.7
	ZnHCO3+	9.74E-09	7.33E-09	-8.011	-8.135	-0.124	0
	MnHCO3+	8.38E-09	6.26E-09	-8.077	-8.203	-0.126	0
	Cu(CO3)2-	3.48E-09	1.11E-09	-8.459	-8.953	-0.494	0
	FeCO3	1.36E-10	1.41E-10	-9.867	-9.849	0.017	0
	CuHCO3+	1.33E-10	1.00E-10	-9.876	-9.999	-0.124	0
	FeHCO3+	5.80E-11	4.36E-11	-10.237	-10.361	-0.124	0
	(CO2)2	2.19E-11	2.28E-11	-10.659	-10.641	0.017	68.87
Ca	3.06E-03						
	Ca+2	2.58E-03	8.59E-04	-2.589	-3.066	-0.477	-17.26
	CaSO4	3.36E-04	3.50E-04	-3.473	-3.456	0.017	7.5
	CaCO3	8.44E-05	8.79E-05	-4.073	-4.056	0.017	-14.6
	CaHCO3+	6.46E-05	4.94E-05	-4.19	-4.307	-0.117	9.87
	CaOH+	5.44E-08	4.09E-08	-7.264	-7.388	-0.124	0
	CaHSO4+	1.06E-11	7.98E-12	-10.974	-11.098	-0.124	0
Cl	1.12E-01						
	Cl-	1.12E-01	8.14E-02	-0.95	-1.09	-0.139	18.43
	ZnOHCl	9.60E-09	1.00E-08	-8.018	-8	0.017	0
	MnCl+	6.91E-09	5.17E-09	-8.16	-8.287	-0.126	-2.89
	CuCl2-	6.69E-09	4.87E-09	-8.175	-8.312	-0.138	0
	ZnCl+	3.89E-09	2.83E-09	-8.411	-8.548	-0.138	-14.29
	CuCl3-2	2.01E-09	6.28E-10	-8.696	-9.202	-0.506	0
	ZnCl2	2.32E-10	2.41E-10	-9.635	-9.618	0.017	102.03
	MnCl2	1.76E-10	1.84E-10	-9.754	-9.736	0.017	85.89
	ZnCl3-	3.02E-11	2.20E-11	-10.52	-10.657	-0.138	16
	FeCl+	1.45E-11	1.09E-11	-10.84	-10.964	-0.124	0
	CuCl+	1.33E-11	9.72E-12	-10.875	-11.013	-0.138	1.09
	MnCl3-	5.50E-12	4.11E-12	-11.259	-11.386	-0.126	44.15
	ZnCl4-2	2.87E-12	8.97E-13	-11.541	-12.047	-0.506	147.18
	CuCl2	4.08E-13	4.25E-13	-12.39	-12.372	0.017	31.02
	CuCl3-	1.68E-16	1.23E-16	-15.774	-15.912	-0.138	0
	FeCl+2	7.27E-19	2.27E-19	-18.138	-18.644	-0.506	0
	CuCl4-2	1.60E-19	5.00E-20	-18.796	-19.301	-0.506	0
	FeCl2+	1.10E-19	8.25E-20	-18.957	-19.083	-0.126	0
	FeCl3	6.45E-22	6.71E-22	-21.19	-21.173	0.017	0
Cu(1)	8.71E-09						
	CuCl2-	6.69E-09	4.87E-09	-8.175	-8.312	-0.138	0

	CuCl3-2	2.01E-09	6.28E-10	-8.696	-9.202	-0.506	0
	Cu+	3.36E-12	2.33E-12	-11.474	-11.633	-0.159	0
Cu(2)	9.13E-08						
	Cu(OH)2	7.34E-08	7.64E-08	-7.134	-7.117	0.017	0
	CuCO3	1.39E-08	1.45E-08	-7.856	-7.838	0.017	0
	Cu(CO3)2-	3.48E-09	1.11E-09	-8.459	-8.953	-0.494	0
	CuOH+	1.75E-10	1.27E-10	-9.757	-9.895	-0.138	0
	CuHCO3+	1.33E-10	1.00E-10	-9.876	-9.999	-0.124	0
	Cu+2	1.30E-10	4.44E-11	-9.885	-10.353	-0.468	-25.8
	CuSO4	1.99E-11	2.08E-11	-10.7	-10.683	0.017	13.09
	CuCl+	1.33E-11	9.72E-12	-10.875	-11.013	-0.138	1.09
	Cu(OH)3-	1.76E-12	1.32E-12	-11.755	-11.879	-0.124	0
	CuCl2	4.08E-13	4.25E-13	-12.39	-12.372	0.017	31.02
	CuF+	1.66E-13	1.25E-13	-12.781	-12.904	-0.124	0
	Cu2(OH)2+	2.22E-14	7.10E-15	-13.654	-14.149	-0.494	0
	Cu(OH)4-2	2.36E-16	7.57E-17	-15.626	-16.121	-0.494	0
	CuCl3-	1.68E-16	1.23E-16	-15.774	-15.912	-0.138	0
	CuCl4-2	1.60E-19	5.00E-20	-18.796	-19.301	-0.506	0
F	3.20E-04						
	F-	2.15E-04	1.55E-04	-3.667	-3.811	-0.144	-0.95
	MgF+	9.80E-05	7.23E-05	-4.009	-4.141	-0.132	-10.36
	NaF	6.85E-06	7.13E-06	-5.164	-5.147	0.017	7.26
	HF	7.72E-10	8.03E-10	-9.113	-9.095	0.017	12.5
	ZnF+	3.75E-11	2.82E-11	-10.426	-10.55	-0.124	0
	MnF+	2.23E-11	1.67E-11	-10.652	-10.778	-0.126	0
	HF2-	6.33E-13	4.76E-13	-12.199	-12.322	-0.124	22.43
	FeF+	1.99E-13	1.50E-13	-12.702	-12.825	-0.124	0
	CuF+	1.66E-13	1.25E-13	-12.781	-12.904	-0.124	0
	FeF2+	1.86E-16	1.39E-16	-15.73	-15.857	-0.126	0
	FeF+2	7.25E-17	2.26E-17	-16.14	-16.645	-0.506	0
	FeF3	3.27E-17	3.41E-17	-16.485	-16.468	0.017	0
Fe(2)	5.42E-10						
	Fe+2	2.84E-10	9.68E-11	-9.547	-10.014	-0.468	-21.29
	FeCO3	1.36E-10	1.41E-10	-9.867	-9.849	0.017	0
	FeHCO3+	5.80E-11	4.36E-11	-10.237	-10.361	-0.124	0
	FeSO4	3.79E-11	3.94E-11	-10.421	-10.404	0.017	18.97
	FeCl+	1.45E-11	1.09E-11	-10.84	-10.964	-0.124	0
	FeOH+	1.18E-11	8.79E-12	-10.93	-11.056	-0.126	0
	FeF+	1.99E-13	1.50E-13	-12.702	-12.825	-0.124	0
	Fe(OH)2	2.06E-14	2.15E-14	-13.686	-13.668	0.017	0
	Fe(OH)3-	3.06E-16	2.29E-16	-15.514	-15.64	-0.126	0
	FeHSO4+	1.20E-18	8.99E-19	-17.923	-18.046	-0.124	0
Fe(3)	8.10E-07						
	Fe(OH)3	5.79E-07	6.03E-07	-6.238	-6.22	0.017	0
	Fe(OH)4-	2.09E-07	1.58E-07	-6.68	-6.802	-0.122	0
	Fe(OH)2+	2.16E-08	1.63E-08	-7.666	-7.788	-0.122	0
	FeOH+2	5.49E-13	1.71E-13	-12.261	-12.766	-0.506	0
	FeF2+	1.86E-16	1.39E-16	-15.73	-15.857	-0.126	0
	FeF+2	7.25E-17	2.26E-17	-16.14	-16.645	-0.506	0
	FeF3	3.27E-17	3.41E-17	-16.485	-16.468	0.017	0

	FeSO4+	3.11E-18	2.32E-18	-17.508	-17.634	-0.126	0
	FeCl+2	7.27E-19	2.27E-19	-18.138	-18.644	-0.506	0
	Fe+3	6.67E-19	9.24E-20	-18.176	-19.034	-0.858	0
	Fe(SO4)2-	1.55E-19	1.17E-19	-18.81	-18.934	-0.124	0
	FeCl2+	1.10E-19	8.25E-20	-18.957	-19.083	-0.126	0
	FeCl3	6.45E-22	6.71E-22	-21.19	-21.173	0.017	0
	Fe2(OH)2+	7.50E-23	7.90E-25	-22.125	-24.102	-1.978	0
	FeHSO4+2	6.73E-26	2.16E-26	-25.172	-25.666	-0.494	0
	Fe3(OH)4+	3.31E-27	2.69E-30	-26.48	-29.57	-3.09	0
H(0)	1.64E-28						
	H2	8.18E-29	8.51E-29	-28.087	-28.07	0.017	28.61
K	1.53E-03						
	K+	1.51E-03	1.09E-03	-2.822	-2.963	-0.141	9.32
	KSO4-	2.32E-05	1.75E-05	-4.634	-4.756	-0.122	34.47
Mg	2.47E-02						
	Mg+2	2.00E-02	7.09E-03	-1.699	-2.149	-0.451	-20.97
	MgSO4	3.66E-03	3.81E-03	-2.437	-2.419	0.017	5.84
	MgHCO3+	5.13E-04	3.74E-04	-3.29	-3.428	-0.138	5.7
	MgCO3	3.96E-04	4.12E-04	-3.403	-3.385	0.017	-17.09
	MgF+	9.80E-05	7.23E-05	-4.009	-4.141	-0.132	-10.36
	MgOH+	9.58E-06	7.39E-06	-5.019	-5.131	-0.113	0
Mn(2)	1.40E-07						
	MnCO3	7.25E-08	7.55E-08	-7.14	-7.122	0.017	0
	Mn+2	4.58E-08	1.56E-08	-7.34	-7.807	-0.468	-17.67
	MnHCO3+	8.38E-09	6.26E-09	-8.077	-8.203	-0.126	0
	MnCl+	6.91E-09	5.17E-09	-8.16	-8.287	-0.126	-2.89
	MnSO4	6.11E-09	6.36E-09	-8.214	-8.197	0.017	22.54
	MnCl2	1.76E-10	1.84E-10	-9.754	-9.736	0.017	85.89
	MnOH+	1.54E-10	1.15E-10	-9.813	-9.939	-0.126	0
	MnF+	2.23E-11	1.67E-11	-10.652	-10.778	-0.126	0
	MnCl3-	5.50E-12	4.11E-12	-11.259	-11.386	-0.126	44.15
	Mn(NO3)2	5.83E-16	6.07E-16	-15.234	-15.217	0.017	41.04
	Mn(OH)3-	7.83E-18	5.85E-18	-17.106	-17.233	-0.126	0
Mn(3)	3.48E-29						
	Mn+3	3.48E-29	4.82E-30	-28.459	-29.317	-0.858	0
N(-3)	1.70E-05						
	NH4+	1.50E-05	1.04E-05	-4.825	-4.984	-0.159	18.23
	NH3	1.64E-06	1.71E-06	-5.786	-5.768	0.017	24.42
	NH4SO4-	4.07E-07	3.06E-07	-6.39	-6.514	-0.124	38.4
N(5)	1.40E-04						
	NO3-	1.40E-04	9.89E-05	-3.854	-4.005	-0.151	29.87
	Mn(NO3)2	5.83E-16	6.07E-16	-15.234	-15.217	0.017	41.04
Na	1.08E-01						
	Na+	1.06E-01	8.02E-02	-0.973	-1.096	-0.122	-0.97
	NaSO4-	1.22E-03	9.22E-04	-2.913	-3.035	-0.122	17.27
	NaHCO3	1.95E-04	2.03E-04	-3.71	-3.692	0.017	1.8
	NaCO3-	1.21E-04	9.10E-05	-3.917	-4.041	-0.124	0.15
	NaF	6.85E-06	7.13E-06	-5.164	-5.147	0.017	7.26
	NaOH	2.24E-17	2.33E-17	-16.65	-16.632	0.017	0
O(0)	1.10E-36						

	O2	5.48E-37	5.70E-37	-36.261	-36.244	0.017	30.4
S(6)	1.27E-02						
	SO4-2	7.46E-03	2.29E-03	-2.127	-2.64	-0.513	15.97
	MgSO4	3.66E-03	3.81E-03	-2.437	-2.419	0.017	5.84
	NaSO4-	1.22E-03	9.22E-04	-2.913	-3.035	-0.122	17.27
	CaSO4	3.36E-04	3.50E-04	-3.473	-3.456	0.017	7.5
	KSO4-	2.32E-05	1.75E-05	-4.634	-4.756	-0.122	34.47
	NH4SO4-	4.07E-07	3.06E-07	-6.39	-6.514	-0.124	38.4
	BaSO4	3.68E-07	3.83E-07	-6.434	-6.417	0.017	0
	ZnSO4	6.67E-09	6.94E-09	-8.176	-8.158	0.017	21.71
	MnSO4	6.11E-09	6.36E-09	-8.214	-8.197	0.017	22.54
	HSO4-	1.03E-09	7.73E-10	-8.988	-9.112	-0.124	40.63
	Zn(SO4)2-2	4.04E-10	1.29E-10	-9.394	-9.888	-0.494	-10.38
	FeSO4	3.79E-11	3.94E-11	-10.421	-10.404	0.017	18.97
	CuSO4	1.99E-11	2.08E-11	-10.7	-10.683	0.017	13.09
	CaHSO4+	1.06E-11	7.98E-12	-10.974	-11.098	-0.124	0
	FeSO4+	3.11E-18	2.32E-18	-17.508	-17.634	-0.126	0
	FeHSO4+	1.20E-18	8.99E-19	-17.923	-18.046	-0.124	0
	Fe(SO4)2-	1.55E-19	1.17E-19	-18.81	-18.934	-0.124	0
	FeHSO4+2	6.73E-26	2.16E-26	-25.172	-25.666	-0.494	0
Zn	8.80E-07						
	Zn(CO3)2-2	6.39E-07	2.05E-07	-6.195	-6.689	-0.494	0
	ZnCO3	1.51E-07	1.57E-07	-6.821	-6.804	0.017	0
	Zn+2	4.14E-08	1.29E-08	-7.383	-7.889	-0.506	-24.53
	Zn(OH)2	1.29E-08	1.34E-08	-7.89	-7.872	0.017	0
	ZnHCO3+	9.74E-09	7.33E-09	-8.011	-8.135	-0.124	0
	ZnOHCl	9.60E-09	1.00E-08	-8.018	-8	0.017	0
	ZnSO4	6.67E-09	6.94E-09	-8.176	-8.158	0.017	21.71
	ZnOH+	5.41E-09	4.07E-09	-8.267	-8.391	-0.124	0
	ZnCl+	3.89E-09	2.83E-09	-8.411	-8.548	-0.138	-14.29
	Zn(SO4)2-2	4.04E-10	1.29E-10	-9.394	-9.888	-0.494	-10.38
	ZnCl2	2.32E-10	2.41E-10	-9.635	-9.618	0.017	102.03
	ZnF+	3.75E-11	2.82E-11	-10.426	-10.55	-0.124	0
	ZnCl3-	3.02E-11	2.20E-11	-10.52	-10.657	-0.138	16
	Zn(OH)3-	1.62E-11	1.22E-11	-10.791	-10.914	-0.124	0
	ZnCl4-2	2.87E-12	8.97E-13	-11.541	-12.047	-0.506	147.18
	Zn(OH)4-2	1.73E-15	5.54E-16	-14.762	-15.256	-0.494	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-1.43	-5.71	-4.28	CaSO4			
Aragonite	1.05	-7.28	-8.34	CaCO3			
Barite	0.73	-9.12	-9.84	BaSO4			
Calcite	1.2	-7.28	-8.48	CaCO3			
CO2(g)	-2.98	-4.45	-1.47	CO2			
Dolomite	3.44	-13.65	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.45	6.34	4.89	Fe(OH)3			
Fluorite	-0.09	-10.69	-10.6	CaF2			

Goethite	7.34	6.34	-1	FeOOH
Gypsum	-1.13	-5.71	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-3.76	-2.19	1.57	NaCl
Hausmann	-8.78	52.25	61.03	Mn3O4
Hematite	16.69	12.69	-4.01	Fe2O3
Jarosite-K	-5.39	-14.6	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.77	21.57	25.34	MnOOH
Melanterit	-10.46	-12.67	-2.21	FeSO4:7H2O
NH3(g)	-7.56	-5.77	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.09	9.11	15.2	Mn(OH)2
Pyrolusite	-7.35	34.03	41.38	MnO2:H2O
Rhodochrc	-0.89	-12.02	-11.13	MnCO3
Siderite	-3.34	-14.23	-10.89	FeCO3
Smithsonit	-2.1	-12.1	-10	ZnCO3
Sylvite	-4.95	-4.05	0.9	KCl
Witherite	-2.13	-10.69	-8.56	BaCO3
Zn(OH)2(e	-2.47	9.03	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 11

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	9.18E-03	9.18E-03
Ba	1.66E-06	1.66E-06
Ca	3.36E-03	3.36E-03
Cl	1.23E-01	1.23E-01
Cu	1.10E-07	1.10E-07
F	3.50E-04	3.50E-04
Fe	8.90E-07	8.90E-07
K	1.69E-03	1.69E-03
Mg	2.72E-02	2.72E-02
Mn	1.50E-07	1.50E-07
N(-3)	1.80E-05	1.80E-05
N(5)	1.60E-04	1.60E-04
Na	1.19E-01	1.19E-01
S(6)	1.40E-02	1.40E-02
Zn	9.70E-07	9.70E-07

#NAME? of solution----------

pH = 8.46
pe = 4

```
Specific    Conductan (µS/cm,    25°C)      =              15344
Density     (g/cm³)   =          1.00482
Volume      (L)       =          1.00499
Activity    of        water      =              0.995
Ionic       strength  (mol/kgw)  =          1.92E-01
Mass        of        water      (kg)       =          1.00E+00
Total       carbon    (mol/kg)   =          8.29E-03
Total       CO2       (mol/kg)   =          8.29E-03
Temperatu   (°C)      =                 25
Electrical  balance   (eq)       =          2.04E-02
Percent     error,    100*(Cat-| =              6.45
Iterations  =                12 (101       overall)
Total       H         =          1.11E+02
Total       O         =          5.56E+01

#NAME?  couples--------------------------------

        Redox     couple    pe        Eh        (volts)

        N(-3)/N(5)    4.437    0.2625

#NAME?  of        species----------------------------

        Log       Log       Log       mole      V
        Species   Molality  Activity  Molality  Activity  Gamma   cm³/mol

        OH-       4.09E-06  2.91E-06  -5.388    -5.537    -0.148  -3.52
        H+        4.34E-09  3.47E-09  -8.363    -8.46     -0.097  0
        H2O       5.55E+01  9.95E-01  1.744     -0.002    0       18.07
Ba        1.66E-06
        Ba+2      1.22E-06  3.54E-07  -5.914    -6.451    -0.538  -11.74
        BaSO4     4.07E-07  4.25E-07  -6.39     -6.371    0.019   0
        BaHCO3+   2.19E-08  1.64E-08  -7.659    -7.785    -0.126  0
        BaCO3     1.14E-08  1.20E-08  -7.942    -7.923    0.019   -10.7
        BaOH+     4.64E-12  3.44E-12  -11.334   -11.463   -0.13   0
C(4)      8.29E-03
        HCO3-     6.46E-03  4.84E-03  -2.19     -2.316    -0.126  25.51
        MgHCO3+   5.95E-04  4.29E-04  -3.226    -3.367    -0.142  5.71
        MgCO3     4.53E-04  4.74E-04  -3.344    -3.325    0.019   -17.09
        NaHCO3    2.28E-04  2.38E-04  -3.642    -3.623    0.019   1.8
        CO3-2     2.08E-04  6.54E-05  -3.682    -4.184    -0.503  -3.65
        NaCO3-    1.43E-04  1.07E-04  -3.846    -3.972    -0.126  0.25
        CaCO3     9.62E-05  1.01E-04  -4.017    -3.997    0.019   -14.6
        CaHCO3+   7.44E-05  5.65E-05  -4.128    -4.248    -0.12   9.88
        CO2       3.63E-05  3.79E-05  -4.441    -4.422    0.019   34.43
        Zn(CO3)2-:7.24E-07  2.27E-07  -6.14     -6.644    -0.504  0
        ZnCO3     1.55E-07  1.62E-07  -6.809    -6.79     0.019   0
        MnCO3     7.86E-08  8.21E-08  -7.105    -7.086    0.019   0
        BaHCO3+   2.19E-08  1.64E-08  -7.659    -7.785    -0.126  0
        CuCO3     1.59E-08  1.66E-08  -7.799    -7.78     0.019   0
```

	BaCO3	1.14E-08	1.20E-08	-7.942	-7.923	0.019	-10.7
	ZnHCO3+	1.01E-08	7.57E-09	-7.995	-8.121	-0.126	0
	MnHCO3+	9.19E-09	6.81E-09	-8.037	-8.167	-0.13	0
	Cu(CO3)2-	4.36E-09	1.37E-09	-8.361	-8.864	-0.504	0
	FeCO3	1.60E-10	1.67E-10	-9.796	-9.777	0.019	0
	CuHCO3+	1.53E-10	1.15E-10	-9.815	-9.941	-0.126	0
	FeHCO3+	6.89E-11	5.15E-11	-10.162	-10.288	-0.126	0
	(CO2)2	2.52E-11	2.63E-11	-10.599	-10.579	0.019	68.87
Ca	3.36E-03						
	Ca+2	2.82E-03	9.16E-04	-2.55	-3.038	-0.488	-17.23
	CaSO4	3.74E-04	3.91E-04	-3.427	-3.408	0.019	7.5
	CaCO3	9.62E-05	1.01E-04	-4.017	-3.997	0.019	-14.6
	CaHCO3+	7.44E-05	5.65E-05	-4.128	-4.248	-0.12	9.88
	CaOH+	5.83E-08	4.36E-08	-7.234	-7.36	-0.126	0
	CaHSO4+	1.19E-11	8.90E-12	-10.924	-11.05	-0.126	0
Cl	1.23E-01						
	Cl-	1.23E-01	8.86E-02	-0.909	-1.052	-0.143	18.45
	ZnOHCl	1.00E-08	1.05E-08	-7.999	-7.98	0.019	0
	CuCl2-	8.54E-09	6.16E-09	-8.068	-8.21	-0.142	0
	MnCl+	7.70E-09	5.71E-09	-8.114	-8.243	-0.13	-2.88
	ZnCl+	4.11E-09	2.97E-09	-8.386	-8.527	-0.142	-14.35
	CuCl3-2	2.86E-09	8.66E-10	-8.543	-9.063	-0.519	0
	ZnCl2	2.64E-10	2.76E-10	-9.579	-9.56	0.019	102.03
	MnCl2	2.11E-10	2.21E-10	-9.675	-9.656	0.019	85.89
	ZnCl3-	3.80E-11	2.74E-11	-10.42	-10.562	-0.142	15.88
	FeCl+	1.74E-11	1.30E-11	-10.759	-10.885	-0.126	0
	CuCl+	1.56E-11	1.13E-11	-10.806	-10.948	-0.142	1.12
	MnCl3-	7.27E-12	5.39E-12	-11.138	-11.268	-0.13	44.21
	ZnCl4-2	4.03E-12	1.22E-12	-11.395	-11.914	-0.519	147.31
	CuCl2	5.14E-13	5.37E-13	-12.289	-12.27	0.019	31.02
	CuCl3-	2.34E-16	1.69E-16	-15.631	-15.773	-0.142	0
	FeCl+2	9.01E-19	2.72E-19	-18.045	-18.565	-0.519	0
	CuCl4-2	2.48E-19	7.50E-20	-18.605	-19.125	-0.519	0
	FeCl2+	1.46E-19	1.08E-19	-18.837	-18.967	-0.13	0
	FeCl3	9.15E-22	9.56E-22	-21.039	-21.019	0.019	0
Cu(1)	1.14E-08						
	CuCl2-	8.54E-09	6.16E-09	-8.068	-8.21	-0.142	0
	CuCl3-2	2.86E-09	8.66E-10	-8.543	-9.063	-0.519	0
	Cu+	3.62E-12	2.48E-12	-11.441	-11.605	-0.164	0
Cu(2)	9.86E-08						
	Cu(OH)2	7.78E-08	8.13E-08	-7.109	-7.09	0.019	0
	CuCO3	1.59E-08	1.66E-08	-7.799	-7.78	0.019	0
	Cu(CO3)2-	4.36E-09	1.37E-09	-8.361	-8.864	-0.504	0
	CuOH+	1.88E-10	1.36E-10	-9.726	-9.868	-0.142	0
	CuHCO3+	1.53E-10	1.15E-10	-9.815	-9.941	-0.126	0
	Cu+2	1.43E-10	4.73E-11	-9.846	-10.325	-0.479	-25.77
	CuSO4	2.22E-11	2.32E-11	-10.654	-10.635	0.019	13.09
	CuCl+	1.56E-11	1.13E-11	-10.806	-10.948	-0.142	1.12
	Cu(OH)3-	1.88E-12	1.41E-12	-11.726	-11.852	-0.126	0
	CuCl2	5.14E-13	5.37E-13	-12.289	-12.27	0.019	31.02

	CuF+	1.88E-13	1.41E-13	-12.726	-12.852	-0.126	0
	Cu2(OH)2+	2.57E-14	8.05E-15	-13.59	-14.094	-0.504	0
	Cu(OH)4-2	2.57E-16	8.05E-17	-15.59	-16.094	-0.504	0
	CuCl3-	2.34E-16	1.69E-16	-15.631	-15.773	-0.142	0
	CuCl4-2	2.48E-19	7.50E-20	-18.605	-19.125	-0.519	0
F	3.50E-04						
	F-	2.30E-04	1.64E-04	-3.638	-3.787	-0.148	-0.93
	MgF+	1.12E-04	8.20E-05	-3.951	-4.086	-0.136	-10.35
	NaF	7.89E-06	8.25E-06	-5.103	-5.084	0.019	7.26
	HF	8.14E-10	8.50E-10	-9.09	-9.07	0.019	12.5
	ZnF+	3.84E-11	2.87E-11	-10.416	-10.542	-0.126	0
	MnF+	2.41E-11	1.79E-11	-10.618	-10.748	-0.13	0
	HF2-	7.13E-13	5.33E-13	-12.147	-12.273	-0.126	22.44
	FeF+	2.33E-13	1.74E-13	-12.633	-12.759	-0.126	0
	CuF+	1.88E-13	1.41E-13	-12.726	-12.852	-0.126	0
	FeF2+	2.31E-16	1.72E-16	-15.636	-15.765	-0.13	0
	FeF+2	8.72E-17	2.64E-17	-16.059	-16.579	-0.519	0
	FeF3	4.26E-17	4.45E-17	-16.371	-16.352	0.019	0
Fe(2)	6.24E-10						
	Fe+2	3.21E-10	1.07E-10	-9.493	-9.972	-0.479	-21.26
	FeCO3	1.60E-10	1.67E-10	-9.796	-9.777	0.019	0
	FeHCO3+	6.89E-11	5.15E-11	-10.162	-10.288	-0.126	0
	FeSO4	4.35E-11	4.55E-11	-10.361	-10.342	0.019	18.97
	FeCl+	1.74E-11	1.30E-11	-10.759	-10.885	-0.126	0
	FeOH+	1.30E-11	9.67E-12	-10.885	-11.015	-0.13	0
	FeF+	2.33E-13	1.74E-13	-12.633	-12.759	-0.126	0
	Fe(OH)2	2.26E-14	2.36E-14	-13.646	-13.627	0.019	0
	Fe(OH)3-	3.40E-16	2.52E-16	-15.469	-15.599	-0.13	0
	FeHSO4+	1.39E-18	1.04E-18	-17.859	-17.985	-0.126	0
Fe(3)	8.89E-07						
	Fe(OH)3	6.34E-07	6.63E-07	-6.198	-6.179	0.019	0
	Fe(OH)4-	2.32E-07	1.73E-07	-6.635	-6.761	-0.126	0
	Fe(OH)2+	2.39E-08	1.79E-08	-7.621	-7.747	-0.126	0
	FeOH+2	6.24E-13	1.89E-13	-12.205	-12.725	-0.519	0
	FeF2+	2.31E-16	1.72E-16	-15.636	-15.765	-0.13	0
	FeF+2	8.72E-17	2.64E-17	-16.059	-16.579	-0.519	0
	FeF3	4.26E-17	4.45E-17	-16.371	-16.352	0.019	0
	FeSO4+	3.61E-18	2.68E-18	-17.442	-17.572	-0.13	0
	FeCl+2	9.01E-19	2.72E-19	-18.045	-18.565	-0.519	0
	Fe+3	7.65E-19	1.02E-19	-18.117	-18.992	-0.876	0
	Fe(SO4)2-	1.88E-19	1.41E-19	-18.726	-18.852	-0.126	0
	FeCl2+	1.46E-19	1.08E-19	-18.837	-18.967	-0.13	0
	FeCl3	9.15E-22	9.56E-22	-21.039	-21.019	0.019	0
	Fe2(OH)2+	9.91E-23	9.57E-25	-22.004	-24.019	-2.015	0
	FeHSO4+2	7.93E-26	2.49E-26	-25.101	-25.605	-0.504	0
	Fe3(OH)4+	5.05E-27	3.58E-30	-26.297	-29.446	-3.149	0
H(0)	1.63E-28						
	H2	8.14E-29	8.51E-29	-28.089	-28.07	0.019	28.61
K	1.69E-03						
	K+	1.66E-03	1.19E-03	-2.779	-2.925	-0.146	9.34

	KSO4-	2.68E-05	2.01E-05	-4.572	-4.698	-0.126	34.49
Mg	2.72E-02						
	Mg+2	2.19E-02	7.59E-03	-1.66	-2.12	-0.46	-20.94
	MgSO4	4.08E-03	4.27E-03	-2.389	-2.37	0.019	5.84
	MgHCO3+	5.95E-04	4.29E-04	-3.226	-3.367	-0.142	5.71
	MgCO3	4.53E-04	4.74E-04	-3.344	-3.325	0.019	-17.09
	MgF+	1.12E-04	8.20E-05	-3.951	-4.086	-0.136	-10.35
	MgOH+	1.03E-05	7.91E-06	-4.987	-5.102	-0.115	0
Mn(2)	1.50E-07						
	MnCO3	7.86E-08	8.21E-08	-7.105	-7.086	0.019	0
	Mn+2	4.77E-08	1.58E-08	-7.322	-7.801	-0.479	-17.58
	MnHCO3+	9.19E-09	6.81E-09	-8.037	-8.167	-0.13	0
	MnCl+	7.70E-09	5.71E-09	-8.114	-8.243	-0.13	-2.88
	MnSO4	6.46E-09	6.75E-09	-8.19	-8.171	0.019	22.54
	MnCl2	2.11E-10	2.21E-10	-9.675	-9.656	0.019	85.89
	MnOH+	1.57E-10	1.17E-10	-9.803	-9.933	-0.13	0
	MnF+	2.41E-11	1.79E-11	-10.618	-10.748	-0.13	0
	MnCl3-	7.27E-12	5.39E-12	-11.138	-11.268	-0.13	44.21
	Mn(NO3)2	7.52E-16	7.86E-16	-15.124	-15.105	0.019	41.04
	Mn(OH)3-	7.99E-18	5.92E-18	-17.098	-17.227	-0.13	0
Mn(3)	3.67E-29						
	Mn+3	3.67E-29	4.89E-30	-28.435	-29.311	-0.876	0
N(-3)	1.80E-05						
	NH4+	1.58E-05	1.09E-05	-4.8	-4.964	-0.164	18.24
	NH3	1.71E-06	1.78E-06	-5.768	-5.749	0.019	24.42
	NH4SO4-	4.49E-07	3.36E-07	-6.348	-6.474	-0.126	38.46
N(5)	1.60E-04						
	NO3-	1.60E-04	1.12E-04	-3.796	-3.952	-0.156	29.89
	Mn(NO3)2	7.52E-16	7.86E-16	-15.124	-15.105	0.019	41.04
Na	1.19E-01						
	Na+	1.17E-01	8.77E-02	-0.932	-1.057	-0.125	-0.94
	NaSO4-	1.41E-03	1.05E-03	-2.851	-2.977	-0.126	17.46
	NaHCO3	2.28E-04	2.38E-04	-3.642	-3.623	0.019	1.8
	NaCO3-	1.43E-04	1.07E-04	-3.846	-3.972	-0.126	0.25
	NaF	7.89E-06	8.25E-06	-5.103	-5.084	0.019	7.26
	NaOH	2.44E-17	2.55E-17	-16.613	-16.594	0.019	0
O(0)	1.09E-36						
	O2	5.45E-37	5.70E-37	-36.263	-36.244	0.019	30.4
S(6)	1.40E-02						
	SO4-2	8.08E-03	2.40E-03	-2.093	-2.62	-0.527	16.05
	MgSO4	4.08E-03	4.27E-03	-2.389	-2.37	0.019	5.84
	NaSO4-	1.41E-03	1.05E-03	-2.851	-2.977	-0.126	17.46
	CaSO4	3.74E-04	3.91E-04	-3.427	-3.408	0.019	7.5
	KSO4-	2.68E-05	2.01E-05	-4.572	-4.698	-0.126	34.49
	NH4SO4-	4.49E-07	3.36E-07	-6.348	-6.474	-0.126	38.46
	BaSO4	4.07E-07	4.25E-07	-6.39	-6.371	0.019	0
	ZnSO4	6.70E-09	7.00E-09	-8.174	-8.155	0.019	21.71
	MnSO4	6.46E-09	6.75E-09	-8.19	-8.171	0.019	22.54
	HSO4-	1.08E-09	8.09E-10	-8.966	-9.092	-0.126	40.64
	Zn(SO4)2-2	4.36E-10	1.37E-10	-9.361	-9.865	-0.504	-10.18

	FeSO4	4.35E-11	4.55E-11	-10.361	-10.342	0.019	18.97
	CuSO4	2.22E-11	2.32E-11	-10.654	-10.635	0.019	13.09
	CaHSO4+	1.19E-11	8.90E-12	-10.924	-11.05	-0.126	0
	FeSO4+	3.61E-18	2.68E-18	-17.442	-17.572	-0.13	0
	FeHSO4+	1.39E-18	1.04E-18	-17.859	-17.985	-0.126	0
	Fe(SO4)2-	1.88E-19	1.41E-19	-18.726	-18.852	-0.126	0
	FeHSO4+2	7.93E-26	2.49E-26	-25.101	-25.605	-0.504	0
Zn	9.70E-07						
	Zn(CO3)2-2	7.24E-07	2.27E-07	-6.14	-6.644	-0.504	0
	ZnCO3	1.55E-07	1.62E-07	-6.809	-6.79	0.019	0
	Zn+2	4.12E-08	1.24E-08	-7.386	-7.905	-0.519	-24.5
	Zn(OH)2	1.23E-08	1.29E-08	-7.909	-7.889	0.019	0
	ZnHCO3+	1.01E-08	7.57E-09	-7.995	-8.121	-0.126	0
	ZnOHCl	1.00E-08	1.05E-08	-7.999	-7.98	0.019	0
	ZnSO4	6.70E-09	7.00E-09	-8.174	-8.155	0.019	21.71
	ZnOH+	5.23E-09	3.92E-09	-8.281	-8.407	-0.126	0
	ZnCl+	4.11E-09	2.97E-09	-8.386	-8.527	-0.142	-14.35
	Zn(SO4)2-2	4.36E-10	1.37E-10	-9.361	-9.865	-0.504	-10.18
	ZnCl2	2.64E-10	2.76E-10	-9.579	-9.56	0.019	102.03
	ZnF+	3.84E-11	2.87E-11	-10.416	-10.542	-0.126	0
	ZnCl3-	3.80E-11	2.74E-11	-10.42	-10.562	-0.142	15.88
	Zn(OH)3-	1.57E-11	1.17E-11	-10.806	-10.932	-0.126	0
	ZnCl4-2	4.03E-12	1.22E-12	-11.395	-11.914	-0.519	147.31
	Zn(OH)4-2	1.70E-15	5.33E-16	-14.77	-15.274	-0.504	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-1.38	-5.66	-4.28	CaSO4			
Aragonite	1.11	-7.22	-8.34	CaCO3			
Barite	0.77	-9.07	-9.84	BaSO4			
Calcite	1.26	-7.22	-8.48	CaCO3			
CO2(g)	-2.95	-4.42	-1.47	CO2			
Dolomite	3.56	-13.53	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.49	6.38	4.89	Fe(OH)3			
Fluorite	-0.01	-10.61	-10.6	CaF2			
Goethite	7.38	6.38	-1	FeOOH			
Gypsum	-1.08	-5.66	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-3.68	-2.11	1.57	NaCl			
Hausmann	-8.76	52.27	61.03	Mn3O4			
Hematite	16.78	12.77	-4.01	Fe2O3			
Jarosite-K	-5.18	-14.39	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.77	21.57	25.34	MnOOH			
Melanterit	-10.4	-12.61	-2.21	FeSO4:7H2O			
NH3(g)	-7.54	-5.75	1.8	NH3			
O2(g)	-33.35	-36.24	-2.89	O2			
Pyrochroit	-6.09	9.11	15.2	Mn(OH)2			

Pyrolusite	-7.35	34.03	41.38	MnO2:H2O
Rhodochrc	-0.86	-11.99	-11.13	MnCO3
Siderite	-3.27	-14.16	-10.89	FeCO3
Smithsonit	-2.09	-12.09	-10	ZnCO3
Sylvite	-4.88	-3.98	0.9	KCl
Witherite	-2.07	-10.64	-8.56	BaCO3
Zn(OH)2(e	-2.49	9.01	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 12

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.00E-02	1.00E-02
Ba	1.81E-06	1.81E-06
Ca	3.67E-03	3.67E-03
Cl	1.35E-01	1.35E-01
Cu	1.20E-07	1.20E-07
F	3.80E-04	3.80E-04
Fe	9.70E-07	9.70E-07
K	1.84E-03	1.84E-03
Mg	2.96E-02	2.96E-02
Mn	1.60E-07	1.60E-07
N(-3)	2.00E-05	2.00E-05
N(5)	1.70E-04	1.70E-04
Na	1.29E-01	1.29E-01
S(6)	1.52E-02	1.52E-02
Zn	1.06E-06	1.06E-06

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 16585
Density (g/cm³) = 1.00551
Volume (L) = 1.00518
Activity of water = 0.995
Ionic strength (mol/kgw) = 2.08E-01
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 9.01E-03
Total CO2 (mol/kg) = 9.01E-03
Temperatu (°C) = 25
Electrical balance (eq) = 2.23E-02
Percent error, 100*(Cat-| = 6.46
Iterations = 12 (113 overall)
Total H = 1.11E+02

Total O = 5.56E+01

#NAME? couples----------

Redox couple pe Eh (volts)

N(-3)/N(5) 4.4347 0.2623

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.13E-06	2.90E-06	-5.384	-5.537	-0.153	-3.48
	H+	4.36E-09	3.47E-09	-8.361	-8.46	-0.099	0
	H2O	5.55E+01	9.95E-01	1.744	-0.002	0	18.07
Ba	1.81E-06						
	Ba+2	1.33E-06	3.74E-07	-5.877	-6.428	-0.55	-11.71
	BaSO4	4.46E-07	4.68E-07	-6.351	-6.33	0.021	0
	BaHCO3+	2.48E-08	1.85E-08	-7.606	-7.734	-0.128	0
	BaCO3	1.28E-08	1.35E-08	-7.892	-7.871	0.021	-10.7
	BaOH+	4.93E-12	3.63E-12	-11.307	-11.44	-0.133	0
C(4)	9.01E-03						
	HCO3-	6.93E-03	5.15E-03	-2.159	-2.288	-0.129	25.56
	MgHCO3+	6.81E-04	4.87E-04	-3.167	-3.312	-0.146	5.72
	MgCO3	5.12E-04	5.37E-04	-3.291	-3.27	0.021	-17.09
	NaHCO3	2.63E-04	2.75E-04	-3.581	-3.56	0.021	1.8
	CO3-2	2.28E-04	6.97E-05	-3.642	-4.157	-0.515	-3.57
	NaCO3-	1.66E-04	1.23E-04	-3.781	-3.909	-0.128	0.35
	CaCO3	1.09E-04	1.14E-04	-3.964	-3.943	0.021	-14.6
	CaHCO3+	8.49E-05	6.40E-05	-4.071	-4.194	-0.123	9.88
	CO2	3.85E-05	4.04E-05	-4.415	-4.394	0.021	34.43
	Zn(CO3)2-2	8.10E-07	2.49E-07	-6.092	-6.603	-0.512	0
	ZnCO3	1.59E-07	1.67E-07	-6.798	-6.777	0.021	0
	MnCO3	8.46E-08	8.88E-08	-7.072	-7.052	0.021	0
	BaHCO3+	2.48E-08	1.85E-08	-7.606	-7.734	-0.128	0
	CuCO3	1.78E-08	1.87E-08	-7.75	-7.729	0.021	0
	BaCO3	1.28E-08	1.35E-08	-7.892	-7.871	0.021	-10.7
	ZnHCO3+	1.05E-08	7.80E-09	-7.98	-8.108	-0.128	0
	MnHCO3+	1.00E-08	7.37E-09	-8	-8.133	-0.133	0
	Cu(CO3)2-	5.32E-09	1.64E-09	-8.274	-8.786	-0.512	0
	FeCO3	1.86E-10	1.95E-10	-9.732	-9.711	0.021	0
	CuHCO3+	1.73E-10	1.29E-10	-9.762	-9.89	-0.128	0
	FeHCO3+	8.05E-11	6.00E-11	-10.094	-10.222	-0.128	0
	(CO2)2	2.85E-11	3.00E-11	-10.545	-10.524	0.021	68.87
Ca	3.67E-03						
	Ca+2	3.06E-03	9.74E-04	-2.514	-3.012	-0.498	-17.2
	CaSO4	4.13E-04	4.33E-04	-3.384	-3.364	0.021	7.5
	CaCO3	1.09E-04	1.14E-04	-3.964	-3.943	0.021	-14.6
	CaHCO3+	8.49E-05	6.40E-05	-4.071	-4.194	-0.123	9.88

	CaOH+	6.22E-08	4.64E-08	-7.206	-7.334	-0.128	0
	CaHSO4+	1.33E-11	9.87E-12	-10.878	-11.006	-0.128	0
Cl	1.35E-01						
	Cl-	1.35E-01	9.59E-02	-0.871	-1.018	-0.147	18.47
	CuCl2-	1.06E-08	7.61E-09	-7.973	-8.119	-0.146	0
	ZnOHCl	1.04E-08	1.10E-08	-7.981	-7.961	0.021	0
	MnCl+	8.51E-09	6.26E-09	-8.07	-8.203	-0.133	-2.87
	ZnCl+	4.34E-09	3.10E-09	-8.363	-8.508	-0.146	-14.4
	CuCl3-2	3.94E-09	1.16E-09	-8.405	-8.937	-0.532	0
	ZnCl2	2.97E-10	3.11E-10	-9.528	-9.507	0.021	102.03
	MnCl2	2.50E-10	2.62E-10	-9.602	-9.582	0.021	85.89
	ZnCl3-	4.68E-11	3.35E-11	-10.33	-10.475	-0.146	15.77
	FeCl+	2.07E-11	1.54E-11	-10.684	-10.812	-0.128	0
	CuCl+	1.80E-11	1.29E-11	-10.745	-10.89	-0.146	1.15
	MnCl3-	9.40E-12	6.92E-12	-11.027	-11.16	-0.133	44.27
	ZnCl4-2	5.48E-12	1.61E-12	-11.261	-11.793	-0.532	147.44
	CuCl2	6.31E-13	6.63E-13	-12.2	-12.179	0.021	31.02
	CuCl3-	3.15E-16	2.25E-16	-15.502	-15.647	-0.146	0
	FeCl+2	1.10E-18	3.22E-19	-17.96	-18.492	-0.532	0
	CuCl4-2	3.69E-19	1.08E-19	-18.433	-18.966	-0.532	0
	FeCl2+	1.87E-19	1.38E-19	-18.728	-18.861	-0.133	0
	FeCl3	1.26E-21	1.32E-21	-20.9	-20.879	0.021	0
Cu(1)	1.46E-08						
	CuCl2-	1.06E-08	7.61E-09	-7.973	-8.119	-0.146	0
	CuCl3-2	3.94E-09	1.16E-09	-8.405	-8.937	-0.532	0
	Cu+	3.87E-12	2.62E-12	-11.413	-11.582	-0.169	0
Cu(2)	1.05E-07						
	Cu(OH)2	8.17E-08	8.58E-08	-7.088	-7.067	0.021	0
	CuCO3	1.78E-08	1.87E-08	-7.75	-7.729	0.021	0
	Cu(CO3)2-	5.32E-09	1.64E-09	-8.274	-8.786	-0.512	0
	CuOH+	2.00E-10	1.43E-10	-9.699	-9.844	-0.146	0
	CuHCO3+	1.73E-10	1.29E-10	-9.762	-9.89	-0.128	0
	Cu+2	1.54E-10	4.99E-11	-9.812	-10.302	-0.49	-25.74
	CuSO4	2.43E-11	2.55E-11	-10.615	-10.594	0.021	13.09
	CuCl+	1.80E-11	1.29E-11	-10.745	-10.89	-0.146	1.15
	Cu(OH)3-	1.99E-12	1.48E-12	-11.701	-11.829	-0.128	0
	CuCl2	6.31E-13	6.63E-13	-12.2	-12.179	0.021	31.02
	CuF+	2.10E-13	1.56E-13	-12.678	-12.806	-0.128	0
	Cu2(OH)2+	2.91E-14	8.96E-15	-13.536	-14.048	-0.512	0
	CuCl3-	3.15E-16	2.25E-16	-15.502	-15.647	-0.146	0
	Cu(OH)4-2	2.76E-16	8.48E-17	-15.56	-16.071	-0.512	0
	CuCl4-2	3.69E-19	1.08E-19	-18.433	-18.966	-0.532	0
F	3.80E-04						
	F-	2.45E-04	1.72E-04	-3.612	-3.764	-0.153	-0.92
	MgF+	1.27E-04	9.19E-05	-3.898	-4.037	-0.139	-10.34
	NaF	8.97E-06	9.41E-06	-5.047	-5.027	0.021	7.26
	HF	8.53E-10	8.95E-10	-9.069	-9.048	0.021	12.5
	ZnF+	3.92E-11	2.92E-11	-10.406	-10.534	-0.128	0
	MnF+	2.59E-11	1.91E-11	-10.586	-10.719	-0.133	0
	HF2-	7.93E-13	5.91E-13	-12.101	-12.229	-0.128	22.46

	FeF+	2.69E-13	2.00E-13	-12.57	-12.698	-0.128	0
	CuF+	2.10E-13	1.56E-13	-12.678	-12.806	-0.128	0
	FeF2+	2.82E-16	2.08E-16	-15.55	-15.683	-0.133	0
	FeF+2	1.03E-16	3.03E-17	-15.986	-16.518	-0.532	0
	FeF3	5.40E-17	5.66E-17	-16.268	-16.247	0.021	0
Fe(2)	7.11E-10						
	Fe+2	3.60E-10	1.16E-10	-9.444	-9.934	-0.49	-21.23
	FeCO3	1.86E-10	1.95E-10	-9.732	-9.711	0.021	0
	FeHCO3+	8.05E-11	6.00E-11	-10.094	-10.222	-0.128	0
	FeSO4	4.93E-11	5.18E-11	-10.307	-10.286	0.021	18.97
	FeCl+	2.07E-11	1.54E-11	-10.684	-10.812	-0.128	0
	FeOH+	1.43E-11	1.06E-11	-10.843	-10.976	-0.133	0
	FeF+	2.69E-13	2.00E-13	-12.57	-12.698	-0.128	0
	Fe(OH)2	2.46E-14	2.58E-14	-13.61	-13.589	0.021	0
	Fe(OH)3-	3.73E-16	2.75E-16	-15.428	-15.561	-0.133	0
	FeHSO4+	1.58E-18	1.18E-18	-17.8	-17.928	-0.128	0
Fe(3)	9.69E-07						
	Fe(OH)3	6.89E-07	7.23E-07	-6.162	-6.141	0.021	0
	Fe(OH)4-	2.54E-07	1.89E-07	-6.595	-6.723	-0.129	0
	Fe(OH)2+	2.63E-08	1.96E-08	-7.58	-7.709	-0.129	0
	FeOH+2	7.01E-13	2.06E-13	-12.154	-12.686	-0.532	0
	FeF2+	2.82E-16	2.08E-16	-15.55	-15.683	-0.133	0
	FeF+2	1.03E-16	3.03E-17	-15.986	-16.518	-0.532	0
	FeF3	5.40E-17	5.66E-17	-16.268	-16.247	0.021	0
	FeSO4+	4.14E-18	3.05E-18	-17.383	-17.516	-0.133	0
	FeCl+2	1.10E-18	3.22E-19	-17.96	-18.492	-0.532	0
	Fe+3	8.67E-19	1.11E-19	-18.062	-18.954	-0.892	0
	Fe(SO4)2-	2.24E-19	1.67E-19	-18.65	-18.778	-0.128	0
	FeCl2+	1.87E-19	1.38E-19	-18.728	-18.861	-0.133	0
	FeCl3	1.26E-21	1.32E-21	-20.9	-20.879	0.021	0
	Fe2(OH)2+	1.27E-22	1.14E-24	-21.895	-23.943	-2.048	0
	FeHSO4+2	9.20E-26	2.83E-26	-25.036	-25.548	-0.512	0
	Fe3(OH)4+	7.37E-27	4.66E-30	-26.132	-29.332	-3.199	0
H(0)	1.62E-28						
	H2	8.11E-29	8.51E-29	-28.091	-28.07	0.021	28.61
K	1.84E-03						
	K+	1.81E-03	1.28E-03	-2.742	-2.892	-0.15	9.35
	KSO4-	3.03E-05	2.25E-05	-4.519	-4.647	-0.129	34.51
Mg	2.96E-02						
	Mg+2	2.38E-02	8.08E-03	-1.624	-2.093	-0.469	-20.91
	MgSO4	4.51E-03	4.74E-03	-2.345	-2.325	0.021	5.84
	MgHCO3+	6.81E-04	4.87E-04	-3.167	-3.312	-0.146	5.72
	MgCO3	5.12E-04	5.37E-04	-3.291	-3.27	0.021	-17.09
	MgF+	1.27E-04	9.19E-05	-3.898	-4.037	-0.139	-10.34
	MgOH+	1.10E-05	8.42E-06	-4.957	-5.075	-0.118	0
Mn(2)	1.60E-07						
	MnCO3	8.46E-08	8.88E-08	-7.072	-7.052	0.021	0
	Mn+2	4.96E-08	1.60E-08	-7.305	-7.795	-0.49	-17.5
	MnHCO3+	1.00E-08	7.37E-09	-8	-8.133	-0.133	0
	MnCl+	8.51E-09	6.26E-09	-8.07	-8.203	-0.133	-2.87

	MnSO4	6.80E-09	7.13E-09	-8.168	-8.147	0.021	22.54
	MnCl2	2.50E-10	2.62E-10	-9.602	-9.582	0.021	85.89
	MnOH+	1.61E-10	1.18E-10	-9.794	-9.927	-0.133	0
	MnF+	2.59E-11	1.91E-11	-10.586	-10.719	-0.133	0
	MnCl3-	9.40E-12	6.92E-12	-11.027	-11.16	-0.133	44.27
	Mn(NO3)2	8.40E-16	8.81E-16	-15.076	-15.055	0.021	41.04
	Mn(OH)3-	8.15E-18	6.00E-18	-17.089	-17.222	-0.133	0
Mn(3)	3.86E-29						
	Mn+3	3.86E-29	4.96E-30	-28.413	-29.305	-0.892	0
N(-3)	2.00E-05						
	NH4+	1.76E-05	1.19E-05	-4.754	-4.923	-0.169	18.26
	NH3	1.87E-06	1.96E-06	-5.729	-5.708	0.021	24.42
	NH4SO4-	5.16E-07	3.84E-07	-6.288	-6.415	-0.128	38.51
N(5)	1.70E-04						
	NO3-	1.70E-04	1.18E-04	-3.77	-3.93	-0.161	29.91
	Mn(NO3)2	8.40E-16	8.81E-16	-15.076	-15.055	0.021	41.04
Na	1.29E-01						
	Na+	1.27E-01	9.50E-02	-0.895	-1.022	-0.127	-0.92
	NaSO4-	1.60E-03	1.19E-03	-2.796	-2.924	-0.129	17.65
	NaHCO3	2.63E-04	2.75E-04	-3.581	-3.56	0.021	1.8
	NaCO3-	1.66E-04	1.23E-04	-3.781	-3.909	-0.128	0.35
	NaF	8.97E-06	9.41E-06	-5.047	-5.027	0.021	7.26
	NaOH	2.63E-17	2.76E-17	-16.58	-16.559	0.021	0
O(0)	1.09E-36						
	O2	5.43E-37	5.69E-37	-36.266	-36.245	0.021	30.4
S(6)	1.52E-02						
	SO4-2	8.68E-03	2.50E-03	-2.061	-2.602	-0.541	16.12
	MgSO4	4.51E-03	4.74E-03	-2.345	-2.325	0.021	5.84
	NaSO4-	1.60E-03	1.19E-03	-2.796	-2.924	-0.129	17.65
	CaSO4	4.13E-04	4.33E-04	-3.384	-3.364	0.021	7.5
	KSO4-	3.03E-05	2.25E-05	-4.519	-4.647	-0.129	34.51
	NH4SO4-	5.16E-07	3.84E-07	-6.288	-6.415	-0.128	38.51
	BaSO4	4.46E-07	4.68E-07	-6.351	-6.33	0.021	0
	MnSO4	6.80E-09	7.13E-09	-8.168	-8.147	0.021	22.54
	ZnSO4	6.72E-09	7.05E-09	-8.173	-8.152	0.021	21.71
	HSO4-	1.13E-09	8.43E-10	-8.946	-9.074	-0.128	40.66
	Zn(SO4)2-2	4.66E-10	1.43E-10	-9.332	-9.844	-0.512	-9.99
	FeSO4	4.93E-11	5.18E-11	-10.307	-10.286	0.021	18.97
	CuSO4	2.43E-11	2.55E-11	-10.615	-10.594	0.021	13.09
	CaHSO4+	1.33E-11	9.87E-12	-10.878	-11.006	-0.128	0
	FeSO4+	4.14E-18	3.05E-18	-17.383	-17.516	-0.133	0
	FeHSO4+	1.58E-18	1.18E-18	-17.8	-17.928	-0.128	0
	Fe(SO4)2-	2.24E-19	1.67E-19	-18.65	-18.778	-0.128	0
	FeHSO4+2	9.20E-26	2.83E-26	-25.036	-25.548	-0.512	0
Zn	1.06E-06						
	Zn(CO3)2-2	8.10E-07	2.49E-07	-6.092	-6.603	-0.512	0
	ZnCO3	1.59E-07	1.67E-07	-6.798	-6.777	0.021	0
	Zn+2	4.10E-08	1.20E-08	-7.388	-7.92	-0.532	-24.47
	Zn(OH)2	1.19E-08	1.25E-08	-7.925	-7.905	0.021	0
	ZnHCO3+	1.05E-08	7.80E-09	-7.98	-8.108	-0.128	0

ZnOHCl	1.04E-08	1.10E-08	-7.981	-7.961	0.021	0
ZnSO4	6.72E-09	7.05E-09	-8.173	-8.152	0.021	21.71
ZnOH+	5.08E-09	3.78E-09	-8.294	-8.422	-0.128	0
ZnCl+	4.34E-09	3.10E-09	-8.363	-8.508	-0.146	-14.4
Zn(SO4)2-2	4.66E-10	1.43E-10	-9.332	-9.844	-0.512	-9.99
ZnCl2	2.97E-10	3.11E-10	-9.528	-9.507	0.021	102.03
ZnCl3-	4.68E-11	3.35E-11	-10.33	-10.475	-0.146	15.77
ZnF+	3.92E-11	2.92E-11	-10.406	-10.534	-0.128	0
Zn(OH)3-	1.52E-11	1.13E-11	-10.819	-10.947	-0.128	0
ZnCl4-2	5.48E-12	1.61E-12	-11.261	-11.793	-0.532	147.44
Zn(OH)4-2	1.67E-15	5.14E-16	-14.777	-15.289	-0.512	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-1.34	-5.61	-4.28	CaSO4			
Aragonite	1.17	-7.17	-8.34	CaCO3			
Barite	0.81	-9.03	-9.84	BaSO4			
Calcite	1.31	-7.17	-8.48	CaCO3			
CO2(g)	-2.93	-4.39	-1.47	CO2			
Dolomite	3.67	-13.42	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.53	6.42	4.89	Fe(OH)3			
Fluorite	0.06	-10.54	-10.6	CaF2			
Goethite	7.42	6.42	-1	FeOOH			
Gypsum	-1.04	-5.62	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	0	1.5	H2O			
Halite	-3.61	-2.04	1.57	NaCl			
Hausmann	-8.74	52.29	61.03	Mn3O4			
Hematite	16.85	12.84	-4.01	Fe2O3			
Jarosite-K	-5	-14.21	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.76	21.58	25.34	MnOOH			
Melanterit	-10.34	-12.55	-2.21	FeSO4:7H2O			
NH3(g)	-7.5	-5.71	1.8	NH3			
O2(g)	-33.35	-36.24	-2.89	O2			
Pyrochroit	-6.08	9.12	15.2	Mn(OH)2			
Pyrolusite	-7.34	34.04	41.38	MnO2:H2O			
Rhodochro	-0.82	-11.95	-11.13	MnCO3			
Siderite	-3.2	-14.09	-10.89	FeCO3			
Smithsonit	-2.08	-12.08	-10	ZnCO3			
Sylvite	-4.81	-3.91	0.9	KCl			
Witherite	-2.02	-10.58	-8.56	BaCO3			
Zn(OH)2(e	-2.5	9	11.5	Zn(OH)2			

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 13

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.08E-02	1.08E-02
Ba	1.96E-06	1.96E-06
Ca	3.97E-03	3.97E-03
Cl	1.46E-01	1.46E-01
Cu	1.30E-07	1.30E-07
F	4.10E-04	4.10E-04
Fe	1.05E-06	1.05E-06
K	1.99E-03	1.99E-03
Mg	3.21E-02	3.21E-02
Mn	1.80E-07	1.80E-07
N(-3)	2.20E-05	2.20E-05
N(5)	1.80E-04	1.80E-04
Na	1.40E-01	1.40E-01
S(6)	1.65E-02	1.65E-02
Zn	1.14E-06	1.14E-06

#NAME? of solution----------

pH	=	8.46			
pe	=	4			
Specific	Conductan	(µS/cm,	25°C)	=	17811
Density	(g/cm³)	=	1.00621		
Volume	(L)	=	1.00537		
Activity	of	water	=	0.994	
Ionic	strength	(mol/kgw)	=	2.25E-01	
Mass	of	water	(kg)	=	1.00E+00
Total	carbon	(mol/kg)	=	9.73E-03	
Total	CO2	(mol/kg)	=	9.73E-03	
Temperatu	(°C)	=	25		
Electrical	balance	(eq)	=	2.42E-02	
Percent	error,	100*(Cat-|	=	6.47	
Iterations	=	10	(123	overall)	
Total	H	=	1.11E+02		
Total	O	=	5.56E+01		

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4327	0.2622		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol

	OH-	4.16E-06	2.90E-06	-5.381	-5.537	-0.157	-3.45
	H+	4.37E-09	3.47E-09	-8.359	-8.46	-0.101	0
	H2O	5.55E+01	9.94E-01	1.744	-0.003	0	18.07
Ba	1.96E-06						
	Ba+2	1.43E-06	3.93E-07	-5.844	-6.406	-0.562	-11.67
	BaSO4	4.85E-07	5.11E-07	-6.314	-6.291	0.023	0
	BaHCO3+	2.77E-08	2.06E-08	-7.557	-7.687	-0.13	0
	BaCO3	1.42E-08	1.50E-08	-7.847	-7.824	0.023	-10.7
	BaOH+	5.22E-12	3.82E-12	-11.282	-11.418	-0.136	0
C(4)	9.73E-03						
	HCO3-	7.39E-03	5.46E-03	-2.131	-2.263	-0.131	25.62
	MgHCO3+	7.72E-04	5.47E-04	-3.113	-3.262	-0.149	5.72
	MgCO3	5.73E-04	6.04E-04	-3.242	-3.219	0.023	-17.09
	NaHCO3	2.99E-04	3.14E-04	-3.525	-3.503	0.023	1.8
	CO3-2	2.48E-04	7.39E-05	-3.606	-4.132	-0.526	-3.49
	NaCO3-	1.90E-04	1.41E-04	-3.722	-3.851	-0.13	0.44
	CaCO3	1.21E-04	1.28E-04	-3.917	-3.894	0.023	-14.6
	CaHCO3+	9.55E-05	7.16E-05	-4.02	-4.145	-0.125	9.89
	CO2	4.07E-05	4.28E-05	-4.391	-4.368	0.023	34.43
	Zn(CO3)2-2	8.88E-07	2.69E-07	-6.052	-6.57	-0.519	0
	ZnCO3	1.62E-07	1.70E-07	-6.791	-6.769	0.023	0
	MnCO3	9.60E-08	1.01E-07	-7.018	-6.995	0.023	0
	BaHCO3+	2.77E-08	2.06E-08	-7.557	-7.687	-0.13	0
	CuCO3	1.97E-08	2.07E-08	-7.706	-7.684	0.023	0
	BaCO3	1.42E-08	1.50E-08	-7.847	-7.824	0.023	-10.7
	MnHCO3+	1.15E-08	8.39E-09	-7.94	-8.076	-0.136	0
	ZnHCO3+	1.07E-08	7.95E-09	-7.97	-8.1	-0.13	0
	Cu(CO3)2-	6.36E-09	1.93E-09	-8.197	-8.715	-0.519	0
	FeCO3	2.12E-10	2.24E-10	-9.673	-9.65	0.023	0
	CuHCO3+	1.93E-10	1.43E-10	-9.715	-9.845	-0.13	0
	FeHCO3+	9.30E-11	6.90E-11	-10.032	-10.161	-0.13	0
	(CO2)2	3.20E-11	3.37E-11	-10.495	-10.473	0.023	68.87
Ca	3.97E-03						
	Ca+2	3.30E-03	1.03E-03	-2.481	-2.988	-0.507	-17.17
	CaSO4	4.50E-04	4.74E-04	-3.346	-3.324	0.023	7.5
	CaCO3	1.21E-04	1.28E-04	-3.917	-3.894	0.023	-14.6
	CaHCO3+	9.55E-05	7.16E-05	-4.02	-4.145	-0.125	9.89
	CaOH+	6.59E-08	4.89E-08	-7.181	-7.311	-0.13	0
	CaHSO4+	1.46E-11	1.08E-11	-10.836	-10.966	-0.13	0
Cl	1.46E-01						
	Cl-	1.46E-01	1.03E-01	-0.836	-0.987	-0.151	18.48
	CuCl2-	1.30E-08	9.19E-09	-7.887	-8.036	-0.149	0
	ZnOHCl	1.07E-08	1.13E-08	-7.969	-7.947	0.023	0
	MnCl+	9.89E-09	7.23E-09	-8.005	-8.141	-0.136	-2.87
	CuCl3-2	5.25E-09	1.50E-09	-8.28	-8.824	-0.544	0
	ZnCl+	4.52E-09	3.20E-09	-8.345	-8.494	-0.149	-14.45
	ZnCl2	3.28E-10	3.46E-10	-9.484	-9.461	0.023	102.03
	MnCl2	3.09E-10	3.25E-10	-9.51	-9.488	0.023	85.89
	ZnCl3-	5.63E-11	4.00E-11	-10.249	-10.398	-0.149	15.66
	FeCl+	2.42E-11	1.80E-11	-10.616	-10.746	-0.13	0

	CuCl+	2.04E-11	1.45E-11	-10.69	-10.839	-0.149	1.18
	MnCl3-	1.26E-11	9.23E-12	-10.899	-11.035	-0.136	44.33
	ZnCl4-2	7.22E-12	2.06E-12	-11.142	-11.686	-0.544	147.56
	CuCl2	7.60E-13	8.01E-13	-12.119	-12.096	0.023	31.02
	CuCl3-	4.13E-16	2.93E-16	-15.385	-15.534	-0.149	0
	FeCl+2	1.31E-18	3.75E-19	-17.882	-18.426	-0.544	0
	CuCl4-2	5.29E-19	1.51E-19	-18.277	-18.821	-0.544	0
	FeCl2+	2.36E-19	1.73E-19	-18.627	-18.763	-0.136	0
	FeCl3	1.69E-21	1.78E-21	-20.773	-20.75	0.023	0
Cu(1)	1.82E-08						
	CuCl2-	1.30E-08	9.19E-09	-7.887	-8.036	-0.149	0
	CuCl3-2	5.25E-09	1.50E-09	-8.28	-8.824	-0.544	0
	Cu+	4.09E-12	2.74E-12	-11.388	-11.562	-0.174	0
Cu(2)	1.12E-07						
	Cu(OH)2	8.51E-08	8.97E-08	-7.07	-7.047	0.023	0
	CuCO3	1.97E-08	2.07E-08	-7.706	-7.684	0.023	0
	Cu(CO3)2-	6.36E-09	1.93E-09	-8.197	-8.715	-0.519	0
	CuOH+	2.11E-10	1.50E-10	-9.676	-9.825	-0.149	0
	CuHCO3+	1.93E-10	1.43E-10	-9.715	-9.845	-0.13	0
	Cu+2	1.65E-10	5.22E-11	-9.782	-10.282	-0.5	-25.72
	CuSO4	2.63E-11	2.77E-11	-10.581	-10.558	0.023	13.09
	CuCl+	2.04E-11	1.45E-11	-10.69	-10.839	-0.149	1.18
	Cu(OH)3-	2.09E-12	1.55E-12	-11.68	-11.81	-0.13	0
	CuCl2	7.60E-13	8.01E-13	-12.119	-12.096	0.023	31.02
	CuF+	2.31E-13	1.71E-13	-12.637	-12.767	-0.13	0
	Cu2(OH)2+	3.24E-14	9.81E-15	-13.49	-14.009	-0.519	0
	CuCl3-	4.13E-16	2.93E-16	-15.385	-15.534	-0.149	0
	Cu(OH)4-2	2.93E-16	8.86E-17	-15.534	-16.052	-0.519	0
	CuCl4-2	5.29E-19	1.51E-19	-18.277	-18.821	-0.544	0
F	4.10E-04						
	F-	2.58E-04	1.80E-04	-3.588	-3.744	-0.157	-0.9
	MgF+	1.42E-04	1.02E-04	-3.849	-3.991	-0.142	-10.34
	NaF	1.01E-05	1.06E-05	-4.997	-4.974	0.023	7.26
	HF	8.90E-10	9.37E-10	-9.051	-9.028	0.023	12.5
	ZnF+	3.97E-11	2.94E-11	-10.402	-10.531	-0.13	0
	MnF+	2.94E-11	2.15E-11	-10.532	-10.668	-0.136	0
	HF2-	8.73E-13	6.48E-13	-12.059	-12.189	-0.13	22.48
	FeF+	3.07E-13	2.28E-13	-12.513	-12.643	-0.13	0
	CuF+	2.31E-13	1.71E-13	-12.637	-12.767	-0.13	0
	FeF2+	3.38E-16	2.47E-16	-15.471	-15.607	-0.136	0
	FeF+2	1.21E-16	3.44E-17	-15.919	-16.463	-0.544	0
	FeF3	6.70E-17	7.06E-17	-16.174	-16.151	0.023	0
Fe(2)	8.01E-10						
	Fe+2	4.00E-10	1.26E-10	-9.398	-9.899	-0.5	-21.21
	FeCO3	2.12E-10	2.24E-10	-9.673	-9.65	0.023	0
	FeHCO3+	9.30E-11	6.90E-11	-10.032	-10.161	-0.13	0
	FeSO4	5.53E-11	5.83E-11	-10.257	-10.234	0.023	18.97
	FeCl+	2.42E-11	1.80E-11	-10.616	-10.746	-0.13	0
	FeOH+	1.57E-11	1.15E-11	-10.805	-10.941	-0.136	0
	FeF+	3.07E-13	2.28E-13	-12.513	-12.643	-0.13	0

	Fe(OH)2	2.65E-14	2.79E-14	-13.576	-13.554	0.023	0
	Fe(OH)3-	4.07E-16	2.98E-16	-15.39	-15.526	-0.136	0
	FeHSO4+	1.79E-18	1.33E-18	-17.747	-17.877	-0.13	0
Fe(3)	1.05E-06						
	Fe(OH)3	7.43E-07	7.83E-07	-6.129	-6.106	0.023	0
	Fe(OH)4-	2.77E-07	2.05E-07	-6.557	-6.689	-0.131	0
	Fe(OH)2+	2.87E-08	2.12E-08	-7.542	-7.674	-0.131	0
	FeOH+2	7.81E-13	2.23E-13	-12.107	-12.651	-0.544	0
	FeF2+	3.38E-16	2.47E-16	-15.471	-15.607	-0.136	0
	FeF+2	1.21E-16	3.44E-17	-15.919	-16.463	-0.544	0
	FeF3	6.70E-17	7.06E-17	-16.174	-16.151	0.023	0
	FeSO4+	4.69E-18	3.43E-18	-17.328	-17.464	-0.136	0
	FeCl+2	1.31E-18	3.75E-19	-17.882	-18.426	-0.544	0
	Fe+3	9.72E-19	1.21E-19	-18.012	-18.919	-0.907	0
	Fe(SO4)2-	2.63E-19	1.95E-19	-18.581	-18.71	-0.13	0
	FeCl2+	2.36E-19	1.73E-19	-18.627	-18.763	-0.136	0
	FeCl3	1.69E-21	1.78E-21	-20.773	-20.75	0.023	0
	Fe2(OH)2+	1.59E-22	1.34E-24	-21.797	-23.872	-2.075	0
	FeHSO4+2	1.05E-25	3.19E-26	-24.978	-25.497	-0.519	0
	Fe3(OH)4+	1.04E-26	5.94E-30	-25.984	-29.226	-3.242	0
H(0)	1.62E-28						
	H2	8.08E-29	8.51E-29	-28.093	-28.07	0.023	28.61
K	1.99E-03						
	K+	1.96E-03	1.38E-03	-2.709	-2.862	-0.153	9.36
	KSO4-	3.39E-05	2.51E-05	-4.469	-4.601	-0.131	34.52
Mg	3.21E-02						
	Mg+2	2.56E-02	8.57E-03	-1.591	-2.067	-0.476	-20.88
	MgSO4	4.95E-03	5.21E-03	-2.306	-2.283	0.023	5.84
	MgHCO3+	7.72E-04	5.47E-04	-3.113	-3.262	-0.149	5.72
	MgCO3	5.73E-04	6.04E-04	-3.242	-3.219	0.023	-17.09
	MgF+	1.42E-04	1.02E-04	-3.849	-3.991	-0.142	-10.34
	MgOH+	1.18E-05	8.92E-06	-4.93	-5.05	-0.12	0
Mn(2)	1.80E-07						
	MnCO3	9.60E-08	1.01E-07	-7.018	-6.995	0.023	0
	Mn+2	5.45E-08	1.72E-08	-7.263	-7.764	-0.5	-17.43
	MnHCO3+	1.15E-08	8.39E-09	-7.94	-8.076	-0.136	0
	MnCl+	9.89E-09	7.23E-09	-8.005	-8.141	-0.136	-2.87
	MnSO4	7.55E-09	7.96E-09	-8.122	-8.099	0.023	22.54
	MnCl2	3.09E-10	3.25E-10	-9.51	-9.488	0.023	85.89
	MnOH+	1.74E-10	1.27E-10	-9.76	-9.896	-0.136	0
	MnF+	2.94E-11	2.15E-11	-10.532	-10.668	-0.136	0
	MnCl3-	1.26E-11	9.23E-12	-10.899	-11.035	-0.136	44.33
	Mn(NO3)2	9.88E-16	1.04E-15	-15.005	-14.983	0.023	41.04
	Mn(OH)3-	8.81E-18	6.44E-18	-17.055	-17.191	-0.136	0
Mn(3)	4.30E-29						
	Mn+3	4.30E-29	5.33E-30	-28.367	-29.274	-0.907	0
N(-3)	2.20E-05						
	NH4+	1.94E-05	1.30E-05	-4.712	-4.887	-0.174	18.27
	NH3	2.03E-06	2.13E-06	-5.693	-5.671	0.023	24.42
	NH4SO4-	5.85E-07	4.34E-07	-6.233	-6.362	-0.13	38.57

N(5)	1.80E-04						
	NO3-	1.80E-04	1.23E-04	-3.745	-3.91	-0.165	29.93
	Mn(NO3)2	9.88E-16	1.04E-15	-15.005	-14.983	0.023	41.04
Na	1.40E-01						
	Na+	1.38E-01	1.02E-01	-0.86	-0.99	-0.129	-0.9
	NaSO4-	1.80E-03	1.33E-03	-2.744	-2.876	-0.131	17.82
	NaHCO3	2.99E-04	3.14E-04	-3.525	-3.503	0.023	1.8
	NaCO3-	1.90E-04	1.41E-04	-3.722	-3.851	-0.13	0.44
	NaF	1.01E-05	1.06E-05	-4.997	-4.974	0.023	7.26
	NaOH	2.82E-17	2.97E-17	-16.55	-16.527	0.023	0
O(0)	1.08E-36						
	O2	5.40E-37	5.69E-37	-36.268	-36.245	0.023	30.4
S(6)	1.65E-02						
	SO4-2	9.27E-03	2.60E-03	-2.033	-2.586	-0.553	16.18
	MgSO4	4.95E-03	5.21E-03	-2.306	-2.283	0.023	5.84
	NaSO4-	1.80E-03	1.33E-03	-2.744	-2.876	-0.131	17.82
	CaSO4	4.50E-04	4.74E-04	-3.346	-3.324	0.023	7.5
	KSO4-	3.39E-05	2.51E-05	-4.469	-4.601	-0.131	34.52
	NH4SO4-	5.85E-07	4.34E-07	-6.233	-6.362	-0.13	38.57
	BaSO4	4.85E-07	5.11E-07	-6.314	-6.291	0.023	0
	MnSO4	7.55E-09	7.96E-09	-8.122	-8.099	0.023	22.54
	ZnSO4	6.68E-09	7.03E-09	-8.176	-8.153	0.023	21.71
	HSO4-	1.18E-09	8.75E-10	-8.928	-9.058	-0.13	40.68
	Zn(SO4)2-2	4.90E-10	1.48E-10	-9.31	-9.829	-0.519	-9.79
	FeSO4	5.53E-11	5.83E-11	-10.257	-10.234	0.023	18.97
	CuSO4	2.63E-11	2.77E-11	-10.581	-10.558	0.023	13.09
	CaHSO4+	1.46E-11	1.08E-11	-10.836	-10.966	-0.13	0
	FeSO4+	4.69E-18	3.43E-18	-17.328	-17.464	-0.136	0
	FeHSO4+	1.79E-18	1.33E-18	-17.747	-17.877	-0.13	0
	Fe(SO4)2-	2.63E-19	1.95E-19	-18.581	-18.71	-0.13	0
	FeHSO4+2	1.05E-25	3.19E-26	-24.978	-25.497	-0.519	0
Zn	1.14E-06						
	Zn(CO3)2-2	8.88E-07	2.69E-07	-6.052	-6.57	-0.519	0
	ZnCO3	1.62E-07	1.70E-07	-6.791	-6.769	0.023	0
	Zn+2	4.05E-08	1.16E-08	-7.393	-7.937	-0.544	-24.45
	Zn(OH)2	1.14E-08	1.20E-08	-7.945	-7.922	0.023	0
	ZnOHCl	1.07E-08	1.13E-08	-7.969	-7.947	0.023	0
	ZnHCO3+	1.07E-08	7.95E-09	-7.97	-8.1	-0.13	0
	ZnSO4	6.68E-09	7.03E-09	-8.176	-8.153	0.023	21.71
	ZnOH+	4.90E-09	3.63E-09	-8.31	-8.44	-0.13	0
	ZnCl+	4.52E-09	3.20E-09	-8.345	-8.494	-0.149	-14.45
	Zn(SO4)2-2	4.90E-10	1.48E-10	-9.31	-9.829	-0.519	-9.79
	ZnCl2	3.28E-10	3.46E-10	-9.484	-9.461	0.023	102.03
	ZnCl3-	5.63E-11	4.00E-11	-10.249	-10.398	-0.149	15.66
	ZnF+	3.97E-11	2.94E-11	-10.402	-10.531	-0.13	0
	Zn(OH)3-	1.46E-11	1.09E-11	-10.835	-10.965	-0.13	0
	ZnCl4-2	7.22E-12	2.06E-12	-11.142	-11.686	-0.544	147.56
	Zn(OH)4-2	1.63E-15	4.93E-16	-14.789	-15.307	-0.519	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-1.3	-5.57	-4.28	CaSO4
Aragonite	1.22	-7.12	-8.34	CaCO3
Barite	0.85	-8.99	-9.84	BaSO4
Calcite	1.36	-7.12	-8.48	CaCO3
CO2(g)	-2.9	-4.37	-1.47	CO2
Dolomite	3.77	-13.32	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.56	6.45	4.89	Fe(OH)3
Fluorite	0.12	-10.48	-10.6	CaF2
Goethite	7.46	6.46	-1	FeOOH
Gypsum	-1	-5.58	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O
Halite	-3.55	-1.98	1.57	NaCl
Hausmann	-8.65	52.38	61.03	Mn3O4
Hematite	16.92	12.92	-4.01	Fe2O3
Jarosite-K	-4.83	-14.04	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.73	21.61	25.34	MnOOH
Melanterit	-10.29	-12.5	-2.21	FeSO4:7H2O
NH3(g)	-7.47	-5.67	1.8	NH3
O2(g)	-33.35	-36.25	-2.89	O2
Pyrochroit	-6.05	9.15	15.2	Mn(OH)2
Pyrolusite	-7.31	34.07	41.38	MnO2:H2O
Rhodochro	-0.77	-11.9	-11.13	MnCO3
Siderite	-3.14	-14.03	-10.89	FeCO3
Smithsonit	-2.07	-12.07	-10	ZnCO3
Sylvite	-4.75	-3.85	0.9	KCl
Witherite	-1.98	-10.54	-8.56	BaCO3
Zn(OH)2(e	-2.52	8.98	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 14

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.17E-02	1.17E-02
Ba	2.12E-06	2.12E-06
Ca	4.28E-03	4.28E-03
Cl	1.57E-01	1.57E-01
Cu	1.40E-07	1.40E-07
F	4.40E-04	4.40E-04
Fe	1.13E-06	1.13E-06
K	2.15E-03	2.15E-03
Mg	3.46E-02	3.46E-02

Mn	1.90E-07	1.90E-07
N(-3)	2.30E-05	2.30E-05
N(5)	2.00E-04	2.00E-04
Na	1.51E-01	1.51E-01
S(6)	1.78E-02	1.78E-02
Zn	1.23E-06	1.23E-06

#NAME? of solution----------

pH	=	8.46			
pe	=	4			
Specific	Conductan	(µS/cm,	25°C)	=	19023
Density	(g/cm³)	=	1.0069		
Volume	(L)	=	1.00556		
Activity	of	water	=	0.994	
Ionic	strength	(mol/kgw)	=	2.42E-01	
Mass	of	water	(kg)	=	1.00E+00
Total	carbon	(mol/kg)	=	1.05E-02	
Total	CO2	(mol/kg)	=	1.05E-02	
Temperatu	(°C)	=	25		
Electrical	balance	(eq)	=	2.60E-02	
Percent	error,	100*(Cat-|	=	6.48	
Iterations	=	10	(133	overall)	
Total	H	=	1.11E+02		
Total	O	=	5.56E+01		

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4361	0.2624		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.20E-06	2.90E-06	-5.377	-5.537	-0.16	-3.41
H+	4.39E-09	3.47E-09	-8.358	-8.46	-0.102	0
H2O	5.55E+01	9.94E-01	1.744	-0.003	0	18.07
Ba	2.12E-06					
Ba+2	1.55E-06	4.14E-07	-5.811	-6.383	-0.573	-11.64
BaSO4	5.27E-07	5.57E-07	-6.278	-6.254	0.024	0
BaHCO3+	3.09E-08	2.28E-08	-7.51	-7.641	-0.131	0
BaCO3	1.58E-08	1.67E-08	-7.803	-7.779	0.024	-10.7
BaOH+	5.53E-12	4.02E-12	-11.257	-11.396	-0.139	0
C(4)	1.05E-02					
HCO3-	7.84E-03	5.76E-03	-2.106	-2.24	-0.134	25.67
MgHCO3+	8.66E-04	6.10E-04	-3.063	-3.215	-0.152	5.73
MgCO3	6.36E-04	6.72E-04	-3.197	-3.172	0.024	-17.09

	NaHCO3	3.36E-04	3.55E-04	-3.474	-3.449	0.024	1.8
	CO3-2	2.68E-04	7.79E-05	-3.573	-4.109	-0.536	-3.42
	NaCO3-	2.15E-04	1.59E-04	-3.667	-3.798	-0.131	0.54
	CaCO3	1.34E-04	1.42E-04	-3.872	-3.848	0.024	-14.6
	CaHCO3+	1.07E-04	7.96E-05	-3.972	-4.099	-0.127	9.89
	CO2	4.27E-05	4.52E-05	-4.369	-4.345	0.024	34.43
	Zn(CO3)2-2	9.74E-07	2.91E-07	-6.011	-6.536	-0.525	0
	ZnCO3	1.65E-07	1.75E-07	-6.782	-6.757	0.024	0
	MnCO3	1.02E-07	1.08E-07	-6.991	-6.967	0.024	0
	BaHCO3+	3.09E-08	2.28E-08	-7.51	-7.641	-0.131	0
	CuCO3	2.15E-08	2.27E-08	-7.668	-7.644	0.024	0
	BaCO3	1.58E-08	1.67E-08	-7.803	-7.779	0.024	-10.7
	MnHCO3+	1.23E-08	8.95E-09	-7.909	-8.048	-0.139	0
	ZnHCO3+	1.10E-08	8.15E-09	-7.957	-8.089	-0.131	0
	Cu(CO3)2-	7.45E-09	2.23E-09	-8.128	-8.653	-0.525	0
	FeCO3	2.41E-10	2.55E-10	-9.618	-9.594	0.024	0
	CuHCO3+	2.12E-10	1.57E-10	-9.674	-9.805	-0.131	0
	FeHCO3+	1.06E-10	7.85E-11	-9.974	-10.105	-0.131	0
	(CO2)2	3.54E-11	3.75E-11	-10.451	-10.426	0.024	68.87
Ca	4.28E-03						
	Ca+2	3.55E-03	1.08E-03	-2.45	-2.965	-0.515	-17.14
	CaSO4	4.90E-04	5.18E-04	-3.31	-3.286	0.024	7.5
	CaCO3	1.34E-04	1.42E-04	-3.872	-3.848	0.024	-14.6
	CaHCO3+	1.07E-04	7.96E-05	-3.972	-4.099	-0.127	9.89
	CaOH+	6.97E-08	5.16E-08	-7.157	-7.288	-0.131	0
	CaHSO4+	1.60E-11	1.18E-11	-10.797	-10.928	-0.131	0
Cl	1.57E-01						
	Cl-	1.57E-01	1.10E-01	-0.804	-0.958	-0.154	18.5
	CuCl2-	1.55E-08	1.09E-08	-7.81	-7.962	-0.152	0
	ZnOHCl	1.11E-08	1.18E-08	-7.954	-7.93	0.024	0
	MnCl+	1.08E-08	7.82E-09	-7.968	-8.107	-0.139	-2.86
	CuCl3-2	6.84E-09	1.91E-09	-8.165	-8.72	-0.555	0
	ZnCl+	4.73E-09	3.33E-09	-8.325	-8.477	-0.152	-14.51
	ZnCl2	3.64E-10	3.84E-10	-9.44	-9.415	0.024	102.03
	MnCl2	3.56E-10	3.76E-10	-9.449	-9.425	0.024	85.89
	ZnCl3-	6.74E-11	4.75E-11	-10.171	-10.324	-0.152	15.54
	FeCl+	2.80E-11	2.07E-11	-10.553	-10.684	-0.131	0
	CuCl+	2.28E-11	1.61E-11	-10.641	-10.794	-0.152	1.21
	MnCl3-	1.57E-11	1.14E-11	-10.804	-10.943	-0.139	44.39
	ZnCl4-2	9.40E-12	2.62E-12	-11.027	-11.582	-0.555	147.68
	CuCl2	8.99E-13	9.51E-13	-12.046	-12.022	0.024	31.02
	CuCl3-	5.28E-16	3.71E-16	-15.278	-15.43	-0.152	0
	FeCl+2	1.55E-18	4.33E-19	-17.809	-18.364	-0.555	0
	CuCl4-2	7.36E-19	2.05E-19	-18.133	-18.688	-0.555	0
	FeCl2+	2.93E-19	2.13E-19	-18.533	-18.672	-0.139	0
	FeCl3	2.22E-21	2.34E-21	-20.655	-20.63	0.024	0
Cu(1)	2.24E-08						
	CuCl2-	1.55E-08	1.09E-08	-7.81	-7.962	-0.152	0
	CuCl3-2	6.84E-09	1.91E-09	-8.165	-8.72	-0.555	0
	Cu+	4.30E-12	2.85E-12	-11.367	-11.545	-0.179	0

Cu(2)	1.18E-07						
	Cu(OH)2	8.81E-08	9.31E-08	-7.055	-7.031	0.024	0
	CuCO3	2.15E-08	2.27E-08	-7.668	-7.644	0.024	0
	Cu(CO3)2-	7.45E-09	2.23E-09	-8.128	-8.653	-0.525	0
	CuOH+	2.21E-10	1.56E-10	-9.656	-9.808	-0.152	0
	CuHCO3+	2.12E-10	1.57E-10	-9.674	-9.805	-0.131	0
	Cu+2	1.75E-10	5.43E-11	-9.756	-10.265	-0.51	-25.7
	CuSO4	2.81E-11	2.98E-11	-10.551	-10.527	0.024	13.09
	CuCl+	2.28E-11	1.61E-11	-10.641	-10.794	-0.152	1.21
	Cu(OH)3-	2.18E-12	1.61E-12	-11.663	-11.794	-0.131	0
	CuCl2	8.99E-13	9.51E-13	-12.046	-12.022	0.024	31.02
	CuF+	2.51E-13	1.86E-13	-12.6	-12.731	-0.131	0
	Cu2(OH)2+	3.54E-14	1.06E-14	-13.451	-13.975	-0.525	0
	CuCl3-	5.28E-16	3.71E-16	-15.278	-15.43	-0.152	0
	Cu(OH)4-2	3.08E-16	9.20E-17	-15.512	-16.036	-0.525	0
	CuCl4-2	7.36E-19	2.05E-19	-18.133	-18.688	-0.555	0
F	4.40E-04						
	F-	2.72E-04	1.88E-04	-3.566	-3.726	-0.16	-0.88
	MgF+	1.57E-04	1.12E-04	-3.804	-3.95	-0.145	-10.33
	NaF	1.12E-05	1.19E-05	-4.95	-4.926	0.024	7.26
	HF	9.24E-10	9.77E-10	-9.034	-9.01	0.024	12.5
	ZnF+	4.04E-11	2.99E-11	-10.394	-10.525	-0.131	0
	MnF+	3.12E-11	2.27E-11	-10.506	-10.644	-0.139	0
	HF2-	9.53E-13	7.05E-13	-12.021	-12.152	-0.131	22.5
	FeF+	3.46E-13	2.56E-13	-12.461	-12.592	-0.131	0
	CuF+	2.51E-13	1.86E-13	-12.6	-12.731	-0.131	0
	FeF2+	3.99E-16	2.90E-16	-15.399	-15.538	-0.139	0
	FeF+2	1.39E-16	3.88E-17	-15.857	-16.412	-0.555	0
	FeF3	8.17E-17	8.64E-17	-16.088	-16.064	0.024	0
Fe(2)	8.94E-10						
	Fe+2	4.40E-10	1.36E-10	-9.356	-9.866	-0.51	-21.18
	FeCO3	2.41E-10	2.55E-10	-9.618	-9.594	0.024	0
	FeHCO3+	1.06E-10	7.85E-11	-9.974	-10.105	-0.131	0
	FeSO4	6.15E-11	6.51E-11	-10.211	-10.187	0.024	18.97
	FeCl+	2.80E-11	2.07E-11	-10.553	-10.684	-0.131	0
	FeOH+	1.70E-11	1.24E-11	-10.77	-10.908	-0.139	0
	FeF+	3.46E-13	2.56E-13	-12.461	-12.592	-0.131	0
	Fe(OH)2	2.85E-14	3.01E-14	-13.545	-13.521	0.024	0
	Fe(OH)3-	4.42E-16	3.21E-16	-15.355	-15.494	-0.139	0
	FeHSO4+	2.01E-18	1.48E-18	-17.698	-17.829	-0.131	0
Fe(3)	1.13E-06						
	Fe(OH)3	7.98E-07	8.44E-07	-6.098	-6.074	0.024	0
	Fe(OH)4-	3.00E-07	2.21E-07	-6.523	-6.657	-0.134	0
	Fe(OH)2+	3.11E-08	2.29E-08	-7.507	-7.641	-0.134	0
	FeOH+2	8.64E-13	2.41E-13	-12.063	-12.618	-0.555	0
	FeF2+	3.99E-16	2.90E-16	-15.399	-15.538	-0.139	0
	FeF+2	1.39E-16	3.88E-17	-15.857	-16.412	-0.555	0
	FeF3	8.17E-17	8.64E-17	-16.088	-16.064	0.024	0
	FeSO4+	5.27E-18	3.83E-18	-17.278	-17.417	-0.139	0
	FeCl+2	1.55E-18	4.33E-19	-17.809	-18.364	-0.555	0

	Fe+3	1.08E-18	1.30E-19	-17.966	-18.886	-0.92	0
	Fe(SO4)2-	3.04E-19	2.25E-19	-18.517	-18.648	-0.131	0
	FeCl2+	2.93E-19	2.13E-19	-18.533	-18.672	-0.139	0
	FeCl3	2.22E-21	2.34E-21	-20.655	-20.63	0.024	0
	Fe2(OH)2+	1.96E-22	1.56E-24	-21.709	-23.807	-2.098	0
	FeHSO4+2	1.19E-25	3.56E-26	-24.924	-25.449	-0.525	0
	Fe3(OH)4+	1.41E-26	7.45E-30	-25.85	-29.128	-3.279	0
H(0)	1.61E-28						
	H2	8.05E-29	8.51E-29	-28.094	-28.07	0.024	28.61
K	2.15E-03						
	K+	2.11E-03	1.47E-03	-2.675	-2.832	-0.157	9.38
	KSO4-	3.78E-05	2.78E-05	-4.422	-4.556	-0.134	34.54
Mg	3.46E-02						
	Mg+2	2.75E-02	9.05E-03	-1.561	-2.044	-0.483	-20.85
	MgSO4	5.39E-03	5.69E-03	-2.269	-2.245	0.024	5.84
	MgHCO3+	8.66E-04	6.10E-04	-3.063	-3.215	-0.152	5.73
	MgCO3	6.36E-04	6.72E-04	-3.197	-3.172	0.024	-17.09
	MgF+	1.57E-04	1.12E-04	-3.804	-3.95	-0.145	-10.33
	MgOH+	1.25E-05	9.41E-06	-4.904	-5.026	-0.122	0
Mn(2)	1.90E-07						
	MnCO3	1.02E-07	1.08E-07	-6.991	-6.967	0.024	0
	Mn+2	5.64E-08	1.74E-08	-7.249	-7.758	-0.51	-17.36
	MnHCO3+	1.23E-08	8.95E-09	-7.909	-8.048	-0.139	0
	MnCl+	1.08E-08	7.82E-09	-7.968	-8.107	-0.139	-2.86
	MnSO4	7.88E-09	8.33E-09	-8.104	-8.079	0.024	22.54
	MnCl2	3.56E-10	3.76E-10	-9.449	-9.425	0.024	85.89
	MnOH+	1.77E-10	1.29E-10	-9.752	-9.891	-0.139	0
	MnF+	3.12E-11	2.27E-11	-10.506	-10.644	-0.139	0
	MnCl3-	1.57E-11	1.14E-11	-10.804	-10.943	-0.139	44.39
	Mn(NO3)2	1.21E-15	1.28E-15	-14.918	-14.894	0.024	41.04
	Mn(OH)3-	8.96E-18	6.51E-18	-17.048	-17.187	-0.139	0
Mn(3)	4.48E-29						
	Mn+3	4.48E-29	5.39E-30	-28.348	-29.268	-0.92	0
N(-3)	2.30E-05						
	NH4+	2.03E-05	1.34E-05	-4.693	-4.872	-0.179	18.27
	NH3	2.09E-06	2.21E-06	-5.68	-5.656	0.024	24.42
	NH4SO4-	6.29E-07	4.65E-07	-6.201	-6.333	-0.131	38.63
N(5)	2.00E-04						
	NO3-	2.00E-04	1.36E-04	-3.699	-3.868	-0.169	29.94
	Mn(NO3)2	1.21E-15	1.28E-15	-14.918	-14.894	0.024	41.04
Na	1.51E-01						
	Na+	1.48E-01	1.10E-01	-0.828	-0.96	-0.131	-0.88
	NaSO4-	2.01E-03	1.48E-03	-2.697	-2.831	-0.134	17.98
	NaHCO3	3.36E-04	3.55E-04	-3.474	-3.449	0.024	1.8
	NaCO3-	2.15E-04	1.59E-04	-3.667	-3.798	-0.131	0.54
	NaF	1.12E-05	1.19E-05	-4.95	-4.926	0.024	7.26
	NaOH	3.01E-17	3.18E-17	-16.521	-16.497	0.024	0
O(0)	1.08E-36						
	O2	5.38E-37	5.68E-37	-36.27	-36.245	0.024	30.4
S(6)	1.78E-02						

SO4-2	9.86E-03	2.69E-03	-2.006	-2.571	-0.565	16.25
MgSO4	5.39E-03	5.69E-03	-2.269	-2.245	0.024	5.84
NaSO4-	2.01E-03	1.48E-03	-2.697	-2.831	-0.134	17.98
CaSO4	4.90E-04	5.18E-04	-3.31	-3.286	0.024	7.5
KSO4-	3.78E-05	2.78E-05	-4.422	-4.556	-0.134	34.54
NH4SO4-	6.29E-07	4.65E-07	-6.201	-6.333	-0.131	38.63
BaSO4	5.27E-07	5.57E-07	-6.278	-6.254	0.024	0
MnSO4	7.88E-09	8.33E-09	-8.104	-8.079	0.024	22.54
ZnSO4	6.70E-09	7.08E-09	-8.174	-8.15	0.024	21.71
HSO4-	1.22E-09	9.05E-10	-8.912	-9.043	-0.131	40.69
Zn(SO4)2-2	5.17E-10	1.55E-10	-9.286	-9.811	-0.525	-9.6
FeSO4	6.15E-11	6.51E-11	-10.211	-10.187	0.024	18.97
CuSO4	2.81E-11	2.98E-11	-10.551	-10.527	0.024	13.09
CaHSO4+	1.60E-11	1.18E-11	-10.797	-10.928	-0.131	0
FeSO4+	5.27E-18	3.83E-18	-17.278	-17.417	-0.139	0
FeHSO4+	2.01E-18	1.48E-18	-17.698	-17.829	-0.131	0
Fe(SO4)2-	3.04E-19	2.25E-19	-18.517	-18.648	-0.131	0
FeHSO4+2	1.19E-25	3.56E-26	-24.924	-25.449	-0.525	0
Zn	1.23E-06					
Zn(CO3)2-2	9.74E-07	2.91E-07	-6.011	-6.536	-0.525	0
ZnCO3	1.65E-07	1.75E-07	-6.782	-6.757	0.024	0
Zn+2	4.04E-08	1.13E-08	-7.394	-7.949	-0.555	-24.43
ZnOHCl	1.11E-08	1.18E-08	-7.954	-7.93	0.024	0
ZnHCO3+	1.10E-08	8.15E-09	-7.957	-8.089	-0.131	0
Zn(OH)2	1.10E-08	1.16E-08	-7.959	-7.934	0.024	0
ZnSO4	6.70E-09	7.08E-09	-8.174	-8.15	0.024	21.71
ZnOH+	4.78E-09	3.54E-09	-8.321	-8.452	-0.131	0
ZnCl+	4.73E-09	3.33E-09	-8.325	-8.477	-0.152	-14.51
Zn(SO4)2-2	5.17E-10	1.55E-10	-9.286	-9.811	-0.525	-9.6
ZnCl2	3.64E-10	3.84E-10	-9.44	-9.415	0.024	102.03
ZnCl3-	6.74E-11	4.75E-11	-10.171	-10.324	-0.152	15.54
ZnF+	4.04E-11	2.99E-11	-10.394	-10.525	-0.131	0
Zn(OH)3-	1.43E-11	1.05E-11	-10.846	-10.977	-0.131	0
ZnCl4-2	9.40E-12	2.62E-12	-11.027	-11.582	-0.555	147.68
Zn(OH)4-2	1.60E-15	4.79E-16	-14.795	-15.32	-0.525	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-1.26	-5.54	-4.28	CaSO4			
Aragonite	1.26	-7.07	-8.34	CaCO3			
Barite	0.89	-8.95	-9.84	BaSO4			
Calcite	1.41	-7.07	-8.48	CaCO3			
CO2(g)	-2.88	-4.35	-1.47	CO2			
Dolomite	3.86	-13.23	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.6	6.49	4.89	Fe(OH)3			
Fluorite	0.18	-10.42	-10.6	CaF2			
Goethite	7.49	6.49	-1	FeOOH			
Gypsum	-0.96	-5.54	-4.58	CaSO4:2H2O			

H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O
Halite	-3.49	-1.92	1.57	NaCl
Hausmann	-8.64	52.39	61.03	Mn3O4
Hematite	16.99	12.98	-4.01	Fe2O3
Jarosite-K	-4.68	-13.89	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.72	21.62	25.34	MnOOH
Melanterit	-10.25	-12.46	-2.21	FeSO4:7H2O
NH3(g)	-7.45	-5.66	1.8	NH3
O2(g)	-33.35	-36.25	-2.89	O2
Pyrochroit	-6.04	9.16	15.2	Mn(OH)2
Pyrolusite	-7.31	34.07	41.38	MnO2:H2O
Rhodochrc	-0.74	-11.87	-11.13	MnCO3
Siderite	-3.08	-13.97	-10.89	FeCO3
Smithsonit	-2.06	-12.06	-10	ZnCO3
Sylvite	-4.69	-3.79	0.9	KCl
Witherite	-1.93	-10.49	-8.56	BaCO3
Zn(OH)2(e	-2.53	8.97	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 15

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.25E-02	1.25E-02
Ba	2.27E-06	2.27E-06
Ca	4.58E-03	4.58E-03
Cl	1.68E-01	1.68E-01
Cu	1.50E-07	1.50E-07
F	4.70E-04	4.70E-04
Fe	1.21E-06	1.21E-06
K	2.30E-03	2.30E-03
Mg	3.70E-02	3.70E-02
Mn	2.00E-07	2.00E-07
N(-3)	2.50E-05	2.50E-05
N(5)	2.10E-04	2.10E-04
Na	1.62E-01	1.62E-01
S(6)	1.91E-02	1.91E-02
Zn	1.32E-06	1.32E-06

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 20221
Density (g/cm³) = 1.0076

```
Volume (L) = 1.00575
Activity of water = 0.993
Ionic strength (mol/kgw) = 2.59E-01
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 1.12E-02
Total CO2 (mol/kg) = 1.12E-02
Temperatu (°C) = 25
Electrical balance (eq) = 2.79E-02
Percent error, 100*(Cat-| = 6.49
Iterations = 10 (143 overall)
Total H = 1.11E+02
Total O = 5.56E+01

#NAME? couples--------------------------------

Redox couple pe Eh (volts)

N(-3)/N(5) 4.4343 0.2623

#NAME? of species----------------------------
```

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.23E-06	2.90E-06	-5.374	-5.538	-0.164	-3.38
H+	4.40E-09	3.47E-09	-8.356	-8.46	-0.104	0
H2O	5.55E+01	9.93E-01	1.744	-0.003	0	18.07
Ba 2.27E-06						
Ba+2	1.65E-06	4.32E-07	-5.782	-6.364	-0.582	-11.6
BaSO4	5.66E-07	6.00E-07	-6.247	-6.222	0.026	0
BaHCO3+	3.40E-08	2.51E-08	-7.469	-7.601	-0.132	0
BaCO3	1.72E-08	1.83E-08	-7.764	-7.738	0.026	-10.7
BaOH+	5.81E-12	4.20E-12	-11.236	-11.377	-0.141	0
C(4) 1.12E-02						
HCO3-	8.28E-03	6.05E-03	-2.082	-2.218	-0.136	25.73
MgHCO3+	9.64E-04	6.74E-04	-3.016	-3.172	-0.155	5.74
MgCO3	7.00E-04	7.43E-04	-3.155	-3.129	0.026	-17.09
NaHCO3	3.75E-04	3.98E-04	-3.426	-3.4	0.026	1.8
CO3-2	2.87E-04	8.18E-05	-3.542	-4.087	-0.545	-3.35
NaCO3-	2.42E-04	1.78E-04	-3.617	-3.749	-0.132	0.63
CaCO3	1.47E-04	1.56E-04	-3.832	-3.806	0.026	-14.6
CaHCO3+	1.18E-04	8.77E-05	-3.928	-4.057	-0.13	9.9
CO2	4.47E-05	4.75E-05	-4.35	-4.324	0.026	34.43
Zn(CO3)2-2	1.06E-06	3.13E-07	-5.975	-6.504	-0.529	0
ZnCO3	1.69E-07	1.79E-07	-6.773	-6.747	0.026	0
MnCO3	1.08E-07	1.15E-07	-6.966	-6.94	0.026	0
BaHCO3+	3.40E-08	2.51E-08	-7.469	-7.601	-0.132	0
CuCO3	2.32E-08	2.46E-08	-7.635	-7.609	0.026	0
BaCO3	1.72E-08	1.83E-08	-7.764	-7.738	0.026	-10.7
MnHCO3+	1.32E-08	9.52E-09	-7.88	-8.022	-0.141	0

	ZnHCO3+	1.13E-08	8.36E-09	-7.946	-8.078	-0.132	0
	Cu(CO3)2-	8.58E-09	2.54E-09	-8.067	-8.596	-0.529	0
	FeCO3	2.70E-10	2.87E-10	-9.568	-9.542	0.026	0
	CuHCO3+	2.30E-10	1.70E-10	-9.638	-9.77	-0.132	0
	FeHCO3+	1.20E-10	8.84E-11	-9.921	-10.053	-0.132	0
	(CO2)2	3.90E-11	4.13E-11	-10.41	-10.384	0.026	68.87
Ca	4.58E-03						
	Ca+2	3.79E-03	1.14E-03	-2.422	-2.944	-0.523	-17.12
	CaSO4	5.28E-04	5.60E-04	-3.278	-3.252	0.026	7.5
	CaCO3	1.47E-04	1.56E-04	-3.832	-3.806	0.026	-14.6
	CaHCO3+	1.18E-04	8.77E-05	-3.928	-4.057	-0.13	9.9
	CaOH+	7.33E-08	5.40E-08	-7.135	-7.267	-0.132	0
	CaHSO4+	1.73E-11	1.28E-11	-10.762	-10.894	-0.132	0
Cl	1.68E-01						
	Cl-	1.68E-01	1.17E-01	-0.774	-0.931	-0.157	18.51
	CuCl2-	1.83E-08	1.28E-08	-7.739	-7.894	-0.155	0
	MnCl+	1.17E-08	8.43E-09	-7.933	-8.074	-0.141	-2.86
	ZnOHCl	1.15E-08	1.22E-08	-7.94	-7.914	0.026	0
	CuCl3-2	8.71E-09	2.37E-09	-8.06	-8.625	-0.565	0
	ZnCl+	4.95E-09	3.46E-09	-8.305	-8.461	-0.155	-14.56
	MnCl2	4.06E-10	4.31E-10	-9.392	-9.366	0.026	85.89
	ZnCl2	4.00E-10	4.25E-10	-9.398	-9.372	0.026	102.03
	ZnCl3-	7.98E-11	5.58E-11	-10.098	-10.253	-0.155	15.43
	FeCl+	3.21E-11	2.37E-11	-10.494	-10.626	-0.132	0
	CuCl+	2.53E-11	1.77E-11	-10.597	-10.753	-0.155	1.24
	MnCl3-	1.93E-11	1.39E-11	-10.716	-10.857	-0.141	44.45
	ZnCl4-2	1.20E-11	3.28E-12	-10.919	-11.485	-0.565	147.8
	CuCl2	1.05E-12	1.11E-12	-11.98	-11.954	0.026	31.02
	CuCl3-	6.61E-16	4.62E-16	-15.18	-15.335	-0.155	0
	FeCl+2	1.82E-18	4.94E-19	-17.741	-18.306	-0.565	0
	CuCl4-2	9.97E-19	2.71E-19	-18.001	-18.567	-0.565	0
	FeCl2+	3.58E-19	2.59E-19	-18.446	-18.588	-0.141	0
	FeCl3	2.85E-21	3.03E-21	-20.545	-20.519	0.026	0
Cu(1)	2.70E-08						
	CuCl2-	1.83E-08	1.28E-08	-7.739	-7.894	-0.155	0
	CuCl3-2	8.71E-09	2.37E-09	-8.06	-8.625	-0.565	0
	Cu+	4.48E-12	2.94E-12	-11.348	-11.531	-0.183	0
Cu(2)	1.23E-07						
	Cu(OH)2	9.06E-08	9.61E-08	-7.043	-7.017	0.026	0
	CuCO3	2.32E-08	2.46E-08	-7.635	-7.609	0.026	0
	Cu(CO3)2-	8.58E-09	2.54E-09	-8.067	-8.596	-0.529	0
	CuHCO3+	2.30E-10	1.70E-10	-9.638	-9.77	-0.132	0
	CuOH+	2.30E-10	1.61E-10	-9.639	-9.794	-0.155	0
	Cu+2	1.85E-10	5.61E-11	-9.733	-10.251	-0.518	-25.68
	CuSO4	2.99E-11	3.17E-11	-10.525	-10.499	0.026	13.09
	CuCl+	2.53E-11	1.77E-11	-10.597	-10.753	-0.155	1.24
	Cu(OH)3-	2.25E-12	1.66E-12	-11.648	-11.78	-0.132	0
	CuCl2	1.05E-12	1.11E-12	-11.98	-11.954	0.026	31.02
	CuF+	2.70E-13	1.99E-13	-12.568	-12.701	-0.132	0
	Cu2(OH)2+	3.82E-14	1.13E-14	-13.418	-13.948	-0.529	0

	CuCl3-	6.61E-16	4.62E-16	-15.18	-15.335	-0.155	0
	Cu(OH)4-2	3.21E-16	9.48E-17	-15.494	-16.023	-0.529	0
	CuCl4-2	9.97E-19	2.71E-19	-18.001	-18.567	-0.565	0
F	4.70E-04						
	F-	2.85E-04	1.95E-04	-3.545	-3.709	-0.164	-0.87
	MgF+	1.73E-04	1.23E-04	-3.762	-3.91	-0.148	-10.33
	NaF	1.24E-05	1.32E-05	-4.907	-4.881	0.026	7.26
	HF	9.57E-10	1.02E-09	-9.019	-8.993	0.026	12.5
	ZnF+	4.11E-11	3.03E-11	-10.386	-10.519	-0.132	0
	MnF+	3.31E-11	2.39E-11	-10.481	-10.622	-0.141	0
	HF2-	1.03E-12	7.62E-13	-11.986	-12.118	-0.132	22.51
	FeF+	3.88E-13	2.86E-13	-12.412	-12.544	-0.132	0
	CuF+	2.70E-13	1.99E-13	-12.568	-12.701	-0.132	0
	FeF2+	4.66E-16	3.36E-16	-15.332	-15.473	-0.141	0
	FeF+2	1.59E-16	4.32E-17	-15.799	-16.364	-0.565	0
	FeF3	9.81E-17	1.04E-16	-16.008	-15.982	0.026	0
Fe(2)	9.91E-10						
	Fe+2	4.82E-10	1.46E-10	-9.317	-9.835	-0.518	-21.15
	FeCO3	2.70E-10	2.87E-10	-9.568	-9.542	0.026	0
	FeHCO3+	1.20E-10	8.84E-11	-9.921	-10.053	-0.132	0
	FeSO4	6.79E-11	7.21E-11	-10.168	-10.142	0.026	18.97
	FeCl+	3.21E-11	2.37E-11	-10.494	-10.626	-0.132	0
	FeOH+	1.83E-11	1.33E-11	-10.737	-10.878	-0.141	0
	FeF+	3.88E-13	2.86E-13	-12.412	-12.544	-0.132	0
	Fe(OH)2	3.04E-14	3.23E-14	-13.517	-13.491	0.026	0
	Fe(OH)3-	4.76E-16	3.44E-16	-15.322	-15.464	-0.141	0
	FeHSO4+	2.23E-18	1.64E-18	-17.652	-17.785	-0.132	0
Fe(3)	1.21E-06						
	Fe(OH)3	8.52E-07	9.04E-07	-6.07	-6.044	0.026	0
	Fe(OH)4-	3.23E-07	2.36E-07	-6.49	-6.627	-0.136	0
	Fe(OH)2+	3.35E-08	2.45E-08	-7.474	-7.611	-0.136	0
	FeOH+2	9.50E-13	2.58E-13	-12.022	-12.588	-0.565	0
	FeF2+	4.66E-16	3.36E-16	-15.332	-15.473	-0.141	0
	FeF+2	1.59E-16	4.32E-17	-15.799	-16.364	-0.565	0
	FeF3	9.81E-17	1.04E-16	-16.008	-15.982	0.026	0
	FeSO4+	5.87E-18	4.24E-18	-17.231	-17.372	-0.141	0
	FeCl+2	1.82E-18	4.94E-19	-17.741	-18.306	-0.565	0
	Fe+3	1.20E-18	1.40E-19	-17.922	-18.855	-0.933	0
	FeCl2+	3.58E-19	2.59E-19	-18.446	-18.588	-0.141	0
	Fe(SO4)2-	3.49E-19	2.57E-19	-18.457	-18.59	-0.132	0
	FeCl3	2.85E-21	3.03E-21	-20.545	-20.519	0.026	0
	Fe2(OH)2+	2.36E-22	1.80E-24	-21.628	-23.746	-2.118	0
	FeHSO4+2	1.33E-25	3.94E-26	-24.875	-25.405	-0.529	0
	Fe3(OH)4+	1.87E-26	9.20E-30	-25.727	-29.036	-3.309	0
H(0)	1.60E-28						
	H2	8.02E-29	8.51E-29	-28.096	-28.07	0.026	28.61
K	2.30E-03						
	K+	2.26E-03	1.56E-03	-2.646	-2.806	-0.16	9.39
	KSO4-	4.17E-05	3.04E-05	-4.38	-4.517	-0.136	34.55
Mg	3.70E-02						

	Mg+2	2.94E-02	9.52E-03	-1.532	-2.021	-0.489	-20.83
	MgSO4	5.83E-03	6.18E-03	-2.235	-2.209	0.026	5.84
	MgHCO3+	9.64E-04	6.74E-04	-3.016	-3.172	-0.155	5.74
	MgCO3	7.00E-04	7.43E-04	-3.155	-3.129	0.026	-17.09
	MgF+	1.73E-04	1.23E-04	-3.762	-3.91	-0.148	-10.33
	MgOH+	1.32E-05	9.90E-06	-4.88	-5.004	-0.124	0
Mn(2)	2.00E-07						
	MnCO3	1.08E-07	1.15E-07	-6.966	-6.94	0.026	0
	Mn+2	5.82E-08	1.77E-08	-7.235	-7.753	-0.518	-17.3
	MnHCO3+	1.32E-08	9.52E-09	-7.88	-8.022	-0.141	0
	MnCl+	1.17E-08	8.43E-09	-7.933	-8.074	-0.141	-2.86
	MnSO4	8.20E-09	8.70E-09	-8.086	-8.06	0.026	22.54
	MnCl2	4.06E-10	4.31E-10	-9.392	-9.366	0.026	85.89
	MnOH+	1.80E-10	1.30E-10	-9.745	-9.886	-0.141	0
	MnF+	3.31E-11	2.39E-11	-10.481	-10.622	-0.141	0
	MnCl3-	1.93E-11	1.39E-11	-10.716	-10.857	-0.141	44.45
	Mn(NO3)2	1.32E-15	1.40E-15	-14.88	-14.854	0.026	41.04
	Mn(OH)3-	9.11E-18	6.58E-18	-17.04	-17.182	-0.141	0
Mn(3)	4.67E-29						
	Mn+3	4.67E-29	5.46E-30	-28.331	-29.263	-0.933	0
N(-3)	2.50E-05						
	NH4+	2.21E-05	1.45E-05	-4.656	-4.839	-0.183	18.28
	NH3	2.24E-06	2.38E-06	-5.65	-5.624	0.026	24.42
	NH4SO4-	7.01E-07	5.17E-07	-6.154	-6.287	-0.132	38.69
N(5)	2.10E-04						
	NO3-	2.10E-04	1.41E-04	-3.678	-3.851	-0.173	29.96
	Mn(NO3)2	1.32E-15	1.40E-15	-14.88	-14.854	0.026	41.04
Na	1.62E-01						
	Na+	1.59E-01	1.17E-01	-0.799	-0.932	-0.133	-0.86
	NaSO4-	2.22E-03	1.63E-03	-2.653	-2.789	-0.136	18.15
	NaHCO3	3.75E-04	3.98E-04	-3.426	-3.4	0.026	1.8
	NaCO3-	2.42E-04	1.78E-04	-3.617	-3.749	-0.132	0.63
	NaF	1.24E-05	1.32E-05	-4.907	-4.881	0.026	7.26
	NaOH	3.20E-17	3.39E-17	-16.495	-16.469	0.026	0
O(0)	1.07E-36						
	O2	5.35E-37	5.68E-37	-36.272	-36.246	0.026	30.4
S(6)	1.91E-02						
	SO4-2	1.04E-02	2.77E-03	-1.982	-2.557	-0.576	16.31
	MgSO4	5.83E-03	6.18E-03	-2.235	-2.209	0.026	5.84
	NaSO4-	2.22E-03	1.63E-03	-2.653	-2.789	-0.136	18.15
	CaSO4	5.28E-04	5.60E-04	-3.278	-3.252	0.026	7.5
	KSO4-	4.17E-05	3.04E-05	-4.38	-4.517	-0.136	34.55
	NH4SO4-	7.01E-07	5.17E-07	-6.154	-6.287	-0.132	38.69
	BaSO4	5.66E-07	6.00E-07	-6.247	-6.222	0.026	0
	MnSO4	8.20E-09	8.70E-09	-8.086	-8.06	0.026	22.54
	ZnSO4	6.72E-09	7.13E-09	-8.173	-8.147	0.026	21.71
	HSO4-	1.27E-09	9.34E-10	-8.897	-9.03	-0.132	40.7
	Zn(SO4)2-2	5.43E-10	1.61E-10	-9.265	-9.794	-0.529	-9.42
	FeSO4	6.79E-11	7.21E-11	-10.168	-10.142	0.026	18.97
	CuSO4	2.99E-11	3.17E-11	-10.525	-10.499	0.026	13.09

	CaHSO4+	1.73E-11	1.28E-11	-10.762	-10.894	-0.132	0
	FeSO4+	5.87E-18	4.24E-18	-17.231	-17.372	-0.141	0
	FeHSO4+	2.23E-18	1.64E-18	-17.652	-17.785	-0.132	0
	Fe(SO4)2-	3.49E-19	2.57E-19	-18.457	-18.59	-0.132	0
	FeHSO4+2	1.33E-25	3.94E-26	-24.875	-25.405	-0.529	0
Zn	1.32E-06						
	Zn(CO3)2-2	1.06E-06	3.13E-07	-5.975	-6.504	-0.529	0
	ZnCO3	1.69E-07	1.79E-07	-6.773	-6.747	0.026	0
	Zn+2	4.04E-08	1.10E-08	-7.394	-7.96	-0.565	-24.41
	ZnOHCl	1.15E-08	1.22E-08	-7.94	-7.914	0.026	0
	ZnHCO3+	1.13E-08	8.36E-09	-7.946	-8.078	-0.132	0
	Zn(OH)2	1.07E-08	1.13E-08	-7.971	-7.945	0.026	0
	ZnSO4	6.72E-09	7.13E-09	-8.173	-8.147	0.026	21.71
	ZnCl+	4.95E-09	3.46E-09	-8.305	-8.461	-0.155	-14.56
	ZnOH+	4.68E-09	3.45E-09	-8.33	-8.462	-0.132	0
	Zn(SO4)2-2	5.43E-10	1.61E-10	-9.265	-9.794	-0.529	-9.42
	ZnCl2	4.00E-10	4.25E-10	-9.398	-9.372	0.026	102.03
	ZnCl3-	7.98E-11	5.58E-11	-10.098	-10.253	-0.155	15.43
	ZnF+	4.11E-11	3.03E-11	-10.386	-10.519	-0.132	0
	Zn(OH)3-	1.39E-11	1.03E-11	-10.856	-10.988	-0.132	0
	ZnCl4-2	1.20E-11	3.28E-12	-10.919	-11.485	-0.565	147.8
	Zn(OH)4-2	1.58E-15	4.67E-16	-14.802	-15.331	-0.529	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-1.22	-5.5	-4.28	CaSO4			
Aragonite	1.3	-7.03	-8.34	CaCO3			
Barite	0.92	-8.92	-9.84	BaSO4			
Calcite	1.45	-7.03	-8.48	CaCO3			
CO2(g)	-2.86	-4.32	-1.47	CO2			
Dolomite	3.94	-13.14	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.63	6.52	4.89	Fe(OH)3			
Fluorite	0.24	-10.36	-10.6	CaF2			
Goethite	7.52	6.52	-1	FeOOH			
Gypsum	-0.93	-5.51	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	0	1.5	H2O			
Halite	-3.43	-1.86	1.57	NaCl			
Hausmann	-8.62	52.41	61.03	Mn3O4			
Hematite	17.05	13.04	-4.01	Fe2O3			
Jarosite-K	-4.53	-13.74	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.72	21.62	25.34	MnOOH			
Melanterit	-10.2	-12.41	-2.21	FeSO4:7H2O			
NH3(g)	-7.42	-5.62	1.8	NH3			
O2(g)	-33.35	-36.25	-2.89	O2			
Pyrochroit	-6.04	9.16	15.2	Mn(OH)2			
Pyrolusite	-7.3	34.08	41.38	MnO2:H2O			
Rhodochro	-0.71	-11.84	-11.13	MnCO3			

Siderite	-3.03	-13.92	-10.89	FeCO3
Smithsonit	-2.05	-12.05	-10	ZnCO3
Sylvite	-4.64	-3.74	0.9	KCl
Witherite	-1.89	-10.45	-8.56	BaCO3
Zn(OH)2(e	-2.55	8.95	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 16

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.34E-02	1.34E-02
Ba	2.42E-06	2.42E-06
Ca	4.89E-03	4.89E-03
Cl	1.79E-01	1.79E-01
Cu	1.60E-07	1.60E-07
F	5.10E-04	5.10E-04
Fe	1.29E-06	1.29E-06
K	2.46E-03	2.46E-03
Mg	3.95E-02	3.95E-02
Mn	2.20E-07	2.20E-07
N(-3)	2.70E-05	2.70E-05
N(5)	2.30E-04	2.30E-04
Na	1.73E-01	1.73E-01
S(6)	2.03E-02	2.03E-02
Zn	1.41E-06	1.41E-06

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 21407
Density (g/cm³) = 1.00829
Volume (L) = 1.00594
Activity of water = 0.993
Ionic strength (mol/kgw) = 2.75E-01
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 1.19E-02
Total CO2 (mol/kg) = 1.19E-02
Temperatu (°C) = 25
Electrical balance (eq) = 2.98E-02
Percent error, 100*(Cat-|= 6.5
Iterations = 10 (153 overall)
Total H = 1.11E+02
Total O = 5.56E+01

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4352	0.2624		

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.26E-06	2.90E-06	-5.371	-5.538	-0.167	-3.34
	H+	4.42E-09	3.47E-09	-8.355	-8.46	-0.105	0
	H2O	5.55E+01	9.93E-01	1.744	-0.003	0	18.07
Ba	2.42E-06						
	Ba+2	1.76E-06	4.51E-07	-5.755	-6.346	-0.592	-11.57
	BaSO4	6.05E-07	6.44E-07	-6.219	-6.191	0.028	0
	BaHCO3+	3.72E-08	2.73E-08	-7.43	-7.563	-0.133	0
	BaCO3	1.87E-08	1.99E-08	-7.728	-7.701	0.028	-10.7
	BaOH+	6.09E-12	4.37E-12	-11.215	-11.359	-0.144	0
C(4)	1.19E-02						
	HCO3-	8.70E-03	6.33E-03	-2.06	-2.199	-0.139	25.78
	MgHCO3+	1.07E-03	7.40E-04	-2.973	-3.131	-0.158	5.74
	MgCO3	7.66E-04	8.16E-04	-3.116	-3.088	0.028	-17.09
	NaHCO3	4.15E-04	4.42E-04	-3.382	-3.354	0.028	1.8
	CO3-2	3.07E-04	8.56E-05	-3.513	-4.068	-0.554	-3.28
	NaCO3-	2.69E-04	1.98E-04	-3.57	-3.703	-0.133	0.73
	CaCO3	1.61E-04	1.71E-04	-3.794	-3.766	0.028	-14.6
	CaHCO3+	1.30E-04	9.61E-05	-3.886	-4.017	-0.132	9.9
	CO2	4.66E-05	4.97E-05	-4.331	-4.304	0.028	34.43
	Zn(CO3)2-2	1.15E-06	3.35E-07	-5.941	-6.474	-0.534	0
	ZnCO3	1.72E-07	1.83E-07	-6.764	-6.737	0.028	0
	MnCO3	1.20E-07	1.27E-07	-6.923	-6.895	0.028	0
	BaHCO3+	3.72E-08	2.73E-08	-7.43	-7.563	-0.133	0
	CuCO3	2.48E-08	2.65E-08	-7.605	-7.577	0.028	0
	BaCO3	1.87E-08	1.99E-08	-7.728	-7.701	0.028	-10.7
	MnHCO3+	1.47E-08	1.06E-08	-7.832	-7.976	-0.144	0
	ZnHCO3+	1.16E-08	8.55E-09	-7.934	-8.068	-0.133	0
	Cu(CO3)2-	9.74E-09	2.85E-09	-8.012	-8.545	-0.534	0
	FeCO3	3.01E-10	3.21E-10	-9.521	-9.494	0.028	0
	CuHCO3+	2.48E-10	1.83E-10	-9.605	-9.739	-0.133	0
	FeHCO3+	1.34E-10	9.89E-11	-9.871	-10.005	-0.133	0
	(CO2)2	4.25E-11	4.53E-11	-10.372	-10.344	0.028	68.87
Ca	4.89E-03						
	Ca+2	4.03E-03	1.19E-03	-2.394	-2.924	-0.53	-17.09
	CaSO4	5.67E-04	6.04E-04	-3.246	-3.219	0.028	7.5
	CaCO3	1.61E-04	1.71E-04	-3.794	-3.766	0.028	-14.6
	CaHCO3+	1.30E-04	9.61E-05	-3.886	-4.017	-0.132	9.9
	CaOH+	7.70E-08	5.66E-08	-7.114	-7.247	-0.133	0
	CaHSO4+	1.87E-11	1.38E-11	-10.728	-10.861	-0.133	0

Cl	1.79E-01						
	Cl-	1.79E-01	1.24E-01	-0.746	-0.906	-0.16	18.53
	CuCl2-	2.12E-08	1.47E-08	-7.674	-7.832	-0.158	0
	MnCl+	1.32E-08	9.47E-09	-7.88	-8.023	-0.144	-2.85
	ZnOHCl	1.19E-08	1.26E-08	-7.926	-7.898	0.028	0
	CuCl3-2	1.09E-08	2.90E-09	-7.963	-8.538	-0.575	0
	ZnCl+	5.17E-09	3.59E-09	-8.287	-8.445	-0.158	-14.61
	MnCl2	4.82E-10	5.13E-10	-9.317	-9.29	0.028	85.89
	ZnCl2	4.38E-10	4.66E-10	-9.359	-9.331	0.028	102.03
	ZnCl3-	9.35E-11	6.50E-11	-10.029	-10.187	-0.158	15.31
	FeCl+	3.64E-11	2.68E-11	-10.439	-10.572	-0.133	0
	CuCl+	2.77E-11	1.92E-11	-10.557	-10.716	-0.158	1.27
	MnCl3-	2.44E-11	1.76E-11	-10.612	-10.756	-0.144	44.51
	ZnCl4-2	1.52E-11	4.04E-12	-10.819	-11.394	-0.575	147.91
	CuCl2	1.20E-12	1.28E-12	-11.92	-11.892	0.028	31.02
	CuCl3-	8.13E-16	5.65E-16	-15.09	-15.248	-0.158	0
	FeCl+2	2.10E-18	5.60E-19	-17.677	-18.252	-0.575	0
	CuCl4-2	1.32E-18	3.51E-19	-17.879	-18.454	-0.575	0
	FeCl2+	4.32E-19	3.10E-19	-18.365	-18.508	-0.144	0
	FeCl3	3.61E-21	3.85E-21	-20.442	-20.414	0.028	0
Cu(1)	3.21E-08						
	CuCl2-	2.12E-08	1.47E-08	-7.674	-7.832	-0.158	0
	CuCl3-2	1.09E-08	2.90E-09	-7.963	-8.538	-0.575	0
	Cu+	4.65E-12	3.02E-12	-11.333	-11.52	-0.187	0
Cu(2)	1.28E-07						
	Cu(OH)2	9.26E-08	9.87E-08	-7.033	-7.006	0.028	0
	CuCO3	2.48E-08	2.65E-08	-7.605	-7.577	0.028	0
	Cu(CO3)2-	9.74E-09	2.85E-09	-8.012	-8.545	-0.534	0
	CuHCO3+	2.48E-10	1.83E-10	-9.605	-9.739	-0.133	0
	CuOH+	2.38E-10	1.65E-10	-9.624	-9.783	-0.158	0
	Cu+2	1.94E-10	5.76E-11	-9.713	-10.24	-0.526	-25.65
	CuSO4	3.15E-11	3.35E-11	-10.502	-10.475	0.028	13.09
	CuCl+	2.77E-11	1.92E-11	-10.557	-10.716	-0.158	1.27
	Cu(OH)3-	2.31E-12	1.70E-12	-11.636	-11.769	-0.133	0
	CuCl2	1.20E-12	1.28E-12	-11.92	-11.892	0.028	31.02
	CuF+	2.94E-13	2.16E-13	-12.531	-12.665	-0.133	0
	Cu2(OH)2+	4.07E-14	1.19E-14	-13.391	-13.925	-0.534	0
	CuCl3-	8.13E-16	5.65E-16	-15.09	-15.248	-0.158	0
	Cu(OH)4-2	3.32E-16	9.73E-17	-15.479	-16.012	-0.534	0
	CuCl4-2	1.32E-18	3.51E-19	-17.879	-18.454	-0.575	0
F	5.10E-04						
	F-	3.03E-04	2.07E-04	-3.518	-3.685	-0.167	-0.85
	MgF+	1.93E-04	1.36E-04	-3.715	-3.865	-0.151	-10.32
	NaF	1.39E-05	1.48E-05	-4.858	-4.831	0.028	7.26
	HF	1.01E-09	1.07E-09	-8.997	-8.969	0.028	12.5
	ZnF+	4.26E-11	3.13E-11	-10.371	-10.504	-0.133	0
	MnF+	3.73E-11	2.68E-11	-10.429	-10.572	-0.144	0
	HF2-	1.16E-12	8.51E-13	-11.937	-12.07	-0.133	22.53
	FeF+	4.39E-13	3.23E-13	-12.358	-12.491	-0.133	0
	CuF+	2.94E-13	2.16E-13	-12.531	-12.665	-0.133	0

	FeF2+	5.59E-16	4.02E-16	-15.252	-15.396	-0.144	0
	FeF+2	1.84E-16	4.89E-17	-15.736	-16.311	-0.575	0
	FeF3	1.23E-16	1.31E-16	-15.909	-15.881	0.028	0
Fe(2)	1.09E-09						
	Fe+2	5.25E-10	1.56E-10	-9.28	-9.806	-0.526	-21.13
	FeCO3	3.01E-10	3.21E-10	-9.521	-9.494	0.028	0
	FeHCO3+	1.34E-10	9.89E-11	-9.871	-10.005	-0.133	0
	FeSO4	7.44E-11	7.93E-11	-10.128	-10.101	0.028	18.97
	FeCl+	3.64E-11	2.68E-11	-10.439	-10.572	-0.133	0
	FeOH+	1.97E-11	1.42E-11	-10.705	-10.849	-0.144	0
	FeF+	4.39E-13	3.23E-13	-12.358	-12.491	-0.133	0
	Fe(OH)2	3.24E-14	3.45E-14	-13.49	-13.462	0.028	0
	Fe(OH)3-	5.11E-16	3.67E-16	-15.292	-15.435	-0.144	0
	FeHSO4+	2.46E-18	1.81E-18	-17.61	-17.743	-0.133	0
Fe(3)	1.29E-06						
	Fe(OH)3	9.06E-07	9.65E-07	-6.043	-6.015	0.028	0
	Fe(OH)4-	3.47E-07	2.52E-07	-6.46	-6.598	-0.139	0
	Fe(OH)2+	3.60E-08	2.62E-08	-7.444	-7.582	-0.139	0
	FeOH+2	1.04E-12	2.76E-13	-11.984	-12.559	-0.575	0
	FeF2+	5.59E-16	4.02E-16	-15.252	-15.396	-0.144	0
	FeF+2	1.84E-16	4.89E-17	-15.736	-16.311	-0.575	0
	FeF3	1.23E-16	1.31E-16	-15.909	-15.881	0.028	0
	FeSO4+	6.50E-18	4.67E-18	-17.187	-17.331	-0.144	0
	FeCl+2	2.10E-18	5.60E-19	-17.677	-18.252	-0.575	0
	Fe+3	1.31E-18	1.49E-19	-17.882	-18.826	-0.944	0
	FeCl2+	4.32E-19	3.10E-19	-18.365	-18.508	-0.144	0
	Fe(SO4)2-	3.96E-19	2.91E-19	-18.402	-18.536	-0.133	0
	FeCl3	3.61E-21	3.85E-21	-20.442	-20.414	0.028	0
	Fe2(OH)2+	2.79E-22	2.05E-24	-21.554	-23.688	-2.134	0
	FeHSO4+2	1.48E-25	4.33E-26	-24.83	-25.363	-0.534	0
	Fe3(OH)4+	2.42E-26	1.12E-29	-25.616	-28.95	-3.335	0
H(0)	1.60E-28						
	H2	7.99E-29	8.51E-29	-28.098	-28.07	0.028	28.61
K	2.46E-03						
	K+	2.41E-03	1.66E-03	-2.617	-2.78	-0.163	9.4
	KSO4-	4.58E-05	3.33E-05	-4.34	-4.478	-0.139	34.57
Mg	3.95E-02						
	Mg+2	3.12E-02	9.99E-03	-1.506	-2	-0.494	-20.81
	MgSO4	6.27E-03	6.68E-03	-2.203	-2.175	0.028	5.84
	MgHCO3+	1.07E-03	7.40E-04	-2.973	-3.131	-0.158	5.74
	MgCO3	7.66E-04	8.16E-04	-3.116	-3.088	0.028	-17.09
	MgF+	1.93E-04	1.36E-04	-3.715	-3.865	-0.151	-10.32
	MgOH+	1.39E-05	1.04E-05	-4.857	-4.984	-0.126	0
Mn(2)	2.20E-07						
	MnCO3	1.20E-07	1.27E-07	-6.923	-6.895	0.028	0
	Mn+2	6.29E-08	1.87E-08	-7.201	-7.727	-0.526	-17.24
	MnHCO3+	1.47E-08	1.06E-08	-7.832	-7.976	-0.144	0
	MnCl+	1.32E-08	9.47E-09	-7.88	-8.023	-0.144	-2.85
	MnSO4	8.92E-09	9.50E-09	-8.05	-8.022	0.028	22.54
	MnCl2	4.82E-10	5.13E-10	-9.317	-9.29	0.028	85.89

	MnOH+	1.92E-10	1.38E-10	-9.717	-9.86	-0.144	0
	MnF+	3.73E-11	2.68E-11	-10.429	-10.572	-0.144	0
	MnCl3-	2.44E-11	1.76E-11	-10.612	-10.756	-0.144	44.51
	Mn(NO3)2	1.64E-15	1.75E-15	-14.784	-14.757	0.028	41.04
	Mn(OH)3-	9.71E-18	6.97E-18	-17.013	-17.157	-0.144	0
Mn(3)	5.09E-29						
	Mn+3	5.09E-29	5.79E-30	-28.293	-29.237	-0.944	0
N(-3)	2.70E-05						
	NH4+	2.38E-05	1.55E-05	-4.623	-4.81	-0.187	18.29
	NH3	2.39E-06	2.55E-06	-5.622	-5.594	0.028	24.42
	NH4SO4-	7.74E-07	5.69E-07	-6.111	-6.245	-0.133	38.74
N(5)	2.30E-04						
	NO3-	2.30E-04	1.53E-04	-3.638	-3.815	-0.176	29.98
	Mn(NO3)2	1.64E-15	1.75E-15	-14.784	-14.757	0.028	41.04
Na	1.73E-01						
	Na+	1.70E-01	1.24E-01	-0.771	-0.905	-0.135	-0.84
	NaSO4-	2.45E-03	1.78E-03	-2.612	-2.75	-0.139	18.3
	NaHCO3	4.15E-04	4.42E-04	-3.382	-3.354	0.028	1.8
	NaCO3-	2.69E-04	1.98E-04	-3.57	-3.703	-0.133	0.73
	NaF	1.39E-05	1.48E-05	-4.858	-4.831	0.028	7.26
	NaOH	3.38E-17	3.60E-17	-16.471	-16.443	0.028	0
O(0)	1.07E-36						
	O2	5.32E-37	5.67E-37	-36.274	-36.246	0.028	30.4
S(6)	2.03E-02						
	SO4-2	1.10E-02	2.85E-03	-1.959	-2.545	-0.586	16.37
	MgSO4	6.27E-03	6.68E-03	-2.203	-2.175	0.028	5.84
	NaSO4-	2.45E-03	1.78E-03	-2.612	-2.75	-0.139	18.3
	CaSO4	5.67E-04	6.04E-04	-3.246	-3.219	0.028	7.5
	KSO4-	4.58E-05	3.33E-05	-4.34	-4.478	-0.139	34.57
	NH4SO4-	7.74E-07	5.69E-07	-6.111	-6.245	-0.133	38.74
	BaSO4	6.05E-07	6.44E-07	-6.219	-6.191	0.028	0
	MnSO4	8.92E-09	9.50E-09	-8.05	-8.022	0.028	22.54
	ZnSO4	6.74E-09	7.18E-09	-8.171	-8.144	0.028	21.71
	HSO4-	1.31E-09	9.61E-10	-8.884	-9.017	-0.133	40.72
	Zn(SO4)2-2	5.69E-10	1.66E-10	-9.245	-9.779	-0.534	-9.23
	FeSO4	7.44E-11	7.93E-11	-10.128	-10.101	0.028	18.97
	CuSO4	3.15E-11	3.35E-11	-10.502	-10.475	0.028	13.09
	CaHSO4+	1.87E-11	1.38E-11	-10.728	-10.861	-0.133	0
	FeSO4+	6.50E-18	4.67E-18	-17.187	-17.331	-0.144	0
	FeHSO4+	2.46E-18	1.81E-18	-17.61	-17.743	-0.133	0
	Fe(SO4)2-	3.96E-19	2.91E-19	-18.402	-18.536	-0.133	0
	FeHSO4+2	1.48E-25	4.33E-26	-24.83	-25.363	-0.534	0
Zn	1.41E-06						
	Zn(CO3)2-2	1.15E-06	3.35E-07	-5.941	-6.474	-0.534	0
	ZnCO3	1.72E-07	1.83E-07	-6.764	-6.737	0.028	0
	Zn+2	4.04E-08	1.07E-08	-7.394	-7.969	-0.575	-24.39
	ZnOHCl	1.19E-08	1.26E-08	-7.926	-7.898	0.028	0
	ZnHCO3+	1.16E-08	8.55E-09	-7.934	-8.068	-0.133	0
	Zn(OH)2	1.04E-08	1.11E-08	-7.983	-7.955	0.028	0
	ZnSO4	6.74E-09	7.18E-09	-8.171	-8.144	0.028	21.71

ZnCl+	5.17E-09	3.59E-09	-8.287	-8.445	-0.158	-14.61
ZnOH+	4.59E-09	3.37E-09	-8.339	-8.472	-0.133	0
Zn(SO4)2-2	5.69E-10	1.66E-10	-9.245	-9.779	-0.534	-9.23
ZnCl2	4.38E-10	4.66E-10	-9.359	-9.331	0.028	102.03
ZnCl3-	9.35E-11	6.50E-11	-10.029	-10.187	-0.158	15.31
ZnF+	4.26E-11	3.13E-11	-10.371	-10.504	-0.133	0
ZnCl4-2	1.52E-11	4.04E-12	-10.819	-11.394	-0.575	147.91
Zn(OH)3-	1.37E-11	1.00E-11	-10.865	-10.998	-0.133	0
Zn(OH)4-2	1.56E-15	4.56E-16	-14.808	-15.341	-0.534	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)
Anhydrite	-1.19	-5.47	-4.28 CaSO4
Aragonite	1.34	-6.99	-8.34 CaCO3
Barite	0.95	-8.89	-9.84 BaSO4
Calcite	1.49	-6.99	-8.48 CaCO3
CO2(g)	-2.84	-4.3	-1.47 CO2
Dolomite	4.02	-13.06	-17.08 CaMg(CO3)2
Fe(OH)3(a)	1.65	6.54	4.89 Fe(OH)3
Fluorite	0.31	-10.29	-10.6 CaF2
Goethite	7.55	6.55	-1 FeOOH
Gypsum	-0.89	-5.48	-4.58 CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1 H2
H2O(g)	-1.51	0	1.5 H2O
Halite	-3.38	-1.81	1.57 NaCl
Hausmann	-8.54	52.49	61.03 Mn3O4
Hematite	17.11	13.1	-4.01 Fe2O3
Jarosite-K	-4.4	-13.61	-9.21 KFe3(SO4)2(OH)6
Manganite	-3.69	21.65	25.34 MnOOH
Melanterit	-10.16	-12.37	-2.21 FeSO4:7H2O
NH3(g)	-7.39	-5.59	1.8 NH3
O2(g)	-33.35	-36.25	-2.89 O2
Pyrochroit	-6.01	9.19	15.2 Mn(OH)2
Pyrolusite	-7.28	34.1	41.38 MnO2:H2O
Rhodochro	-0.67	-11.8	-11.13 MnCO3
Siderite	-2.98	-13.87	-10.89 FeCO3
Smithsonit	-2.04	-12.04	-10 ZnCO3
Sylvite	-4.59	-3.69	0.9 KCl
Witherite	-1.85	-10.41	-8.56 BaCO3
Zn(OH)2(e	-2.56	8.94	11.5 Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 17

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.42E-02	1.42E-02
Ba	2.57E-06	2.57E-06
Ca	5.20E-03	5.20E-03
Cl	1.91E-01	1.91E-01
Cu	1.70E-07	1.70E-07
F	5.40E-04	5.40E-04
Fe	1.37E-06	1.37E-06
K	2.61E-03	2.61E-03
Mg	4.20E-02	4.20E-02
Mn	2.30E-07	2.30E-07
N(-3)	2.80E-05	2.80E-05
N(5)	2.40E-04	2.40E-04
Na	1.83E-01	1.83E-01
S(6)	2.16E-02	2.16E-02
Zn	1.49E-06	1.49E-06

#NAME? of solution----------

pH	=	8.46			
pe	=	4			
Specific	Conductan	(µS/cm,	25°C)	=	22579
Density	(g/cm³)	=	1.00898		
Volume	(L)	=	1.00614		
Activity	of	water	=	0.992	
Ionic	strength	(mol/kgw)	=	2.92E-01	
Mass	of	water	(kg)	=	1.00E+00
Total	carbon	(mol/kg)	=	1.26E-02	
Total	CO2	(mol/kg)	=	1.26E-02	
Temperatu	(°C)	=	25		
Electrical	balance	(eq)	=	3.16E-02	
Percent	error,	100*(Cat-|	=	6.51	
Iterations	=	10	(163	overall)	
Total	H	=	1.11E+02		
Total	O	=	5.56E+01		

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4356	0.2624		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.29E-06	2.90E-06	-5.368	-5.538	-0.17	-3.31
H+	4.43E-09	3.47E-09	-8.354	-8.46	-0.106	0

	H2O	5.55E+01	9.92E-01	1.744	-0.003	0	18.07
Ba	2.57E-06						
	Ba+2	1.87E-06	4.69E-07	-5.729	-6.329	-0.6	-11.54
	BaSO4	6.43E-07	6.88E-07	-6.192	-6.162	0.029	0
	BaHCO3+	4.04E-08	2.96E-08	-7.394	-7.528	-0.134	0
	BaCO3	2.02E-08	2.16E-08	-7.695	-7.665	0.029	-10.7
	BaOH+	6.36E-12	4.55E-12	-11.196	-11.342	-0.146	0
C(4)	1.26E-02						
	HCO3-	9.12E-03	6.60E-03	-2.04	-2.181	-0.141	25.83
	MgHCO3+	1.17E-03	8.07E-04	-2.932	-3.093	-0.161	5.75
	MgCO3	8.33E-04	8.90E-04	-3.08	-3.05	0.029	-17.09
	NaHCO3	4.56E-04	4.88E-04	-3.341	-3.311	0.029	1.8
	CO3-2	3.26E-04	8.92E-05	-3.487	-4.05	-0.563	-3.21
	NaCO3-	2.98E-04	2.19E-04	-3.526	-3.66	-0.134	0.82
	CaCO3	1.75E-04	1.87E-04	-3.758	-3.729	0.029	-14.6
	CaHCO3+	1.43E-04	1.05E-04	-3.846	-3.98	-0.133	9.9
	CO2	4.85E-05	5.18E-05	-4.315	-4.286	0.029	34.43
	Zn(CO3)2-2	1.22E-06	3.55E-07	-5.912	-6.449	-0.537	0
	ZnCO3	1.74E-07	1.86E-07	-6.759	-6.73	0.029	0
	MnCO3	1.26E-07	1.34E-07	-6.901	-6.872	0.029	0
	BaHCO3+	4.04E-08	2.96E-08	-7.394	-7.528	-0.134	0
	CuCO3	2.64E-08	2.82E-08	-7.579	-7.55	0.029	0
	BaCO3	2.02E-08	2.16E-08	-7.695	-7.665	0.029	-10.7
	MnHCO3+	1.56E-08	1.11E-08	-7.807	-7.953	-0.146	0
	ZnHCO3+	1.18E-08	8.69E-09	-7.927	-8.061	-0.134	0
	Cu(CO3)2-	1.09E-08	3.17E-09	-7.962	-8.499	-0.537	0
	FeCO3	3.33E-10	3.56E-10	-9.477	-9.448	0.029	0
	CuHCO3+	2.65E-10	1.95E-10	-9.576	-9.711	-0.134	0
	FeHCO3+	1.50E-10	1.10E-10	-9.825	-9.959	-0.134	0
	(CO2)2	4.61E-11	4.93E-11	-10.336	-10.307	0.029	68.87
Ca	5.20E-03						
	Ca+2	4.28E-03	1.25E-03	-2.369	-2.905	-0.536	-17.07
	CaSO4	6.06E-04	6.49E-04	-3.217	-3.188	0.029	7.5
	CaCO3	1.75E-04	1.87E-04	-3.758	-3.729	0.029	-14.6
	CaHCO3+	1.43E-04	1.05E-04	-3.846	-3.98	-0.133	9.9
	CaOH+	8.06E-08	5.91E-08	-7.094	-7.228	-0.134	0
	CaHSO4+	2.01E-11	1.48E-11	-10.696	-10.83	-0.134	0
Cl	1.91E-01						
	Cl-	1.91E-01	1.31E-01	-0.72	-0.883	-0.163	18.54
	CuCl2-	2.43E-08	1.68E-08	-7.614	-7.775	-0.161	0
	MnCl+	1.42E-08	1.01E-08	-7.849	-7.995	-0.146	-2.85
	CuCl3-2	1.34E-08	3.49E-09	-7.874	-8.458	-0.584	0
	ZnOHCl	1.22E-08	1.30E-08	-7.915	-7.886	0.029	0
	ZnCl+	5.35E-09	3.69E-09	-8.272	-8.433	-0.161	-14.67
	MnCl2	5.41E-10	5.79E-10	-9.267	-9.238	0.029	85.89
	ZnCl2	4.74E-10	5.07E-10	-9.324	-9.295	0.029	102.03
	ZnCl3-	1.08E-10	7.45E-11	-9.967	-10.128	-0.161	15.2
	FeCl+	4.10E-11	3.01E-11	-10.387	-10.521	-0.134	0
	CuCl+	3.01E-11	2.08E-11	-10.521	-10.683	-0.161	1.3
	MnCl3-	2.92E-11	2.09E-11	-10.534	-10.68	-0.146	44.56

	ZnCl4-2	1.88E-11	4.89E-12	-10.726	-11.31	-0.584	148.03
	CuCl2	1.37E-12	1.46E-12	-11.864	-11.835	0.029	31.02
	CuCl3-	9.85E-16	6.80E-16	-15.006	-15.168	-0.161	0
	FeCl+2	2.42E-18	6.29E-19	-17.617	-18.201	-0.584	0
	CuCl4-2	1.71E-18	4.47E-19	-17.766	-18.35	-0.584	0
	FeCl2+	5.16E-19	3.68E-19	-18.288	-18.434	-0.146	0
	FeCl3	4.51E-21	4.83E-21	-20.345	-20.316	0.029	0
Cu(1)	3.77E-08						
	CuCl2-	2.43E-08	1.68E-08	-7.614	-7.775	-0.161	0
	CuCl3-2	1.34E-08	3.49E-09	-7.874	-8.458	-0.584	0
	Cu+	4.80E-12	3.09E-12	-11.319	-11.51	-0.191	0
Cu(2)	1.32E-07						
	Cu(OH)2	9.42E-08	1.01E-07	-7.026	-6.997	0.029	0
	CuCO3	2.64E-08	2.82E-08	-7.579	-7.55	0.029	0
	Cu(CO3)2-	1.09E-08	3.17E-09	-7.962	-8.499	-0.537	0
	CuHCO3+	2.65E-10	1.95E-10	-9.576	-9.711	-0.134	0
	CuOH+	2.44E-10	1.69E-10	-9.612	-9.773	-0.161	0
	Cu+2	2.01E-10	5.89E-11	-9.696	-10.23	-0.534	-25.64
	CuSO4	3.29E-11	3.52E-11	-10.483	-10.453	0.029	13.09
	CuCl+	3.01E-11	2.08E-11	-10.521	-10.683	-0.161	1.3
	Cu(OH)3-	2.37E-12	1.74E-12	-11.626	-11.76	-0.134	0
	CuCl2	1.37E-12	1.46E-12	-11.864	-11.835	0.029	31.02
	CuF+	3.11E-13	2.28E-13	-12.507	-12.641	-0.134	0
	Cu2(OH)2+	4.28E-14	1.24E-14	-13.369	-13.906	-0.537	0
	CuCl3-	9.85E-16	6.80E-16	-15.006	-15.168	-0.161	0
	Cu(OH)4-2	3.42E-16	9.93E-17	-15.466	-16.003	-0.537	0
	CuCl4-2	1.71E-18	4.47E-19	-17.766	-18.35	-0.584	0
F	5.40E-04						
	F-	3.15E-04	2.13E-04	-3.501	-3.671	-0.17	-0.84
	MgF+	2.10E-04	1.47E-04	-3.679	-3.832	-0.153	-10.32
	NaF	1.51E-05	1.61E-05	-4.821	-4.792	0.029	7.26
	HF	1.04E-09	1.11E-09	-8.984	-8.955	0.029	12.5
	ZnF+	4.29E-11	3.15E-11	-10.367	-10.501	-0.134	0
	MnF+	3.91E-11	2.79E-11	-10.408	-10.554	-0.146	0
	HF2-	1.24E-12	9.07E-13	-11.908	-12.043	-0.134	22.54
	FeF+	4.83E-13	3.55E-13	-12.316	-12.45	-0.134	0
	CuF+	3.11E-13	2.28E-13	-12.507	-12.641	-0.134	0
	FeF2+	6.38E-16	4.56E-16	-15.195	-15.341	-0.146	0
	FeF+2	2.06E-16	5.37E-17	-15.686	-16.27	-0.584	0
	FeF3	1.44E-16	1.54E-16	-15.842	-15.813	0.029	0
Fe(2)	1.20E-09						
	Fe+2	5.69E-10	1.67E-10	-9.245	-9.779	-0.534	-21.11
	FeCO3	3.33E-10	3.56E-10	-9.477	-9.448	0.029	0
	FeHCO3+	1.50E-10	1.10E-10	-9.825	-9.959	-0.134	0
	FeSO4	8.11E-11	8.67E-11	-10.091	-10.062	0.029	18.97
	FeCl+	4.10E-11	3.01E-11	-10.387	-10.521	-0.134	0
	FeOH+	2.11E-11	1.51E-11	-10.676	-10.822	-0.146	0
	FeF+	4.83E-13	3.55E-13	-12.316	-12.45	-0.134	0
	Fe(OH)2	3.43E-14	3.67E-14	-13.465	-13.435	0.029	0
	Fe(OH)3-	5.46E-16	3.90E-16	-15.263	-15.409	-0.146	0

	FeHSO4+	2.69E-18	1.98E-18	-17.57	-17.704	-0.134	0
Fe(3)	1.37E-06						
	Fe(OH)3	9.60E-07	1.03E-06	-6.018	-5.989	0.029	0
	Fe(OH)4-	3.71E-07	2.68E-07	-6.431	-6.572	-0.141	0
	Fe(OH)2+	3.85E-08	2.78E-08	-7.415	-7.555	-0.141	0
	FeOH+2	1.13E-12	2.94E-13	-11.948	-12.532	-0.584	0
	FeF2+	6.38E-16	4.56E-16	-15.195	-15.341	-0.146	0
	FeF+2	2.06E-16	5.37E-17	-15.686	-16.27	-0.584	0
	FeF3	1.44E-16	1.54E-16	-15.842	-15.813	0.029	0
	FeSO4+	7.15E-18	5.11E-18	-17.146	-17.292	-0.146	0
	FeCl+2	2.42E-18	6.29E-19	-17.617	-18.201	-0.584	0
	Fe+3	1.43E-18	1.59E-19	-17.844	-18.799	-0.955	0
	FeCl2+	5.16E-19	3.68E-19	-18.288	-18.434	-0.146	0
	Fe(SO4)2-	4.46E-19	3.27E-19	-18.351	-18.485	-0.134	0
	FeCl3	4.51E-21	4.83E-21	-20.345	-20.316	0.029	0
	Fe2(OH)2+	3.27E-22	2.32E-24	-21.486	-23.634	-2.148	0
	FeHSO4+2	1.63E-25	4.74E-26	-24.787	-25.324	-0.537	0
	Fe3(OH)4+	3.07E-26	1.35E-29	-25.513	-28.869	-3.356	0
H(0)	1.59E-28						
	H2	7.96E-29	8.51E-29	-28.099	-28.07	0.029	28.61
K	2.61E-03						
	K+	2.56E-03	1.75E-03	-2.592	-2.757	-0.166	9.42
	KSO4-	4.98E-05	3.60E-05	-4.303	-4.444	-0.141	34.58
Mg	4.20E-02						
	Mg+2	3.30E-02	1.05E-02	-1.481	-1.981	-0.499	-20.78
	MgSO4	6.71E-03	7.18E-03	-2.173	-2.144	0.029	5.84
	MgHCO3+	1.17E-03	8.07E-04	-2.932	-3.093	-0.161	5.75
	MgCO3	8.33E-04	8.90E-04	-3.08	-3.05	0.029	-17.09
	MgF+	2.10E-04	1.47E-04	-3.679	-3.832	-0.153	-10.32
	MgOH+	1.46E-05	1.09E-05	-4.836	-4.964	-0.128	0
Mn(2)	2.30E-07						
	MnCO3	1.26E-07	1.34E-07	-6.901	-6.872	0.029	0
	Mn+2	6.48E-08	1.89E-08	-7.189	-7.723	-0.534	-17.19
	MnHCO3+	1.56E-08	1.11E-08	-7.807	-7.953	-0.146	0
	MnCl+	1.42E-08	1.01E-08	-7.849	-7.995	-0.146	-2.85
	MnSO4	9.22E-09	9.86E-09	-8.035	-8.006	0.029	22.54
	MnCl2	5.41E-10	5.79E-10	-9.267	-9.238	0.029	85.89
	MnOH+	1.95E-10	1.39E-10	-9.71	-9.856	-0.146	0
	MnF+	3.91E-11	2.79E-11	-10.408	-10.554	-0.146	0
	MnCl3-	2.92E-11	2.09E-11	-10.534	-10.68	-0.146	44.56
	Mn(NO3)2	1.77E-15	1.90E-15	-14.751	-14.722	0.029	41.04
	Mn(OH)3-	9.85E-18	7.04E-18	-17.007	-17.153	-0.146	0
Mn(3)	5.28E-29						
	Mn+3	5.28E-29	5.85E-30	-28.278	-29.233	-0.955	0
N(-3)	2.80E-05						
	NH4+	2.47E-05	1.59E-05	-4.607	-4.798	-0.191	18.3
	NH3	2.45E-06	2.62E-06	-5.611	-5.582	0.029	24.42
	NH4SO4-	8.19E-07	6.01E-07	-6.087	-6.221	-0.134	38.79
N(5)	2.40E-04						
	NO3-	2.40E-04	1.59E-04	-3.62	-3.8	-0.18	30

	Mn(NO3)2	1.77E-15	1.90E-15	-14.751	-14.722	0.029	41.04
Na	1.83E-01						
	Na+	1.80E-01	1.32E-01	-0.745	-0.881	-0.136	-0.82
	NaSO4-	2.67E-03	1.93E-03	-2.573	-2.714	-0.141	18.45
	NaHCO3	4.56E-04	4.88E-04	-3.341	-3.311	0.029	1.8
	NaCO3-	2.98E-04	2.19E-04	-3.526	-3.66	-0.134	0.82
	NaF	1.51E-05	1.61E-05	-4.821	-4.792	0.029	7.26
	NaOH	3.56E-17	3.81E-17	-16.448	-16.419	0.029	0
O(0)	1.06E-36						
	O2	5.30E-37	5.67E-37	-36.276	-36.247	0.029	30.4
S(6)	2.16E-02						
	SO4-2	1.16E-02	2.93E-03	-1.938	-2.533	-0.596	16.43
	MgSO4	6.71E-03	7.18E-03	-2.173	-2.144	0.029	5.84
	NaSO4-	2.67E-03	1.93E-03	-2.573	-2.714	-0.141	18.45
	CaSO4	6.06E-04	6.49E-04	-3.217	-3.188	0.029	7.5
	KSO4-	4.98E-05	3.60E-05	-4.303	-4.444	-0.141	34.58
	NH4SO4-	8.19E-07	6.01E-07	-6.087	-6.221	-0.134	38.79
	BaSO4	6.43E-07	6.88E-07	-6.192	-6.162	0.029	0
	MnSO4	9.22E-09	9.86E-09	-8.035	-8.006	0.029	22.54
	ZnSO4	6.72E-09	7.19E-09	-8.173	-8.143	0.029	21.71
	HSO4-	1.35E-09	9.87E-10	-8.871	-9.005	-0.134	40.73
	Zn(SO4)2-2	5.89E-10	1.71E-10	-9.23	-9.767	-0.537	-9.05
	FeSO4	8.11E-11	8.67E-11	-10.091	-10.062	0.029	18.97
	CuSO4	3.29E-11	3.52E-11	-10.483	-10.453	0.029	13.09
	CaHSO4+	2.01E-11	1.48E-11	-10.696	-10.83	-0.134	0
	FeSO4+	7.15E-18	5.11E-18	-17.146	-17.292	-0.146	0
	FeHSO4+	2.69E-18	1.98E-18	-17.57	-17.704	-0.134	0
	Fe(SO4)2-	4.46E-19	3.27E-19	-18.351	-18.485	-0.134	0
	FeHSO4+2	1.63E-25	4.74E-26	-24.787	-25.324	-0.537	0
Zn	1.49E-06						
	Zn(CO3)2-2	1.22E-06	3.55E-07	-5.912	-6.449	-0.537	0
	ZnCO3	1.74E-07	1.86E-07	-6.759	-6.73	0.029	0
	Zn+2	4.02E-08	1.05E-08	-7.396	-7.98	-0.584	-24.37
	ZnOHCl	1.22E-08	1.30E-08	-7.915	-7.886	0.029	0
	ZnHCO3+	1.18E-08	8.69E-09	-7.927	-8.061	-0.134	0
	Zn(OH)2	1.01E-08	1.08E-08	-7.996	-7.967	0.029	0
	ZnSO4	6.72E-09	7.19E-09	-8.173	-8.143	0.029	21.71
	ZnCl+	5.35E-09	3.69E-09	-8.272	-8.433	-0.161	-14.67
	ZnOH+	4.47E-09	3.29E-09	-8.349	-8.484	-0.134	0
	Zn(SO4)2-2	5.89E-10	1.71E-10	-9.23	-9.767	-0.537	-9.05
	ZnCl2	4.74E-10	5.07E-10	-9.324	-9.295	0.029	102.03
	ZnCl3-	1.08E-10	7.45E-11	-9.967	-10.128	-0.161	15.2
	ZnF+	4.29E-11	3.15E-11	-10.367	-10.501	-0.134	0
	ZnCl4-2	1.88E-11	4.89E-12	-10.726	-11.31	-0.584	148.03
	Zn(OH)3-	1.33E-11	9.77E-12	-10.876	-11.01	-0.134	0
	Zn(OH)4-2	1.53E-15	4.43E-16	-14.816	-15.353	-0.537	0

#NAME? indices----------

Phase SI** log IAP log K(298 K, 1 atm)

Anhydrite	-1.16	-5.44	-4.28	CaSO4
Aragonite	1.38	-6.95	-8.34	CaCO3
Barite	0.98	-8.86	-9.84	BaSO4
Calcite	1.53	-6.95	-8.48	CaCO3
CO2(g)	-2.82	-4.29	-1.47	CO2
Dolomite	4.1	-12.98	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.68	6.57	4.89	Fe(OH)3
Fluorite	0.35	-10.25	-10.6	CaF2
Goethite	7.57	6.57	-1	FeOOH
Gypsum	-0.86	-5.44	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O
Halite	-3.33	-1.76	1.57	NaCl
Hausmann	-8.53	52.5	61.03	Mn3O4
Hematite	17.16	13.15	-4.01	Fe2O3
Jarosite-K	-4.27	-13.48	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.69	21.65	25.34	MnOOH
Melanterit	-10.13	-12.34	-2.21	FeSO4:7H2O
NH3(g)	-7.38	-5.58	1.8	NH3
O2(g)	-33.35	-36.25	-2.89	O2
Pyrochroit	-6.01	9.19	15.2	Mn(OH)2
Pyrolusite	-7.27	34.11	41.38	MnO2:H2O
Rhodochrc	-0.64	-11.77	-11.13	MnCO3
Siderite	-2.94	-13.83	-10.89	FeCO3
Smithsonit	-2.03	-12.03	-10	ZnCO3
Sylvite	-4.54	-3.64	0.9	KCl
Witherite	-1.82	-10.38	-8.56	BaCO3
Zn(OH)2(e	-2.57	8.93	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 18

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.50E-02	1.50E-02
Ba	2.72E-06	2.72E-06
Ca	5.50E-03	5.50E-03
Cl	2.02E-01	2.02E-01
Cu	1.80E-07	1.80E-07
F	5.70E-04	5.70E-04
Fe	1.45E-06	1.45E-06
K	2.76E-03	2.76E-03
Mg	4.44E-02	4.44E-02
Mn	2.50E-07	2.50E-07
N(-3)	3.00E-05	3.00E-05

```
        N(5)        2.50E-04  2.50E-04
        Na          1.94E-01  1.94E-01
        S(6)        2.29E-02  2.29E-02
        Zn          1.58E-06  1.58E-06

#NAME?  of          solution----------------------------

        pH          =                 8.46
        pe          =                    4
        Specific    Conductan (µS/cm,     25°C)      =                23740
        Density     (g/cm³)   =             1.00967
        Volume      (L)       =             1.00633
        Activity    of        water       =                0.992
        Ionic       strength  (mol/kgw)   =            3.09E-01
        Mass        of        water       (kg)       =          1.00E+00
        Total       carbon    (mol/kg)    =            1.33E-02
        Total       CO2       (mol/kg)    =            1.33E-02
        Temperatu   (°C)      =                   25
        Electrical  balance   (eq)        =            3.35E-02
        Percent     error,    100*(Cat-|=                 6.52
        Iterations  =                 10  (173       overall)
        Total       H         =            1.11E+02
        Total       O         =            5.56E+01

#NAME?  couples--------------------------------

        Redox       couple    pe          Eh          (volts)

        N(-3)/N(5)     4.4342     0.2623

#NAME?  of          species----------------------------

        Log         Log       Log         mole        V
        Species     Molality  Activity    Molality    Activity    Gamma    cm³/mol

        OH-         4.31E-06  2.90E-06     -5.365      -5.538     -0.173     -3.28
        H+          4.44E-09  3.47E-09     -8.353      -8.46      -0.107        0
        H2O         5.55E+01  9.92E-01      1.744      -0.003          0     18.07
Ba        2.72E-06
        Ba+2        1.97E-06  4.87E-07     -5.705      -6.313     -0.608    -11.51
        BaSO4       6.82E-07  7.32E-07     -6.166      -6.135      0.031        0
        BaHCO3+     4.37E-08  3.20E-08      -7.36      -7.495     -0.135        0
        BaCO3       2.17E-08  2.33E-08     -7.663      -7.632      0.031     -10.7
        BaOH+       6.63E-12  4.72E-12    -11.178     -11.326     -0.148        0
C(4)      1.33E-02
        HCO3-       9.53E-03  6.86E-03     -2.021      -2.164     -0.143     25.89
        MgHCO3+     1.28E-03  8.77E-04     -2.893      -3.057     -0.164      5.75
        MgCO3       9.01E-04  9.67E-04     -3.045      -3.015      0.031    -17.09
        NaHCO3      4.99E-04  5.36E-04     -3.302      -3.271      0.031       1.8
        CO3-2       3.45E-04  9.28E-05     -3.462      -4.033     -0.571     -3.15
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	NaCO3-	3.27E-04	2.40E-04	-3.485	-3.62	-0.135	0.91
	CaCO3	1.88E-04	2.02E-04	-3.725	-3.695	0.031	-14.6
	CaHCO3+	1.55E-04	1.13E-04	-3.81	-3.945	-0.135	9.91
	CO2	5.02E-05	5.39E-05	-4.299	-4.268	0.031	34.43
	Zn(CO3)2-2	1.31E-06	3.78E-07	-5.883	-6.423	-0.54	0
	ZnCO3	1.78E-07	1.91E-07	-6.751	-6.72	0.031	0
	MnCO3	1.37E-07	1.47E-07	-6.864	-6.833	0.031	0
	BaHCO3+	4.37E-08	3.20E-08	-7.36	-7.495	-0.135	0
	CuCO3	2.78E-08	2.99E-08	-7.556	-7.525	0.031	0
	BaCO3	2.17E-08	2.33E-08	-7.663	-7.632	0.031	-10.7
	MnHCO3+	1.72E-08	1.22E-08	-7.766	-7.914	-0.148	0
	ZnHCO3+	1.21E-08	8.89E-09	-7.916	-8.051	-0.135	0
	Cu(CO3)2-	1.21E-08	3.49E-09	-7.918	-8.457	-0.54	0
	FeCO3	3.66E-10	3.93E-10	-9.436	-9.405	0.031	0
	CuHCO3+	2.81E-10	2.06E-10	-9.551	-9.686	-0.135	0
	FeHCO3+	1.65E-10	1.21E-10	-9.782	-9.917	-0.135	0
	(CO2)2	4.97E-11	5.34E-11	-10.304	-10.273	0.031	68.87
Ca	5.50E-03						
	Ca+2	4.51E-03	1.30E-03	-2.346	-2.887	-0.542	-17.05
	CaSO4	6.45E-04	6.92E-04	-3.191	-3.16	0.031	7.5
	CaCO3	1.88E-04	2.02E-04	-3.725	-3.695	0.031	-14.6
	CaHCO3+	1.55E-04	1.13E-04	-3.81	-3.945	-0.135	9.91
	CaOH+	8.40E-08	6.15E-08	-7.076	-7.211	-0.135	0
	CaHSO4+	2.15E-11	1.58E-11	-10.667	-10.802	-0.135	0
Cl	2.02E-01						
	Cl-	2.02E-01	1.38E-01	-0.695	-0.86	-0.165	18.56
	CuCl2-	2.76E-08	1.89E-08	-7.559	-7.723	-0.164	0
	CuCl3-2	1.62E-08	4.14E-09	-7.79	-8.383	-0.593	0
	MnCl+	1.58E-08	1.12E-08	-7.802	-7.95	-0.148	-2.85
	ZnOHCl	1.25E-08	1.35E-08	-7.902	-7.871	0.031	0
	ZnCl+	5.57E-09	3.82E-09	-8.254	-8.418	-0.164	-14.72
	MnCl2	6.29E-10	6.75E-10	-9.201	-9.171	0.031	85.89
	ZnCl2	5.14E-10	5.52E-10	-9.289	-9.258	0.031	102.03
	ZnCl3-	1.25E-10	8.55E-11	-9.904	-10.068	-0.164	15.08
	FeCl+	4.59E-11	3.36E-11	-10.338	-10.473	-0.135	0
	MnCl3-	3.61E-11	2.57E-11	-10.443	-10.591	-0.148	44.62
	CuCl+	3.25E-11	2.23E-11	-10.489	-10.653	-0.164	1.32
	ZnCl4-2	2.31E-11	5.91E-12	-10.636	-11.228	-0.593	148.14
	CuCl2	1.54E-12	1.65E-12	-11.814	-11.783	0.031	31.02
	CuCl3-	1.18E-15	8.07E-16	-14.929	-15.093	-0.164	0
	FeCl+2	2.75E-18	7.03E-19	-17.56	-18.153	-0.593	0
	CuCl4-2	2.19E-18	5.58E-19	-17.661	-18.253	-0.593	0
	FeCl2+	6.09E-19	4.33E-19	-18.215	-18.363	-0.148	0
	FeCl3	5.57E-21	5.98E-21	-20.254	-20.224	0.031	0
Cu(1)	4.38E-08						
	CuCl2-	2.76E-08	1.89E-08	-7.559	-7.723	-0.164	0
	CuCl3-2	1.62E-08	4.14E-09	-7.79	-8.383	-0.593	0
	Cu+	4.92E-12	3.15E-12	-11.308	-11.502	-0.195	0
Cu(2)	1.36E-07						
	Cu(OH)2	9.55E-08	1.03E-07	-7.02	-6.989	0.031	0

	CuCO3	2.78E-08	2.99E-08	-7.556	-7.525	0.031	0
	Cu(CO3)2-	1.21E-08	3.49E-09	-7.918	-8.457	-0.54	0
	CuHCO3+	2.81E-10	2.06E-10	-9.551	-9.686	-0.135	0
	CuOH+	2.50E-10	1.72E-10	-9.602	-9.766	-0.164	0
	Cu+2	2.08E-10	5.99E-11	-9.681	-10.222	-0.541	-25.62
	CuSO4	3.42E-11	3.68E-11	-10.466	-10.435	0.031	13.09
	CuCl+	3.25E-11	2.23E-11	-10.489	-10.653	-0.164	1.32
	Cu(OH)3-	2.41E-12	1.77E-12	-11.618	-11.753	-0.135	0
	CuCl2	1.54E-12	1.65E-12	-11.814	-11.783	0.031	31.02
	CuF+	3.27E-13	2.40E-13	-12.486	-12.621	-0.135	0
	Cu2(OH)2+	4.46E-14	1.29E-14	-13.351	-13.891	-0.54	0
	CuCl3-	1.18E-15	8.07E-16	-14.929	-15.093	-0.164	0
	Cu(OH)4-2	3.50E-16	1.01E-16	-15.457	-15.996	-0.54	0
	CuCl4-2	2.19E-18	5.58E-19	-17.661	-18.253	-0.593	0
F	5.70E-04						
	F-	3.27E-04	2.20E-04	-3.486	-3.658	-0.173	-0.82
	MgF+	2.27E-04	1.59E-04	-3.645	-3.8	-0.156	-10.31
	NaF	1.63E-05	1.76E-05	-4.787	-4.756	0.031	7.26
	HF	1.06E-09	1.14E-09	-8.973	-8.942	0.031	12.5
	ZnF+	4.36E-11	3.19E-11	-10.361	-10.496	-0.135	0
	MnF+	4.26E-11	3.03E-11	-10.37	-10.519	-0.148	0
	HF2-	1.31E-12	9.62E-13	-11.882	-12.017	-0.135	22.56
	FeF+	5.29E-13	3.88E-13	-12.276	-12.411	-0.135	0
	CuF+	3.27E-13	2.40E-13	-12.486	-12.621	-0.135	0
	FeF2+	7.22E-16	5.13E-16	-15.142	-15.29	-0.148	0
	FeF+2	2.30E-16	5.87E-17	-15.639	-16.231	-0.593	0
	FeF3	1.66E-16	1.79E-16	-15.779	-15.748	0.031	0
Fe(2)	1.30E-09						
	Fe+2	6.14E-10	1.77E-10	-9.212	-9.753	-0.541	-21.09
	FeCO3	3.66E-10	3.93E-10	-9.436	-9.405	0.031	0
	FeHCO3+	1.65E-10	1.21E-10	-9.782	-9.917	-0.135	0
	FeSO4	8.79E-11	9.43E-11	-10.056	-10.025	0.031	18.97
	FeCl+	4.59E-11	3.36E-11	-10.338	-10.473	-0.135	0
	FeOH+	2.25E-11	1.60E-11	-10.648	-10.796	-0.148	0
	FeF+	5.29E-13	3.88E-13	-12.276	-12.411	-0.135	0
	Fe(OH)2	3.63E-14	3.89E-14	-13.441	-13.41	0.031	0
	Fe(OH)3-	5.82E-16	4.14E-16	-15.235	-15.383	-0.148	0
	FeHSO4+	2.93E-18	2.15E-18	-17.533	-17.668	-0.135	0
Fe(3)	1.45E-06						
	Fe(OH)3	1.01E-06	1.09E-06	-5.994	-5.963	0.031	0
	Fe(OH)4-	3.94E-07	2.84E-07	-6.404	-6.547	-0.143	0
	Fe(OH)2+	4.10E-08	2.95E-08	-7.387	-7.53	-0.143	0
	FeOH+2	1.22E-12	3.12E-13	-11.914	-12.506	-0.593	0
	FeF2+	7.22E-16	5.13E-16	-15.142	-15.29	-0.148	0
	FeF+2	2.30E-16	5.87E-17	-15.639	-16.231	-0.593	0
	FeF3	1.66E-16	1.79E-16	-15.779	-15.748	0.031	0
	FeSO4+	7.81E-18	5.56E-18	-17.107	-17.255	-0.148	0
	FeCl+2	2.75E-18	7.03E-19	-17.56	-18.153	-0.593	0
	Fe+3	1.56E-18	1.69E-19	-17.808	-18.773	-0.965	0
	FeCl2+	6.09E-19	4.33E-19	-18.215	-18.363	-0.148	0

	Fe(SO4)2-	4.98E-19	3.65E-19	-18.303	-18.438	-0.135	0
	FeCl3	5.57E-21	5.98E-21	-20.254	-20.224	0.031	0
	Fe2(OH)2+	3.77E-22	2.61E-24	-21.424	-23.583	-2.159	0
	FeHSO4+2	1.79E-25	5.16E-26	-24.748	-25.288	-0.54	0
	Fe3(OH)4+	3.81E-26	1.61E-29	-25.419	-28.793	-3.373	0
H(0)	1.59E-28						
	H2	7.93E-29	8.51E-29	-28.101	-28.07	0.031	28.61
K	2.76E-03						
	K+	2.71E-03	1.84E-03	-2.568	-2.736	-0.168	9.43
	KSO4-	5.38E-05	3.88E-05	-4.269	-4.412	-0.143	34.6
Mg	4.44E-02						
	Mg+2	3.49E-02	1.09E-02	-1.458	-1.962	-0.504	-20.76
	MgSO4	7.16E-03	7.69E-03	-2.145	-2.114	0.031	5.84
	MgHCO3+	1.28E-03	8.77E-04	-2.893	-3.057	-0.164	5.75
	MgCO3	9.01E-04	9.67E-04	-3.045	-3.015	0.031	-17.09
	MgF+	2.27E-04	1.59E-04	-3.645	-3.8	-0.156	-10.31
	MgOH+	1.53E-05	1.14E-05	-4.816	-4.945	-0.13	0
Mn(2)	2.50E-07						
	MnCO3	1.37E-07	1.47E-07	-6.864	-6.833	0.031	0
	Mn+2	6.93E-08	2.00E-08	-7.159	-7.7	-0.541	-17.13
	MnHCO3+	1.72E-08	1.22E-08	-7.766	-7.914	-0.148	0
	MnCl+	1.58E-08	1.12E-08	-7.802	-7.95	-0.148	-2.85
	MnSO4	9.92E-09	1.07E-08	-8.003	-7.973	0.031	22.54
	MnCl2	6.29E-10	6.75E-10	-9.201	-9.171	0.031	85.89
	MnOH+	2.06E-10	1.47E-10	-9.685	-9.834	-0.148	0
	MnF+	4.26E-11	3.03E-11	-10.37	-10.519	-0.148	0
	MnCl3-	3.61E-11	2.57E-11	-10.443	-10.591	-0.148	44.62
	Mn(NO3)2	1.99E-15	2.14E-15	-14.701	-14.67	0.031	41.04
	Mn(OH)3-	1.04E-17	7.40E-18	-16.982	-17.131	-0.148	0
Mn(3)	5.69E-29						
	Mn+3	5.69E-29	6.16E-30	-28.245	-29.21	-0.965	0
N(-3)	3.00E-05						
	NH4+	2.65E-05	1.69E-05	-4.577	-4.771	-0.195	18.31
	NH3	2.59E-06	2.78E-06	-5.586	-5.555	0.031	24.42
	NH4SO4-	8.94E-07	6.55E-07	-6.049	-6.184	-0.135	38.85
N(5)	2.50E-04						
	NO3-	2.50E-04	1.64E-04	-3.602	-3.785	-0.183	30.01
	Mn(NO3)2	1.99E-15	2.14E-15	-14.701	-14.67	0.031	41.04
Na	1.94E-01						
	Na+	1.90E-01	1.39E-01	-0.72	-0.857	-0.137	-0.8
	NaSO4-	2.90E-03	2.09E-03	-2.537	-2.68	-0.143	18.6
	NaHCO3	4.99E-04	5.36E-04	-3.302	-3.271	0.031	1.8
	NaCO3-	3.27E-04	2.40E-04	-3.485	-3.62	-0.135	0.91
	NaF	1.63E-05	1.76E-05	-4.787	-4.756	0.031	7.26
	NaOH	3.75E-17	4.02E-17	-16.426	-16.396	0.031	0
O(0)	1.06E-36						
	O2	5.27E-37	5.66E-37	-36.278	-36.247	0.031	30.4
S(6)	2.29E-02						
	SO4-2	1.21E-02	3.00E-03	-1.917	-2.522	-0.605	16.49
	MgSO4	7.16E-03	7.69E-03	-2.145	-2.114	0.031	5.84

NaSO4-	2.90E-03	2.09E-03	-2.537	-2.68	-0.143	18.6
CaSO4	6.45E-04	6.92E-04	-3.191	-3.16	0.031	7.5
KSO4-	5.38E-05	3.88E-05	-4.269	-4.412	-0.143	34.6
NH4SO4-	8.94E-07	6.55E-07	-6.049	-6.184	-0.135	38.85
BaSO4	6.82E-07	7.32E-07	-6.166	-6.135	0.031	0
MnSO4	9.92E-09	1.07E-08	-8.003	-7.973	0.031	22.54
ZnSO4	6.75E-09	7.25E-09	-8.171	-8.14	0.031	21.71
HSO4-	1.38E-09	1.01E-09	-8.86	-8.995	-0.135	40.74
Zn(SO4)2-2	6.13E-10	1.77E-10	-9.213	-9.752	-0.54	-8.87
FeSO4	8.79E-11	9.43E-11	-10.056	-10.025	0.031	18.97
CuSO4	3.42E-11	3.68E-11	-10.466	-10.435	0.031	13.09
CaHSO4+	2.15E-11	1.58E-11	-10.667	-10.802	-0.135	0
FeSO4+	7.81E-18	5.56E-18	-17.107	-17.255	-0.148	0
FeHSO4+	2.93E-18	2.15E-18	-17.533	-17.668	-0.135	0
Fe(SO4)2-	4.98E-19	3.65E-19	-18.303	-18.438	-0.135	0
FeHSO4+2	1.79E-25	5.16E-26	-24.748	-25.288	-0.54	0
Zn	1.58E-06					
Zn(CO3)2-2	1.31E-06	3.78E-07	-5.883	-6.423	-0.54	0
ZnCO3	1.78E-07	1.91E-07	-6.751	-6.72	0.031	0
Zn+2	4.03E-08	1.03E-08	-7.395	-7.987	-0.593	-24.35
ZnOHCl	1.25E-08	1.35E-08	-7.902	-7.871	0.031	0
ZnHCO3+	1.21E-08	8.89E-09	-7.916	-8.051	-0.135	0
Zn(OH)2	9.88E-09	1.06E-08	-8.005	-7.974	0.031	0
ZnSO4	6.75E-09	7.25E-09	-8.171	-8.14	0.031	21.71
ZnCl+	5.57E-09	3.82E-09	-8.254	-8.418	-0.164	-14.72
ZnOH+	4.41E-09	3.23E-09	-8.356	-8.491	-0.135	0
Zn(SO4)2-2	6.13E-10	1.77E-10	-9.213	-9.752	-0.54	-8.87
ZnCl2	5.14E-10	5.52E-10	-9.289	-9.258	0.031	102.03
ZnCl3-	1.25E-10	8.55E-11	-9.904	-10.068	-0.164	15.08
ZnF+	4.36E-11	3.19E-11	-10.361	-10.496	-0.135	0
ZnCl4-2	2.31E-11	5.91E-12	-10.636	-11.228	-0.593	148.14
Zn(OH)3-	1.31E-11	9.60E-12	-10.883	-11.018	-0.135	0
Zn(OH)4-2	1.51E-15	4.35E-16	-14.822	-15.361	-0.54	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-1.13	-5.41	-4.28	CaSO4			
Aragonite	1.42	-6.92	-8.34	CaCO3			
Barite	1.01	-8.84	-9.84	BaSO4			
Calcite	1.56	-6.92	-8.48	CaCO3			
CO2(g)	-2.8	-4.27	-1.47	CO2			
Dolomite	4.17	-12.91	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.71	6.6	4.89	Fe(OH)3			
Fluorite	0.4	-10.2	-10.6	CaF2			
Goethite	7.6	6.6	-1	FeOOH			
Gypsum	-0.83	-5.42	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	0	1.5	H2O			

Halite	-3.29	-1.72	1.57	NaCl
Hausmann	-8.46	52.57	61.03	Mn3O4
Hematite	17.21	13.2	-4.01	Fe2O3
Jarosite-K	-4.15	-13.36	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.67	21.67	25.34	MnOOH
Melanterit	-10.09	-12.3	-2.21	FeSO4:7H2O
NH3(g)	-7.35	-5.56	1.8	NH3
O2(g)	-33.35	-36.25	-2.89	O2
Pyrochroit	-5.99	9.21	15.2	Mn(OH)2
Pyrolusite	-7.25	34.13	41.38	MnO2:H2O
Rhodochrc	-0.6	-11.73	-11.13	MnCO3
Siderite	-2.9	-13.79	-10.89	FeCO3
Smithsonit	-2.02	-12.02	-10	ZnCO3
Sylvite	-4.5	-3.6	0.9	KCl
Witherite	-1.78	-10.35	-8.56	BaCO3
Zn(OH)2(e	-2.57	8.93	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 19

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.59E-02	1.59E-02
Ba	2.87E-06	2.87E-06
Ca	5.81E-03	5.81E-03
Cl	2.13E-01	2.13E-01
Cu	1.90E-07	1.90E-07
F	6.00E-04	6.00E-04
Fe	1.53E-06	1.53E-06
K	2.92E-03	2.92E-03
Mg	4.69E-02	4.69E-02
Mn	2.60E-07	2.60E-07
N(-3)	3.20E-05	3.20E-05
N(5)	2.70E-04	2.70E-04
Na	2.05E-01	2.05E-01
S(6)	2.41E-02	2.41E-02
Zn	1.67E-06	1.67E-06

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 24890
Density (g/cm³) = 1.01036
Volume (L) = 1.00652
Activity of water = 0.992

```
Ionic      strength   (mol/kgw) =          3.25E-01
Mass       of         water     (kg)     =          1.00E+00
Total      carbon     (mol/kg)  =          1.40E-02
Total      CO2        (mol/kg)  =          1.40E-02
Temperatu  (°C)       =                25
Electrical balance    (eq)      =          3.53E-02
Percent    error,     100*(Cat-|=               6.52
Iterations =                10 (183      overall)
Total      H          =          1.11E+02
Total      O          =          5.56E+01

#NAME?  couples--------------------------------

        Redox      couple     pe         Eh         (volts)

        N(-3)/N(5)    4.4349     0.2624

#NAME?  of         species---------------------------

        Log        Log        Log        mole       V
        Species    Molality   Activity   Molality   Activity   Gamma    cm³/mol

        OH-         4.34E-06  2.89E-06     -5.363     -5.538   -0.176      -3.25
        H+          4.45E-09  3.47E-09     -8.352      -8.46   -0.108          0
        H2O        5.55E+01   9.92E-01      1.744     -0.004        0      18.07
Ba        2.87E-06
        Ba+2        2.08E-06  5.04E-07     -5.682     -6.297   -0.615     -11.48
        BaSO4       7.21E-07  7.77E-07     -6.142      -6.11    0.033          0
        BaHCO3+     4.70E-08  3.44E-08     -7.328     -7.464   -0.135          0
        BaCO3       2.33E-08  2.51E-08     -7.633     -7.601    0.033       -10.7
        BaOH+       6.90E-12  4.89E-12    -11.161    -11.311    -0.15          0
C(4)      1.40E-02
        HCO3-       9.93E-03  7.12E-03     -2.003     -2.148   -0.145      25.94
        MgHCO3+     1.39E-03  9.48E-04     -2.857     -3.023   -0.166       5.76
        MgCO3       9.70E-04  1.05E-03     -3.013     -2.981    0.033     -17.09
        NaHCO3      5.43E-04  5.85E-04     -3.265     -3.233    0.033        1.8
        CO3-2       3.65E-04  9.63E-05     -3.438     -4.017   -0.578      -3.09
        NaCO3-      3.58E-04  2.62E-04     -3.446     -3.582   -0.135          1
        CaCO3       2.02E-04  2.18E-04     -3.694     -3.661    0.033       -14.6
        CaHCO3+     1.68E-04  1.23E-04     -3.775     -3.912   -0.137       9.91
        CO2         5.19E-05  5.60E-05     -4.285     -4.252    0.033      34.43
        Zn(CO3)2-:  1.40E-06  4.01E-07     -5.855     -6.397   -0.542          0
        ZnCO3       1.81E-07  1.95E-07     -6.743     -6.711    0.033          0
        MnCO3       1.43E-07  1.54E-07     -6.845     -6.813    0.033          0
        BaHCO3+     4.70E-08  3.44E-08     -7.328     -7.464   -0.135          0
        CuCO3       2.92E-08  3.14E-08     -7.535     -7.503    0.033          0
        BaCO3       2.33E-08  2.51E-08     -7.633     -7.601    0.033       -10.7
        MnHCO3+     1.81E-08  1.28E-08     -7.744     -7.894    -0.15          0
        Cu(CO3)2-   1.33E-08  3.81E-09     -7.878     -8.419   -0.542          0
        ZnHCO3+     1.24E-08  9.09E-09     -7.906     -8.042   -0.135          0
```

	FeCO3	4.00E-10	4.32E-10	-9.397	-9.365	0.033	0
	CuHCO3+	2.96E-10	2.17E-10	-9.529	-9.664	-0.135	0
	FeHCO3+	1.82E-10	1.33E-10	-9.741	-9.876	-0.135	0
	(CO2)2	5.33E-11	5.75E-11	-10.273	-10.241	0.033	68.87
Ca	5.81E-03						
	Ca+2	4.76E-03	1.35E-03	-2.323	-2.87	-0.547	-17.03
	CaSO4	6.84E-04	7.38E-04	-3.165	-3.132	0.033	7.5
	CaCO3	2.02E-04	2.18E-04	-3.694	-3.661	0.033	-14.6
	CaHCO3+	1.68E-04	1.23E-04	-3.775	-3.912	-0.137	9.91
	CaOH+	8.75E-08	6.40E-08	-7.058	-7.194	-0.135	0
	CaHSO4+	2.30E-11	1.68E-11	-10.639	-10.774	-0.135	0
Cl	2.13E-01						
	Cl-	2.13E-01	1.45E-01	-0.672	-0.839	-0.168	18.57
	CuCl2-	3.10E-08	2.12E-08	-7.508	-7.675	-0.166	0
	CuCl3-2	1.94E-08	4.86E-09	-7.713	-8.314	-0.601	0
	MnCl+	1.68E-08	1.19E-08	-7.775	-7.925	-0.15	-2.84
	ZnOHCl	1.29E-08	1.39E-08	-7.889	-7.857	0.033	0
	ZnCl+	5.80E-09	3.95E-09	-8.237	-8.403	-0.166	-14.77
	MnCl2	6.97E-10	7.51E-10	-9.157	-9.124	0.033	85.89
	ZnCl2	5.56E-10	6.00E-10	-9.255	-9.222	0.033	102.03
	ZnCl3-	1.43E-10	9.74E-11	-9.845	-10.011	-0.166	14.97
	FeCl+	5.10E-11	3.74E-11	-10.292	-10.428	-0.135	0
	MnCl3-	4.23E-11	3.00E-11	-10.373	-10.523	-0.15	44.67
	CuCl+	3.47E-11	2.37E-11	-10.459	-10.625	-0.166	1.35
	ZnCl4-2	2.82E-11	7.07E-12	-10.55	-11.151	-0.601	148.25
	CuCl2	1.71E-12	1.84E-12	-11.767	-11.735	0.033	31.02
	CuCl3-	1.39E-15	9.47E-16	-14.857	-15.024	-0.166	0
	FeCl+2	3.11E-18	7.81E-19	-17.507	-18.108	-0.601	0
	CuCl4-2	2.74E-18	6.87E-19	-17.562	-18.163	-0.601	0
	FeCl2+	7.14E-19	5.05E-19	-18.146	-18.297	-0.15	0
	FeCl3	6.79E-21	7.31E-21	-20.168	-20.136	0.033	0
Cu(1)	5.04E-08						
	CuCl2-	3.10E-08	2.12E-08	-7.508	-7.675	-0.166	0
	CuCl3-2	1.94E-08	4.86E-09	-7.713	-8.314	-0.601	0
	Cu+	5.03E-12	3.19E-12	-11.298	-11.496	-0.198	0
Cu(2)	1.40E-07						
	Cu(OH)2	9.64E-08	1.04E-07	-7.016	-6.984	0.033	0
	CuCO3	2.92E-08	3.14E-08	-7.535	-7.503	0.033	0
	Cu(CO3)2-	1.33E-08	3.81E-09	-7.878	-8.419	-0.542	0
	CuHCO3+	2.96E-10	2.17E-10	-9.529	-9.664	-0.135	0
	CuOH+	2.55E-10	1.74E-10	-9.594	-9.76	-0.166	0
	Cu+2	2.15E-10	6.08E-11	-9.668	-10.216	-0.548	-25.6
	CuSO4	3.54E-11	3.82E-11	-10.451	-10.418	0.033	13.09
	CuCl+	3.47E-11	2.37E-11	-10.459	-10.625	-0.166	1.35
	Cu(OH)3-	2.44E-12	1.79E-12	-11.612	-11.747	-0.135	0
	CuCl2	1.71E-12	1.84E-12	-11.767	-11.735	0.033	31.02
	CuF+	3.41E-13	2.50E-13	-12.467	-12.603	-0.135	0
	Cu2(OH)2+	4.60E-14	1.32E-14	-13.337	-13.879	-0.542	0
	CuCl3-	1.39E-15	9.47E-16	-14.857	-15.024	-0.166	0
	Cu(OH)4-2	3.56E-16	1.02E-16	-15.449	-15.991	-0.542	0

	CuCl4-2	2.74E-18	6.87E-19	-17.562	-18.163	-0.601	0
F	6.00E-04						
	F-	3.38E-04	2.26E-04	-3.471	-3.646	-0.176	-0.81
	MgF+	2.44E-04	1.70E-04	-3.612	-3.77	-0.158	-10.31
	NaF	1.76E-05	1.90E-05	-4.754	-4.722	0.033	7.26
	HF	1.09E-09	1.17E-09	-8.963	-8.93	0.033	12.5
	MnF+	4.44E-11	3.15E-11	-10.352	-10.502	-0.15	0
	ZnF+	4.42E-11	3.23E-11	-10.355	-10.49	-0.135	0
	HF2-	1.39E-12	1.02E-12	-11.857	-11.993	-0.135	22.57
	FeF+	5.76E-13	4.22E-13	-12.239	-12.375	-0.135	0
	CuF+	3.41E-13	2.50E-13	-12.467	-12.603	-0.135	0
	FeF2+	8.11E-16	5.74E-16	-15.091	-15.241	-0.15	0
	FeF+2	2.55E-16	6.39E-17	-15.594	-16.195	-0.601	0
	FeF3	1.90E-16	2.05E-16	-15.72	-15.688	0.033	0
Fe(2)	1.41E-09						
	Fe+2	6.60E-10	1.87E-10	-9.181	-9.728	-0.548	-21.07
	FeCO3	4.00E-10	4.32E-10	-9.397	-9.365	0.033	0
	FeHCO3+	1.82E-10	1.33E-10	-9.741	-9.876	-0.135	0
	FeSO4	9.48E-11	1.02E-10	-10.023	-9.991	0.033	18.97
	FeCl+	5.10E-11	3.74E-11	-10.292	-10.428	-0.135	0
	FeOH+	2.39E-11	1.69E-11	-10.622	-10.772	-0.15	0
	FeF+	5.76E-13	4.22E-13	-12.239	-12.375	-0.135	0
	Fe(OH)2	3.82E-14	4.11E-14	-13.418	-13.386	0.033	0
	Fe(OH)3-	6.18E-16	4.37E-16	-15.209	-15.359	-0.15	0
	FeHSO4+	3.18E-18	2.33E-18	-17.497	-17.633	-0.135	0
Fe(3)	1.53E-06						
	Fe(OH)3	1.07E-06	1.15E-06	-5.972	-5.939	0.033	0
	Fe(OH)4-	4.18E-07	3.00E-07	-6.379	-6.523	-0.145	0
	Fe(OH)2+	4.35E-08	3.12E-08	-7.361	-7.506	-0.145	0
	FeOH+2	1.31E-12	3.30E-13	-11.881	-12.482	-0.601	0
	FeF2+	8.11E-16	5.74E-16	-15.091	-15.241	-0.15	0
	FeF+2	2.55E-16	6.39E-17	-15.594	-16.195	-0.601	0
	FeF3	1.90E-16	2.05E-16	-15.72	-15.688	0.033	0
	FeSO4+	8.50E-18	6.02E-18	-17.07	-17.221	-0.15	0
	FeCl+2	3.11E-18	7.81E-19	-17.507	-18.108	-0.601	0
	Fe+3	1.68E-18	1.79E-19	-17.774	-18.748	-0.975	0
	FeCl2+	7.14E-19	5.05E-19	-18.146	-18.297	-0.15	0
	Fe(SO4)2-	5.53E-19	4.05E-19	-18.257	-18.393	-0.135	0
	FeCl3	6.79E-21	7.31E-21	-20.168	-20.136	0.033	0
	Fe2(OH)2+	4.30E-22	2.92E-24	-21.367	-23.534	-2.167	0
	FeHSO4+2	1.95E-25	5.59E-26	-24.711	-25.253	-0.542	0
	Fe3(OH)4+	4.64E-26	1.91E-29	-25.333	-28.72	-3.387	0
H(0)	1.58E-28						
	H2	7.90E-29	8.51E-29	-28.103	-28.07	0.033	28.61
K	2.92E-03						
	K+	2.86E-03	1.93E-03	-2.543	-2.714	-0.171	9.44
	KSO4-	5.82E-05	4.17E-05	-4.235	-4.38	-0.145	34.61
Mg	4.69E-02						
	Mg+2	3.67E-02	1.14E-02	-1.436	-1.944	-0.508	-20.74
	MgSO4	7.61E-03	8.20E-03	-2.118	-2.086	0.033	5.84

	MgHCO3+	1.39E-03	9.48E-04	-2.857	-3.023	-0.166	5.76
	MgCO3	9.70E-04	1.05E-03	-3.013	-2.981	0.033	-17.09
	MgF+	2.44E-04	1.70E-04	-3.612	-3.77	-0.158	-10.31
	MgOH+	1.60E-05	1.18E-05	-4.796	-4.927	-0.131	0
Mn(2)	2.60E-07						
	MnCO3	1.43E-07	1.54E-07	-6.845	-6.813	0.033	0
	Mn+2	7.11E-08	2.01E-08	-7.148	-7.696	-0.548	-17.08
	MnHCO3+	1.81E-08	1.28E-08	-7.744	-7.894	-0.15	0
	MnCl+	1.68E-08	1.19E-08	-7.775	-7.925	-0.15	-2.84
	MnSO4	1.02E-08	1.10E-08	-7.991	-7.958	0.033	22.54
	MnCl2	6.97E-10	7.51E-10	-9.157	-9.124	0.033	85.89
	MnOH+	2.09E-10	1.48E-10	-9.679	-9.83	-0.15	0
	MnF+	4.44E-11	3.15E-11	-10.352	-10.502	-0.15	0
	MnCl3-	4.23E-11	3.00E-11	-10.373	-10.523	-0.15	44.67
	Mn(NO3)2	2.30E-15	2.48E-15	-14.638	-14.606	0.033	41.04
	Mn(OH)3-	1.06E-17	7.46E-18	-16.977	-17.127	-0.15	0
Mn(3)	5.87E-29						
	Mn+3	5.87E-29	6.22E-30	-28.231	-29.206	-0.975	0
N(-3)	3.20E-05						
	NH4+	2.83E-05	1.79E-05	-4.548	-4.746	-0.198	18.32
	NH3	2.74E-06	2.95E-06	-5.563	-5.531	0.033	24.42
	NH4SO4-	9.70E-07	7.10E-07	-6.013	-6.149	-0.135	38.9
N(5)	2.70E-04						
	NO3-	2.70E-04	1.76E-04	-3.569	-3.755	-0.186	30.03
	Mn(NO3)2	2.30E-15	2.48E-15	-14.638	-14.606	0.033	41.04
Na	2.05E-01						
	Na+	2.01E-01	1.46E-01	-0.697	-0.835	-0.138	-0.79
	NaSO4-	3.14E-03	2.25E-03	-2.503	-2.647	-0.145	18.74
	NaHCO3	5.43E-04	5.85E-04	-3.265	-3.233	0.033	1.8
	NaCO3-	3.58E-04	2.62E-04	-3.446	-3.582	-0.135	1
	NaF	1.76E-05	1.90E-05	-4.754	-4.722	0.033	7.26
	NaOH	3.93E-17	4.23E-17	-16.406	-16.374	0.033	0
O(0)	1.05E-36						
	O2	5.25E-37	5.66E-37	-36.28	-36.247	0.033	30.4
S(6)	2.41E-02						
	SO4-2	1.26E-02	3.07E-03	-1.899	-2.512	-0.614	16.55
	MgSO4	7.61E-03	8.20E-03	-2.118	-2.086	0.033	5.84
	NaSO4-	3.14E-03	2.25E-03	-2.503	-2.647	-0.145	18.74
	CaSO4	6.84E-04	7.38E-04	-3.165	-3.132	0.033	7.5
	KSO4-	5.82E-05	4.17E-05	-4.235	-4.38	-0.145	34.61
	NH4SO4-	9.70E-07	7.10E-07	-6.013	-6.149	-0.135	38.9
	BaSO4	7.21E-07	7.77E-07	-6.142	-6.11	0.033	0
	MnSO4	1.02E-08	1.10E-08	-7.991	-7.958	0.033	22.54
	ZnSO4	6.78E-09	7.31E-09	-8.169	-8.136	0.033	21.71
	HSO4-	1.42E-09	1.04E-09	-8.849	-8.984	-0.135	40.76
	Zn(SO4)2-2	6.36E-10	1.83E-10	-9.197	-9.738	-0.542	-8.69
	FeSO4	9.48E-11	1.02E-10	-10.023	-9.991	0.033	18.97
	CuSO4	3.54E-11	3.82E-11	-10.451	-10.418	0.033	13.09
	CaHSO4+	2.30E-11	1.68E-11	-10.639	-10.774	-0.135	0
	FeSO4+	8.50E-18	6.02E-18	-17.07	-17.221	-0.15	0

	FeHSO4+	3.18E-18	2.33E-18	-17.497	-17.633	-0.135	0
	Fe(SO4)2-	5.53E-19	4.05E-19	-18.257	-18.393	-0.135	0
	FeHSO4+2	1.95E-25	5.59E-26	-24.711	-25.253	-0.542	0
Zn	1.67E-06						
	Zn(CO3)2-2	1.40E-06	4.01E-07	-5.855	-6.397	-0.542	0
	ZnCO3	1.81E-07	1.95E-07	-6.743	-6.711	0.033	0
	Zn+2	4.04E-08	1.01E-08	-7.393	-7.994	-0.601	-24.34
	ZnOHCl	1.29E-08	1.39E-08	-7.889	-7.857	0.033	0
	ZnHCO3+	1.24E-08	9.09E-09	-7.906	-8.042	-0.135	0
	Zn(OH)2	9.69E-09	1.04E-08	-8.014	-7.981	0.033	0
	ZnSO4	6.78E-09	7.31E-09	-8.169	-8.136	0.033	21.71
	ZnCl+	5.80E-09	3.95E-09	-8.237	-8.403	-0.166	-14.77
	ZnOH+	4.34E-09	3.18E-09	-8.362	-8.498	-0.135	0
	Zn(SO4)2-2	6.36E-10	1.83E-10	-9.197	-9.738	-0.542	-8.69
	ZnCl2	5.56E-10	6.00E-10	-9.255	-9.222	0.033	102.03
	ZnCl3-	1.43E-10	9.74E-11	-9.845	-10.011	-0.166	14.97
	ZnF+	4.42E-11	3.23E-11	-10.355	-10.49	-0.135	0
	ZnCl4-2	2.82E-11	7.07E-12	-10.55	-11.151	-0.601	148.25
	Zn(OH)3-	1.29E-11	9.44E-12	-10.889	-11.025	-0.135	0
	Zn(OH)4-2	1.49E-15	4.28E-16	-14.827	-15.369	-0.542	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-1.1	-5.38	-4.28	CaSO4			
Aragonite	1.45	-6.89	-8.34	CaCO3			
Barite	1.03	-8.81	-9.84	BaSO4			
Calcite	1.59	-6.89	-8.48	CaCO3			
CO2(g)	-2.78	-4.25	-1.47	CO2			
Dolomite	4.24	-12.85	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.73	6.62	4.89	Fe(OH)3			
Fluorite	0.44	-10.16	-10.6	CaF2			
Goethite	7.62	6.62	-1	FeOOH			
Gypsum	-0.81	-5.39	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	0	1.5	H2O			
Halite	-3.24	-1.67	1.57	NaCl			
Hausmann	-8.45	52.58	61.03	Mn3O4			
Hematite	17.26	13.25	-4.01	Fe2O3			
Jarosite-K	-4.04	-13.25	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.66	21.68	25.34	MnOOH			
Melanterit	-10.06	-12.27	-2.21	FeSO4:7H2O			
NH3(g)	-7.33	-5.53	1.8	NH3			
O2(g)	-33.36	-36.25	-2.89	O2			
Pyrochroit	-5.98	9.22	15.2	Mn(OH)2			
Pyrolusite	-7.25	34.13	41.38	MnO2:H2O			
Rhodochro	-0.58	-11.71	-11.13	MnCO3			
Siderite	-2.85	-13.74	-10.89	FeCO3			
Smithsonit	-2.01	-12.01	-10	ZnCO3			

Sylvite	-4.45	-3.55	0.9	KCl
Witherite	-1.75	-10.31	-8.56	BaCO3
Zn(OH)2(e	-2.58	8.92	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 20

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.67E-02	1.67E-02
Ba	3.02E-06	3.02E-06
Ca	6.11E-03	6.11E-03
Cl	2.24E-01	2.24E-01
Cu	2.00E-07	2.00E-07
F	6.30E-04	6.30E-04
Fe	1.61E-06	1.61E-06
K	3.07E-03	3.07E-03
Mg	4.94E-02	4.94E-02
Mn	2.70E-07	2.70E-07
N(-3)	3.30E-05	3.30E-05
N(5)	2.80E-04	2.80E-04
Na	2.16E-01	2.16E-01
S(6)	2.54E-02	2.54E-02
Zn	1.76E-06	1.76E-06

#NAME? of solution----------

pH	=	8.46		
pe	=	4		
Specific	Conductan	(µS/cm,	25°C)	= 26027
Density	(g/cm³)	=	1.01105	
Volume	(L)	=	1.00672	
Activity	of	water	=	0.991
Ionic	strength	(mol/kgw)	=	3.42E-01
Mass	of	water	(kg)	= 1.00E+00
Total	carbon	(mol/kg)	=	1.47E-02
Total	CO2	(mol/kg)	=	1.47E-02
Temperatu	(°C)	=	25	
Electrical	balance	(eq)	=	3.72E-02
Percent	error,	100*(Cat-|	=	6.53
Iterations	=	10	(193	overall)
Total	H	=	1.11E+02	
Total	O	=	5.57E+01	

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4353	0.2624		

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.36E-06	2.89E-06	-5.36	-5.539	-0.178	-3.21
	H+	4.46E-09	3.47E-09	-8.351	-8.46	-0.109	0
	H2O	5.55E+01	9.91E-01	1.744	-0.004	0	18.07
Ba	3.02E-06						
	Ba+2	2.19E-06	5.22E-07	-5.66	-6.283	-0.622	-11.45
	BaSO4	7.59E-07	8.22E-07	-6.12	-6.085	0.034	0
	BaHCO3+	5.04E-08	3.68E-08	-7.298	-7.434	-0.136	0
	BaCO3	2.48E-08	2.68E-08	-7.605	-7.571	0.034	-10.7
	BaOH+	7.17E-12	5.05E-12	-11.144	-11.297	-0.152	0
C(4)	1.47E-02						
	HCO3-	1.03E-02	7.37E-03	-1.986	-2.133	-0.146	25.99
	MgHCO3+	1.51E-03	1.02E-03	-2.822	-2.991	-0.169	5.76
	MgCO3	1.04E-03	1.13E-03	-2.983	-2.948	0.034	-17.09
	NaHCO3	5.87E-04	6.35E-04	-3.231	-3.197	0.034	1.8
	NaCO3-	3.89E-04	2.85E-04	-3.41	-3.546	-0.136	1.1
	CO3-2	3.84E-04	9.96E-05	-3.416	-4.002	-0.585	-3.02
	CaCO3	2.17E-04	2.34E-04	-3.665	-3.63	0.034	-14.6
	CaHCO3+	1.81E-04	1.32E-04	-3.742	-3.881	-0.139	9.91
	CO2	5.36E-05	5.79E-05	-4.271	-4.237	0.034	34.43
	Zn(CO3)2-2	1.48E-06	4.24E-07	-5.829	-6.373	-0.543	0
	ZnCO3	1.84E-07	1.99E-07	-6.735	-6.701	0.034	0
	MnCO3	1.49E-07	1.61E-07	-6.827	-6.793	0.034	0
	BaHCO3+	5.04E-08	3.68E-08	-7.298	-7.434	-0.136	0
	CuCO3	3.04E-08	3.29E-08	-7.518	-7.483	0.034	0
	BaCO3	2.48E-08	2.68E-08	-7.605	-7.571	0.034	-10.7
	MnHCO3+	1.90E-08	1.34E-08	-7.722	-7.874	-0.152	0
	Cu(CO3)2-	1.44E-08	4.12E-09	-7.842	-8.385	-0.543	0
	ZnHCO3+	1.27E-08	9.28E-09	-7.896	-8.032	-0.136	0
	FeCO3	4.36E-10	4.71E-10	-9.361	-9.327	0.034	0
	CuHCO3+	3.10E-10	2.27E-10	-9.509	-9.644	-0.136	0
	FeHCO3+	1.99E-10	1.45E-10	-9.702	-9.838	-0.136	0
	(CO2)2	5.69E-11	6.16E-11	-10.245	-10.21	0.034	68.87
Ca	6.11E-03						
	Ca+2	4.99E-03	1.40E-03	-2.302	-2.854	-0.552	-17.01
	CaSO4	7.23E-04	7.82E-04	-3.141	-3.107	0.034	7.5
	CaCO3	2.17E-04	2.34E-04	-3.665	-3.63	0.034	-14.6
	CaHCO3+	1.81E-04	1.32E-04	-3.742	-3.881	-0.139	9.91
	CaOH+	9.08E-08	6.64E-08	-7.042	-7.178	-0.136	0
	CaHSO4+	2.44E-11	1.78E-11	-10.613	-10.749	-0.136	0
Cl	2.24E-01						
	Cl-	2.24E-01	1.52E-01	-0.649	-0.819	-0.17	18.58

	CuCl2-	3.46E-08	2.34E-08	-7.461	-7.63	-0.169	0
	CuCl3-2	2.29E-08	5.63E-09	-7.641	-8.249	-0.608	0
	MnCl+	1.78E-08	1.26E-08	-7.749	-7.901	-0.152	-2.84
	ZnOHCl	1.33E-08	1.44E-08	-7.877	-7.843	0.034	0
	ZnCl+	6.03E-09	4.09E-09	-8.22	-8.389	-0.169	-14.83
	MnCl2	7.69E-10	8.32E-10	-9.114	-9.08	0.034	85.89
	ZnCl2	6.00E-10	6.49E-10	-9.222	-9.188	0.034	102.03
	ZnCl3-	1.63E-10	1.10E-10	-9.788	-9.957	-0.169	14.85
	FeCl+	5.65E-11	4.13E-11	-10.248	-10.384	-0.136	0
	MnCl3-	4.93E-11	3.47E-11	-10.307	-10.459	-0.152	44.73
	CuCl+	3.70E-11	2.51E-11	-10.432	-10.601	-0.169	1.38
	ZnCl4-2	3.41E-11	8.39E-12	-10.468	-11.076	-0.608	148.36
	CuCl2	1.89E-12	2.04E-12	-11.724	-11.69	0.034	31.02
	CuCl3-	1.62E-15	1.10E-15	-14.791	-14.959	-0.169	0
	FeCl+2	3.50E-18	8.63E-19	-17.456	-18.064	-0.608	0
	CuCl4-2	3.39E-18	8.35E-19	-17.47	-18.078	-0.608	0
	FeCl2+	8.29E-19	5.84E-19	-18.081	-18.233	-0.152	0
	FeCl3	8.19E-21	8.86E-21	-20.087	-20.052	0.034	0
Cu(1)	5.74E-08						
	CuCl2-	3.46E-08	2.34E-08	-7.461	-7.63	-0.169	0
	CuCl3-2	2.29E-08	5.63E-09	-7.641	-8.249	-0.608	0
	Cu+	5.13E-12	3.22E-12	-11.29	-11.492	-0.201	0
Cu(2)	1.43E-07						
	Cu(OH)2	9.69E-08	1.05E-07	-7.014	-6.979	0.034	0
	CuCO3	3.04E-08	3.29E-08	-7.518	-7.483	0.034	0
	Cu(CO3)2-	1.44E-08	4.12E-09	-7.842	-8.385	-0.543	0
	CuHCO3+	3.10E-10	2.27E-10	-9.509	-9.644	-0.136	0
	CuOH+	2.59E-10	1.76E-10	-9.587	-9.756	-0.169	0
	Cu+2	2.20E-10	6.14E-11	-9.658	-10.212	-0.554	-25.58
	CuCl+	3.70E-11	2.51E-11	-10.432	-10.601	-0.169	1.38
	CuSO4	3.64E-11	3.94E-11	-10.439	-10.404	0.034	13.09
	Cu(OH)3-	2.47E-12	1.81E-12	-11.607	-11.743	-0.136	0
	CuCl2	1.89E-12	2.04E-12	-11.724	-11.69	0.034	31.02
	CuF+	3.54E-13	2.59E-13	-12.451	-12.587	-0.136	0
	Cu2(OH)2+	4.72E-14	1.35E-14	-13.327	-13.87	-0.543	0
	CuCl3-	1.62E-15	1.10E-15	-14.791	-14.959	-0.169	0
	Cu(OH)4-2	3.60E-16	1.03E-16	-15.444	-15.987	-0.543	0
	CuCl4-2	3.39E-18	8.35E-19	-17.47	-18.078	-0.608	0
F	6.30E-04						
	F-	3.49E-04	2.32E-04	-3.457	-3.635	-0.178	-0.8
	MgF+	2.62E-04	1.81E-04	-3.582	-3.742	-0.16	-10.31
	NaF	1.89E-05	2.05E-05	-4.724	-4.689	0.034	7.26
	HF	1.11E-09	1.20E-09	-8.953	-8.919	0.034	12.5
	MnF+	4.63E-11	3.26E-11	-10.335	-10.487	-0.152	0
	ZnF+	4.48E-11	3.28E-11	-10.349	-10.485	-0.136	0
	HF2-	1.46E-12	1.07E-12	-11.835	-11.971	-0.136	22.58
	FeF+	6.25E-13	4.57E-13	-12.204	-12.34	-0.136	0
	CuF+	3.54E-13	2.59E-13	-12.451	-12.587	-0.136	0
	FeF2+	9.05E-16	6.37E-16	-15.043	-15.196	-0.152	0
	FeF+2	2.81E-16	6.91E-17	-15.552	-16.16	-0.608	0

	FeF3	2.16E-16	2.34E-16	-15.665	-15.631	0.034	0
Fe(2)	1.53E-09						
	Fe+2	7.07E-10	1.97E-10	-9.151	-9.705	-0.554	-21.04
	FeCO3	4.36E-10	4.71E-10	-9.361	-9.327	0.034	0
	FeHCO3+	1.99E-10	1.45E-10	-9.702	-9.838	-0.136	0
	FeSO4	1.02E-10	1.10E-10	-9.992	-9.958	0.034	18.97
	FeCl+	5.65E-11	4.13E-11	-10.248	-10.384	-0.136	0
	FeOH+	2.53E-11	1.78E-11	-10.597	-10.749	-0.152	0
	FeF+	6.25E-13	4.57E-13	-12.204	-12.34	-0.136	0
	Fe(OH)2	4.01E-14	4.34E-14	-13.397	-13.363	0.034	0
	Fe(OH)3-	6.54E-16	4.61E-16	-15.185	-15.337	-0.152	0
	FeHSO4+	3.44E-18	2.51E-18	-17.464	-17.6	-0.136	0
Fe(3)	1.61E-06						
	Fe(OH)3	1.12E-06	1.21E-06	-5.951	-5.917	0.034	0
	Fe(OH)4-	4.42E-07	3.16E-07	-6.354	-6.501	-0.146	0
	Fe(OH)2+	4.61E-08	3.29E-08	-7.336	-7.483	-0.146	0
	FeOH+2	1.41E-12	3.48E-13	-11.85	-12.459	-0.608	0
	FeF2+	9.05E-16	6.37E-16	-15.043	-15.196	-0.152	0
	FeF+2	2.81E-16	6.91E-17	-15.552	-16.16	-0.608	0
	FeF3	2.16E-16	2.34E-16	-15.665	-15.631	0.034	0
	FeSO4+	9.21E-18	6.49E-18	-17.036	-17.188	-0.152	0
	FeCl+2	3.50E-18	8.63E-19	-17.456	-18.064	-0.608	0
	Fe+3	1.81E-18	1.88E-19	-17.741	-18.725	-0.984	0
	FeCl2+	8.29E-19	5.84E-19	-18.081	-18.233	-0.152	0
	Fe(SO4)2-	6.10E-19	4.46E-19	-18.215	-18.351	-0.136	0
	FeCl3	8.19E-21	8.86E-21	-20.087	-20.052	0.034	0
	Fe2(OH)2+	4.86E-22	3.25E-24	-21.314	-23.488	-2.174	0
	FeHSO4+2	2.11E-25	6.03E-26	-24.676	-25.22	-0.543	0
	Fe3(OH)4+	5.58E-26	2.24E-29	-25.254	-28.65	-3.397	0
H(0)	1.57E-28						
	H2	7.87E-29	8.51E-29	-28.104	-28.07	0.034	28.61
K	3.07E-03						
	K+	3.01E-03	2.02E-03	-2.522	-2.695	-0.173	9.45
	KSO4-	6.24E-05	4.46E-05	-4.205	-4.351	-0.146	34.63
Mg	4.94E-02						
	Mg+2	3.85E-02	1.19E-02	-1.415	-1.926	-0.512	-20.72
	MgSO4	8.07E-03	8.73E-03	-2.093	-2.059	0.034	5.84
	MgHCO3+	1.51E-03	1.02E-03	-2.822	-2.991	-0.169	5.76
	MgCO3	1.04E-03	1.13E-03	-2.983	-2.948	0.034	-17.09
	MgF+	2.62E-04	1.81E-04	-3.582	-3.742	-0.16	-10.31
	MgOH+	1.67E-05	1.23E-05	-4.778	-4.91	-0.133	0
Mn(2)	2.70E-07						
	MnCO3	1.49E-07	1.61E-07	-6.827	-6.793	0.034	0
	Mn+2	7.29E-08	2.03E-08	-7.138	-7.692	-0.554	-17.03
	MnHCO3+	1.90E-08	1.34E-08	-7.722	-7.874	-0.152	0
	MnCl+	1.78E-08	1.26E-08	-7.749	-7.901	-0.152	-2.84
	MnSO4	1.05E-08	1.14E-08	-7.979	-7.944	0.034	22.54
	MnCl2	7.69E-10	8.32E-10	-9.114	-9.08	0.034	85.89
	MnOH+	2.12E-10	1.49E-10	-9.673	-9.826	-0.152	0
	MnCl3-	4.93E-11	3.47E-11	-10.307	-10.459	-0.152	44.73

	MnF+	4.63E-11	3.26E-11	-10.335	-10.487	-0.152	0
	Mn(NO3)2	2.46E-15	2.66E-15	-14.61	-14.576	0.034	41.04
	Mn(OH)3-	1.07E-17	7.53E-18	-16.971	-17.123	-0.152	0
Mn(3)	6.05E-29						
	Mn+3	6.05E-29	6.29E-30	-28.218	-29.202	-0.984	0
N(-3)	3.30E-05						
	NH4+	2.92E-05	1.84E-05	-4.535	-4.736	-0.201	18.32
	NH3	2.79E-06	3.02E-06	-5.555	-5.52	0.034	24.42
	NH4SO4-	1.02E-06	7.43E-07	-5.993	-6.129	-0.136	38.96
N(5)	2.80E-04						
	NO3-	2.80E-04	1.81E-04	-3.553	-3.742	-0.189	30.04
	Mn(NO3)2	2.46E-15	2.66E-15	-14.61	-14.576	0.034	41.04
Na	2.16E-01						
	Na+	2.11E-01	1.53E-01	-0.675	-0.814	-0.139	-0.77
	NaSO4-	3.39E-03	2.42E-03	-2.47	-2.617	-0.146	18.88
	NaHCO3	5.87E-04	6.35E-04	-3.231	-3.197	0.034	1.8
	NaCO3-	3.89E-04	2.85E-04	-3.41	-3.546	-0.136	1.1
	NaF	1.89E-05	2.05E-05	-4.724	-4.689	0.034	7.26
	NaOH	4.10E-17	4.44E-17	-16.387	-16.353	0.034	0
O(0)	1.05E-36						
	O2	5.23E-37	5.65E-37	-36.282	-36.248	0.034	30.4
S(6)	2.54E-02						
	SO4-2	1.32E-02	3.14E-03	-1.881	-2.503	-0.622	16.6
	MgSO4	8.07E-03	8.73E-03	-2.093	-2.059	0.034	5.84
	NaSO4-	3.39E-03	2.42E-03	-2.47	-2.617	-0.146	18.88
	CaSO4	7.23E-04	7.82E-04	-3.141	-3.107	0.034	7.5
	KSO4-	6.24E-05	4.46E-05	-4.205	-4.351	-0.146	34.63
	NH4SO4-	1.02E-06	7.43E-07	-5.993	-6.129	-0.136	38.96
	BaSO4	7.59E-07	8.22E-07	-6.12	-6.085	0.034	0
	MnSO4	1.05E-08	1.14E-08	-7.979	-7.944	0.034	22.54
	ZnSO4	6.82E-09	7.38E-09	-8.166	-8.132	0.034	21.71
	HSO4-	1.45E-09	1.06E-09	-8.839	-8.975	-0.136	40.77
	Zn(SO4)2-2	6.58E-10	1.88E-10	-9.182	-9.725	-0.543	-8.51
	FeSO4	1.02E-10	1.10E-10	-9.992	-9.958	0.034	18.97
	CuSO4	3.64E-11	3.94E-11	-10.439	-10.404	0.034	13.09
	CaHSO4+	2.44E-11	1.78E-11	-10.613	-10.749	-0.136	0
	FeSO4+	9.21E-18	6.49E-18	-17.036	-17.188	-0.152	0
	FeHSO4+	3.44E-18	2.51E-18	-17.464	-17.6	-0.136	0
	Fe(SO4)2-	6.10E-19	4.46E-19	-18.215	-18.351	-0.136	0
	FeHSO4+2	2.11E-25	6.03E-26	-24.676	-25.22	-0.543	0
Zn	1.76E-06						
	Zn(CO3)2-2	1.48E-06	4.24E-07	-5.829	-6.373	-0.543	0
	ZnCO3	1.84E-07	1.99E-07	-6.735	-6.701	0.034	0
	Zn+2	4.06E-08	1.00E-08	-7.391	-7.999	-0.608	-24.32
	ZnOHCl	1.33E-08	1.44E-08	-7.877	-7.843	0.034	0
	ZnHCO3+	1.27E-08	9.28E-09	-7.896	-8.032	-0.136	0
	Zn(OH)2	9.52E-09	1.03E-08	-8.021	-7.987	0.034	0
	ZnSO4	6.82E-09	7.38E-09	-8.166	-8.132	0.034	21.71
	ZnCl+	6.03E-09	4.09E-09	-8.22	-8.389	-0.169	-14.83
	ZnOH+	4.29E-09	3.14E-09	-8.367	-8.503	-0.136	0

Zn(SO4)2-2	6.58E-10	1.88E-10	-9.182	-9.725	-0.543	-8.51
ZnCl2	6.00E-10	6.49E-10	-9.222	-9.188	0.034	102.03
ZnCl3-	1.63E-10	1.10E-10	-9.788	-9.957	-0.169	14.85
ZnF+	4.48E-11	3.28E-11	-10.349	-10.485	-0.136	0
ZnCl4-2	3.41E-11	8.39E-12	-10.468	-11.076	-0.608	148.36
Zn(OH)3-	1.27E-11	9.31E-12	-10.895	-11.031	-0.136	0
Zn(OH)4-2	1.47E-15	4.22E-16	-14.832	-15.375	-0.543	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-1.08	-5.36	-4.28	CaSO4
Aragonite	1.48	-6.86	-8.34	CaCO3
Barite	1.06	-8.79	-9.84	BaSO4
Calcite	1.62	-6.86	-8.48	CaCO3
CO2(g)	-2.77	-4.24	-1.47	CO2
Dolomite	4.3	-12.78	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.75	6.64	4.89	Fe(OH)3
Fluorite	0.48	-10.12	-10.6	CaF2
Goethite	7.65	6.65	-1	FeOOH
Gypsum	-0.78	-5.36	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O
Halite	-3.2	-1.63	1.57	NaCl
Hausmann	-8.44	52.59	61.03	Mn3O4
Hematite	17.31	13.3	-4.01	Fe2O3
Jarosite-K	-3.93	-13.14	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.66	21.68	25.34	MnOOH
Melanterit	-10.03	-12.23	-2.21	FeSO4:7H2O
NH3(g)	-7.32	-5.52	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.98	9.22	15.2	Mn(OH)2
Pyrolusite	-7.24	34.14	41.38	MnO2:H2O
Rhodochro	-0.56	-11.69	-11.13	MnCO3
Siderite	-2.82	-13.71	-10.89	FeCO3
Smithsonit	-2	-12	-10	ZnCO3
Sylvite	-4.41	-3.51	0.9	KCl
Witherite	-1.72	-10.28	-8.56	BaCO3
Zn(OH)2(e	-2.59	8.91	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 21

#NAME? composition----------

Elements	Molality	Moles

Alkalinity	1.75E-02	1.75E-02
Ba	3.17E-06	3.17E-06
Ca	6.42E-03	6.42E-03
Cl	2.35E-01	2.35E-01
Cu	2.10E-07	2.10E-07
F	6.60E-04	6.60E-04
Fe	1.69E-06	1.69E-06
K	3.22E-03	3.22E-03
Mg	5.18E-02	5.18E-02
Mn	2.90E-07	2.90E-07
N(-3)	3.50E-05	3.50E-05
N(5)	3.00E-04	3.00E-04
Na	2.27E-01	2.27E-01
S(6)	2.67E-02	2.67E-02
Zn	1.85E-06	1.85E-06

#NAME? of solution----------

pH	=	8.46			
pe	=	4			
Specific	Conductan	(µS/cm,	25°C)	=	27154
Density	(g/cm³)	=	1.01173		
Volume	(L)	=	1.00691		
Activity	of	water	=	0.991	
Ionic	strength	(mol/kgw)	=	3.58E-01	
Mass	of	water	(kg)	=	1.00E+00
Total	carbon	(mol/kg)	=	1.54E-02	
Total	CO2	(mol/kg)	=	1.54E-02	
Temperatu	(°C)	=	25		
Electrical	balance	(eq)	=	3.91E-02	
Percent	error,	100*(Cat-|	=	6.54	
Iterations	=	10	(203	overall)	
Total	H	=	1.11E+02		
Total	O	=	5.57E+01		

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.436	0.2624		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.39E-06	2.89E-06	-5.358	-5.539	-0.181	-3.18
H+	4.47E-09	3.47E-09	-8.35	-8.46	-0.11	0
H2O	5.55E+01	9.91E-01	1.744	-0.004	0	18.07

Ba 3.17E-06

	Ba+2	2.29E-06	5.39E-07	-5.64	-6.268	-0.629	-11.43
	BaSO4	7.98E-07	8.66E-07	-6.098	-6.062	0.036	0
	BaHCO3+	5.38E-08	3.93E-08	-7.269	-7.406	-0.136	0
	BaCO3	2.64E-08	2.87E-08	-7.579	-7.543	0.036	-10.7
	BaOH+	7.44E-12	5.22E-12	-11.129	-11.283	-0.154	0
C(4)	1.54E-02						
	HCO3-	1.07E-02	7.61E-03	-1.971	-2.119	-0.148	26.04
	MgHCO3+	1.62E-03	1.10E-03	-2.79	-2.96	-0.171	5.76
	MgCO3	1.11E-03	1.21E-03	-2.954	-2.918	0.036	-17.09
	NaHCO3	6.33E-04	6.87E-04	-3.199	-3.163	0.036	1.8
	NaCO3-	4.21E-04	3.08E-04	-3.375	-3.512	-0.136	1.18
	CO3-2	4.02E-04	1.03E-04	-3.395	-3.988	-0.592	-2.96
	CaCO3	2.31E-04	2.51E-04	-3.636	-3.6	0.036	-14.6
	CaHCO3+	1.95E-04	1.41E-04	-3.711	-3.851	-0.14	9.92
	CO2	5.51E-05	5.99E-05	-4.259	-4.223	0.036	34.43
	Zn(CO3)2-2	1.57E-06	4.47E-07	-5.805	-6.35	-0.545	0
	ZnCO3	1.87E-07	2.03E-07	-6.728	-6.692	0.036	0
	MnCO3	1.60E-07	1.74E-07	-6.795	-6.76	0.036	0
	BaHCO3+	5.38E-08	3.93E-08	-7.269	-7.406	-0.136	0
	CuCO3	3.15E-08	3.42E-08	-7.502	-7.466	0.036	0
	BaCO3	2.64E-08	2.87E-08	-7.579	-7.543	0.036	-10.7
	MnHCO3+	2.06E-08	1.44E-08	-7.687	-7.841	-0.154	0
	Cu(CO3)2-	1.55E-08	4.43E-09	-7.809	-8.354	-0.545	0
	ZnHCO3+	1.30E-08	9.48E-09	-7.887	-8.023	-0.136	0
	FeCO3	4.72E-10	5.13E-10	-9.326	-9.29	0.036	0
	CuHCO3+	3.23E-10	2.36E-10	-9.491	-9.627	-0.136	0
	FeHCO3+	2.16E-10	1.58E-10	-9.665	-9.801	-0.136	0
	(CO2)2	6.06E-11	6.58E-11	-10.218	-10.182	0.036	68.87
Ca	6.42E-03						
	Ca+2	5.23E-03	1.45E-03	-2.281	-2.838	-0.557	-16.99
	CaSO4	7.63E-04	8.28E-04	-3.118	-3.082	0.036	7.5
	CaCO3	2.31E-04	2.51E-04	-3.636	-3.6	0.036	-14.6
	CaHCO3+	1.95E-04	1.41E-04	-3.711	-3.851	-0.14	9.92
	CaOH+	9.42E-08	6.89E-08	-7.026	-7.162	-0.136	0
	CaHSO4+	2.58E-11	1.89E-11	-10.588	-10.724	-0.136	0
Cl	2.35E-01						
	Cl-	2.35E-01	1.58E-01	-0.628	-0.8	-0.172	18.59
	CuCl2-	3.82E-08	2.58E-08	-7.418	-7.589	-0.171	0
	CuCl3-2	2.67E-08	6.47E-09	-7.573	-8.189	-0.616	0
	MnCl+	1.96E-08	1.37E-08	-7.708	-7.862	-0.154	-2.84
	ZnOHCl	1.37E-08	1.48E-08	-7.864	-7.828	0.036	0
	ZnCl+	6.26E-09	4.22E-09	-8.204	-8.374	-0.171	-14.88
	MnCl2	8.75E-10	9.50E-10	-9.058	-9.022	0.036	85.89
	ZnCl2	6.45E-10	7.01E-10	-9.19	-9.155	0.036	102.03
	ZnCl3-	1.85E-10	1.25E-10	-9.734	-9.905	-0.171	14.74
	FeCl+	6.21E-11	4.54E-11	-10.207	-10.343	-0.136	0
	MnCl3-	5.91E-11	4.15E-11	-10.228	-10.382	-0.154	44.78
	ZnCl4-2	4.08E-11	9.89E-12	-10.389	-11.005	-0.616	148.46
	CuCl+	3.91E-11	2.64E-11	-10.408	-10.579	-0.171	1.4
	CuCl2	2.07E-12	2.25E-12	-11.685	-11.649	0.036	31.02

	CuCl3-	1.87E-15	1.26E-15	-14.728	-14.899	-0.171	0
	CuCl4-2	4.14E-18	1.00E-18	-17.383	-17.999	-0.616	0
	FeCl+2	3.92E-18	9.49E-19	-17.407	-18.023	-0.616	0
	FeCl2+	9.57E-19	6.72E-19	-18.019	-18.173	-0.154	0
	FeCl3	9.80E-21	1.06E-20	-20.009	-19.973	0.036	0
Cu(1)	6.49E-08						
	CuCl2-	3.82E-08	2.58E-08	-7.418	-7.589	-0.171	0
	CuCl3-2	2.67E-08	6.47E-09	-7.573	-8.189	-0.616	0
	Cu+	5.20E-12	3.25E-12	-11.284	-11.488	-0.205	0
Cu(2)	1.45E-07						
	Cu(OH)2	9.72E-08	1.06E-07	-7.012	-6.977	0.036	0
	CuCO3	3.15E-08	3.42E-08	-7.502	-7.466	0.036	0
	Cu(CO3)2-	1.55E-08	4.43E-09	-7.809	-8.354	-0.545	0
	CuHCO3+	3.23E-10	2.36E-10	-9.491	-9.627	-0.136	0
	CuOH+	2.62E-10	1.77E-10	-9.582	-9.753	-0.171	0
	Cu+2	2.25E-10	6.19E-11	-9.648	-10.208	-0.56	-25.56
	CuCl+	3.91E-11	2.64E-11	-10.408	-10.579	-0.171	1.4
	CuSO4	3.73E-11	4.05E-11	-10.428	-10.392	0.036	13.09
	Cu(OH)3-	2.49E-12	1.82E-12	-11.605	-11.741	-0.136	0
	CuCl2	2.07E-12	2.25E-12	-11.685	-11.649	0.036	31.02
	CuF+	3.66E-13	2.67E-13	-12.437	-12.573	-0.136	0
	Cu2(OH)2+	4.79E-14	1.37E-14	-13.319	-13.864	-0.545	0
	CuCl3-	1.87E-15	1.26E-15	-14.728	-14.899	-0.171	0
	Cu(OH)4-2	3.63E-16	1.04E-16	-15.44	-15.985	-0.545	0
	CuCl4-2	4.14E-18	1.00E-18	-17.383	-17.999	-0.616	0
F	6.60E-04						
	F-	3.60E-04	2.37E-04	-3.444	-3.625	-0.181	-0.78
	MgF+	2.80E-04	1.93E-04	-3.553	-3.715	-0.162	-10.3
	NaF	2.02E-05	2.19E-05	-4.695	-4.659	0.036	7.26
	HF	1.14E-09	1.23E-09	-8.945	-8.909	0.036	12.5
	MnF+	4.98E-11	3.49E-11	-10.303	-10.457	-0.154	0
	ZnF+	4.54E-11	3.32E-11	-10.343	-10.479	-0.136	0
	HF2-	1.54E-12	1.12E-12	-11.814	-11.95	-0.136	22.6
	FeF+	6.74E-13	4.93E-13	-12.171	-12.308	-0.136	0
	CuF+	3.66E-13	2.67E-13	-12.437	-12.573	-0.136	0
	FeF2+	1.00E-15	7.04E-16	-14.998	-15.152	-0.154	0
	FeF+2	3.08E-16	7.46E-17	-15.512	-16.128	-0.616	0
	FeF3	2.44E-16	2.65E-16	-15.613	-15.577	0.036	0
Fe(2)	1.64E-09						
	Fe+2	7.54E-10	2.08E-10	-9.122	-9.683	-0.56	-21.02
	FeCO3	4.72E-10	5.13E-10	-9.326	-9.29	0.036	0
	FeHCO3+	2.16E-10	1.58E-10	-9.665	-9.801	-0.136	0
	FeSO4	1.09E-10	1.18E-10	-9.962	-9.927	0.036	18.97
	FeCl+	6.21E-11	4.54E-11	-10.207	-10.343	-0.136	0
	FeOH+	2.67E-11	1.88E-11	-10.573	-10.727	-0.154	0
	FeF+	6.74E-13	4.93E-13	-12.171	-12.308	-0.136	0
	Fe(OH)2	4.20E-14	4.56E-14	-13.377	-13.341	0.036	0
	Fe(OH)3-	6.90E-16	4.84E-16	-15.161	-15.315	-0.154	0
	FeHSO4+	3.69E-18	2.70E-18	-17.433	-17.569	-0.136	0
Fe(3)	1.69E-06						

	Fe(OH)3	1.17E-06	1.27E-06	-5.931	-5.895	0.036	0
	Fe(OH)4-	4.67E-07	3.32E-07	-6.331	-6.479	-0.148	0
	Fe(OH)2+	4.87E-08	3.46E-08	-7.313	-7.461	-0.148	0
	FeOH+2	1.51E-12	3.66E-13	-11.821	-12.437	-0.616	0
	FeF2+	1.00E-15	7.04E-16	-14.998	-15.152	-0.154	0
	FeF+2	3.08E-16	7.46E-17	-15.512	-16.128	-0.616	0
	FeF3	2.44E-16	2.65E-16	-15.613	-15.577	0.036	0
	FeSO4+	9.94E-18	6.97E-18	-17.003	-17.157	-0.154	0
	FeCl+2	3.92E-18	9.49E-19	-17.407	-18.023	-0.616	0
	Fe+3	1.95E-18	1.98E-19	-17.711	-18.703	-0.992	0
	FeCl2+	9.57E-19	6.72E-19	-18.019	-18.173	-0.154	0
	Fe(SO4)2-	6.70E-19	4.89E-19	-18.174	-18.31	-0.136	0
	FeCl3	9.80E-21	1.06E-20	-20.009	-19.973	0.036	0
	Fe2(OH)2+	5.43E-22	3.60E-24	-21.265	-23.444	-2.178	0
	FeHSO4+2	2.27E-25	6.48E-26	-24.644	-25.189	-0.545	0
	Fe3(OH)4+	6.60E-26	2.60E-29	-25.181	-28.584	-3.404	0
H(0)	1.57E-28						
	H2	7.84E-29	8.51E-29	-28.106	-28.07	0.036	28.61
K	3.22E-03						
	K+	3.15E-03	2.11E-03	-2.501	-2.677	-0.175	9.47
	KSO4-	6.67E-05	4.75E-05	-4.176	-4.324	-0.148	34.64
Mg	5.18E-02						
	Mg+2	4.03E-02	1.23E-02	-1.395	-1.91	-0.515	-20.7
	MgSO4	8.52E-03	9.25E-03	-2.07	-2.034	0.036	5.84
	MgHCO3+	1.62E-03	1.10E-03	-2.79	-2.96	-0.171	5.76
	MgCO3	1.11E-03	1.21E-03	-2.954	-2.918	0.036	-17.09
	MgF+	2.80E-04	1.93E-04	-3.553	-3.715	-0.162	-10.3
	MgOH+	1.74E-05	1.28E-05	-4.76	-4.894	-0.134	0
Mn(2)	2.90E-07						
	MnCO3	1.60E-07	1.74E-07	-6.795	-6.76	0.036	0
	Mn+2	7.73E-08	2.13E-08	-7.112	-7.672	-0.56	-16.99
	MnHCO3+	2.06E-08	1.44E-08	-7.687	-7.841	-0.154	0
	MnCl+	1.96E-08	1.37E-08	-7.708	-7.862	-0.154	-2.84
	MnSO4	1.12E-08	1.21E-08	-7.952	-7.916	0.036	22.54
	MnCl2	8.75E-10	9.50E-10	-9.058	-9.022	0.036	85.89
	MnOH+	2.23E-10	1.56E-10	-9.652	-9.806	-0.154	0
	MnCl3-	5.91E-11	4.15E-11	-10.228	-10.382	-0.154	44.78
	MnF+	4.98E-11	3.49E-11	-10.303	-10.457	-0.154	0
	Mn(NO3)2	2.90E-15	3.15E-15	-14.538	-14.502	0.036	41.04
	Mn(OH)3-	1.12E-17	7.87E-18	-16.95	-17.104	-0.154	0
Mn(3)	6.46E-29						
	Mn+3	6.46E-29	6.58E-30	-28.19	-29.182	-0.992	0
N(-3)	3.50E-05						
	NH4+	3.10E-05	1.93E-05	-4.509	-4.714	-0.205	18.33
	NH3	2.93E-06	3.18E-06	-5.534	-5.498	0.036	24.42
	NH4SO4-	1.09E-06	7.99E-07	-5.961	-6.097	-0.136	39.01
N(5)	3.00E-04						
	NO3-	3.00E-04	1.93E-04	-3.523	-3.715	-0.192	30.06
	Mn(NO3)2	2.90E-15	3.15E-15	-14.538	-14.502	0.036	41.04
Na	2.27E-01						

	Na+	2.22E-01	1.61E-01	-0.654	-0.794	-0.14	-0.75
	NaSO4-	3.63E-03	2.58E-03	-2.44	-2.588	-0.148	19.02
	NaHCO3	6.33E-04	6.87E-04	-3.199	-3.163	0.036	1.8
	NaCO3-	4.21E-04	3.08E-04	-3.375	-3.512	-0.136	1.18
	NaF	2.02E-05	2.19E-05	-4.695	-4.659	0.036	7.26
	NaOH	4.28E-17	4.65E-17	-16.369	-16.333	0.036	0
O(0)	1.04E-36						
	O2	5.20E-37	5.65E-37	-36.284	-36.248	0.036	30.4
S(6)	2.67E-02						
	SO4-2	1.37E-02	3.21E-03	-1.864	-2.494	-0.63	16.65
	MgSO4	8.52E-03	9.25E-03	-2.07	-2.034	0.036	5.84
	NaSO4-	3.63E-03	2.58E-03	-2.44	-2.588	-0.148	19.02
	CaSO4	7.63E-04	8.28E-04	-3.118	-3.082	0.036	7.5
	KSO4-	6.67E-05	4.75E-05	-4.176	-4.324	-0.148	34.64
	NH4SO4-	1.09E-06	7.99E-07	-5.961	-6.097	-0.136	39.01
	BaSO4	7.98E-07	8.66E-07	-6.098	-6.062	0.036	0
	MnSO4	1.12E-08	1.21E-08	-7.952	-7.916	0.036	22.54
	ZnSO4	6.86E-09	7.45E-09	-8.164	-8.128	0.036	21.71
	HSO4-	1.48E-09	1.08E-09	-8.83	-8.966	-0.136	40.78
	Zn(SO4)2-2	6.80E-10	1.94E-10	-9.167	-9.712	-0.545	-8.34
	FeSO4	1.09E-10	1.18E-10	-9.962	-9.927	0.036	18.97
	CuSO4	3.73E-11	4.05E-11	-10.428	-10.392	0.036	13.09
	CaHSO4+	2.58E-11	1.89E-11	-10.588	-10.724	-0.136	0
	FeSO4+	9.94E-18	6.97E-18	-17.003	-17.157	-0.154	0
	FeHSO4+	3.69E-18	2.70E-18	-17.433	-17.569	-0.136	0
	Fe(SO4)2-	6.70E-19	4.89E-19	-18.174	-18.31	-0.136	0
	FeHSO4+2	2.27E-25	6.48E-26	-24.644	-25.189	-0.545	0
Zn	1.85E-06						
	Zn(CO3)2-2	1.57E-06	4.47E-07	-5.805	-6.35	-0.545	0
	ZnCO3	1.87E-07	2.03E-07	-6.728	-6.692	0.036	0
	Zn+2	4.09E-08	9.90E-09	-7.389	-8.004	-0.616	-24.31
	ZnOHCl	1.37E-08	1.48E-08	-7.864	-7.828	0.036	0
	ZnHCO3+	1.30E-08	9.48E-09	-7.887	-8.023	-0.136	0
	Zn(OH)2	9.37E-09	1.02E-08	-8.028	-7.992	0.036	0
	ZnSO4	6.86E-09	7.45E-09	-8.164	-8.128	0.036	21.71
	ZnCl+	6.26E-09	4.22E-09	-8.204	-8.374	-0.171	-14.88
	ZnOH+	4.24E-09	3.10E-09	-8.372	-8.508	-0.136	0
	Zn(SO4)2-2	6.80E-10	1.94E-10	-9.167	-9.712	-0.545	-8.34
	ZnCl2	6.45E-10	7.01E-10	-9.19	-9.155	0.036	102.03
	ZnCl3-	1.85E-10	1.25E-10	-9.734	-9.905	-0.171	14.74
	ZnF+	4.54E-11	3.32E-11	-10.343	-10.479	-0.136	0
	ZnCl4-2	4.08E-11	9.89E-12	-10.389	-11.005	-0.616	148.46
	Zn(OH)3-	1.26E-11	9.19E-12	-10.9	-11.036	-0.136	0
	Zn(OH)4-2	1.46E-15	4.16E-16	-14.836	-15.381	-0.545	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-1.05	-5.33	-4.28	CaSO4

Aragonite	1.51	-6.83	-8.34	CaCO3
Barite	1.08	-8.76	-9.84	BaSO4
Calcite	1.65	-6.83	-8.48	CaCO3
CO2(g)	-2.75	-4.22	-1.47	CO2
Dolomite	4.36	-12.72	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.77	6.67	4.89	Fe(OH)3
Fluorite	0.51	-10.09	-10.6	CaF2
Goethite	7.67	6.67	-1	FeOOH
Gypsum	-0.76	-5.34	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O
Halite	-3.16	-1.59	1.57	NaCl
Hausmann	-8.38	52.65	61.03	Mn3O4
Hematite	17.35	13.34	-4.01	Fe2O3
Jarosite-K	-3.83	-13.04	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.64	21.7	25.34	MnOOH
Melanterit	-10	-12.21	-2.21	FeSO4:7H2O
NH3(g)	-7.29	-5.5	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.96	9.24	15.2	Mn(OH)2
Pyrolusite	-7.22	34.16	41.38	MnO2:H2O
Rhodochro	-0.53	-11.66	-11.13	MnCO3
Siderite	-2.78	-13.67	-10.89	FeCO3
Smithsonit	-1.99	-11.99	-10	ZnCO3
Sylvite	-4.38	-3.48	0.9	KCl
Witherite	-1.69	-10.26	-8.56	BaCO3
Zn(OH)2(e	-2.59	8.91	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 22

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.84E-02	1.84E-02
Ba	3.32E-06	3.32E-06
Ca	6.72E-03	6.72E-03
Cl	2.47E-01	2.47E-01
Cu	2.30E-07	2.30E-07
F	6.90E-04	6.90E-04
Fe	1.77E-06	1.77E-06
K	3.38E-03	3.38E-03
Mg	5.43E-02	5.43E-02
Mn	3.00E-07	3.00E-07
N(-3)	3.70E-05	3.70E-05
N(5)	3.10E-04	3.10E-04
Na	2.37E-01	2.37E-01

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        S(6)        2.79E-02   2.79E-02
        Zn          1.93E-06   1.93E-06

#NAME?  of          solution----------------------------

        pH          =                8.46
        pe          =                   4
        Specific    Conductan (µS/cm,   25°C)      =              28271
        Density     (g/cm³)   =            1.01242
        Volume      (L)       =            1.00711
        Activity    of        water      =                 0.99
        Ionic       strength  (mol/kgw)  =            3.75E-01
        Mass        of        water      (kg)        =          1.00E+00
        Total       carbon    (mol/kg)   =            1.61E-02
        Total       CO2       (mol/kg)   =            1.61E-02
        Temperatu   (°C)      =                  25
        Electrical  balance   (eq)       =            4.09E-02
        Percent     error,    100*(Cat-| =                 6.55
        Iterations  =                 10 (213        overall)
        Total       H         =            1.11E+02
        Total       O         =            5.57E+01

#NAME?  couples--------------------------------

        Redox       couple    pe         Eh          (volts)

        N(-3)/N(5)    4.4348    0.2623

#NAME?  of          species----------------------------

        Log         Log       Log        mole        V
        Species     Molality  Activity   Molality    Activity    Gamma    cm³/mol

        OH-         4.41E-06  2.89E-06     -5.356      -5.539    -0.183      -3.15
        H+          4.48E-09  3.47E-09     -8.349       -8.46    -0.111          0
        H2O         5.55E+01  9.90E-01      1.744      -0.004         0      18.07
Ba        3.32E-06
        Ba+2        2.40E-06  5.56E-07      -5.62      -6.255    -0.635      -11.4
        BaSO4       8.36E-07  9.12E-07     -6.078       -6.04     0.037          0
        BaHCO3+     5.72E-08  4.18E-08     -7.242      -7.379    -0.136          0
        BaCO3       2.80E-08  3.05E-08     -7.553      -7.516     0.037      -10.7
        BaOH+       7.70E-12  5.38E-12    -11.113     -11.269    -0.156          0
C(4)      1.61E-02
        HCO3-       1.11E-02  7.84E-03     -1.956      -2.106     -0.15      26.09
        MgHCO3+     1.75E-03  1.17E-03     -2.758      -2.931    -0.173       5.77
        MgCO3       1.19E-03  1.29E-03     -2.926      -2.889     0.037     -17.09
        NaHCO3      6.80E-04  7.41E-04     -3.168       -3.13     0.037        1.8
        NaCO3-      4.54E-04  3.32E-04     -3.343      -3.479    -0.136       1.28
        CO3-2       4.21E-04  1.06E-04     -3.376      -3.974    -0.599       -2.9
        CaCO3       2.46E-04  2.68E-04      -3.61      -3.572     0.037      -14.6
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	CaHCO3+	2.08E-04	1.50E-04	-3.682	-3.823	-0.141	9.92
	CO2	5.66E-05	6.18E-05	-4.247	-4.209	0.037	34.43
	Zn(CO3)2-	1.64E-06	4.68E-07	-5.784	-6.329	-0.545	0
	ZnCO3	1.90E-07	2.07E-07	-6.722	-6.685	0.037	0
	MnCO3	1.66E-07	1.81E-07	-6.78	-6.742	0.037	0
	BaHCO3+	5.72E-08	4.18E-08	-7.242	-7.379	-0.136	0
	CuCO3	3.40E-08	3.70E-08	-7.469	-7.432	0.037	0
	BaCO3	2.80E-08	3.05E-08	-7.553	-7.516	0.037	-10.7
	MnHCO3+	2.15E-08	1.50E-08	-7.668	-7.824	-0.156	0
	Cu(CO3)2-	1.74E-08	4.94E-09	-7.761	-8.306	-0.545	0
	ZnHCO3+	1.32E-08	9.63E-09	-7.88	-8.016	-0.136	0
	FeCO3	5.09E-10	5.55E-10	-9.293	-9.256	0.037	0
	CuHCO3+	3.50E-10	2.55E-10	-9.456	-9.593	-0.136	0
	FeHCO3+	2.34E-10	1.71E-10	-9.631	-9.767	-0.136	0
	(CO2)2	6.42E-11	7.00E-11	-10.192	-10.155	0.037	68.87
Ca	6.72E-03						
	Ca+2	5.47E-03	1.50E-03	-2.262	-2.823	-0.561	-16.97
	CaSO4	8.01E-04	8.74E-04	-3.096	-3.059	0.037	7.5
	CaCO3	2.46E-04	2.68E-04	-3.61	-3.572	0.037	-14.6
	CaHCO3+	2.08E-04	1.50E-04	-3.682	-3.823	-0.141	9.92
	CaOH+	9.74E-08	7.12E-08	-7.011	-7.148	-0.136	0
	CaHSO4+	2.73E-11	1.99E-11	-10.565	-10.701	-0.136	0
Cl	2.47E-01						
	Cl-	2.47E-01	1.65E-01	-0.608	-0.782	-0.174	18.61
	CuCl2-	4.38E-08	2.94E-08	-7.358	-7.531	-0.173	0
	CuCl3-2	3.23E-08	7.71E-09	-7.491	-8.113	-0.623	0
	MnCl+	2.07E-08	1.45E-08	-7.684	-7.84	-0.156	-2.83
	ZnOHCl	1.40E-08	1.52E-08	-7.854	-7.817	0.037	0
	ZnCl+	6.46E-09	4.34E-09	-8.19	-8.363	-0.173	-14.94
	MnCl2	9.56E-10	1.04E-09	-9.02	-8.982	0.037	85.89
	ZnCl2	6.88E-10	7.51E-10	-9.162	-9.125	0.037	102.03
	ZnCl3-	2.07E-10	1.39E-10	-9.684	-9.857	-0.173	14.62
	FeCl+	6.81E-11	4.97E-11	-10.167	-10.303	-0.136	0
	MnCl3-	6.79E-11	4.74E-11	-10.168	-10.324	-0.156	44.84
	ZnCl4-2	4.83E-11	1.15E-11	-10.316	-10.939	-0.623	148.57
	CuCl+	4.30E-11	2.89E-11	-10.366	-10.539	-0.173	1.43
	CuCl2	2.35E-12	2.56E-12	-11.629	-11.591	0.037	31.02
	CuCl3-	2.24E-15	1.50E-15	-14.65	-14.823	-0.173	0
	CuCl4-2	5.22E-18	1.24E-18	-17.283	-17.905	-0.623	0
	FeCl+2	4.36E-18	1.04E-18	-17.361	-17.983	-0.623	0
	FeCl2+	1.10E-18	7.67E-19	-17.96	-18.115	-0.156	0
	FeCl3	1.16E-20	1.27E-20	-19.935	-19.897	0.037	0
Cu(1)	7.62E-08						
	CuCl2-	4.38E-08	2.94E-08	-7.358	-7.531	-0.173	0
	CuCl3-2	3.23E-08	7.71E-09	-7.491	-8.113	-0.623	0
	Cu+	5.50E-12	3.41E-12	-11.259	-11.467	-0.208	0
Cu(2)	1.54E-07						
	Cu(OH)2	1.02E-07	1.11E-07	-6.993	-6.956	0.037	0
	CuCO3	3.40E-08	3.70E-08	-7.469	-7.432	0.037	0
	Cu(CO3)2-	1.74E-08	4.94E-09	-7.761	-8.306	-0.545	0

	CuHCO3+	3.50E-10	2.55E-10	-9.456	-9.593	-0.136	0
	CuOH+	2.76E-10	1.86E-10	-9.558	-9.731	-0.173	0
	Cu+2	2.39E-10	6.50E-11	-9.621	-10.187	-0.566	-25.55
	CuCl+	4.30E-11	2.89E-11	-10.366	-10.539	-0.173	1.43
	CuSO4	3.98E-11	4.34E-11	-10.4	-10.363	0.037	13.09
	Cu(OH)3-	2.61E-12	1.91E-12	-11.584	-11.72	-0.136	0
	CuCl2	2.35E-12	2.56E-12	-11.629	-11.591	0.037	31.02
	CuF+	3.93E-13	2.87E-13	-12.406	-12.542	-0.136	0
	Cu2(OH)2+	5.29E-14	1.51E-14	-13.277	-13.822	-0.545	0
	CuCl3-	2.24E-15	1.50E-15	-14.65	-14.823	-0.173	0
	Cu(OH)4-2	3.81E-16	1.09E-16	-15.419	-15.964	-0.545	0
	CuCl4-2	5.22E-18	1.24E-18	-17.283	-17.905	-0.623	0
F	6.90E-04						
	F-	3.70E-04	2.43E-04	-3.432	-3.615	-0.183	-0.77
	MgF+	2.99E-04	2.05E-04	-3.525	-3.689	-0.164	-10.3
	NaF	2.15E-05	2.35E-05	-4.667	-4.63	0.037	7.26
	HF	1.16E-09	1.26E-09	-8.936	-8.899	0.037	12.5
	MnF+	5.16E-11	3.61E-11	-10.287	-10.443	-0.156	0
	ZnF+	4.58E-11	3.34E-11	-10.339	-10.476	-0.136	0
	HF2-	1.61E-12	1.18E-12	-11.794	-11.93	-0.136	22.61
	FeF+	7.24E-13	5.29E-13	-12.14	-12.276	-0.136	0
	CuF+	3.93E-13	2.87E-13	-12.406	-12.542	-0.136	0
	FeF2+	1.11E-15	7.74E-16	-14.956	-15.111	-0.156	0
	FeF+2	3.36E-16	8.01E-17	-15.474	-16.096	-0.623	0
	FeF3	2.73E-16	2.98E-16	-15.564	-15.526	0.037	0
Fe(2)	1.76E-09						
	Fe+2	8.03E-10	2.18E-10	-9.095	-9.661	-0.566	-21.01
	FeCO3	5.09E-10	5.55E-10	-9.293	-9.256	0.037	0
	FeHCO3+	2.34E-10	1.71E-10	-9.631	-9.767	-0.136	0
	FeSO4	1.16E-10	1.27E-10	-9.934	-9.897	0.037	18.97
	FeCl+	6.81E-11	4.97E-11	-10.167	-10.303	-0.136	0
	FeOH+	2.82E-11	1.97E-11	-10.55	-10.706	-0.156	0
	FeF+	7.24E-13	5.29E-13	-12.14	-12.276	-0.136	0
	Fe(OH)2	4.39E-14	4.79E-14	-13.357	-13.32	0.037	0
	Fe(OH)3-	7.27E-16	5.08E-16	-15.138	-15.294	-0.156	0
	FeHSO4+	3.96E-18	2.89E-18	-17.403	-17.539	-0.136	0
Fe(3)	1.77E-06						
	Fe(OH)3	1.23E-06	1.34E-06	-5.912	-5.874	0.037	0
	Fe(OH)4-	4.91E-07	3.48E-07	-6.309	-6.458	-0.15	0
	Fe(OH)2+	5.13E-08	3.63E-08	-7.29	-7.44	-0.15	0
	FeOH+2	1.61E-12	3.84E-13	-11.793	-12.416	-0.623	0
	FeF2+	1.11E-15	7.74E-16	-14.956	-15.111	-0.156	0
	FeF+2	3.36E-16	8.01E-17	-15.474	-16.096	-0.623	0
	FeF3	2.73E-16	2.98E-16	-15.564	-15.526	0.037	0
	FeSO4+	1.07E-17	7.47E-18	-16.971	-17.127	-0.156	0
	FeCl+2	4.36E-18	1.04E-18	-17.361	-17.983	-0.623	0
	Fe+3	2.08E-18	2.08E-19	-17.681	-18.681	-1	0
	FeCl2+	1.10E-18	7.67E-19	-17.96	-18.115	-0.156	0
	Fe(SO4)2-	7.32E-19	5.34E-19	-18.136	-18.272	-0.136	0
	FeCl3	1.16E-20	1.27E-20	-19.935	-19.897	0.037	0

	Fe2(OH)2+	6.03E-22	3.97E-24	-21.22	-23.401	-2.181	0
	FeHSO4+2	2.43E-25	6.94E-26	-24.614	-25.159	-0.545	0
	Fe3(OH)4+	7.71E-26	3.01E-29	-25.113	-28.521	-3.408	0
H(0)	1.56E-28						
	H2	7.81E-29	8.51E-29	-28.107	-28.07	0.037	28.61
K	3.38E-03						
	K+	3.31E-03	2.20E-03	-2.48	-2.658	-0.178	9.48
	KSO4-	7.13E-05	5.05E-05	-4.147	-4.297	-0.15	34.65
Mg	5.43E-02						
	Mg+2	4.21E-02	1.28E-02	-1.376	-1.894	-0.518	-20.69
	MgSO4	8.98E-03	9.79E-03	-2.047	-2.009	0.037	5.84
	MgHCO3+	1.75E-03	1.17E-03	-2.758	-2.931	-0.173	5.77
	MgCO3	1.19E-03	1.29E-03	-2.926	-2.889	0.037	-17.09
	MgF+	2.99E-04	2.05E-04	-3.525	-3.689	-0.164	-10.3
	MgOH+	1.81E-05	1.32E-05	-4.743	-4.878	-0.135	0
Mn(2)	3.00E-07						
	MnCO3	1.66E-07	1.81E-07	-6.78	-6.742	0.037	0
	Mn+2	7.91E-08	2.15E-08	-7.102	-7.668	-0.566	-16.95
	MnHCO3+	2.15E-08	1.50E-08	-7.668	-7.824	-0.156	0
	MnCl+	2.07E-08	1.45E-08	-7.684	-7.84	-0.156	-2.83
	MnSO4	1.15E-08	1.25E-08	-7.941	-7.903	0.037	22.54
	MnCl2	9.56E-10	1.04E-09	-9.02	-8.982	0.037	85.89
	MnOH+	2.26E-10	1.58E-10	-9.647	-9.802	-0.156	0
	MnCl3-	6.79E-11	4.74E-11	-10.168	-10.324	-0.156	44.84
	MnF+	5.16E-11	3.61E-11	-10.287	-10.443	-0.156	0
	Mn(NO3)2	3.07E-15	3.35E-15	-14.512	-14.475	0.037	41.04
	Mn(OH)3-	1.14E-17	7.93E-18	-16.945	-17.101	-0.156	0
Mn(3)	6.64E-29						
	Mn+3	6.64E-29	6.64E-30	-28.178	-29.178	-1	0
N(-3)	3.70E-05						
	NH4+	3.28E-05	2.03E-05	-4.485	-4.692	-0.208	18.34
	NH3	3.06E-06	3.34E-06	-5.514	-5.477	0.037	24.42
	NH4SO4-	1.17E-06	8.56E-07	-5.931	-6.068	-0.136	39.06
N(5)	3.10E-04						
	NO3-	3.10E-04	1.98E-04	-3.509	-3.703	-0.195	30.07
	Mn(NO3)2	3.07E-15	3.35E-15	-14.512	-14.475	0.037	41.04
Na	2.37E-01						
	Na+	2.32E-01	1.68E-01	-0.634	-0.775	-0.141	-0.74
	NaSO4-	3.89E-03	2.75E-03	-2.41	-2.56	-0.15	19.15
	NaHCO3	6.80E-04	7.41E-04	-3.168	-3.13	0.037	1.8
	NaCO3-	4.54E-04	3.32E-04	-3.343	-3.479	-0.136	1.28
	NaF	2.15E-05	2.35E-05	-4.667	-4.63	0.037	7.26
	NaOH	4.45E-17	4.86E-17	-16.351	-16.314	0.037	0
O(0)	1.04E-36						
	O2	5.18E-37	5.64E-37	-36.286	-36.249	0.037	30.4
S(6)	2.79E-02						
	SO4-2	1.42E-02	3.27E-03	-1.848	-2.485	-0.638	16.7
	MgSO4	8.98E-03	9.79E-03	-2.047	-2.009	0.037	5.84
	NaSO4-	3.89E-03	2.75E-03	-2.41	-2.56	-0.15	19.15
	CaSO4	8.01E-04	8.74E-04	-3.096	-3.059	0.037	7.5

	KSO4-	7.13E-05	5.05E-05	-4.147	-4.297	-0.15	34.65
	NH4SO4-	1.17E-06	8.56E-07	-5.931	-6.068	-0.136	39.06
	BaSO4	8.36E-07	9.12E-07	-6.078	-6.04	0.037	0
	MnSO4	1.15E-08	1.25E-08	-7.941	-7.903	0.037	22.54
	ZnSO4	6.86E-09	7.48E-09	-8.164	-8.126	0.037	21.71
	HSO4-	1.51E-09	1.10E-09	-8.821	-8.958	-0.136	40.79
	Zn(SO4)2-2	6.98E-10	1.99E-10	-9.156	-9.701	-0.545	-8.16
	FeSO4	1.16E-10	1.27E-10	-9.934	-9.897	0.037	18.97
	CuSO4	3.98E-11	4.34E-11	-10.4	-10.363	0.037	13.09
	CaHSO4+	2.73E-11	1.99E-11	-10.565	-10.701	-0.136	0
	FeSO4+	1.07E-17	7.47E-18	-16.971	-17.127	-0.156	0
	FeHSO4+	3.96E-18	2.89E-18	-17.403	-17.539	-0.136	0
	Fe(SO4)2-	7.32E-19	5.34E-19	-18.136	-18.272	-0.136	0
	FeHSO4+2	2.43E-25	6.94E-26	-24.614	-25.159	-0.545	0
Zn	1.93E-06						
	Zn(CO3)2-2	1.64E-06	4.68E-07	-5.784	-6.329	-0.545	0
	ZnCO3	1.90E-07	2.07E-07	-6.722	-6.685	0.037	0
	Zn+2	4.09E-08	9.76E-09	-7.388	-8.011	-0.623	-24.29
	ZnOHCl	1.40E-08	1.52E-08	-7.854	-7.817	0.037	0
	ZnHCO3+	1.32E-08	9.63E-09	-7.88	-8.016	-0.136	0
	Zn(OH)2	9.19E-09	1.00E-08	-8.037	-7.999	0.037	0
	ZnSO4	6.86E-09	7.48E-09	-8.164	-8.126	0.037	21.71
	ZnCl+	6.46E-09	4.34E-09	-8.19	-8.363	-0.173	-14.94
	ZnOH+	4.18E-09	3.06E-09	-8.379	-8.515	-0.136	0
	Zn(SO4)2-2	6.98E-10	1.99E-10	-9.156	-9.701	-0.545	-8.16
	ZnCl2	6.88E-10	7.51E-10	-9.162	-9.125	0.037	102.03
	ZnCl3-	2.07E-10	1.39E-10	-9.684	-9.857	-0.173	14.62
	ZnCl4-2	4.83E-11	1.15E-11	-10.316	-10.939	-0.623	148.57
	ZnF+	4.58E-11	3.34E-11	-10.339	-10.476	-0.136	0
	Zn(OH)3-	1.24E-11	9.05E-12	-10.907	-11.043	-0.136	0
	Zn(OH)4-2	1.44E-15	4.10E-16	-14.842	-15.388	-0.545	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-1.03	-5.31	-4.28	CaSO4
Aragonite	1.54	-6.8	-8.34	CaCO3
Barite	1.1	-8.74	-9.84	BaSO4
Calcite	1.68	-6.8	-8.48	CaCO3
CO2(g)	-2.74	-4.21	-1.47	CO2
Dolomite	4.42	-12.67	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.79	6.69	4.89	Fe(OH)3
Fluorite	0.55	-10.05	-10.6	CaF2
Goethite	7.69	6.69	-1	FeOOH
Gypsum	-0.73	-5.32	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O
Halite	-3.13	-1.56	1.57	NaCl
Hausmann	-8.37	52.66	61.03	Mn3O4

Hematite	17.39	13.38	-4.01	Fe2O3
Jarosite-K	-3.73	-12.94	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.64	21.7	25.34	MnOOH
Melanterit	-9.97	-12.18	-2.21	FeSO4:7H2O
NH3(g)	-7.27	-5.48	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.96	9.24	15.2	Mn(OH)2
Pyrolusite	-7.22	34.16	41.38	MnO2:H2O
Rhodochrc	-0.51	-11.64	-11.13	MnCO3
Siderite	-2.75	-13.64	-10.89	FeCO3
Smithsonit	-1.99	-11.99	-10	ZnCO3
Sylvite	-4.34	-3.44	0.9	KCl
Witherite	-1.67	-10.23	-8.56	BaCO3
Zn(OH)2(e	-2.6	8.9	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 23

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.92E-02	1.92E-02
Ba	3.48E-06	3.48E-06
Ca	7.03E-03	7.03E-03
Cl	2.58E-01	2.58E-01
Cu	2.40E-07	2.40E-07
F	7.30E-04	7.30E-04
Fe	1.85E-06	1.85E-06
K	3.53E-03	3.53E-03
Mg	5.68E-02	5.68E-02
Mn	3.10E-07	3.10E-07
N(-3)	3.80E-05	3.80E-05
N(5)	3.20E-04	3.20E-04
Na	2.48E-01	2.48E-01
S(6)	2.92E-02	2.92E-02
Zn	2.02E-06	2.02E-06

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 29379
Density (g/cm³) = 1.01311
Volume (L) = 1.00731
Activity of water = 0.99
Ionic strength (mol/kgw) = 3.91E-01
Mass of water (kg) = 1.00E+00

```
Total carbon (mol/kg) = 1.68E-02
Total CO2 (mol/kg) = 1.68E-02
Temperatu (°C) = 25
Electrical balance (eq) = 4.28E-02
Percent error, 100*(Cat-| = 6.55
Iterations = 10 (223 overall)
Total H = 1.11E+02
Total O = 5.57E+01

#NAME? couples----------

Redox couple pe Eh (volts)

N(-3)/N(5) 4.4352 0.2624

#NAME? of species----------
```

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.43E-06	2.89E-06	-5.354	-5.539	-0.186	-3.12
H+	4.49E-09	3.47E-09	-8.348	-8.46	-0.112	0
H2O	5.55E+01	9.90E-01	1.744	-0.004	0	18.07
Ba 3.48E-06						
Ba+2	2.51E-06	5.75E-07	-5.6	-6.24	-0.641	-11.38
BaSO4	8.77E-07	9.60E-07	-6.057	-6.018	0.039	0
BaHCO3+	6.09E-08	4.45E-08	-7.215	-7.352	-0.136	0
BaCO3	2.96E-08	3.24E-08	-7.528	-7.489	0.039	-10.7
BaOH+	7.99E-12	5.56E-12	-11.098	-11.255	-0.157	0
C(4) 1.68E-02						
HCO3-	1.14E-02	8.07E-03	-1.942	-2.093	-0.151	26.14
MgHCO3+	1.87E-03	1.25E-03	-2.728	-2.903	-0.175	5.77
MgCO3	1.26E-03	1.38E-03	-2.9	-2.861	0.039	-17.09
NaHCO3	7.27E-04	7.96E-04	-3.138	-3.099	0.039	1.8
NaCO3-	4.88E-04	3.56E-04	-3.312	-3.448	-0.136	1.37
CO3-2	4.40E-04	1.09E-04	-3.357	-3.962	-0.605	-2.85
CaCO3	2.61E-04	2.85E-04	-3.584	-3.545	0.039	-14.6
CaHCO3+	2.22E-04	1.60E-04	-3.653	-3.796	-0.143	9.92
CO2	5.81E-05	6.36E-05	-4.236	-4.197	0.039	34.43
Zn(CO3)2-2	1.73E-06	4.92E-07	-5.762	-6.308	-0.546	0
ZnCO3	1.93E-07	2.11E-07	-6.715	-6.676	0.039	0
MnCO3	1.72E-07	1.88E-07	-6.765	-6.726	0.039	0
BaHCO3+	6.09E-08	4.45E-08	-7.215	-7.352	-0.136	0
CuCO3	3.48E-08	3.81E-08	-7.458	-7.419	0.039	0
BaCO3	2.96E-08	3.24E-08	-7.528	-7.489	0.039	-10.7
MnHCO3+	2.24E-08	1.56E-08	-7.65	-7.807	-0.157	0
Cu(CO3)2-	1.84E-08	5.24E-09	-7.735	-8.281	-0.546	0
ZnHCO3+	1.35E-08	9.84E-09	-7.871	-8.007	-0.136	0
FeCO3	5.47E-10	5.99E-10	-9.262	-9.223	0.039	0
CuHCO3+	3.60E-10	2.63E-10	-9.444	-9.58	-0.136	0

	FeHCO3+	2.53E-10	1.85E-10	-9.597	-9.734	-0.136	0
	(CO2)2	6.78E-11	7.42E-11	-10.169	-10.13	0.039	68.87
Ca	7.03E-03						
	Ca+2	5.71E-03	1.55E-03	-2.244	-2.809	-0.565	-16.95
	CaSO4	8.41E-04	9.21E-04	-3.075	-3.036	0.039	7.5
	CaCO3	2.61E-04	2.85E-04	-3.584	-3.545	0.039	-14.6
	CaHCO3+	2.22E-04	1.60E-04	-3.653	-3.796	-0.143	9.92
	CaOH+	1.01E-07	7.36E-08	-6.997	-7.133	-0.136	0
	CaHSO4+	2.87E-11	2.10E-11	-10.542	-10.678	-0.136	0
Cl	2.58E-01						
	Cl-	2.58E-01	1.72E-01	-0.589	-0.765	-0.176	18.62
	CuCl2-	4.77E-08	3.19E-08	-7.321	-7.497	-0.175	0
	CuCl3-2	3.70E-08	8.69E-09	-7.432	-8.061	-0.629	0
	MnCl+	2.18E-08	1.52E-08	-7.661	-7.819	-0.157	-2.83
	ZnOHCl	1.44E-08	1.57E-08	-7.842	-7.803	0.039	0
	ZnCl+	6.71E-09	4.48E-09	-8.174	-8.349	-0.175	-14.99
	MnCl2	1.04E-09	1.14E-09	-8.982	-8.943	0.039	85.89
	ZnCl2	7.37E-10	8.07E-10	-9.132	-9.093	0.039	102.03
	ZnCl3-	2.33E-10	1.56E-10	-9.633	-9.808	-0.175	14.51
	MnCl3-	7.75E-11	5.40E-11	-10.111	-10.268	-0.157	44.89
	FeCl+	7.43E-11	5.43E-11	-10.129	-10.266	-0.136	0
	ZnCl4-2	5.71E-11	1.34E-11	-10.243	-10.873	-0.629	148.67
	CuCl+	4.50E-11	3.01E-11	-10.347	-10.522	-0.175	1.46
	CuCl2	2.54E-12	2.78E-12	-11.596	-11.557	0.039	31.02
	CuCl3-	2.54E-15	1.69E-15	-14.596	-14.771	-0.175	0
	CuCl4-2	6.22E-18	1.46E-18	-17.206	-17.836	-0.629	0
	FeCl+2	4.83E-18	1.13E-18	-17.316	-17.946	-0.629	0
	FeCl2+	1.25E-18	8.71E-19	-17.903	-18.06	-0.157	0
	FeCl3	1.37E-20	1.50E-20	-19.864	-19.825	0.039	0
Cu(1)	8.47E-08						
	CuCl2-	4.77E-08	3.19E-08	-7.321	-7.497	-0.175	0
	CuCl3-2	3.70E-08	8.69E-09	-7.432	-8.061	-0.629	0
	Cu+	5.54E-12	3.41E-12	-11.256	-11.467	-0.211	0
Cu(2)	1.55E-07						
	Cu(OH)2	1.01E-07	1.11E-07	-6.995	-6.956	0.039	0
	CuCO3	3.48E-08	3.81E-08	-7.458	-7.419	0.039	0
	Cu(CO3)2-	1.84E-08	5.24E-09	-7.735	-8.281	-0.546	0
	CuHCO3+	3.60E-10	2.63E-10	-9.444	-9.58	-0.136	0
	CuOH+	2.78E-10	1.86E-10	-9.557	-9.732	-0.175	0
	Cu+2	2.42E-10	6.50E-11	-9.616	-10.187	-0.571	-25.53
	CuCl+	4.50E-11	3.01E-11	-10.347	-10.522	-0.175	1.46
	CuSO4	4.04E-11	4.42E-11	-10.394	-10.355	0.039	13.09
	Cu(OH)3-	2.61E-12	1.90E-12	-11.584	-11.721	-0.136	0
	CuCl2	2.54E-12	2.78E-12	-11.596	-11.557	0.039	31.02
	CuF+	4.07E-13	2.97E-13	-12.391	-12.527	-0.136	0
	Cu2(OH)2+	5.29E-14	1.51E-14	-13.277	-13.822	-0.546	0
	CuCl3-	2.54E-15	1.69E-15	-14.596	-14.771	-0.175	0
	Cu(OH)4-2	3.81E-16	1.08E-16	-15.419	-15.965	-0.546	0
	CuCl4-2	6.22E-18	1.46E-18	-17.206	-17.836	-0.629	0
F	7.30E-04						

	F-	3.85E-04	2.51E-04	-3.414	-3.6	-0.186	-0.76
	MgF+	3.22E-04	2.20E-04	-3.493	-3.658	-0.166	-10.3
	NaF	2.32E-05	2.53E-05	-4.635	-4.596	0.039	7.26
	HF	1.19E-09	1.31E-09	-8.923	-8.884	0.039	12.5
	MnF+	5.41E-11	3.77E-11	-10.266	-10.424	-0.157	0
	ZnF+	4.71E-11	3.44E-11	-10.327	-10.464	-0.136	0
	HF2-	1.73E-12	1.26E-12	-11.763	-11.9	-0.136	22.62
	FeF+	7.87E-13	5.75E-13	-12.104	-12.241	-0.136	0
	CuF+	4.07E-13	2.97E-13	-12.391	-12.527	-0.136	0
	FeF2+	1.25E-15	8.70E-16	-14.903	-15.061	-0.157	0
	FeF+2	3.70E-16	8.70E-17	-15.431	-16.061	-0.629	0
	FeF3	3.17E-16	3.47E-16	-15.499	-15.46	0.039	0
Fe(2)	1.88E-09						
	Fe+2	8.52E-10	2.29E-10	-9.069	-9.641	-0.571	-20.99
	FeCO3	5.47E-10	5.99E-10	-9.262	-9.223	0.039	0
	FeHCO3+	2.53E-10	1.85E-10	-9.597	-9.734	-0.136	0
	FeSO4	1.24E-10	1.35E-10	-9.907	-9.868	0.039	18.97
	FeCl+	7.43E-11	5.43E-11	-10.129	-10.266	-0.136	0
	FeOH+	2.97E-11	2.06E-11	-10.528	-10.685	-0.157	0
	FeF+	7.87E-13	5.75E-13	-12.104	-12.241	-0.136	0
	Fe(OH)2	4.58E-14	5.02E-14	-13.339	-13.3	0.039	0
	Fe(OH)3-	7.64E-16	5.32E-16	-15.117	-15.274	-0.157	0
	FeHSO4+	4.23E-18	3.09E-18	-17.374	-17.511	-0.136	0
Fe(3)	1.85E-06						
	Fe(OH)3	1.28E-06	1.40E-06	-5.893	-5.854	0.039	0
	Fe(OH)4-	5.16E-07	3.64E-07	-6.287	-6.439	-0.151	0
	Fe(OH)2+	5.39E-08	3.80E-08	-7.269	-7.42	-0.151	0
	FeOH+2	1.71E-12	4.02E-13	-11.766	-12.395	-0.629	0
	FeF2+	1.25E-15	8.70E-16	-14.903	-15.061	-0.157	0
	FeF+2	3.70E-16	8.70E-17	-15.431	-16.061	-0.629	0
	FeF3	3.17E-16	3.47E-16	-15.499	-15.46	0.039	0
	FeSO4+	1.15E-17	7.98E-18	-16.941	-17.098	-0.157	0
	FeCl+2	4.83E-18	1.13E-18	-17.316	-17.946	-0.629	0
	Fe+3	2.22E-18	2.18E-19	-17.653	-18.661	-1.008	0
	FeCl2+	1.25E-18	8.71E-19	-17.903	-18.06	-0.157	0
	Fe(SO4)2-	7.96E-19	5.81E-19	-18.099	-18.236	-0.136	0
	FeCl3	1.37E-20	1.50E-20	-19.864	-19.825	0.039	0
	Fe2(OH)2+	6.63E-22	4.36E-24	-21.178	-23.361	-2.182	0
	FeHSO4+2	2.60E-25	7.40E-26	-24.585	-25.131	-0.546	0
	Fe3(OH)4+	8.90E-26	3.46E-29	-25.051	-28.46	-3.41	0
H(0)	1.56E-28						
	H2	7.78E-29	8.51E-29	-28.109	-28.07	0.039	28.61
K	3.53E-03						
	K+	3.45E-03	2.28E-03	-2.462	-2.641	-0.18	9.49
	KSO4-	7.57E-05	5.35E-05	-4.121	-4.272	-0.151	34.67
Mg	5.68E-02						
	Mg+2	4.39E-02	1.32E-02	-1.358	-1.879	-0.521	-20.67
	MgSO4	9.44E-03	1.03E-02	-2.025	-1.986	0.039	5.84
	MgHCO3+	1.87E-03	1.25E-03	-2.728	-2.903	-0.175	5.77
	MgCO3	1.26E-03	1.38E-03	-2.9	-2.861	0.039	-17.09

	MgF+	3.22E-04	2.20E-04	-3.493	-3.658	-0.166	-10.3
	MgOH+	1.88E-05	1.37E-05	-4.726	-4.863	-0.137	0
Mn(2)	3.10E-07						
	MnCO3	1.72E-07	1.88E-07	-6.765	-6.726	0.039	0
	Mn+2	8.08E-08	2.17E-08	-7.092	-7.664	-0.571	-16.9
	MnHCO3+	2.24E-08	1.56E-08	-7.65	-7.807	-0.157	0
	MnCl+	2.18E-08	1.52E-08	-7.661	-7.819	-0.157	-2.83
	MnSO4	1.17E-08	1.28E-08	-7.931	-7.891	0.039	22.54
	MnCl2	1.04E-09	1.14E-09	-8.982	-8.943	0.039	85.89
	MnOH+	2.29E-10	1.59E-10	-9.641	-9.798	-0.157	0
	MnCl3-	7.75E-11	5.40E-11	-10.111	-10.268	-0.157	44.89
	MnF+	5.41E-11	3.77E-11	-10.266	-10.424	-0.157	0
	Mn(NO3)2	3.26E-15	3.56E-15	-14.487	-14.448	0.039	41.04
	Mn(OH)3-	1.15E-17	7.99E-18	-16.94	-17.097	-0.157	0
Mn(3)	6.82E-29						
	Mn+3	6.82E-29	6.70E-30	-28.166	-29.174	-1.008	0
N(-3)	3.80E-05						
	NH4+	3.37E-05	2.07E-05	-4.473	-4.684	-0.211	18.34
	NH3	3.11E-06	3.41E-06	-5.507	-5.468	0.039	24.42
	NH4SO4-	1.22E-06	8.89E-07	-5.915	-6.051	-0.136	39.11
N(5)	3.20E-04						
	NO3-	3.20E-04	2.03E-04	-3.495	-3.692	-0.197	30.08
	Mn(NO3)2	3.26E-15	3.56E-15	-14.487	-14.448	0.039	41.04
Na	2.48E-01						
	Na+	2.43E-01	1.75E-01	-0.615	-0.756	-0.141	-0.72
	NaSO4-	4.14E-03	2.93E-03	-2.383	-2.534	-0.151	19.28
	NaHCO3	7.27E-04	7.96E-04	-3.138	-3.099	0.039	1.8
	NaCO3-	4.88E-04	3.56E-04	-3.312	-3.448	-0.136	1.37
	NaF	2.32E-05	2.53E-05	-4.635	-4.596	0.039	7.26
	NaOH	4.63E-17	5.06E-17	-16.335	-16.296	0.039	0
O(0)	1.03E-36						
	O2	5.15E-37	5.64E-37	-36.288	-36.249	0.039	30.4
S(6)	2.92E-02						
	SO4-2	1.47E-02	3.33E-03	-1.832	-2.477	-0.645	16.75
	MgSO4	9.44E-03	1.03E-02	-2.025	-1.986	0.039	5.84
	NaSO4-	4.14E-03	2.93E-03	-2.383	-2.534	-0.151	19.28
	CaSO4	8.41E-04	9.21E-04	-3.075	-3.036	0.039	7.5
	KSO4-	7.57E-05	5.35E-05	-4.121	-4.272	-0.151	34.67
	NH4SO4-	1.22E-06	8.89E-07	-5.915	-6.051	-0.136	39.11
	BaSO4	8.77E-07	9.60E-07	-6.057	-6.018	0.039	0
	MnSO4	1.17E-08	1.28E-08	-7.931	-7.891	0.039	22.54
	ZnSO4	6.91E-09	7.56E-09	-8.161	-8.121	0.039	21.71
	HSO4-	1.54E-09	1.12E-09	-8.813	-8.95	-0.136	40.8
	Zn(SO4)2-2	7.19E-10	2.05E-10	-9.143	-9.689	-0.546	-7.99
	FeSO4	1.24E-10	1.35E-10	-9.907	-9.868	0.039	18.97
	CuSO4	4.04E-11	4.42E-11	-10.394	-10.355	0.039	13.09
	CaHSO4+	2.87E-11	2.10E-11	-10.542	-10.678	-0.136	0
	FeSO4+	1.15E-17	7.98E-18	-16.941	-17.098	-0.157	0
	FeHSO4+	4.23E-18	3.09E-18	-17.374	-17.511	-0.136	0
	Fe(SO4)2-	7.96E-19	5.81E-19	-18.099	-18.236	-0.136	0

	FeHSO4+2	2.60E-25	7.40E-26	-24.585	-25.131	-0.546	0
Zn	2.02E-06						
	Zn(CO3)2-2	1.73E-06	4.92E-07	-5.762	-6.308	-0.546	0
	ZnCO3	1.93E-07	2.11E-07	-6.715	-6.676	0.039	0
	Zn+2	4.12E-08	9.68E-09	-7.385	-8.014	-0.629	-24.28
	ZnOHCl	1.44E-08	1.57E-08	-7.842	-7.803	0.039	0
	ZnHCO3+	1.35E-08	9.84E-09	-7.871	-8.007	-0.136	0
	Zn(OH)2	9.08E-09	9.93E-09	-8.042	-8.003	0.039	0
	ZnSO4	6.91E-09	7.56E-09	-8.161	-8.121	0.039	21.71
	ZnCl+	6.71E-09	4.48E-09	-8.174	-8.349	-0.175	-14.99
	ZnOH+	4.15E-09	3.03E-09	-8.382	-8.518	-0.136	0
	ZnCl2	7.37E-10	8.07E-10	-9.132	-9.093	0.039	102.03
	Zn(SO4)2-2	7.19E-10	2.05E-10	-9.143	-9.689	-0.546	-7.99
	ZnCl3-	2.33E-10	1.56E-10	-9.633	-9.808	-0.175	14.51
	ZnCl4-2	5.71E-11	1.34E-11	-10.243	-10.873	-0.629	148.67
	ZnF+	4.71E-11	3.44E-11	-10.327	-10.464	-0.136	0
	Zn(OH)3-	1.23E-11	8.97E-12	-10.911	-11.047	-0.136	0
	Zn(OH)4-2	1.43E-15	4.06E-16	-14.846	-15.392	-0.546	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-1.01	-5.29	-4.28	CaSO4			
Aragonite	1.57	-6.77	-8.34	CaCO3			
Barite	1.13	-8.72	-9.84	BaSO4			
Calcite	1.71	-6.77	-8.48	CaCO3			
CO2(g)	-2.73	-4.2	-1.47	CO2			
Dolomite	4.47	-12.61	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.81	6.71	4.89	Fe(OH)3			
Fluorite	0.59	-10.01	-10.6	CaF2			
Goethite	7.71	6.71	-1	FeOOH			
Gypsum	-0.71	-5.29	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	0	1.5	H2O			
Halite	-3.09	-1.52	1.57	NaCl			
Hausmann	-8.36	52.67	61.03	Mn3O4			
Hematite	17.43	13.42	-4.01	Fe2O3			
Jarosite-K	-3.64	-12.85	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.63	21.71	25.34	MnOOH			
Melanterit	-9.94	-12.15	-2.21	FeSO4:7H2O			
NH3(g)	-7.26	-5.47	1.8	NH3			
O2(g)	-33.36	-36.25	-2.89	O2			
Pyrochroit	-5.95	9.25	15.2	Mn(OH)2			
Pyrolusite	-7.22	34.16	41.38	MnO2:H2O			
Rhodochro	-0.5	-11.63	-11.13	MnCO3			
Siderite	-2.71	-13.6	-10.89	FeCO3			
Smithsonit	-1.98	-11.98	-10	ZnCO3			
Sylvite	-4.31	-3.41	0.9	KCl			
Witherite	-1.64	-10.2	-8.56	BaCO3			

```
        Zn(OH)2(e       -2.6        8.9       11.5 Zn(OH)2

**For   a       gas,    SI      =       log10(fuga Fugacity  =       pressure  *
        For     ideal   gases,  phi     =                  1

Initial solution        24

 #NAME? composition-----------------------------

        Elements Molality  Moles

        Alkalinity  2.00E-02  2.00E-02
        Ba          3.63E-06  3.63E-06
        Ca          7.34E-03  7.34E-03
        Cl          2.69E-01  2.69E-01
        Cu          2.50E-07  2.50E-07
        F           7.60E-04  7.60E-04
        Fe          1.93E-06  1.93E-06
        K           3.68E-03  3.68E-03
        Mg          5.93E-02  5.93E-02
        Mn          3.30E-07  3.30E-07
        N(-3)       4.00E-05  4.00E-05
        N(5)        3.40E-04  3.40E-04
        Na          2.59E-01  2.59E-01
        S(6)        3.05E-02  3.05E-02
        Zn          2.11E-06  2.11E-06

 #NAME? of      solution---------------------------

        pH      =           8.46
        pe      =              4
        Specific Conductan (µS/cm,  25°C)   =          30476
        Density (g/cm³)  =       1.01379
        Volume  (L)      =        1.0075
        Activity of     water   =          0.989
        Ionic   strength (mol/kgw) =      4.08E-01
        Mass    of      water   (kg)   =      1.00E+00
        Total   carbon  (mol/kg) =        1.75E-02
        Total   CO2     (mol/kg) =        1.75E-02
        Temperatu (°C)  =            25
        Electrical balance (eq)  =        4.46E-02
        Percent error,  100*(Cat-|=          6.56
        Iterations =          10 (233   overall)
        Total   H       =       1.11E+02
        Total   O       =       5.57E+01

 #NAME? couples--------------------------------

        Redox   couple  pe      Eh      (volts)
```

N(-3)/N(5) 4.4358 0.2624

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.45E-06	2.89E-06	-5.352	-5.539	-0.188	-3.09
	H+	4.50E-09	3.47E-09	-8.347	-8.46	-0.113	0
	H2O	5.55E+01	9.89E-01	1.744	-0.005	0	18.07
Ba	3.63E-06						
	Ba+2	2.62E-06	5.92E-07	-5.582	-6.228	-0.646	-11.35
	BaSO4	9.15E-07	1.01E-06	-6.038	-5.998	0.041	0
	BaHCO3+	6.44E-08	4.71E-08	-7.191	-7.327	-0.136	0
	BaCO3	3.12E-08	3.43E-08	-7.505	-7.465	0.041	-10.7
	BaOH+	8.25E-12	5.72E-12	-11.083	-11.242	-0.159	0
C(4)	1.75E-02						
	HCO3-	1.18E-02	8.30E-03	-1.928	-2.081	-0.153	26.19
	MgHCO3+	2.00E-03	1.33E-03	-2.7	-2.877	-0.177	5.78
	MgCO3	1.33E-03	1.47E-03	-2.875	-2.834	0.041	-17.09
	NaHCO3	7.75E-04	8.52E-04	-3.11	-3.07	0.041	1.8
	NaCO3-	5.22E-04	3.81E-04	-3.282	-3.419	-0.136	1.45
	CO3-2	4.58E-04	1.12E-04	-3.339	-3.95	-0.611	-2.79
	CaCO3	2.76E-04	3.03E-04	-3.56	-3.519	0.041	-14.6
	CaHCO3+	2.37E-04	1.70E-04	-3.625	-3.77	-0.144	9.93
	CO2	5.95E-05	6.54E-05	-4.225	-4.185	0.041	34.43
	Zn(CO3)2-2	1.82E-06	5.17E-07	-5.741	-6.287	-0.545	0
	ZnCO3	1.96E-07	2.15E-07	-6.707	-6.667	0.041	0
	MnCO3	1.83E-07	2.01E-07	-6.737	-6.696	0.041	0
	BaHCO3+	6.44E-08	4.71E-08	-7.191	-7.327	-0.136	0
	CuCO3	3.56E-08	3.91E-08	-7.449	-7.408	0.041	0
	BaCO3	3.12E-08	3.43E-08	-7.505	-7.465	0.041	-10.7
	MnHCO3+	2.41E-08	1.67E-08	-7.619	-7.778	-0.159	0
	Cu(CO3)2-	1.94E-08	5.52E-09	-7.713	-8.258	-0.545	0
	ZnHCO3+	1.38E-08	1.01E-08	-7.861	-7.998	-0.136	0
	FeCO3	5.86E-10	6.44E-10	-9.232	-9.191	0.041	0
	CuHCO3+	3.69E-10	2.70E-10	-9.433	-9.569	-0.136	0
	FeHCO3+	2.72E-10	1.99E-10	-9.566	-9.702	-0.136	0
	(CO2)2	7.14E-11	7.85E-11	-10.146	-10.105	0.041	68.87
Ca	7.34E-03						
	Ca+2	5.95E-03	1.61E-03	-2.226	-2.794	-0.569	-16.93
	CaSO4	8.81E-04	9.68E-04	-3.055	-3.014	0.041	7.5
	CaCO3	2.76E-04	3.03E-04	-3.56	-3.519	0.041	-14.6
	CaHCO3+	2.37E-04	1.70E-04	-3.625	-3.77	-0.144	9.93
	CaOH+	1.04E-07	7.60E-08	-6.983	-7.119	-0.136	0
	CaHSO4+	3.02E-11	2.21E-11	-10.52	-10.656	-0.136	0
Cl	2.69E-01						
	Cl-	2.69E-01	1.79E-01	-0.57	-0.748	-0.178	18.63
	CuCl2-	5.16E-08	3.43E-08	-7.287	-7.464	-0.177	0
	CuCl3-2	4.20E-08	9.72E-09	-7.377	-8.012	-0.636	0

	MnCl+	2.37E-08	1.64E-08	-7.626	-7.785	-0.159	-2.83
	ZnOHCl	1.48E-08	1.62E-08	-7.83	-7.789	0.041	0
	ZnCl+	6.95E-09	4.63E-09	-8.158	-8.335	-0.177	-15.05
	MnCl2	1.17E-09	1.28E-09	-8.933	-8.893	0.041	85.89
	ZnCl2	7.88E-10	8.65E-10	-9.104	-9.063	0.041	102.03
	ZnCl3-	2.61E-10	1.73E-10	-9.584	-9.761	-0.177	14.39
	MnCl3-	9.09E-11	6.30E-11	-10.042	-10.201	-0.159	44.95
	FeCl+	8.08E-11	5.90E-11	-10.093	-10.229	-0.136	0
	ZnCl4-2	6.71E-11	1.55E-11	-10.173	-10.809	-0.636	148.77
	CuCl+	4.69E-11	3.12E-11	-10.329	-10.506	-0.177	1.48
	CuCl2	2.72E-12	2.99E-12	-11.565	-11.524	0.041	31.02
	CuCl3-	2.85E-15	1.90E-15	-14.545	-14.722	-0.177	0
	CuCl4-2	7.34E-18	1.70E-18	-17.135	-17.77	-0.636	0
	FeCl+2	5.33E-18	1.23E-18	-17.273	-17.909	-0.636	0
	FeCl2+	1.42E-18	9.83E-19	-17.848	-18.007	-0.159	0
	FeCl3	1.60E-20	1.76E-20	-19.796	-19.755	0.041	0
Cu(1)	9.37E-08						
	CuCl2-	5.16E-08	3.43E-08	-7.287	-7.464	-0.177	0
	CuCl3-2	4.20E-08	9.72E-09	-7.377	-8.012	-0.636	0
	Cu+	5.57E-12	3.40E-12	-11.255	-11.468	-0.214	0
Cu(2)	1.56E-07						
	Cu(OH)2	1.00E-07	1.10E-07	-6.998	-6.957	0.041	0
	CuCO3	3.56E-08	3.91E-08	-7.449	-7.408	0.041	0
	Cu(CO3)2-	1.94E-08	5.52E-09	-7.713	-8.258	-0.545	0
	CuHCO3+	3.69E-10	2.70E-10	-9.433	-9.569	-0.136	0
	CuOH+	2.78E-10	1.85E-10	-9.556	-9.733	-0.177	0
	Cu+2	2.45E-10	6.48E-11	-9.611	-10.188	-0.577	-25.52
	CuCl+	4.69E-11	3.12E-11	-10.329	-10.506	-0.177	1.48
	CuSO4	4.09E-11	4.49E-11	-10.389	-10.348	0.041	13.09
	CuCl2	2.72E-12	2.99E-12	-11.565	-11.524	0.041	31.02
	Cu(OH)3-	2.60E-12	1.90E-12	-11.586	-11.722	-0.136	0
	CuF+	4.14E-13	3.02E-13	-12.383	-12.52	-0.136	0
	Cu2(OH)2+	5.26E-14	1.50E-14	-13.279	-13.825	-0.545	0
	CuCl3-	2.85E-15	1.90E-15	-14.545	-14.722	-0.177	0
	Cu(OH)4-2	3.79E-16	1.08E-16	-15.421	-15.967	-0.545	0
	CuCl4-2	7.34E-18	1.70E-18	-17.135	-17.77	-0.636	0
F	7.60E-04						
	F-	3.95E-04	2.56E-04	-3.404	-3.591	-0.188	-0.74
	MgF+	3.41E-04	2.32E-04	-3.468	-3.635	-0.168	-10.29
	NaF	2.45E-05	2.69E-05	-4.611	-4.57	0.041	7.26
	HF	1.21E-09	1.33E-09	-8.916	-8.875	0.041	12.5
	MnF+	5.77E-11	4.00E-11	-10.239	-10.398	-0.159	0
	ZnF+	4.77E-11	3.48E-11	-10.322	-10.458	-0.136	0
	HF2-	1.79E-12	1.31E-12	-11.746	-11.883	-0.136	22.63
	FeF+	8.39E-13	6.13E-13	-12.076	-12.213	-0.136	0
	CuF+	4.14E-13	3.02E-13	-12.383	-12.52	-0.136	0
	FeF2+	1.37E-15	9.46E-16	-14.865	-15.024	-0.159	0
	FeF+2	4.01E-16	9.28E-17	-15.397	-16.033	-0.636	0
	FeF3	3.50E-16	3.84E-16	-15.456	-15.415	0.041	0
Fe(2)	2.01E-09						

	Fe+2	9.03E-10	2.39E-10	-9.044	-9.621	-0.577	-20.97
	FeCO3	5.86E-10	6.44E-10	-9.232	-9.191	0.041	0
	FeHCO3+	2.72E-10	1.99E-10	-9.566	-9.702	-0.136	0
	FeSO4	1.31E-10	1.44E-10	-9.882	-9.841	0.041	18.97
	FeCl+	8.08E-11	5.90E-11	-10.093	-10.229	-0.136	0
	FeOH+	3.11E-11	2.16E-11	-10.507	-10.666	-0.159	0
	FeF+	8.39E-13	6.13E-13	-12.076	-12.213	-0.136	0
	Fe(OH)2	4.77E-14	5.24E-14	-13.321	-13.28	0.041	0
	Fe(OH)3-	8.01E-16	5.56E-16	-15.096	-15.255	-0.159	0
	FeHSO4+	4.50E-18	3.29E-18	-17.347	-17.483	-0.136	0
Fe(3)	1.93E-06						
	Fe(OH)3	1.33E-06	1.46E-06	-5.876	-5.835	0.041	0
	Fe(OH)4-	5.41E-07	3.80E-07	-6.267	-6.42	-0.153	0
	Fe(OH)2+	5.65E-08	3.98E-08	-7.248	-7.4	-0.153	0
	FeOH+2	1.82E-12	4.21E-13	-11.74	-12.376	-0.636	0
	FeF2+	1.37E-15	9.46E-16	-14.865	-15.024	-0.159	0
	FeF+2	4.01E-16	9.28E-17	-15.397	-16.033	-0.636	0
	FeF3	3.50E-16	3.84E-16	-15.456	-15.415	0.041	0
	FeSO4+	1.22E-17	8.49E-18	-16.912	-17.071	-0.159	0
	FeCl+2	5.33E-18	1.23E-18	-17.273	-17.909	-0.636	0
	Fe+3	2.36E-18	2.29E-19	-17.626	-18.641	-1.015	0
	FeCl2+	1.42E-18	9.83E-19	-17.848	-18.007	-0.159	0
	Fe(SO4)2-	8.62E-19	6.30E-19	-18.065	-18.201	-0.136	0
	FeCl3	1.60E-20	1.76E-20	-19.796	-19.755	0.041	0
	Fe2(OH)2+	7.25E-22	4.77E-24	-21.14	-23.322	-2.182	0
	FeHSO4+2	2.77E-25	7.88E-26	-24.558	-25.103	-0.545	0
	Fe3(OH)4+	1.02E-25	3.96E-29	-24.993	-28.402	-3.409	0
H(0)	1.55E-28						
	H2	7.75E-29	8.51E-29	-28.111	-28.07	0.041	28.61
K	3.68E-03						
	K+	3.60E-03	2.37E-03	-2.444	-2.625	-0.182	9.5
	KSO4-	8.02E-05	5.64E-05	-4.096	-4.249	-0.153	34.68
Mg	5.93E-02						
	Mg+2	4.57E-02	1.37E-02	-1.34	-1.864	-0.523	-20.65
	MgSO4	9.90E-03	1.09E-02	-2.004	-1.964	0.041	5.84
	MgHCO3+	2.00E-03	1.33E-03	-2.7	-2.877	-0.177	5.78
	MgCO3	1.33E-03	1.47E-03	-2.875	-2.834	0.041	-17.09
	MgF+	3.41E-04	2.32E-04	-3.468	-3.635	-0.168	-10.29
	MgOH+	1.95E-05	1.42E-05	-4.711	-4.848	-0.138	0
Mn(2)	3.30E-07						
	MnCO3	1.83E-07	2.01E-07	-6.737	-6.696	0.041	0
	Mn+2	8.52E-08	2.26E-08	-7.07	-7.646	-0.577	-16.86
	MnHCO3+	2.41E-08	1.67E-08	-7.619	-7.778	-0.159	0
	MnCl+	2.37E-08	1.64E-08	-7.626	-7.785	-0.159	-2.83
	MnSO4	1.24E-08	1.36E-08	-7.907	-7.866	0.041	22.54
	MnCl2	1.17E-09	1.28E-09	-8.933	-8.893	0.041	85.89
	MnOH+	2.39E-10	1.66E-10	-9.622	-9.781	-0.159	0
	MnCl3-	9.09E-11	6.30E-11	-10.042	-10.201	-0.159	44.95
	MnF+	5.77E-11	4.00E-11	-10.239	-10.398	-0.159	0
	Mn(NO3)2	3.77E-15	4.14E-15	-14.424	-14.383	0.041	41.04

	Mn(OH)3-	1.20E-17	8.31E-18	-16.921	-17.08	-0.159	0
Mn(3)	7.22E-29						
	Mn+3	7.22E-29	6.98E-30	-28.142	-29.156	-1.015	0
N(-3)	4.00E-05						
	NH4+	3.55E-05	2.17E-05	-4.45	-4.664	-0.214	18.35
	NH3	3.24E-06	3.56E-06	-5.489	-5.448	0.041	24.42
	NH4SO4-	1.30E-06	9.47E-07	-5.887	-6.024	-0.136	39.17
N(5)	3.40E-04						
	NO3-	3.40E-04	2.15E-04	-3.469	-3.668	-0.2	30.1
	Mn(NO3)2	3.77E-15	4.14E-15	-14.424	-14.383	0.041	41.04
Na	2.59E-01						
	Na+	2.53E-01	1.83E-01	-0.597	-0.739	-0.142	-0.71
	NaSO4-	4.41E-03	3.10E-03	-2.356	-2.509	-0.153	19.41
	NaHCO3	7.75E-04	8.52E-04	-3.11	-3.07	0.041	1.8
	NaCO3-	5.22E-04	3.81E-04	-3.282	-3.419	-0.136	1.45
	NaF	2.45E-05	2.69E-05	-4.611	-4.57	0.041	7.26
	NaOH	4.80E-17	5.27E-17	-16.319	-16.278	0.041	0
O(0)	1.03E-36						
	O2	5.13E-37	5.63E-37	-36.29	-36.249	0.041	30.4
S(6)	3.05E-02						
	SO4-2	1.52E-02	3.39E-03	-1.818	-2.47	-0.652	16.8
	MgSO4	9.90E-03	1.09E-02	-2.004	-1.964	0.041	5.84
	NaSO4-	4.41E-03	3.10E-03	-2.356	-2.509	-0.153	19.41
	CaSO4	8.81E-04	9.68E-04	-3.055	-3.014	0.041	7.5
	KSO4-	8.02E-05	5.64E-05	-4.096	-4.249	-0.153	34.68
	NH4SO4-	1.30E-06	9.47E-07	-5.887	-6.024	-0.136	39.17
	BaSO4	9.15E-07	1.01E-06	-6.038	-5.998	0.041	0
	MnSO4	1.24E-08	1.36E-08	-7.907	-7.866	0.041	22.54
	ZnSO4	6.96E-09	7.64E-09	-8.157	-8.117	0.041	21.71
	HSO4-	1.56E-09	1.14E-09	-8.806	-8.942	-0.136	40.81
	Zn(SO4)2-2	7.39E-10	2.11E-10	-9.131	-9.677	-0.545	-7.82
	FeSO4	1.31E-10	1.44E-10	-9.882	-9.841	0.041	18.97
	CuSO4	4.09E-11	4.49E-11	-10.389	-10.348	0.041	13.09
	CaHSO4+	3.02E-11	2.21E-11	-10.52	-10.656	-0.136	0
	FeSO4+	1.22E-17	8.49E-18	-16.912	-17.071	-0.159	0
	FeHSO4+	4.50E-18	3.29E-18	-17.347	-17.483	-0.136	0
	Fe(SO4)2-	8.62E-19	6.30E-19	-18.065	-18.201	-0.136	0
	FeHSO4+2	2.77E-25	7.88E-26	-24.558	-25.103	-0.545	0
Zn	2.11E-06						
	Zn(CO3)2-2	1.82E-06	5.17E-07	-5.741	-6.287	-0.545	0
	ZnCO3	1.96E-07	2.15E-07	-6.707	-6.667	0.041	0
	Zn+2	4.16E-08	9.62E-09	-7.381	-8.017	-0.636	-24.27
	ZnOHCl	1.48E-08	1.62E-08	-7.83	-7.789	0.041	0
	ZnHCO3+	1.38E-08	1.01E-08	-7.861	-7.998	-0.136	0
	Zn(OH)2	8.98E-09	9.86E-09	-8.047	-8.006	0.041	0
	ZnSO4	6.96E-09	7.64E-09	-8.157	-8.117	0.041	21.71
	ZnCl+	6.95E-09	4.63E-09	-8.158	-8.335	-0.177	-15.05
	ZnOH+	4.12E-09	3.01E-09	-8.385	-8.521	-0.136	0
	ZnCl2	7.88E-10	8.65E-10	-9.104	-9.063	0.041	102.03
	Zn(SO4)2-2	7.39E-10	2.11E-10	-9.131	-9.677	-0.545	-7.82

ZnCl3-	2.61E-10	1.73E-10	-9.584	-9.761	-0.177	14.39
ZnCl4-2	6.71E-11	1.55E-11	-10.173	-10.809	-0.636	148.77
ZnF+	4.77E-11	3.48E-11	-10.322	-10.458	-0.136	0
Zn(OH)3-	1.22E-11	8.90E-12	-10.914	-11.051	-0.136	0
Zn(OH)4-2	1.41E-15	4.02E-16	-14.85	-15.395	-0.545	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-0.99	-5.26	-4.28	CaSO4
Aragonite	1.59	-6.74	-8.34	CaCO3
Barite	1.15	-8.7	-9.84	BaSO4
Calcite	1.74	-6.74	-8.48	CaCO3
CO2(g)	-2.72	-4.18	-1.47	CO2
Dolomite	4.53	-12.56	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.83	6.72	4.89	Fe(OH)3
Fluorite	0.62	-9.98	-10.6	CaF2
Goethite	7.73	6.73	-1	FeOOH
Gypsum	-0.69	-5.27	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O
Halite	-3.06	-1.49	1.57	NaCl
Hausmann	-8.31	52.72	61.03	Mn3O4
Hematite	17.47	13.46	-4.01	Fe2O3
Jarosite-K	-3.55	-12.76	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.62	21.72	25.34	MnOOH
Melanterit	-9.91	-12.12	-2.21	FeSO4:7H2O
NH3(g)	-7.24	-5.45	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.94	9.26	15.2	Mn(OH)2
Pyrolusite	-7.2	34.18	41.38	MnO2:H2O
Rhodochro	-0.47	-11.6	-11.13	MnCO3
Siderite	-2.68	-13.57	-10.89	FeCO3
Smithsonit	-1.97	-11.97	-10	ZnCO3
Sylvite	-4.27	-3.37	0.9	KCl
Witherite	-1.62	-10.18	-8.56	BaCO3
Zn(OH)2(e	-2.61	8.89	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 25

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	2.09E-02	2.09E-02
Ba	3.78E-06	3.78E-06

Ca	7.64E-03	7.64E-03
Cl	2.80E-01	2.80E-01
Cu	2.60E-07	2.60E-07
F	7.90E-04	7.90E-04
Fe	2.01E-06	2.01E-06
K	3.84E-03	3.84E-03
Mg	6.17E-02	6.17E-02
Mn	3.40E-07	3.40E-07
N(-3)	4.20E-05	4.20E-05
N(5)	3.50E-04	3.50E-04
Na	2.70E-01	2.70E-01
S(6)	3.18E-02	3.18E-02
Zn	2.20E-06	2.20E-06

#NAME? of solution----------

pH	=	8.46		
pe	=	4		
Specific	Conductan	(µS/cm,	25°C)	= 31564
Density	(g/cm³)	=	1.01447	
Volume	(L)	=	1.0077	
Activity	of	water	=	0.989
Ionic	strength	(mol/kgw)	=	4.24E-01
Mass	of	water	(kg)	= 1.00E+00
Total	carbon	(mol/kg)	=	1.82E-02
Total	CO2	(mol/kg)	=	1.82E-02
Temperatu	(°C)	=	25	
Electrical	balance	(eq)	=	4.65E-02
Percent	error,	100*(Cat-|	=	6.57
Iterations	=	11	(244	overall)
Total	H	=	1.11E+02	
Total	O	=	5.57E+01	

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4348	0.2623		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.47E-06	2.89E-06	-5.35	-5.54	-0.19	-3.06
H+	4.50E-09	3.47E-09	-8.346	-8.46	-0.114	0
H2O	5.55E+01	9.89E-01	1.744	-0.005	0	18.07
Ba	3.78E-06					
Ba+2	2.73E-06	6.09E-07	-5.565	-6.216	-0.651	-11.33
BaSO4	9.54E-07	1.05E-06	-6.021	-5.978	0.042	0

	BaHCO3+	6.80E-08	4.97E-08	-7.167	-7.304	-0.136	0
	BaCO3	3.29E-08	3.62E-08	-7.483	-7.441	0.042	-10.7
	BaOH+	8.51E-12	5.88E-12	-11.07	-11.23	-0.16	0
C(4)	1.82E-02						
	HCO3-	1.21E-02	8.52E-03	-1.916	-2.07	-0.154	26.24
	MgHCO3+	2.13E-03	1.41E-03	-2.672	-2.851	-0.179	5.78
	MgCO3	1.41E-03	1.56E-03	-2.851	-2.808	0.042	-17.09
	NaHCO3	8.25E-04	9.09E-04	-3.084	-3.041	0.042	1.8
	NaCO3-	5.57E-04	4.07E-04	-3.254	-3.39	-0.136	1.54
	CO3-2	4.76E-04	1.15E-04	-3.322	-3.939	-0.616	-2.73
	CaCO3	2.91E-04	3.20E-04	-3.537	-3.494	0.042	-14.6
	CaHCO3+	2.51E-04	1.80E-04	-3.6	-3.745	-0.145	9.93
	CO2	6.09E-05	6.71E-05	-4.215	-4.173	0.042	34.43
	Zn(CO3)2-2	1.90E-06	5.42E-07	-5.721	-6.266	-0.545	0
	ZnCO3	2.00E-07	2.20E-07	-6.7	-6.658	0.042	0
	MnCO3	1.89E-07	2.08E-07	-6.724	-6.681	0.042	0
	BaHCO3+	6.80E-08	4.97E-08	-7.167	-7.304	-0.136	0
	CuCO3	3.62E-08	3.99E-08	-7.441	-7.399	0.042	0
	BaCO3	3.29E-08	3.62E-08	-7.483	-7.441	0.042	-10.7
	MnHCO3+	2.50E-08	1.73E-08	-7.602	-7.762	-0.16	0
	Cu(CO3)2-	2.03E-08	5.79E-09	-7.692	-8.237	-0.545	0
	ZnHCO3+	1.40E-08	1.03E-08	-7.853	-7.989	-0.136	0
	FeCO3	6.26E-10	6.91E-10	-9.203	-9.161	0.042	0
	CuHCO3+	3.77E-10	2.76E-10	-9.424	-9.56	-0.136	0
	FeHCO3+	2.91E-10	2.13E-10	-9.536	-9.672	-0.136	0
	(CO2)2	7.50E-11	8.27E-11	-10.125	-10.082	0.042	68.87
Ca	7.64E-03						
	Ca+2	6.18E-03	1.66E-03	-2.209	-2.781	-0.572	-16.92
	CaSO4	9.20E-04	1.01E-03	-3.036	-2.994	0.042	7.5
	CaCO3	2.91E-04	3.20E-04	-3.537	-3.494	0.042	-14.6
	CaHCO3+	2.51E-04	1.80E-04	-3.6	-3.745	-0.145	9.93
	CaOH+	1.07E-07	7.84E-08	-6.97	-7.106	-0.136	0
	CaHSO4+	3.16E-11	2.31E-11	-10.5	-10.636	-0.136	0
Cl	2.80E-01						
	Cl-	2.80E-01	1.85E-01	-0.552	-0.732	-0.18	18.64
	CuCl2-	5.56E-08	3.68E-08	-7.255	-7.434	-0.179	0
	CuCl3-2	4.74E-08	1.08E-08	-7.324	-7.966	-0.642	0
	MnCl+	2.49E-08	1.72E-08	-7.604	-7.765	-0.16	-2.82
	ZnOHCl	1.52E-08	1.68E-08	-7.818	-7.776	0.042	0
	ZnCl+	7.21E-09	4.77E-09	-8.142	-8.321	-0.179	-15.1
	MnCl2	1.26E-09	1.39E-09	-8.899	-8.857	0.042	85.89
	ZnCl2	8.40E-10	9.26E-10	-9.076	-9.033	0.042	102.03
	ZnCl3-	2.91E-10	1.93E-10	-9.536	-9.715	-0.179	14.28
	MnCl3-	1.03E-10	7.10E-11	-9.989	-10.149	-0.16	45
	FeCl+	8.75E-11	6.39E-11	-10.058	-10.194	-0.136	0
	ZnCl4-2	7.84E-11	1.79E-11	-10.106	-10.747	-0.642	148.87
	CuCl+	4.86E-11	3.22E-11	-10.313	-10.492	-0.179	1.51
	CuCl2	2.91E-12	3.21E-12	-11.537	-11.494	0.042	31.02
	CuCl3-	3.18E-15	2.11E-15	-14.497	-14.676	-0.179	0
	CuCl4-2	8.58E-18	1.96E-18	-17.067	-17.708	-0.642	0

	FeCl+2	5.86E-18	1.34E-18	-17.232	-17.874	-0.642	0
	FeCl2+	1.60E-18	1.11E-18	-17.796	-17.956	-0.16	0
	FeCl3	1.86E-20	2.05E-20	-19.731	-19.689	0.042	0
Cu(1)	1.03E-07						
	CuCl2-	5.56E-08	3.68E-08	-7.255	-7.434	-0.179	0
	CuCl3-2	4.74E-08	1.08E-08	-7.324	-7.966	-0.642	0
	Cu+	5.58E-12	3.39E-12	-11.254	-11.47	-0.216	0
Cu(2)	1.57E-07						
	Cu(OH)2	9.95E-08	1.10E-07	-7.002	-6.96	0.042	0
	CuCO3	3.62E-08	3.99E-08	-7.441	-7.399	0.042	0
	Cu(CO3)2-	2.03E-08	5.79E-09	-7.692	-8.237	-0.545	0
	CuHCO3+	3.77E-10	2.76E-10	-9.424	-9.56	-0.136	0
	CuOH+	2.78E-10	1.84E-10	-9.556	-9.735	-0.179	0
	Cu+2	2.47E-10	6.46E-11	-9.608	-10.19	-0.582	-25.5
	CuCl+	4.86E-11	3.22E-11	-10.313	-10.492	-0.179	1.51
	CuSO4	4.12E-11	4.54E-11	-10.385	-10.343	0.042	13.09
	CuCl2	2.91E-12	3.21E-12	-11.537	-11.494	0.042	31.02
	Cu(OH)3-	2.58E-12	1.89E-12	-11.588	-11.725	-0.136	0
	CuF+	4.20E-13	3.07E-13	-12.377	-12.513	-0.136	0
	Cu2(OH)2+	5.21E-14	1.48E-14	-13.284	-13.829	-0.545	0
	CuCl3-	3.18E-15	2.11E-15	-14.497	-14.676	-0.179	0
	Cu(OH)4-2	3.76E-16	1.07E-16	-15.424	-15.969	-0.545	0
	CuCl4-2	8.58E-18	1.96E-18	-17.067	-17.708	-0.642	0
F	7.90E-04						
	F-	4.04E-04	2.61E-04	-3.394	-3.583	-0.19	-0.73
	MgF+	3.60E-04	2.44E-04	-3.444	-3.613	-0.169	-10.29
	NaF	2.59E-05	2.85E-05	-4.587	-4.545	0.042	7.26
	HF	1.23E-09	1.36E-09	-8.91	-8.867	0.042	12.5
	MnF+	5.95E-11	4.11E-11	-10.226	-10.386	-0.16	0
	ZnF+	4.83E-11	3.53E-11	-10.316	-10.452	-0.136	0
	HF2-	1.86E-12	1.36E-12	-11.731	-11.867	-0.136	22.65
	FeF+	8.93E-13	6.52E-13	-12.049	-12.186	-0.136	0
	CuF+	4.20E-13	3.07E-13	-12.377	-12.513	-0.136	0
	FeF2+	1.48E-15	1.03E-15	-14.829	-14.989	-0.16	0
	FeF+2	4.33E-16	9.87E-17	-15.364	-16.006	-0.642	0
	FeF3	3.85E-16	4.24E-16	-15.415	-15.373	0.042	0
Fe(2)	2.13E-09						
	Fe+2	9.54E-10	2.50E-10	-9.02	-9.602	-0.582	-20.95
	FeCO3	6.26E-10	6.91E-10	-9.203	-9.161	0.042	0
	FeHCO3+	2.91E-10	2.13E-10	-9.536	-9.672	-0.136	0
	FeSO4	1.39E-10	1.53E-10	-9.857	-9.815	0.042	18.97
	FeCl+	8.75E-11	6.39E-11	-10.058	-10.194	-0.136	0
	FeOH+	3.26E-11	2.25E-11	-10.487	-10.647	-0.16	0
	FeF+	8.93E-13	6.52E-13	-12.049	-12.186	-0.136	0
	Fe(OH)2	4.96E-14	5.47E-14	-13.304	-13.262	0.042	0
	Fe(OH)3-	8.39E-16	5.80E-16	-15.076	-15.237	-0.16	0
	FeHSO4+	4.78E-18	3.49E-18	-17.321	-17.457	-0.136	0
Fe(3)	2.01E-06						
	Fe(OH)3	1.38E-06	1.53E-06	-5.859	-5.817	0.042	0
	Fe(OH)4-	5.66E-07	3.97E-07	-6.247	-6.402	-0.154	0

	Fe(OH)2+	5.92E-08	4.15E-08	-7.228	-7.382	-0.154	0
	FeOH+2	1.93E-12	4.40E-13	-11.715	-12.357	-0.642	0
	FeF2+	1.48E-15	1.03E-15	-14.829	-14.989	-0.16	0
	FeF+2	4.33E-16	9.87E-17	-15.364	-16.006	-0.642	0
	FeF3	3.85E-16	4.24E-16	-15.415	-15.373	0.042	0
	FeSO4+	1.31E-17	9.02E-18	-16.885	-17.045	-0.16	0
	FeCl+2	5.86E-18	1.34E-18	-17.232	-17.874	-0.642	0
	Fe+3	2.51E-18	2.39E-19	-17.6	-18.622	-1.022	0
	FeCl2+	1.60E-18	1.11E-18	-17.796	-17.956	-0.16	0
	Fe(SO4)2-	9.30E-19	6.80E-19	-18.031	-18.168	-0.136	0
	FeCl3	1.86E-20	2.05E-20	-19.731	-19.689	0.042	0
	Fe2(OH)2+	7.87E-22	5.20E-24	-21.104	-23.284	-2.18	0
	FeHSO4+2	2.94E-25	8.37E-26	-24.532	-25.077	-0.545	0
	Fe3(OH)4+	1.15E-25	4.51E-29	-24.94	-28.346	-3.407	0
H(0)	1.54E-28						
	H2	7.72E-29	8.51E-29	-28.112	-28.07	0.042	28.61
K	3.84E-03						
	K+	3.76E-03	2.46E-03	-2.425	-2.609	-0.184	9.51
	KSO4-	8.49E-05	5.96E-05	-4.071	-4.225	-0.154	34.69
Mg	6.17E-02						
	Mg+2	4.74E-02	1.41E-02	-1.324	-1.849	-0.526	-20.63
	MgSO4	1.04E-02	1.14E-02	-1.985	-1.942	0.042	5.84
	MgHCO3+	2.13E-03	1.41E-03	-2.672	-2.851	-0.179	5.78
	MgCO3	1.41E-03	1.56E-03	-2.851	-2.808	0.042	-17.09
	MgF+	3.60E-04	2.44E-04	-3.444	-3.613	-0.169	-10.29
	MgOH+	2.02E-05	1.47E-05	-4.695	-4.834	-0.139	0
Mn(2)	3.40E-07						
	MnCO3	1.89E-07	2.08E-07	-6.724	-6.681	0.042	0
	Mn+2	8.69E-08	2.28E-08	-7.061	-7.643	-0.582	-16.82
	MnHCO3+	2.50E-08	1.73E-08	-7.602	-7.762	-0.16	0
	MnCl+	2.49E-08	1.72E-08	-7.604	-7.765	-0.16	-2.82
	MnSO4	1.27E-08	1.40E-08	-7.898	-7.855	0.042	22.54
	MnCl2	1.26E-09	1.39E-09	-8.899	-8.857	0.042	85.89
	MnOH+	2.42E-10	1.67E-10	-9.617	-9.778	-0.16	0
	MnCl3-	1.03E-10	7.10E-11	-9.989	-10.149	-0.16	45
	MnF+	5.95E-11	4.11E-11	-10.226	-10.386	-0.16	0
	Mn(NO3)2	3.97E-15	4.37E-15	-14.402	-14.359	0.042	41.04
	Mn(OH)3-	1.21E-17	8.37E-18	-16.917	-17.077	-0.16	0
Mn(3)	7.40E-29						
	Mn+3	7.40E-29	7.04E-30	-28.131	-29.153	-1.022	0
N(-3)	4.20E-05						
	NH4+	3.73E-05	2.26E-05	-4.429	-4.645	-0.216	18.36
	NH3	3.37E-06	3.72E-06	-5.472	-5.429	0.042	24.42
	NH4SO4-	1.38E-06	1.01E-06	-5.862	-5.998	-0.136	39.22
N(5)	3.50E-04						
	NO3-	3.50E-04	2.20E-04	-3.456	-3.658	-0.202	30.11
	Mn(NO3)2	3.97E-15	4.37E-15	-14.402	-14.359	0.042	41.04
Na	2.70E-01						
	Na+	2.64E-01	1.90E-01	-0.579	-0.722	-0.143	-0.69
	NaSO4-	4.67E-03	3.28E-03	-2.33	-2.484	-0.154	19.53

	NaHCO3	8.25E-04	9.09E-04	-3.084	-3.041	0.042	1.8
	NaCO3-	5.57E-04	4.07E-04	-3.254	-3.39	-0.136	1.54
	NaF	2.59E-05	2.85E-05	-4.587	-4.545	0.042	7.26
	NaOH	4.97E-17	5.48E-17	-16.304	-16.261	0.042	0
O(0)	1.02E-36						
	O2	5.10E-37	5.63E-37	-36.292	-36.25	0.042	30.4
S(6)	3.18E-02						
	SO4-2	1.57E-02	3.45E-03	-1.804	-2.463	-0.659	16.85
	MgSO4	1.04E-02	1.14E-02	-1.985	-1.942	0.042	5.84
	NaSO4-	4.67E-03	3.28E-03	-2.33	-2.484	-0.154	19.53
	CaSO4	9.20E-04	1.01E-03	-3.036	-2.994	0.042	7.5
	KSO4-	8.49E-05	5.96E-05	-4.071	-4.225	-0.154	34.69
	NH4SO4-	1.38E-06	1.01E-06	-5.862	-5.998	-0.136	39.22
	BaSO4	9.54E-07	1.05E-06	-6.021	-5.978	0.042	0
	MnSO4	1.27E-08	1.40E-08	-7.898	-7.855	0.042	22.54
	ZnSO4	7.01E-09	7.73E-09	-8.154	-8.112	0.042	21.71
	HSO4-	1.59E-09	1.16E-09	-8.799	-8.935	-0.136	40.82
	Zn(SO4)2-2	7.60E-10	2.17E-10	-9.119	-9.665	-0.545	-7.65
	FeSO4	1.39E-10	1.53E-10	-9.857	-9.815	0.042	18.97
	CuSO4	4.12E-11	4.54E-11	-10.385	-10.343	0.042	13.09
	CaHSO4+	3.16E-11	2.31E-11	-10.5	-10.636	-0.136	0
	FeSO4+	1.31E-17	9.02E-18	-16.885	-17.045	-0.16	0
	FeHSO4+	4.78E-18	3.49E-18	-17.321	-17.457	-0.136	0
	Fe(SO4)2-	9.30E-19	6.80E-19	-18.031	-18.168	-0.136	0
	FeHSO4+2	2.94E-25	8.37E-26	-24.532	-25.077	-0.545	0
Zn	2.20E-06						
	Zn(CO3)2-2	1.90E-06	5.42E-07	-5.721	-6.266	-0.545	0
	ZnCO3	2.00E-07	2.20E-07	-6.7	-6.658	0.042	0
	Zn+2	4.20E-08	9.57E-09	-7.377	-8.019	-0.642	-24.25
	ZnOHCl	1.52E-08	1.68E-08	-7.818	-7.776	0.042	0
	ZnHCO3+	1.40E-08	1.03E-08	-7.853	-7.989	-0.136	0
	Zn(OH)2	8.89E-09	9.80E-09	-8.051	-8.009	0.042	0
	ZnCl+	7.21E-09	4.77E-09	-8.142	-8.321	-0.179	-15.1
	ZnSO4	7.01E-09	7.73E-09	-8.154	-8.112	0.042	21.71
	ZnOH+	4.10E-09	2.99E-09	-8.388	-8.524	-0.136	0
	ZnCl2	8.40E-10	9.26E-10	-9.076	-9.033	0.042	102.03
	Zn(SO4)2-2	7.60E-10	2.17E-10	-9.119	-9.665	-0.545	-7.65
	ZnCl3-	2.91E-10	1.93E-10	-9.536	-9.715	-0.179	14.28
	ZnCl4-2	7.84E-11	1.79E-11	-10.106	-10.747	-0.642	148.87
	ZnF+	4.83E-11	3.53E-11	-10.316	-10.452	-0.136	0
	Zn(OH)3-	1.21E-11	8.84E-12	-10.917	-11.054	-0.136	0
	Zn(OH)4-2	1.40E-15	4.00E-16	-14.853	-15.398	-0.545	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-0.97	-5.24	-4.28	CaSO4
Aragonite	1.62	-6.72	-8.34	CaCO3
Barite	1.17	-8.68	-9.84	BaSO4

Calcite	1.76	-6.72	-8.48	CaCO3
CO2(g)	-2.7	-4.17	-1.47	CO2
Dolomite	4.58	-12.51	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.85	6.74	4.89	Fe(OH)3
Fluorite	0.65	-9.95	-10.6	CaF2
Goethite	7.75	6.75	-1	FeOOH
Gypsum	-0.67	-5.25	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O
Halite	-3.02	-1.45	1.57	NaCl
Hausmann	-8.3	52.73	61.03	Mn3O4
Hematite	17.51	13.5	-4.01	Fe2O3
Jarosite-K	-3.46	-12.67	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.61	21.73	25.34	MnOOH
Melanterit	-9.89	-12.1	-2.21	FeSO4:7H2O
NH3(g)	-7.23	-5.43	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.93	9.27	15.2	Mn(OH)2
Pyrolusite	-7.2	34.18	41.38	MnO2:H2O
Rhodochrc	-0.45	-11.58	-11.13	MnCO3
Siderite	-2.65	-13.54	-10.89	FeCO3
Smithsonit	-1.96	-11.96	-10	ZnCO3
Sylvite	-4.24	-3.34	0.9	KCl
Witherite	-1.59	-10.15	-8.56	BaCO3
Zn(OH)2(e	-2.61	8.89	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 26

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	2.17E-02	2.17E-02
Ba	3.93E-06	3.93E-06
Ca	7.95E-03	7.95E-03
Cl	2.92E-01	2.92E-01
Cu	2.70E-07	2.70E-07
F	8.20E-04	8.20E-04
Fe	2.10E-06	2.10E-06
K	3.99E-03	3.99E-03
Mg	6.42E-02	6.42E-02
Mn	3.50E-07	3.50E-07
N(-3)	4.30E-05	4.30E-05
N(5)	3.70E-04	3.70E-04
Na	2.81E-01	2.81E-01
S(6)	3.30E-02	3.30E-02
Zn	2.29E-06	2.29E-06

#NAME? of solution----------

pH	=	8.46		
pe	=	4		
Specific	Conductan	(µS/cm,	25°C)	= 32642
Density	(g/cm³)	=	1.01516	
Volume	(L)	=	1.0079	
Activity	of	water	=	0.988
Ionic	strength	(mol/kgw)	=	4.40E-01
Mass	of	water	(kg)	= 1.00E+00
Total	carbon	(mol/kg)	=	1.88E-02
Total	CO2	(mol/kg)	=	1.88E-02
Temperatu	(°C)	=	25	
Electrical	balance	(eq)	=	4.84E-02
Percent	error,	100*(Cat-|	=	6.57
Iterations	=	11	(255	overall)
Total	H	=	1.11E+02	
Total	O	=	5.57E+01	

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4366	0.2625		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.49E-06	2.89E-06	-5.348	-5.54	-0.192	-3.03
H+	4.51E-09	3.47E-09	-8.346	-8.46	-0.114	0
H2O	5.55E+01	9.89E-01	1.744	-0.005	0	18.07
Ba	3.93E-06					
Ba+2	2.83E-06	6.26E-07	-5.548	-6.204	-0.656	-11.3
BaSO4	9.92E-07	1.10E-06	-6.004	-5.96	0.044	0
BaHCO3+	7.16E-08	5.24E-08	-7.145	-7.281	-0.136	0
BaCO3	3.45E-08	3.82E-08	-7.462	-7.418	0.044	-10.7
BaOH+	8.78E-12	6.04E-12	-11.057	-11.219	-0.162	0
C(4)	1.88E-02					
HCO3-	1.25E-02	8.73E-03	-1.904	-2.059	-0.155	26.29
MgHCO3+	2.26E-03	1.49E-03	-2.646	-2.826	-0.181	5.78
MgCO3	1.49E-03	1.65E-03	-2.828	-2.784	0.044	-17.09
NaHCO3	8.74E-04	9.68E-04	-3.058	-3.014	0.044	1.8
NaCO3-	5.93E-04	4.33E-04	-3.227	-3.363	-0.136	1.63
CO3-2	4.94E-04	1.18E-04	-3.306	-3.928	-0.622	-2.68
CaCO3	3.06E-04	3.39E-04	-3.514	-3.47	0.044	-14.6
CaHCO3+	2.67E-04	1.90E-04	-3.574	-3.721	-0.147	9.93
CO2	6.22E-05	6.88E-05	-4.206	-4.162	0.044	34.43

	Zn(CO3)2-2	1.99E-06	5.67E-07	-5.702	-6.246	-0.544	0
	ZnCO3	2.03E-07	2.25E-07	-6.693	-6.649	0.044	0
	MnCO3	1.95E-07	2.15E-07	-6.711	-6.667	0.044	0
	BaHCO3+	7.16E-08	5.24E-08	-7.145	-7.281	-0.136	0
	CuCO3	3.68E-08	4.07E-08	-7.435	-7.39	0.044	0
	BaCO3	3.45E-08	3.82E-08	-7.462	-7.418	0.044	-10.7
	MnHCO3+	2.59E-08	1.79E-08	-7.586	-7.748	-0.162	0
	Cu(CO3)2-	2.12E-08	6.05E-09	-7.674	-8.218	-0.544	0
	ZnHCO3+	1.43E-08	1.05E-08	-7.844	-7.98	-0.136	0
	FeCO3	6.70E-10	7.42E-10	-9.174	-9.13	0.044	0
	CuHCO3+	3.84E-10	2.81E-10	-9.416	-9.552	-0.136	0
	FeHCO3+	3.13E-10	2.29E-10	-9.505	-9.641	-0.136	0
	(CO2)2	7.86E-11	8.70E-11	-10.105	-10.061	0.044	68.87
Ca	7.95E-03						
	Ca+2	6.42E-03	1.71E-03	-2.193	-2.768	-0.575	-16.9
	CaSO4	9.60E-04	1.06E-03	-3.018	-2.974	0.044	7.5
	CaCO3	3.06E-04	3.39E-04	-3.514	-3.47	0.044	-14.6
	CaHCO3+	2.67E-04	1.90E-04	-3.574	-3.721	-0.147	9.93
	CaOH+	1.11E-07	8.08E-08	-6.957	-7.093	-0.136	0
	CaHSO4+	3.31E-11	2.42E-11	-10.48	-10.616	-0.136	0
Cl	2.92E-01						
	Cl-	2.92E-01	1.92E-01	-0.535	-0.717	-0.181	18.65
	CuCl2-	5.95E-08	3.93E-08	-7.225	-7.406	-0.181	0
	CuCl3-2	5.31E-08	1.19E-08	-7.275	-7.923	-0.648	0
	MnCl+	2.61E-08	1.80E-08	-7.584	-7.746	-0.162	-2.82
	ZnOHCl	1.56E-08	1.73E-08	-7.807	-7.763	0.044	0
	ZnCl+	7.47E-09	4.93E-09	-8.127	-8.307	-0.181	-15.16
	MnCl2	1.36E-09	1.51E-09	-8.867	-8.822	0.044	85.89
	ZnCl2	8.95E-10	9.90E-10	-9.048	-9.004	0.044	102.03
	ZnCl3-	3.23E-10	2.13E-10	-9.49	-9.671	-0.181	14.16
	MnCl3-	1.16E-10	7.96E-11	-9.937	-10.099	-0.162	45.05
	FeCl+	9.49E-11	6.94E-11	-10.023	-10.159	-0.136	0
	ZnCl4-2	9.12E-11	2.05E-11	-10.04	-10.688	-0.648	148.97
	CuCl+	5.03E-11	3.32E-11	-10.299	-10.479	-0.181	1.53
	CuCl2	3.09E-12	3.42E-12	-11.51	-11.466	0.044	31.02
	CuCl3-	3.53E-15	2.33E-15	-14.452	-14.633	-0.181	0
	CuCl4-2	9.95E-18	2.24E-18	-17.002	-17.65	-0.648	0
	FeCl+2	6.44E-18	1.45E-18	-17.191	-17.839	-0.648	0
	FeCl2+	1.81E-18	1.24E-18	-17.744	-17.905	-0.162	0
	FeCl3	2.16E-20	2.39E-20	-19.666	-19.622	0.044	0
Cu(1)	1.13E-07						
	CuCl2-	5.95E-08	3.93E-08	-7.225	-7.406	-0.181	0
	CuCl3-2	5.31E-08	1.19E-08	-7.275	-7.923	-0.648	0
	Cu+	5.58E-12	3.37E-12	-11.254	-11.473	-0.219	0
Cu(2)	1.57E-07						
	Cu(OH)2	9.85E-08	1.09E-07	-7.007	-6.963	0.044	0
	CuCO3	3.68E-08	4.07E-08	-7.435	-7.39	0.044	0
	Cu(CO3)2-	2.12E-08	6.05E-09	-7.674	-8.218	-0.544	0
	CuHCO3+	3.84E-10	2.81E-10	-9.416	-9.552	-0.136	0
	CuOH+	2.77E-10	1.83E-10	-9.557	-9.738	-0.181	0

	Cu+2	2.48E-10	6.42E-11	-9.606	-10.193	-0.587	-25.49
	CuCl+	5.03E-11	3.32E-11	-10.299	-10.479	-0.181	1.53
	CuSO4	4.14E-11	4.59E-11	-10.383	-10.339	0.044	13.09
	CuCl2	3.09E-12	3.42E-12	-11.51	-11.466	0.044	31.02
	Cu(OH)3-	2.56E-12	1.87E-12	-11.592	-11.728	-0.136	0
	CuF+	4.24E-13	3.10E-13	-12.372	-12.508	-0.136	0
	Cu2(OH)2+	5.13E-14	1.47E-14	-13.29	-13.834	-0.544	0
	CuCl3-	3.53E-15	2.33E-15	-14.452	-14.633	-0.181	0
	Cu(OH)4-2	3.73E-16	1.07E-16	-15.428	-15.973	-0.544	0
	CuCl4-2	9.95E-18	2.24E-18	-17.002	-17.65	-0.648	0
F	8.20E-04						
	F-	4.13E-04	2.66E-04	-3.384	-3.576	-0.192	-0.72
	MgF+	3.80E-04	2.56E-04	-3.421	-3.591	-0.171	-10.29
	NaF	2.72E-05	3.01E-05	-4.565	-4.521	0.044	7.26
	HF	1.25E-09	1.38E-09	-8.904	-8.86	0.044	12.5
	MnF+	6.13E-11	4.22E-11	-10.213	-10.375	-0.162	0
	ZnF+	4.89E-11	3.58E-11	-10.311	-10.447	-0.136	0
	HF2-	1.92E-12	1.41E-12	-11.716	-11.852	-0.136	22.66
	FeF+	9.51E-13	6.95E-13	-12.022	-12.158	-0.136	0
	CuF+	4.24E-13	3.10E-13	-12.372	-12.508	-0.136	0
	FeF2+	1.62E-15	1.11E-15	-14.792	-14.954	-0.162	0
	FeF+2	4.68E-16	1.05E-16	-15.33	-15.978	-0.648	0
	FeF3	4.23E-16	4.68E-16	-15.374	-15.33	0.044	0
Fe(2)	2.27E-09						
	Fe+2	1.01E-09	2.62E-10	-8.995	-9.582	-0.587	-20.93
	FeCO3	6.70E-10	7.42E-10	-9.174	-9.13	0.044	0
	FeHCO3+	3.13E-10	2.29E-10	-9.505	-9.641	-0.136	0
	FeSO4	1.47E-10	1.63E-10	-9.832	-9.788	0.044	18.97
	FeCl+	9.49E-11	6.94E-11	-10.023	-10.159	-0.136	0
	FeOH+	3.43E-11	2.36E-11	-10.465	-10.627	-0.162	0
	FeF+	9.51E-13	6.95E-13	-12.022	-12.158	-0.136	0
	Fe(OH)2	5.18E-14	5.73E-14	-13.286	-13.242	0.044	0
	Fe(OH)3-	8.81E-16	6.07E-16	-15.055	-15.217	-0.162	0
	FeHSO4+	5.08E-18	3.72E-18	-17.294	-17.43	-0.136	0
Fe(3)	2.10E-06						
	Fe(OH)3	1.44E-06	1.60E-06	-5.841	-5.797	0.044	0
	Fe(OH)4-	5.94E-07	4.15E-07	-6.227	-6.382	-0.155	0
	Fe(OH)2+	6.22E-08	4.35E-08	-7.206	-7.362	-0.155	0
	FeOH+2	2.05E-12	4.60E-13	-11.689	-12.337	-0.648	0
	FeF2+	1.62E-15	1.11E-15	-14.792	-14.954	-0.162	0
	FeF+2	4.68E-16	1.05E-16	-15.33	-15.978	-0.648	0
	FeF3	4.23E-16	4.68E-16	-15.374	-15.33	0.044	0
	FeSO4+	1.39E-17	9.60E-18	-16.856	-17.018	-0.162	0
	FeCl+2	6.44E-18	1.45E-18	-17.191	-17.839	-0.648	0
	Fe+3	2.67E-18	2.50E-19	-17.573	-18.602	-1.028	0
	FeCl2+	1.81E-18	1.24E-18	-17.744	-17.905	-0.162	0
	Fe(SO4)2-	1.01E-18	7.35E-19	-17.998	-18.134	-0.136	0
	FeCl3	2.16E-20	2.39E-20	-19.666	-19.622	0.044	0
	Fe2(OH)2+	8.58E-22	5.70E-24	-21.067	-23.244	-2.177	0
	FeHSO4+2	3.12E-25	8.91E-26	-24.506	-25.05	-0.544	0

	Fe3(OH)4+	1.31E-25	5.18E-29	-24.884	-28.286	-3.402	0
H(0)	1.54E-28						
	H2	7.69E-29	8.51E-29	-28.114	-28.07	0.044	28.61
K	3.99E-03						
	K+	3.90E-03	2.55E-03	-2.409	-2.594	-0.185	9.52
	KSO4-	8.95E-05	6.26E-05	-4.048	-4.203	-0.155	34.7
Mg	6.42E-02						
	Mg+2	4.92E-02	1.46E-02	-1.308	-1.836	-0.528	-20.62
	MgSO4	1.08E-02	1.20E-02	-1.966	-1.922	0.044	5.84
	MgHCO3+	2.26E-03	1.49E-03	-2.646	-2.826	-0.181	5.78
	MgCO3	1.49E-03	1.65E-03	-2.828	-2.784	0.044	-17.09
	MgF+	3.80E-04	2.56E-04	-3.421	-3.591	-0.171	-10.29
	MgOH+	2.09E-05	1.51E-05	-4.681	-4.821	-0.14	0
Mn(2)	3.50E-07						
	MnCO3	1.95E-07	2.15E-07	-6.711	-6.667	0.044	0
	Mn+2	8.87E-08	2.30E-08	-7.052	-7.639	-0.587	-16.79
	MnCl+	2.61E-08	1.80E-08	-7.584	-7.746	-0.162	-2.82
	MnHCO3+	2.59E-08	1.79E-08	-7.586	-7.748	-0.162	0
	MnSO4	1.29E-08	1.43E-08	-7.889	-7.845	0.044	22.54
	MnCl2	1.36E-09	1.51E-09	-8.867	-8.822	0.044	85.89
	MnOH+	2.44E-10	1.68E-10	-9.612	-9.774	-0.162	0
	MnCl3-	1.16E-10	7.96E-11	-9.937	-10.099	-0.162	45.05
	MnF+	6.13E-11	4.22E-11	-10.213	-10.375	-0.162	0
	Mn(NO3)2	4.41E-15	4.88E-15	-14.356	-14.312	0.044	41.04
	Mn(OH)3-	1.22E-17	8.43E-18	-16.912	-17.074	-0.162	0
Mn(3)	7.58E-29						
	Mn+3	7.58E-29	7.10E-30	-28.12	-29.149	-1.028	0
N(-3)	4.30E-05						
	NH4+	3.82E-05	2.30E-05	-4.418	-4.637	-0.219	18.36
	NH3	3.42E-06	3.79E-06	-5.466	-5.422	0.044	24.42
	NH4SO4-	1.42E-06	1.04E-06	-5.847	-5.983	-0.136	39.27
N(5)	3.70E-04						
	NO3-	3.70E-04	2.31E-04	-3.432	-3.636	-0.205	30.12
	Mn(NO3)2	4.41E-15	4.88E-15	-14.356	-14.312	0.044	41.04
Na	2.81E-01						
	Na+	2.74E-01	1.97E-01	-0.562	-0.705	-0.143	-0.68
	NaSO4-	4.95E-03	3.46E-03	-2.306	-2.461	-0.155	19.65
	NaHCO3	8.74E-04	9.68E-04	-3.058	-3.014	0.044	1.8
	NaCO3-	5.93E-04	4.33E-04	-3.227	-3.363	-0.136	1.63
	NaF	2.72E-05	3.01E-05	-4.565	-4.521	0.044	7.26
	NaOH	5.14E-17	5.69E-17	-16.289	-16.245	0.044	0
O(0)	1.02E-36						
	O2	5.08E-37	5.62E-37	-36.294	-36.25	0.044	30.4
S(6)	3.30E-02						
	SO4-2	1.62E-02	3.50E-03	-1.791	-2.456	-0.665	16.9
	MgSO4	1.08E-02	1.20E-02	-1.966	-1.922	0.044	5.84
	NaSO4-	4.95E-03	3.46E-03	-2.306	-2.461	-0.155	19.65
	CaSO4	9.60E-04	1.06E-03	-3.018	-2.974	0.044	7.5
	KSO4-	8.95E-05	6.26E-05	-4.048	-4.203	-0.155	34.7
	NH4SO4-	1.42E-06	1.04E-06	-5.847	-5.983	-0.136	39.27

BaSO4	9.92E-07	1.10E-06	-6.004	-5.96	0.044	0
MnSO4	1.29E-08	1.43E-08	-7.889	-7.845	0.044	22.54
ZnSO4	7.07E-09	7.82E-09	-8.151	-8.107	0.044	21.71
HSO4-	1.61E-09	1.18E-09	-8.792	-8.928	-0.136	40.84
Zn(SO4)2-2	7.79E-10	2.23E-10	-9.108	-9.653	-0.544	-7.48
FeSO4	1.47E-10	1.63E-10	-9.832	-9.788	0.044	18.97
CuSO4	4.14E-11	4.59E-11	-10.383	-10.339	0.044	13.09
CaHSO4+	3.31E-11	2.42E-11	-10.48	-10.616	-0.136	0
FeSO4+	1.39E-17	9.60E-18	-16.856	-17.018	-0.162	0
FeHSO4+	5.08E-18	3.72E-18	-17.294	-17.43	-0.136	0
Fe(SO4)2-	1.01E-18	7.35E-19	-17.998	-18.134	-0.136	0
FeHSO4+2	3.12E-25	8.91E-26	-24.506	-25.05	-0.544	0
Zn	2.29E-06					
Zn(CO3)2-2	1.99E-06	5.67E-07	-5.702	-6.246	-0.544	0
ZnCO3	2.03E-07	2.25E-07	-6.693	-6.649	0.044	0
Zn+2	4.24E-08	9.53E-09	-7.373	-8.021	-0.648	-24.24
ZnOHCl	1.56E-08	1.73E-08	-7.807	-7.763	0.044	0
ZnHCO3+	1.43E-08	1.05E-08	-7.844	-7.98	-0.136	0
Zn(OH)2	8.81E-09	9.76E-09	-8.055	-8.011	0.044	0
ZnCl+	7.47E-09	4.93E-09	-8.127	-8.307	-0.181	-15.16
ZnSO4	7.07E-09	7.82E-09	-8.151	-8.107	0.044	21.71
ZnOH+	4.08E-09	2.98E-09	-8.39	-8.526	-0.136	0
ZnCl2	8.95E-10	9.90E-10	-9.048	-9.004	0.044	102.03
Zn(SO4)2-2	7.79E-10	2.23E-10	-9.108	-9.653	-0.544	-7.48
ZnCl3-	3.23E-10	2.13E-10	-9.49	-9.671	-0.181	14.16
ZnCl4-2	9.12E-11	2.05E-11	-10.04	-10.688	-0.648	148.97
ZnF+	4.89E-11	3.58E-11	-10.311	-10.447	-0.136	0
Zn(OH)3-	1.20E-11	8.79E-12	-10.92	-11.056	-0.136	0
Zn(OH)4-2	1.39E-15	3.97E-16	-14.857	-15.401	-0.544	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-0.95	-5.22	-4.28	CaSO4			
Aragonite	1.64	-6.7	-8.34	CaCO3			
Barite	1.18	-8.66	-9.84	BaSO4			
Calcite	1.78	-6.7	-8.48	CaCO3			
CO2(g)	-2.69	-4.16	-1.47	CO2			
Dolomite	4.62	-12.46	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.87	6.76	4.89	Fe(OH)3			
Fluorite	0.68	-9.92	-10.6	CaF2			
Goethite	7.77	6.77	-1	FeOOH			
Gypsum	-0.65	-5.23	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	-0.01	1.5	H2O			
Halite	-2.99	-1.42	1.57	NaCl			
Hausmann	-8.29	52.74	61.03	Mn3O4			
Hematite	17.55	13.54	-4.01	Fe2O3			
Jarosite-K	-3.37	-12.58	-9.21	KFe3(SO4)2(OH)6			

Manganite	-3.61	21.73	25.34	MnOOH
Melanterit	-9.86	-12.07	-2.21	FeSO4:7H2O
NH3(g)	-7.22	-5.42	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.93	9.27	15.2	Mn(OH)2
Pyrolusite	-7.19	34.19	41.38	MnO2:H2O
Rhodochrc	-0.44	-11.57	-11.13	MnCO3
Siderite	-2.62	-13.51	-10.89	FeCO3
Smithsonit	-1.95	-11.95	-10	ZnCO3
Sylvite	-4.21	-3.31	0.9	KCl
Witherite	-1.57	-10.13	-8.56	BaCO3
Zn(OH)2(e	-2.61	8.89	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 27

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	2.25E-02	2.25E-02
Ba	4.08E-06	4.08E-06
Ca	8.25E-03	8.25E-03
Cl	3.03E-01	3.03E-01
Cu	2.80E-07	2.80E-07
F	8.50E-04	8.50E-04
Fe	2.18E-06	2.18E-06
K	4.14E-03	4.14E-03
Mg	6.67E-02	6.67E-02
Mn	3.70E-07	3.70E-07
N(-3)	4.50E-05	4.50E-05
N(5)	3.80E-04	3.80E-04
Na	2.91E-01	2.91E-01
S(6)	3.43E-02	3.43E-02
Zn	2.37E-06	2.37E-06

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 33712
Density (g/cm³) = 1.01584
Volume (L) = 1.0081
Activity of water = 0.988
Ionic strength (mol/kgw) = 4.57E-01
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 1.95E-02
Total CO2 (mol/kg) = 1.95E-02

```
Temperatu (°C)          =                25
Electrical  balance     (eq)        =          5.02E-02
Percent     error,      100*(Cat-|=                6.58
Iterations  =                   12 (267        overall)
Total       H           =          1.11E+02
Total       O           =          5.57E+01

#NAME?  couples--------------------------------

        Redox       couple      pe          Eh          (volts)

        N(-3)/N(5)     4.4357      0.2624

#NAME?  of          species----------------------------

        Log         Log         Log         mole        V
        Species     Molality    Activity    Molality    Activity    Gamma    cm³/mol

        OH-          4.51E-06   2.88E-06     -5.346      -5.54     -0.194        -3
        H+           4.52E-09   3.47E-09     -8.345      -8.46     -0.115         0
        H2O          5.55E+01   9.88E-01      1.744     -0.005          0     18.07
Ba        4.08E-06
        Ba+2         2.94E-06   6.43E-07     -5.532     -6.192      -0.66    -11.28
        BaSO4        1.03E-06   1.14E-06     -5.987     -5.942      0.046         0
        BaHCO3+      7.52E-08   5.50E-08     -7.124     -7.259     -0.136         0
        BaCO3        3.61E-08   4.01E-08     -7.442     -7.397      0.046      -10.7
        BaOH+        9.04E-12   6.20E-12    -11.044    -11.207     -0.163         0
C(4)      1.95E-02
        HCO3-        1.28E-02   8.94E-03     -1.892     -2.049     -0.157     26.34
        MgHCO3+      2.40E-03   1.58E-03      -2.62     -2.803     -0.183      5.79
        MgCO3        1.56E-03   1.74E-03     -2.806      -2.76      0.046    -17.09
        NaHCO3       9.25E-04   1.03E-03     -3.034     -2.988      0.046       1.8
        NaCO3-       6.29E-04   4.60E-04     -3.201     -3.337     -0.136      1.72
        CO3-2        5.12E-04   1.21E-04     -3.291     -3.918     -0.627     -2.62
        CaCO3        3.21E-04   3.57E-04     -3.493     -3.448      0.046     -14.6
        CaHCO3+      2.82E-04   2.00E-04     -3.551     -3.698     -0.148      9.93
        CO2          6.35E-05   7.05E-05     -4.197     -4.152      0.046     34.43
        Zn(CO3)2-:   2.06E-06   5.90E-07     -5.686     -6.229     -0.543         0
        MnCO3        2.06E-07   2.29E-07     -6.686     -6.641      0.046         0
        ZnCO3        2.06E-07   2.28E-07     -6.687     -6.641      0.046         0
        BaHCO3+      7.52E-08   5.50E-08     -7.124     -7.259     -0.136         0
        CuCO3        3.72E-08   4.13E-08     -7.429     -7.384      0.046         0
        BaCO3        3.61E-08   4.01E-08     -7.442     -7.397      0.046      -10.7
        MnHCO3+      2.76E-08   1.90E-08     -7.559     -7.722     -0.163         0
        Cu(CO3)2-    2.20E-08   6.29E-09     -7.658     -8.201     -0.543         0
        ZnHCO3+      1.46E-08   1.07E-08     -7.837     -7.973     -0.136         0
        FeCO3        7.12E-10   7.91E-10     -9.148     -9.102      0.046         0
        CuHCO3+      3.90E-10   2.85E-10     -9.409     -9.545     -0.136         0
        FeHCO3+      3.33E-10   2.44E-10     -9.477     -9.613     -0.136         0
        (CO2)2       8.22E-11   9.13E-11    -10.085     -10.04      0.046     68.87
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Ca	8.25E-03						
	Ca+2	6.65E-03	1.76E-03	-2.177	-2.755	-0.578	-16.88
	CaSO4	9.99E-04	1.11E-03	-3	-2.955	0.046	7.5
	CaCO3	3.21E-04	3.57E-04	-3.493	-3.448	0.046	-14.6
	CaHCO3+	2.82E-04	2.00E-04	-3.551	-3.698	-0.148	9.93
	CaOH+	1.14E-07	8.31E-08	-6.945	-7.081	-0.136	0
	CaHSO4+	3.46E-11	2.53E-11	-10.461	-10.597	-0.136	0
Cl	3.03E-01						
	Cl-	3.03E-01	1.99E-01	-0.519	-0.702	-0.183	18.66
	CuCl2-	6.35E-08	4.17E-08	-7.197	-7.38	-0.183	0
	CuCl3-2	5.91E-08	1.31E-08	-7.229	-7.882	-0.653	0
	MnCl+	2.81E-08	1.93E-08	-7.552	-7.715	-0.163	-2.82
	ZnOHCl	1.60E-08	1.77E-08	-7.797	-7.751	0.046	0
	ZnCl+	7.71E-09	5.06E-09	-8.113	-8.296	-0.183	-15.21
	MnCl2	1.50E-09	1.67E-09	-8.823	-8.777	0.046	85.89
	ZnCl2	9.47E-10	1.05E-09	-9.024	-8.978	0.046	102.03
	ZnCl3-	3.57E-10	2.35E-10	-9.447	-9.63	-0.183	14.05
	MnCl3-	1.33E-10	9.14E-11	-9.876	-10.039	-0.163	45.11
	ZnCl4-2	1.05E-10	2.33E-11	-9.979	-10.632	-0.653	149.07
	FeCl+	1.02E-10	7.48E-11	-9.991	-10.126	-0.136	0
	CuCl+	5.18E-11	3.40E-11	-10.285	-10.468	-0.183	1.56
	CuCl2	3.27E-12	3.63E-12	-11.486	-11.44	0.046	31.02
	CuCl3-	3.90E-15	2.56E-15	-14.41	-14.592	-0.183	0
	CuCl4-2	1.15E-17	2.55E-18	-16.941	-17.594	-0.653	0
	FeCl+2	7.03E-18	1.56E-18	-17.153	-17.806	-0.653	0
	FeCl2+	2.02E-18	1.39E-18	-17.695	-17.858	-0.163	0
	FeCl3	2.48E-20	2.75E-20	-19.606	-19.56	0.046	0
Cu(1)	1.23E-07						
	CuCl2-	6.35E-08	4.17E-08	-7.197	-7.38	-0.183	0
	CuCl3-2	5.91E-08	1.31E-08	-7.229	-7.882	-0.653	0
	Cu+	5.57E-12	3.34E-12	-11.254	-11.476	-0.222	0
Cu(2)	1.58E-07						
	Cu(OH)2	9.73E-08	1.08E-07	-7.012	-6.966	0.046	0
	CuCO3	3.72E-08	4.13E-08	-7.429	-7.384	0.046	0
	Cu(CO3)2-	2.20E-08	6.29E-09	-7.658	-8.201	-0.543	0
	CuHCO3+	3.90E-10	2.85E-10	-9.409	-9.545	-0.136	0
	CuOH+	2.76E-10	1.82E-10	-9.559	-9.741	-0.183	0
	Cu+2	2.49E-10	6.37E-11	-9.605	-10.196	-0.591	-25.47
	CuCl+	5.18E-11	3.40E-11	-10.285	-10.468	-0.183	1.56
	CuSO4	4.16E-11	4.62E-11	-10.381	-10.335	0.046	13.09
	CuCl2	3.27E-12	3.63E-12	-11.486	-11.44	0.046	31.02
	Cu(OH)3-	2.54E-12	1.86E-12	-11.596	-11.732	-0.136	0
	CuF+	4.28E-13	3.13E-13	-12.369	-12.505	-0.136	0
	Cu2(OH)2+	5.03E-14	1.44E-14	-13.298	-13.841	-0.543	0
	CuCl3-	3.90E-15	2.56E-15	-14.41	-14.592	-0.183	0
	Cu(OH)4-2	3.68E-16	1.06E-16	-15.434	-15.977	-0.543	0
	CuCl4-2	1.15E-17	2.55E-18	-16.941	-17.594	-0.653	0
F	8.50E-04						
	F-	4.22E-04	2.70E-04	-3.375	-3.569	-0.194	-0.71
	MgF+	4.00E-04	2.69E-04	-3.398	-3.571	-0.172	-10.28

	NaF	2.86E-05	3.18E-05	-4.544	-4.498	0.046	7.26
	HF	1.26E-09	1.40E-09	-8.898	-8.853	0.046	12.5
	MnF+	6.48E-11	4.45E-11	-10.189	-10.352	-0.163	0
	ZnF+	4.94E-11	3.61E-11	-10.307	-10.443	-0.136	0
	HF2-	1.99E-12	1.45E-12	-11.702	-11.838	-0.136	22.67
	FeF+	1.01E-12	7.36E-13	-11.997	-12.133	-0.136	0
	CuF+	4.28E-13	3.13E-13	-12.369	-12.505	-0.136	0
	FeF2+	1.74E-15	1.20E-15	-14.759	-14.922	-0.163	0
	FeF+2	5.02E-16	1.11E-16	-15.3	-15.953	-0.653	0
	FeF3	4.61E-16	5.12E-16	-15.336	-15.291	0.046	0
Fe(2)	2.40E-09						
	Fe+2	1.06E-09	2.73E-10	-8.973	-9.564	-0.591	-20.92
	FeCO3	7.12E-10	7.91E-10	-9.148	-9.102	0.046	0
	FeHCO3+	3.33E-10	2.44E-10	-9.477	-9.613	-0.136	0
	FeSO4	1.55E-10	1.72E-10	-9.809	-9.764	0.046	18.97
	FeCl+	1.02E-10	7.48E-11	-9.991	-10.126	-0.136	0
	FeOH+	3.58E-11	2.46E-11	-10.446	-10.61	-0.163	0
	FeF+	1.01E-12	7.36E-13	-11.997	-12.133	-0.136	0
	Fe(OH)2	5.37E-14	5.96E-14	-13.27	-13.225	0.046	0
	Fe(OH)3-	9.19E-16	6.31E-16	-15.037	-15.2	-0.163	0
	FeHSO4+	5.37E-18	3.93E-18	-17.27	-17.406	-0.136	0
Fe(3)	2.18E-06						
	Fe(OH)3	1.49E-06	1.66E-06	-5.826	-5.78	0.046	0
	Fe(OH)4-	6.19E-07	4.31E-07	-6.208	-6.365	-0.157	0
	Fe(OH)2+	6.49E-08	4.52E-08	-7.188	-7.345	-0.157	0
	FeOH+2	2.16E-12	4.79E-13	-11.666	-12.32	-0.653	0
	FeF2+	1.74E-15	1.20E-15	-14.759	-14.922	-0.163	0
	FeF+2	5.02E-16	1.11E-16	-15.3	-15.953	-0.653	0
	FeF3	4.61E-16	5.12E-16	-15.336	-15.291	0.046	0
	FeSO4+	1.48E-17	1.01E-17	-16.83	-16.994	-0.163	0
	FeCl+2	7.03E-18	1.56E-18	-17.153	-17.806	-0.653	0
	Fe+3	2.82E-18	2.60E-19	-17.55	-18.584	-1.035	0
	FeCl2+	2.02E-18	1.39E-18	-17.695	-17.858	-0.163	0
	Fe(SO4)2-	1.08E-18	7.88E-19	-17.967	-18.103	-0.136	0
	FeCl3	2.48E-20	2.75E-20	-19.606	-19.56	0.046	0
	Fe2(OH)2+	9.20E-22	6.18E-24	-21.036	-23.209	-2.173	0
	FeHSO4+2	3.29E-25	9.42E-26	-24.483	-25.026	-0.543	0
	Fe3(OH)4+	1.45E-25	5.84E-29	-24.839	-28.234	-3.395	0
H(0)	1.53E-28						
	H2	7.66E-29	8.51E-29	-28.116	-28.07	0.046	28.61
K	4.14E-03						
	K+	4.05E-03	2.63E-03	-2.393	-2.58	-0.187	9.53
	KSO4-	9.42E-05	6.56E-05	-4.026	-4.183	-0.157	34.71
Mg	6.67E-02						
	Mg+2	5.10E-02	1.51E-02	-1.293	-1.822	-0.529	-20.6
	MgSO4	1.13E-02	1.25E-02	-1.947	-1.902	0.046	5.84
	MgHCO3+	2.40E-03	1.58E-03	-2.62	-2.803	-0.183	5.79
	MgCO3	1.56E-03	1.74E-03	-2.806	-2.76	0.046	-17.09
	MgF+	4.00E-04	2.69E-04	-3.398	-3.571	-0.172	-10.28
	MgOH+	2.16E-05	1.56E-05	-4.666	-4.807	-0.141	0

Mn(2)	3.70E-07						
	MnCO3	2.06E-07	2.29E-07	-6.686	-6.641	0.046	0
	Mn+2	9.29E-08	2.38E-08	-7.032	-7.623	-0.591	-16.75
	MnCl+	2.81E-08	1.93E-08	-7.552	-7.715	-0.163	-2.82
	MnHCO3+	2.76E-08	1.90E-08	-7.559	-7.722	-0.163	0
	MnSO4	1.35E-08	1.51E-08	-7.868	-7.823	0.046	22.54
	MnCl2	1.50E-09	1.67E-09	-8.823	-8.777	0.046	85.89
	MnOH+	2.54E-10	1.75E-10	-9.595	-9.758	-0.163	0
	MnCl3-	1.33E-10	9.14E-11	-9.876	-10.039	-0.163	45.11
	MnF+	6.48E-11	4.45E-11	-10.189	-10.352	-0.163	0
	Mn(NO3)2	4.75E-15	5.28E-15	-14.323	-14.277	0.046	41.04
	Mn(OH)3-	1.27E-17	8.73E-18	-16.895	-17.059	-0.163	0
Mn(3)	7.97E-29						
	Mn+3	7.97E-29	7.36E-30	-28.098	-29.133	-1.035	0
N(-3)	4.50E-05						
	NH4+	4.00E-05	2.40E-05	-4.398	-4.62	-0.222	18.37
	NH3	3.55E-06	3.94E-06	-5.45	-5.404	0.046	24.42
	NH4SO4-	1.50E-06	1.10E-06	-5.824	-5.96	-0.136	39.32
N(5)	3.80E-04						
	NO3-	3.80E-04	2.36E-04	-3.42	-3.627	-0.207	30.14
	Mn(NO3)2	4.75E-15	5.28E-15	-14.323	-14.277	0.046	41.04
Na	2.91E-01						
	Na+	2.85E-01	2.05E-01	-0.546	-0.689	-0.143	-0.67
	NaSO4-	5.22E-03	3.64E-03	-2.282	-2.439	-0.157	19.77
	NaHCO3	9.25E-04	1.03E-03	-3.034	-2.988	0.046	1.8
	NaCO3-	6.29E-04	4.60E-04	-3.201	-3.337	-0.136	1.72
	NaF	2.86E-05	3.18E-05	-4.544	-4.498	0.046	7.26
	NaOH	5.31E-17	5.90E-17	-16.275	-16.229	0.046	0
O(0)	1.01E-36						
	O2	5.06E-37	5.62E-37	-36.296	-36.25	0.046	30.4
S(6)	3.43E-02						
	SO4-2	1.67E-02	3.55E-03	-1.778	-2.449	-0.672	16.94
	MgSO4	1.13E-02	1.25E-02	-1.947	-1.902	0.046	5.84
	NaSO4-	5.22E-03	3.64E-03	-2.282	-2.439	-0.157	19.77
	CaSO4	9.99E-04	1.11E-03	-3	-2.955	0.046	7.5
	KSO4-	9.42E-05	6.56E-05	-4.026	-4.183	-0.157	34.71
	NH4SO4-	1.50E-06	1.10E-06	-5.824	-5.96	-0.136	39.32
	BaSO4	1.03E-06	1.14E-06	-5.987	-5.942	0.046	0
	MnSO4	1.35E-08	1.51E-08	-7.868	-7.823	0.046	22.54
	ZnSO4	7.10E-09	7.89E-09	-8.149	-8.103	0.046	21.71
	HSO4-	1.64E-09	1.20E-09	-8.786	-8.922	-0.136	40.85
	Zn(SO4)2-2	7.95E-10	2.28E-10	-9.1	-9.643	-0.543	-7.31
	FeSO4	1.55E-10	1.72E-10	-9.809	-9.764	0.046	18.97
	CuSO4	4.16E-11	4.62E-11	-10.381	-10.335	0.046	13.09
	CaHSO4+	3.46E-11	2.53E-11	-10.461	-10.597	-0.136	0
	FeSO4+	1.48E-17	1.01E-17	-16.83	-16.994	-0.163	0
	FeHSO4+	5.37E-18	3.93E-18	-17.27	-17.406	-0.136	0
	Fe(SO4)2-	1.08E-18	7.88E-19	-17.967	-18.103	-0.136	0
	FeHSO4+2	3.29E-25	9.42E-26	-24.483	-25.026	-0.543	0
Zn	2.37E-06						

Zn(CO3)2-2	2.06E-06	5.90E-07	-5.686	-6.229	-0.543	0
ZnCO3	2.06E-07	2.28E-07	-6.687	-6.641	0.046	0
Zn+2	4.26E-08	9.47E-09	-7.37	-8.024	-0.653	-24.23
ZnOHCl	1.60E-08	1.77E-08	-7.797	-7.751	0.046	0
ZnHCO3+	1.46E-08	1.07E-08	-7.837	-7.973	-0.136	0
Zn(OH)2	8.71E-09	9.68E-09	-8.06	-8.014	0.046	0
ZnCl+	7.71E-09	5.06E-09	-8.113	-8.296	-0.183	-15.21
ZnSO4	7.10E-09	7.89E-09	-8.149	-8.103	0.046	21.71
ZnOH+	4.04E-09	2.96E-09	-8.393	-8.529	-0.136	0
ZnCl2	9.47E-10	1.05E-09	-9.024	-8.978	0.046	102.03
Zn(SO4)2-2	7.95E-10	2.28E-10	-9.1	-9.643	-0.543	-7.31
ZnCl3-	3.57E-10	2.35E-10	-9.447	-9.63	-0.183	14.05
ZnCl4-2	1.05E-10	2.33E-11	-9.979	-10.632	-0.653	149.07
ZnF+	4.94E-11	3.61E-11	-10.307	-10.443	-0.136	0
Zn(OH)3-	1.19E-11	8.72E-12	-10.924	-11.059	-0.136	0
Zn(OH)4-2	1.38E-15	3.94E-16	-14.861	-15.405	-0.543	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-0.93	-5.2	-4.28	CaSO4			
Aragonite	1.66	-6.67	-8.34	CaCO3			
Barite	1.2	-8.64	-9.84	BaSO4			
Calcite	1.81	-6.67	-8.48	CaCO3			
CO2(g)	-2.68	-4.15	-1.47	CO2			
Dolomite	4.67	-12.41	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.89	6.78	4.89	Fe(OH)3			
Fluorite	0.71	-9.89	-10.6	CaF2			
Goethite	7.79	6.79	-1	FeOOH			
Gypsum	-0.63	-5.22	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	-0.01	1.5	H2O			
Halite	-2.96	-1.39	1.57	NaCl			
Hausmann	-8.24	52.79	61.03	Mn3O4			
Hematite	17.58	13.58	-4.01	Fe2O3			
Jarosite-K	-3.29	-12.5	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.59	21.75	25.34	MnOOH			
Melanterit	-9.84	-12.05	-2.21	FeSO4:7H2O			
NH3(g)	-7.2	-5.4	1.8	NH3			
O2(g)	-33.36	-36.25	-2.89	O2			
Pyrochroit	-5.91	9.29	15.2	Mn(OH)2			
Pyrolusite	-7.18	34.2	41.38	MnO2:H2O			
Rhodochro	-0.41	-11.54	-11.13	MnCO3			
Siderite	-2.59	-13.48	-10.89	FeCO3			
Smithsonit	-1.94	-11.94	-10	ZnCO3			
Sylvite	-4.18	-3.28	0.9	KCl			
Witherite	-1.55	-10.11	-8.56	BaCO3			
Zn(OH)2(e	-2.61	8.89	11.5	Zn(OH)2			

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**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 28

#NAME? composition-----------------------------

Elements Molality Moles

Alkalinity 2.34E-02 2.34E-02
Ba 4.23E-06 4.23E-06
Ca 8.56E-03 8.56E-03
Cl 3.14E-01 3.14E-01
Cu 2.90E-07 2.90E-07
F 8.80E-04 8.80E-04
Fe 2.26E-06 2.26E-06
K 4.30E-03 4.30E-03
Mg 6.91E-02 6.91E-02
Mn 3.80E-07 3.80E-07
N(-3) 4.70E-05 4.70E-05
N(5) 4.00E-04 4.00E-04
Na 3.02E-01 3.02E-01
S(6) 3.56E-02 3.56E-02
Zn 2.46E-06 2.46E-06

#NAME? of solution---------------------------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 34774
Density (g/cm³) = 1.01652
Volume (L) = 1.0083
Activity of water = 0.988
Ionic strength (mol/kgw) = 4.73E-01
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 2.02E-02
Total CO2 (mol/kg) = 2.02E-02
Temperatu (°C) = 25
Electrical balance (eq) = 5.21E-02
Percent error, 100*(Cat-| = 6.58
Iterations = 13 (280 overall)
Total H = 1.11E+02
Total O = 5.57E+01

#NAME? couples--------------------------------

Redox couple pe Eh (volts)

N(-3)/N(5) 4.4362 0.2624
```

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.53E-06	2.88E-06	-5.344	-5.54	-0.196	-2.97
	H+	4.53E-09	3.47E-09	-8.344	-8.46	-0.116	0
	H2O	5.55E+01	9.88E-01	1.744	-0.005	0	18.07
Ba	4.23E-06						
	Ba+2	3.05E-06	6.59E-07	-5.516	-6.181	-0.665	-11.25
	BaSO4	1.07E-06	1.19E-06	-5.972	-5.924	0.047	0
	BaHCO3+	7.89E-08	5.78E-08	-7.103	-7.238	-0.135	0
	BaCO3	3.78E-08	4.21E-08	-7.423	-7.376	0.047	-10.7
	BaOH+	9.30E-12	6.36E-12	-11.032	-11.196	-0.165	0
C(4)	2.02E-02						
	HCO3-	1.32E-02	9.14E-03	-1.881	-2.039	-0.158	26.39
	MgHCO3+	2.54E-03	1.66E-03	-2.596	-2.78	-0.184	5.79
	MgCO3	1.64E-03	1.83E-03	-2.784	-2.737	0.047	-17.09
	NaHCO3	9.76E-04	1.09E-03	-3.01	-2.963	0.047	1.8
	NaCO3-	6.66E-04	4.88E-04	-3.177	-3.312	-0.135	1.81
	CO3-2	5.30E-04	1.24E-04	-3.276	-3.908	-0.632	-2.57
	CaCO3	3.37E-04	3.76E-04	-3.473	-3.425	0.047	-14.6
	CaHCO3+	2.97E-04	2.11E-04	-3.527	-3.676	-0.149	9.94
	CO2	6.47E-05	7.22E-05	-4.189	-4.142	0.047	34.43
	Zn(CO3)2-2	2.15E-06	6.16E-07	-5.668	-6.21	-0.542	0
	MnCO3	2.12E-07	2.36E-07	-6.675	-6.627	0.047	0
	ZnCO3	2.09E-07	2.33E-07	-6.68	-6.632	0.047	0
	BaHCO3+	7.89E-08	5.78E-08	-7.103	-7.238	-0.135	0
	BaCO3	3.78E-08	4.21E-08	-7.423	-7.376	0.047	-10.7
	CuCO3	3.76E-08	4.19E-08	-7.425	-7.378	0.047	0
	MnHCO3+	2.86E-08	1.96E-08	-7.544	-7.708	-0.165	0
	Cu(CO3)2-	2.27E-08	6.52E-09	-7.644	-8.186	-0.542	0
	ZnHCO3+	1.49E-08	1.09E-08	-7.828	-7.963	-0.135	0
	FeCO3	7.54E-10	8.41E-10	-9.122	-9.075	0.047	0
	CuHCO3+	3.95E-10	2.89E-10	-9.404	-9.539	-0.135	0
	FeHCO3+	3.54E-10	2.59E-10	-9.451	-9.586	-0.135	0
	(CO2)2	8.57E-11	9.56E-11	-10.067	-10.02	0.047	68.87
Ca	8.56E-03						
	Ca+2	6.89E-03	1.81E-03	-2.162	-2.743	-0.581	-16.87
	CaSO4	1.04E-03	1.16E-03	-2.983	-2.936	0.047	7.5
	CaCO3	3.37E-04	3.76E-04	-3.473	-3.425	0.047	-14.6
	CaHCO3+	2.97E-04	2.11E-04	-3.527	-3.676	-0.149	9.94
	CaOH+	1.17E-07	8.55E-08	-6.933	-7.068	-0.135	0
	CaHSO4+	3.61E-11	2.64E-11	-10.443	-10.578	-0.135	0
Cl	3.14E-01						
	Cl-	3.14E-01	2.05E-01	-0.503	-0.688	-0.185	18.67
	CuCl2-	6.74E-08	4.41E-08	-7.171	-7.356	-0.184	0
	CuCl3-2	6.54E-08	1.43E-08	-7.185	-7.843	-0.659	0
	MnCl+	2.93E-08	2.01E-08	-7.533	-7.697	-0.165	-2.82
	ZnOHCl	1.64E-08	1.83E-08	-7.785	-7.738	0.047	0

	ZnCl+	7.98E-09	5.22E-09	-8.098	-8.282	-0.184	-15.27
	MnCl2	1.61E-09	1.80E-09	-8.792	-8.745	0.047	85.89
	ZnCl2	1.01E-09	1.12E-09	-8.997	-8.95	0.047	102.03
	ZnCl3-	3.95E-10	2.58E-10	-9.404	-9.588	-0.184	13.93
	MnCl3-	1.49E-10	1.02E-10	-9.828	-9.993	-0.165	45.16
	ZnCl4-2	1.21E-10	2.66E-11	-9.917	-10.576	-0.659	149.17
	FeCl+	1.10E-10	8.03E-11	-9.96	-10.095	-0.135	0
	CuCl+	5.33E-11	3.49E-11	-10.274	-10.458	-0.184	1.59
	CuCl2	3.44E-12	3.84E-12	-11.463	-11.416	0.047	31.02
	CuCl3-	4.27E-15	2.80E-15	-14.369	-14.553	-0.184	0
	CuCl4-2	1.31E-17	2.88E-18	-16.882	-17.541	-0.659	0
	FeCl+2	7.65E-18	1.68E-18	-17.116	-17.775	-0.659	0
	FeCl2+	2.25E-18	1.54E-18	-17.648	-17.813	-0.165	0
	FeCl3	2.83E-20	3.16E-20	-19.548	-19.501	0.047	0
Cu(1)	1.33E-07						
	CuCl2-	6.74E-08	4.41E-08	-7.171	-7.356	-0.184	0
	CuCl3-2	6.54E-08	1.43E-08	-7.185	-7.843	-0.659	0
	Cu+	5.55E-12	3.31E-12	-11.256	-11.48	-0.224	0
Cu(2)	1.57E-07						
	Cu(OH)2	9.59E-08	1.07E-07	-7.018	-6.971	0.047	0
	CuCO3	3.76E-08	4.19E-08	-7.425	-7.378	0.047	0
	Cu(CO3)2-	2.27E-08	6.52E-09	-7.644	-8.186	-0.542	0
	CuHCO3+	3.95E-10	2.89E-10	-9.404	-9.539	-0.135	0
	CuOH+	2.75E-10	1.80E-10	-9.561	-9.745	-0.184	0
	Cu+2	2.49E-10	6.31E-11	-9.604	-10.2	-0.596	-25.46
	CuCl+	5.33E-11	3.49E-11	-10.274	-10.458	-0.184	1.59
	CuSO4	4.16E-11	4.64E-11	-10.381	-10.333	0.047	13.09
	CuCl2	3.44E-12	3.84E-12	-11.463	-11.416	0.047	31.02
	Cu(OH)3-	2.51E-12	1.84E-12	-11.601	-11.736	-0.135	0
	CuF+	4.30E-13	3.15E-13	-12.367	-12.502	-0.135	0
	Cu2(OH)2+	4.92E-14	1.41E-14	-13.308	-13.85	-0.542	0
	CuCl3-	4.27E-15	2.80E-15	-14.369	-14.553	-0.184	0
	Cu(OH)4-2	3.63E-16	1.04E-16	-15.44	-15.982	-0.542	0
	CuCl4-2	1.31E-17	2.88E-18	-16.882	-17.541	-0.659	0
F	8.80E-04						
	F-	4.30E-04	2.74E-04	-3.366	-3.562	-0.196	-0.7
	MgF+	4.20E-04	2.81E-04	-3.377	-3.551	-0.174	-10.28
	NaF	3.00E-05	3.34E-05	-4.523	-4.476	0.047	7.26
	HF	1.28E-09	1.43E-09	-8.893	-8.846	0.047	12.5
	MnF+	6.66E-11	4.56E-11	-10.177	-10.342	-0.165	0
	ZnF+	5.00E-11	3.66E-11	-10.301	-10.436	-0.135	0
	HF2-	2.05E-12	1.50E-12	-11.689	-11.824	-0.135	22.68
	FeF+	1.06E-12	7.77E-13	-11.974	-12.109	-0.135	0
	CuF+	4.30E-13	3.15E-13	-12.367	-12.502	-0.135	0
	FeF2+	1.88E-15	1.28E-15	-14.727	-14.891	-0.165	0
	FeF+2	5.36E-16	1.18E-16	-15.271	-15.929	-0.659	0
	FeF3	5.00E-16	5.58E-16	-15.301	-15.253	0.047	0
Fe(2)	2.54E-09						
	Fe+2	1.12E-09	2.84E-10	-8.952	-9.547	-0.596	-20.9
	FeCO3	7.54E-10	8.41E-10	-9.122	-9.075	0.047	0

	FeHCO3+	3.54E-10	2.59E-10	-9.451	-9.586	-0.135	0
	FeSO4	1.63E-10	1.82E-10	-9.788	-9.741	0.047	18.97
	FeCl+	1.10E-10	8.03E-11	-9.96	-10.095	-0.135	0
	FeOH+	3.73E-11	2.55E-11	-10.428	-10.593	-0.165	0
	FeF+	1.06E-12	7.77E-13	-11.974	-12.109	-0.135	0
	Fe(OH)2	5.55E-14	6.19E-14	-13.255	-13.208	0.047	0
	Fe(OH)3-	9.58E-16	6.55E-16	-15.019	-15.184	-0.165	0
	FeHSO4+	5.66E-18	4.14E-18	-17.247	-17.383	-0.135	0
Fe(3)	2.26E-06						
	Fe(OH)3	1.55E-06	1.72E-06	-5.811	-5.764	0.047	0
	Fe(OH)4-	6.44E-07	4.48E-07	-6.191	-6.349	-0.158	0
	Fe(OH)2+	6.76E-08	4.70E-08	-7.17	-7.328	-0.158	0
	FeOH+2	2.27E-12	4.98E-13	-11.644	-12.303	-0.659	0
	FeF2+	1.88E-15	1.28E-15	-14.727	-14.891	-0.165	0
	FeF+2	5.36E-16	1.18E-16	-15.271	-15.929	-0.659	0
	FeF3	5.00E-16	5.58E-16	-15.301	-15.253	0.047	0
	FeSO4+	1.56E-17	1.07E-17	-16.806	-16.971	-0.165	0
	FeCl+2	7.65E-18	1.68E-18	-17.116	-17.775	-0.659	0
	Fe+3	2.98E-18	2.71E-19	-17.527	-18.567	-1.041	0
	FeCl2+	2.25E-18	1.54E-18	-17.648	-17.813	-0.165	0
	Fe(SO4)2-	1.15E-18	8.43E-19	-17.939	-18.074	-0.135	0
	FeCl3	2.83E-20	3.16E-20	-19.548	-19.501	0.047	0
	Fe2(OH)2+	9.82E-22	6.68E-24	-21.008	-23.175	-2.167	0
	FeHSO4+2	3.46E-25	9.93E-26	-24.461	-25.003	-0.542	0
	Fe3(OH)4+	1.60E-25	6.55E-29	-24.797	-28.184	-3.387	0
H(0)	1.53E-28						
	H2	7.63E-29	8.51E-29	-28.117	-28.07	0.047	28.61
K	4.30E-03						
	K+	4.20E-03	2.72E-03	-2.377	-2.565	-0.189	9.54
	KSO4-	9.91E-05	6.89E-05	-4.004	-4.162	-0.158	34.72
Mg	6.91E-02						
	Mg+2	5.27E-02	1.55E-02	-1.278	-1.809	-0.531	-20.59
	MgSO4	1.18E-02	1.31E-02	-1.93	-1.882	0.047	5.84
	MgHCO3+	2.54E-03	1.66E-03	-2.596	-2.78	-0.184	5.79
	MgCO3	1.64E-03	1.83E-03	-2.784	-2.737	0.047	-17.09
	MgF+	4.20E-04	2.81E-04	-3.377	-3.551	-0.174	-10.28
	MgOH+	2.23E-05	1.61E-05	-4.652	-4.794	-0.142	0
Mn(2)	3.80E-07						
	MnCO3	2.12E-07	2.36E-07	-6.675	-6.627	0.047	0
	Mn+2	9.47E-08	2.40E-08	-7.024	-7.619	-0.596	-16.72
	MnCl+	2.93E-08	2.01E-08	-7.533	-7.697	-0.165	-2.82
	MnHCO3+	2.86E-08	1.96E-08	-7.544	-7.708	-0.165	0
	MnSO4	1.38E-08	1.54E-08	-7.86	-7.813	0.047	22.54
	MnCl2	1.61E-09	1.80E-09	-8.792	-8.745	0.047	85.89
	MnOH+	2.57E-10	1.76E-10	-9.59	-9.755	-0.165	0
	MnCl3-	1.49E-10	1.02E-10	-9.828	-9.993	-0.165	45.16
	MnF+	6.66E-11	4.56E-11	-10.177	-10.342	-0.165	0
	Mn(NO3)2	5.24E-15	5.84E-15	-14.281	-14.233	0.047	41.04
	Mn(OH)3-	1.29E-17	8.80E-18	-16.891	-17.056	-0.165	0
Mn(3)	8.15E-29						

	Mn+3	8.15E-29	7.42E-30	-28.089	-29.129	-1.041	0
N(-3)	4.70E-05						
	NH4+	4.18E-05	2.49E-05	-4.379	-4.604	-0.224	18.38
	NH3	3.67E-06	4.10E-06	-5.435	-5.388	0.047	24.42
	NH4SO4-	1.58E-06	1.16E-06	-5.801	-5.937	-0.135	39.37
N(5)	4.00E-04						
	NO3-	4.00E-04	2.47E-04	-3.398	-3.607	-0.209	30.15
	Mn(NO3)2	5.24E-15	5.84E-15	-14.281	-14.233	0.047	41.04
Na	3.02E-01						
	Na+	2.95E-01	2.12E-01	-0.53	-0.674	-0.144	-0.65
	NaSO4-	5.50E-03	3.82E-03	-2.259	-2.417	-0.158	19.89
	NaHCO3	9.76E-04	1.09E-03	-3.01	-2.963	0.047	1.8
	NaCO3-	6.66E-04	4.88E-04	-3.177	-3.312	-0.135	1.81
	NaF	3.00E-05	3.34E-05	-4.523	-4.476	0.047	7.26
	NaOH	5.48E-17	6.11E-17	-16.262	-16.214	0.047	0
O(0)	1.01E-36						
	O2	5.03E-37	5.61E-37	-36.298	-36.251	0.047	30.4
S(6)	3.56E-02						
	SO4-2	1.72E-02	3.60E-03	-1.766	-2.443	-0.678	16.99
	MgSO4	1.18E-02	1.31E-02	-1.93	-1.882	0.047	5.84
	NaSO4-	5.50E-03	3.82E-03	-2.259	-2.417	-0.158	19.89
	CaSO4	1.04E-03	1.16E-03	-2.983	-2.936	0.047	7.5
	KSO4-	9.91E-05	6.89E-05	-4.004	-4.162	-0.158	34.72
	NH4SO4-	1.58E-06	1.16E-06	-5.801	-5.937	-0.135	39.37
	BaSO4	1.07E-06	1.19E-06	-5.972	-5.924	0.047	0
	MnSO4	1.38E-08	1.54E-08	-7.86	-7.813	0.047	22.54
	ZnSO4	7.16E-09	7.99E-09	-8.145	-8.098	0.047	21.71
	HSO4-	1.66E-09	1.22E-09	-8.78	-8.916	-0.135	40.86
	Zn(SO4)2-2	8.14E-10	2.34E-10	-9.089	-9.631	-0.542	-7.14
	FeSO4	1.63E-10	1.82E-10	-9.788	-9.741	0.047	18.97
	CuSO4	4.16E-11	4.64E-11	-10.381	-10.333	0.047	13.09
	CaHSO4+	3.61E-11	2.64E-11	-10.443	-10.578	-0.135	0
	FeSO4+	1.56E-17	1.07E-17	-16.806	-16.971	-0.165	0
	FeHSO4+	5.66E-18	4.14E-18	-17.247	-17.383	-0.135	0
	Fe(SO4)2-	1.15E-18	8.43E-19	-17.939	-18.074	-0.135	0
	FeHSO4+2	3.46E-25	9.93E-26	-24.461	-25.003	-0.542	0
Zn	2.46E-06						
	Zn(CO3)2-2	2.15E-06	6.16E-07	-5.668	-6.21	-0.542	0
	ZnCO3	2.09E-07	2.33E-07	-6.68	-6.632	0.047	0
	Zn+2	4.31E-08	9.45E-09	-7.366	-8.024	-0.659	-24.22
	ZnOHCl	1.64E-08	1.83E-08	-7.785	-7.738	0.047	0
	ZnHCO3+	1.49E-08	1.09E-08	-7.828	-7.963	-0.135	0
	Zn(OH)2	8.66E-09	9.66E-09	-8.063	-8.015	0.047	0
	ZnCl+	7.98E-09	5.22E-09	-8.098	-8.282	-0.184	-15.27
	ZnSO4	7.16E-09	7.99E-09	-8.145	-8.098	0.047	21.71
	ZnOH+	4.03E-09	2.95E-09	-8.394	-8.53	-0.135	0
	ZnCl2	1.01E-09	1.12E-09	-8.997	-8.95	0.047	102.03
	Zn(SO4)2-2	8.14E-10	2.34E-10	-9.089	-9.631	-0.542	-7.14
	ZnCl3-	3.95E-10	2.58E-10	-9.404	-9.588	-0.184	13.93
	ZnCl4-2	1.21E-10	2.66E-11	-9.917	-10.576	-0.659	149.17

ZnF+	5.00E-11	3.66E-11	-10.301	-10.436	-0.135	0
Zn(OH)3-	1.19E-11	8.70E-12	-10.925	-11.061	-0.135	0
Zn(OH)4-2	1.37E-15	3.93E-16	-14.864	-15.406	-0.542	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-0.91	-5.19	-4.28	CaSO4
Aragonite	1.69	-6.65	-8.34	CaCO3
Barite	1.22	-8.62	-9.84	BaSO4
Calcite	1.83	-6.65	-8.48	CaCO3
CO2(g)	-2.67	-4.14	-1.47	CO2
Dolomite	4.72	-12.37	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.91	6.8	4.89	Fe(OH)3
Fluorite	0.73	-9.87	-10.6	CaF2
Goethite	7.8	6.8	-1	FeOOH
Gypsum	-0.61	-5.2	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	-0.01	1.5	H2O
Halite	-2.93	-1.36	1.57	NaCl
Hausmann	-8.23	52.8	61.03	Mn3O4
Hematite	17.62	13.61	-4.01	Fe2O3
Jarosite-K	-3.22	-12.43	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.59	21.75	25.34	MnOOH
Melanterit	-9.82	-12.03	-2.21	FeSO4:7H2O
NH3(g)	-7.18	-5.39	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.91	9.29	15.2	Mn(OH)2
Pyrolusite	-7.18	34.2	41.38	MnO2:H2O
Rhodochro	-0.4	-11.53	-11.13	MnCO3
Siderite	-2.57	-13.46	-10.89	FeCO3
Smithsonit	-1.93	-11.93	-10	ZnCO3
Sylvite	-4.15	-3.25	0.9	KCl
Witherite	-1.53	-10.09	-8.56	BaCO3
Zn(OH)2(e	-2.62	8.88	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 29

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	2.42E-02	2.42E-02
Ba	4.38E-06	4.38E-06
Ca	8.86E-03	8.86E-03
Cl	3.25E-01	3.25E-01

Cu	3.00E-07	3.00E-07
F	9.20E-04	9.20E-04
Fe	2.34E-06	2.34E-06
K	4.45E-03	4.45E-03
Mg	7.16E-02	7.16E-02
Mn	4.00E-07	4.00E-07
N(-3)	4.80E-05	4.80E-05
N(5)	4.10E-04	4.10E-04
Na	3.13E-01	3.13E-01
S(6)	3.68E-02	3.68E-02
Zn	2.55E-06	2.55E-06

#NAME? of solution----------

pH	=	8.46			
pe	=	4			
Specific	Conductan	(µS/cm,	25°C)	=	35825
Density	(g/cm³)	=	1.0172		
Volume	(L)	=	1.0085		
Activity	of	water	=	0.987	
Ionic	strength	(mol/kgw)	=	4.89E-01	
Mass	of	water	(kg)	=	1.00E+00
Total	carbon	(mol/kg)	=	2.09E-02	
Total	CO2	(mol/kg)	=	2.09E-02	
Temperatu	(°C)	=	25		
Electrical	balance	(eq)	=	5.39E-02	
Percent	error,	100*(Cat-|	=	6.58	
Iterations	=	13	(293	overall)	
Total	H	=	1.11E+02		
Total	O	=	5.57E+01		

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4365	0.2624		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.54E-06	2.88E-06	-5.343	-5.54	-0.198	-2.95
H+	4.53E-09	3.47E-09	-8.344	-8.46	-0.116	0
H2O	5.55E+01	9.87E-01	1.744	-0.006	0	18.07
Ba	4.38E-06					
Ba+2	3.15E-06	6.76E-07	-5.501	-6.17	-0.669	-11.23
BaSO4	1.11E-06	1.24E-06	-5.956	-5.907	0.049	0
BaHCO3+	8.26E-08	6.05E-08	-7.083	-7.218	-0.135	0
BaCO3	3.94E-08	4.41E-08	-7.404	-7.355	0.049	-10.7

	BaOH+	9.56E-12	6.52E-12	-11.02	-11.186	-0.166	0
C(4)	2.09E-02						
	HCO3-	1.35E-02	9.34E-03	-1.87	-2.03	-0.159	26.44
	MgHCO3+	2.68E-03	1.75E-03	-2.572	-2.758	-0.186	5.79
	MgCO3	1.72E-03	1.93E-03	-2.764	-2.715	0.049	-17.09
	NaHCO3	1.03E-03	1.15E-03	-2.988	-2.939	0.049	1.8
	NaCO3-	7.03E-04	5.15E-04	-3.153	-3.288	-0.135	1.9
	CO3-2	5.47E-04	1.26E-04	-3.262	-3.899	-0.637	-2.52
	CaCO3	3.52E-04	3.94E-04	-3.453	-3.404	0.049	-14.6
	CaHCO3+	3.13E-04	2.21E-04	-3.505	-3.655	-0.15	9.94
	CO2	6.59E-05	7.38E-05	-4.181	-4.132	0.049	34.43
	Zn(CO3)2-2	2.23E-06	6.43E-07	-5.652	-6.192	-0.54	0
	MnCO3	2.23E-07	2.49E-07	-6.652	-6.603	0.049	0
	ZnCO3	2.13E-07	2.38E-07	-6.672	-6.623	0.049	0
	BaHCO3+	8.26E-08	6.05E-08	-7.083	-7.218	-0.135	0
	BaCO3	3.94E-08	4.41E-08	-7.404	-7.355	0.049	-10.7
	CuCO3	3.78E-08	4.24E-08	-7.422	-7.373	0.049	0
	MnHCO3+	3.03E-08	2.07E-08	-7.518	-7.684	-0.166	0
	Cu(CO3)2-	2.34E-08	6.74E-09	-7.631	-8.172	-0.54	0
	ZnHCO3+	1.52E-08	1.11E-08	-7.819	-7.954	-0.135	0
	FeCO3	7.97E-10	8.93E-10	-9.098	-9.049	0.049	0
	CuHCO3+	3.99E-10	2.92E-10	-9.399	-9.534	-0.135	0
	FeHCO3+	3.75E-10	2.75E-10	-9.425	-9.561	-0.135	0
	(CO2)2	8.92E-11	9.99E-11	-10.05	-10.001	0.049	68.87
Ca	8.86E-03						
	Ca+2	7.12E-03	1.86E-03	-2.148	-2.731	-0.583	-16.85
	CaSO4	1.08E-03	1.21E-03	-2.967	-2.918	0.049	7.5
	CaCO3	3.52E-04	3.94E-04	-3.453	-3.404	0.049	-14.6
	CaHCO3+	3.13E-04	2.21E-04	-3.505	-3.655	-0.15	9.94
	CaOH+	1.20E-07	8.78E-08	-6.922	-7.057	-0.135	0
	CaHSO4+	3.75E-11	2.75E-11	-10.426	-10.561	-0.135	0
Cl	3.25E-01						
	Cl-	3.25E-01	2.12E-01	-0.488	-0.674	-0.186	18.68
	CuCl3-2	7.20E-08	1.56E-08	-7.143	-7.807	-0.664	0
	CuCl2-	7.13E-08	4.65E-08	-7.147	-7.333	-0.186	0
	MnCl+	3.14E-08	2.14E-08	-7.503	-7.669	-0.166	-2.81
	ZnOHCl	1.69E-08	1.89E-08	-7.773	-7.724	0.049	0
	ZnCl+	8.26E-09	5.39E-09	-8.083	-8.269	-0.186	-15.32
	MnCl2	1.77E-09	1.98E-09	-8.752	-8.703	0.049	85.89
	ZnCl2	1.07E-09	1.19E-09	-8.972	-8.923	0.049	102.03
	ZnCl3-	4.35E-10	2.84E-10	-9.361	-9.547	-0.186	13.82
	MnCl3-	1.69E-10	1.16E-10	-9.771	-9.937	-0.166	45.21
	ZnCl4-2	1.39E-10	3.01E-11	-9.857	-10.521	-0.664	149.27
	FeCl+	1.18E-10	8.61E-11	-9.93	-10.065	-0.135	0
	CuCl+	5.46E-11	3.56E-11	-10.263	-10.449	-0.186	1.61
	CuCl2	3.62E-12	4.05E-12	-11.442	-11.393	0.049	31.02
	CuCl3-	4.67E-15	3.04E-15	-14.331	-14.517	-0.186	0
	CuCl4-2	1.49E-17	3.23E-18	-16.827	-17.491	-0.664	0
	FeCl+2	8.30E-18	1.80E-18	-17.081	-17.745	-0.664	0
	FeCl2+	2.49E-18	1.70E-18	-17.603	-17.769	-0.166	0

	FeCl3	3.22E-20	3.60E-20	-19.492	-19.443	0.049	0
Cu(1)	1.43E-07						
	CuCl3-2	7.20E-08	1.56E-08	-7.143	-7.807	-0.664	0
	CuCl2-	7.13E-08	4.65E-08	-7.147	-7.333	-0.186	0
	Cu+	5.52E-12	3.28E-12	-11.258	-11.485	-0.227	0
Cu(2)	1.57E-07						
	Cu(OH)2	9.45E-08	1.06E-07	-7.025	-6.976	0.049	0
	CuCO3	3.78E-08	4.24E-08	-7.422	-7.373	0.049	0
	Cu(CO3)2-	2.34E-08	6.74E-09	-7.631	-8.172	-0.54	0
	CuHCO3+	3.99E-10	2.92E-10	-9.399	-9.534	-0.135	0
	CuOH+	2.73E-10	1.78E-10	-9.564	-9.75	-0.186	0
	Cu+2	2.49E-10	6.24E-11	-9.605	-10.205	-0.6	-25.45
	CuCl+	5.46E-11	3.56E-11	-10.263	-10.449	-0.186	1.61
	CuSO4	4.16E-11	4.66E-11	-10.381	-10.332	0.049	13.09
	CuCl2	3.62E-12	4.05E-12	-11.442	-11.393	0.049	31.02
	Cu(OH)3-	2.48E-12	1.81E-12	-11.606	-11.741	-0.135	0
	CuF+	4.36E-13	3.20E-13	-12.36	-12.495	-0.135	0
	Cu2(OH)2+	4.80E-14	1.38E-14	-13.319	-13.859	-0.54	0
	CuCl3-	4.67E-15	3.04E-15	-14.331	-14.517	-0.186	0
	Cu(OH)4-2	3.58E-16	1.03E-16	-15.447	-15.987	-0.54	0
	CuCl4-2	1.49E-17	3.23E-18	-16.827	-17.491	-0.664	0
F	9.20E-04						
	MgF+	4.45E-04	2.97E-04	-3.352	-3.527	-0.175	-10.28
	F-	4.43E-04	2.81E-04	-3.353	-3.551	-0.198	-0.69
	NaF	3.17E-05	3.55E-05	-4.499	-4.45	0.049	7.26
	HF	1.31E-09	1.46E-09	-8.884	-8.835	0.049	12.5
	MnF+	7.08E-11	4.83E-11	-10.15	-10.316	-0.166	0
	ZnF+	5.12E-11	3.75E-11	-10.291	-10.426	-0.135	0
	HF2-	2.15E-12	1.58E-12	-11.667	-11.802	-0.135	22.69
	FeF+	1.13E-12	8.28E-13	-11.947	-12.082	-0.135	0
	CuF+	4.36E-13	3.20E-13	-12.36	-12.495	-0.135	0
	FeF2+	2.06E-15	1.40E-15	-14.687	-14.853	-0.166	0
	FeF+2	5.79E-16	1.25E-16	-15.238	-15.902	-0.664	0
	FeF3	5.59E-16	6.26E-16	-15.253	-15.204	0.049	0
Fe(2)	2.67E-09						
	Fe+2	1.17E-09	2.95E-10	-8.931	-9.531	-0.6	-20.88
	FeCO3	7.97E-10	8.93E-10	-9.098	-9.049	0.049	0
	FeHCO3+	3.75E-10	2.75E-10	-9.425	-9.561	-0.135	0
	FeSO4	1.71E-10	1.91E-10	-9.767	-9.718	0.049	18.97
	FeCl+	1.18E-10	8.61E-11	-9.93	-10.065	-0.135	0
	FeOH+	3.89E-11	2.65E-11	-10.41	-10.576	-0.166	0
	FeF+	1.13E-12	8.28E-13	-11.947	-12.082	-0.135	0
	Fe(OH)2	5.74E-14	6.43E-14	-13.241	-13.192	0.049	0
	Fe(OH)3-	9.96E-16	6.80E-16	-15.002	-15.168	-0.166	0
	FeHSO4+	5.95E-18	4.36E-18	-17.225	-17.361	-0.135	0
Fe(3)	2.34E-06						
	Fe(OH)3	1.60E-06	1.79E-06	-5.797	-5.748	0.049	0
	Fe(OH)4-	6.70E-07	4.64E-07	-6.174	-6.333	-0.159	0
	Fe(OH)2+	7.03E-08	4.87E-08	-7.153	-7.312	-0.159	0
	FeOH+2	2.39E-12	5.17E-13	-11.622	-12.286	-0.664	0

	FeF2+	2.06E-15	1.40E-15	-14.687	-14.853	-0.166	0
	FeF+2	5.79E-16	1.25E-16	-15.238	-15.902	-0.664	0
	FeF3	5.59E-16	6.26E-16	-15.253	-15.204	0.049	0
	FeSO4+	1.65E-17	1.13E-17	-16.782	-16.948	-0.166	0
	FeCl+2	8.30E-18	1.80E-18	-17.081	-17.745	-0.664	0
	Fe+3	3.13E-18	2.81E-19	-17.504	-18.551	-1.047	0
	FeCl2+	2.49E-18	1.70E-18	-17.603	-17.769	-0.166	0
	Fe(SO4)2-	1.23E-18	9.00E-19	-17.911	-18.046	-0.135	0
	FeCl3	3.22E-20	3.60E-20	-19.492	-19.443	0.049	0
	Fe2(OH)2+	1.04E-21	7.20E-24	-20.982	-23.143	-2.161	0
	FeHSO4+2	3.63E-25	1.05E-25	-24.44	-24.981	-0.54	0
	Fe3(OH)4+	1.74E-25	7.33E-29	-24.759	-28.135	-3.376	0
H(0)	1.52E-28						
	H2	7.61E-29	8.51E-29	-28.119	-28.07	0.049	28.61
K	4.45E-03						
	K+	4.35E-03	2.80E-03	-2.362	-2.552	-0.19	9.55
	KSO4-	1.04E-04	7.20E-05	-3.984	-4.143	-0.159	34.73
Mg	7.16E-02						
	Mg+2	5.45E-02	1.60E-02	-1.264	-1.796	-0.533	-20.57
	MgSO4	1.22E-02	1.37E-02	-1.913	-1.864	0.049	5.84
	MgHCO3+	2.68E-03	1.75E-03	-2.572	-2.758	-0.186	5.79
	MgCO3	1.72E-03	1.93E-03	-2.764	-2.715	0.049	-17.09
	MgF+	4.45E-04	2.97E-04	-3.352	-3.527	-0.175	-10.28
	MgOH+	2.30E-05	1.65E-05	-4.639	-4.782	-0.143	0
Mn(2)	4.00E-07						
	MnCO3	2.23E-07	2.49E-07	-6.652	-6.603	0.049	0
	Mn+2	9.89E-08	2.48E-08	-7.005	-7.605	-0.6	-16.68
	MnCl+	3.14E-08	2.14E-08	-7.503	-7.669	-0.166	-2.81
	MnHCO3+	3.03E-08	2.07E-08	-7.518	-7.684	-0.166	0
	MnSO4	1.44E-08	1.61E-08	-7.841	-7.792	0.049	22.54
	MnCl2	1.77E-09	1.98E-09	-8.752	-8.703	0.049	85.89
	MnOH+	2.66E-10	1.82E-10	-9.574	-9.74	-0.166	0
	MnCl3-	1.69E-10	1.16E-10	-9.771	-9.937	-0.166	45.21
	MnF+	7.08E-11	4.83E-11	-10.15	-10.316	-0.166	0
	Mn(NO3)2	5.62E-15	6.29E-15	-14.25	-14.202	0.049	41.04
	Mn(OH)3-	1.33E-17	9.09E-18	-16.876	-17.042	-0.166	0
Mn(3)	8.55E-29						
	Mn+3	8.55E-29	7.68E-30	-28.068	-29.115	-1.047	0
N(-3)	4.80E-05						
	NH4+	4.27E-05	2.53E-05	-4.37	-4.597	-0.227	18.38
	NH3	3.72E-06	4.16E-06	-5.43	-5.381	0.049	24.42
	NH4SO4-	1.63E-06	1.19E-06	-5.789	-5.924	-0.135	39.42
N(5)	4.10E-04						
	NO3-	4.10E-04	2.52E-04	-3.387	-3.598	-0.211	30.16
	Mn(NO3)2	5.62E-15	6.29E-15	-14.25	-14.202	0.049	41.04
Na	3.13E-01						
	Na+	3.05E-01	2.19E-01	-0.515	-0.659	-0.144	-0.64
	NaSO4-	5.79E-03	4.01E-03	-2.238	-2.397	-0.159	20
	NaHCO3	1.03E-03	1.15E-03	-2.988	-2.939	0.049	1.8
	NaCO3-	7.03E-04	5.15E-04	-3.153	-3.288	-0.135	1.9

	NaF	3.17E-05	3.55E-05	-4.499	-4.45	0.049	7.26
	NaOH	5.64E-17	6.31E-17	-16.249	-16.2	0.049	0
O(0)	1.00E-36						
	O2	5.01E-37	5.61E-37	-36.3	-36.251	0.049	30.4
S(6)	3.68E-02						
	SO4-2	1.76E-02	3.65E-03	-1.754	-2.437	-0.684	17.03
	MgSO4	1.22E-02	1.37E-02	-1.913	-1.864	0.049	5.84
	NaSO4-	5.79E-03	4.01E-03	-2.238	-2.397	-0.159	20
	CaSO4	1.08E-03	1.21E-03	-2.967	-2.918	0.049	7.5
	KSO4-	1.04E-04	7.20E-05	-3.984	-4.143	-0.159	34.73
	NH4SO4-	1.63E-06	1.19E-06	-5.789	-5.924	-0.135	39.42
	BaSO4	1.11E-06	1.24E-06	-5.956	-5.907	0.049	0
	MnSO4	1.44E-08	1.61E-08	-7.841	-7.792	0.049	22.54
	ZnSO4	7.23E-09	8.09E-09	-8.141	-8.092	0.049	21.71
	HSO4-	1.68E-09	1.23E-09	-8.775	-8.91	-0.135	40.86
	Zn(SO4)2-2	8.33E-10	2.40E-10	-9.079	-9.62	-0.54	-6.98
	FeSO4	1.71E-10	1.91E-10	-9.767	-9.718	0.049	18.97
	CuSO4	4.16E-11	4.66E-11	-10.381	-10.332	0.049	13.09
	CaHSO4+	3.75E-11	2.75E-11	-10.426	-10.561	-0.135	0
	FeSO4+	1.65E-17	1.13E-17	-16.782	-16.948	-0.166	0
	FeHSO4+	5.95E-18	4.36E-18	-17.225	-17.361	-0.135	0
	Fe(SO4)2-	1.23E-18	9.00E-19	-17.911	-18.046	-0.135	0
	FeHSO4+2	3.63E-25	1.05E-25	-24.44	-24.981	-0.54	0
Zn	2.55E-06						
	Zn(CO3)2-2	2.23E-06	6.43E-07	-5.652	-6.192	-0.54	0
	ZnCO3	2.13E-07	2.38E-07	-6.672	-6.623	0.049	0
	Zn+2	4.36E-08	9.45E-09	-7.361	-8.025	-0.664	-24.21
	ZnOHCl	1.69E-08	1.89E-08	-7.773	-7.724	0.049	0
	ZnHCO3+	1.52E-08	1.11E-08	-7.819	-7.954	-0.135	0
	Zn(OH)2	8.61E-09	9.64E-09	-8.065	-8.016	0.049	0
	ZnCl+	8.26E-09	5.39E-09	-8.083	-8.269	-0.186	-15.32
	ZnSO4	7.23E-09	8.09E-09	-8.141	-8.092	0.049	21.71
	ZnOH+	4.03E-09	2.95E-09	-8.395	-8.53	-0.135	0
	ZnCl2	1.07E-09	1.19E-09	-8.972	-8.923	0.049	102.03
	Zn(SO4)2-2	8.33E-10	2.40E-10	-9.079	-9.62	-0.54	-6.98
	ZnCl3-	4.35E-10	2.84E-10	-9.361	-9.547	-0.186	13.82
	ZnCl4-2	1.39E-10	3.01E-11	-9.857	-10.521	-0.664	149.27
	ZnF+	5.12E-11	3.75E-11	-10.291	-10.426	-0.135	0
	Zn(OH)3-	1.19E-11	8.68E-12	-10.926	-11.062	-0.135	0
	Zn(OH)4-2	1.36E-15	3.92E-16	-14.867	-15.407	-0.54	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-0.89	-5.17	-4.28	CaSO4			
Aragonite	1.71	-6.63	-8.34	CaCO3			
Barite	1.24	-8.61	-9.84	BaSO4			
Calcite	1.85	-6.63	-8.48	CaCO3			
CO2(g)	-2.66	-4.13	-1.47	CO2			

Dolomite	4.76	-12.32	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.92	6.81	4.89	Fe(OH)3
Fluorite	0.77	-9.83	-10.6	CaF2
Goethite	7.82	6.82	-1	FeOOH
Gypsum	-0.6	-5.18	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	-0.01	1.5	H2O
Halite	-2.9	-1.33	1.57	NaCl
Hausmann	-8.19	52.84	61.03	Mn3O4
Hematite	17.65	13.64	-4.01	Fe2O3
Jarosite-K	-3.14	-12.35	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.58	21.76	25.34	MnOOH
Melanterit	-9.8	-12.01	-2.21	FeSO4:7H2O
NH3(g)	-7.18	-5.38	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.9	9.3	15.2	Mn(OH)2
Pyrolusite	-7.16	34.22	41.38	MnO2:H2O
Rhodochro	-0.37	-11.5	-11.13	MnCO3
Siderite	-2.54	-13.43	-10.89	FeCO3
Smithsonit	-1.92	-11.92	-10	ZnCO3
Sylvite	-4.13	-3.23	0.9	KCl
Witherite	-1.51	-10.07	-8.56	BaCO3
Zn(OH)2(e	-2.62	8.88	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 30

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	2.50E-02	2.50E-02
Ba	4.53E-06	4.53E-06
Ca	9.17E-03	9.17E-03
Cl	3.36E-01	3.36E-01
Cu	3.10E-07	3.10E-07
F	9.50E-04	9.50E-04
Fe	2.42E-06	2.42E-06
K	4.60E-03	4.60E-03
Mg	7.41E-02	7.41E-02
Mn	4.10E-07	4.10E-07
N(-3)	5.00E-05	5.00E-05
N(5)	4.20E-04	4.20E-04
Na	3.24E-01	3.24E-01
S(6)	3.81E-02	3.81E-02
Zn	2.64E-06	2.64E-06

#NAME? of solution----------

pH	=	8.46			
pe	=	4			
Specific	Conductan	(µS/cm,	25°C)	=	36870
Density	(g/cm³)	=	1.01788		
Volume	(L)	=	1.0087		
Activity	of	water	=	0.987	
Ionic	strength	(mol/kgw)	=	5.05E-01	
Mass	of	water	(kg)	=	1.00E+00
Total	carbon	(mol/kg)	=	2.16E-02	
Total	CO2	(mol/kg)	=	2.16E-02	
Temperatu	(°C)	=	25		
Electrical	balance	(eq)	=	5.58E-02	
Percent	error,	100*(Cat-|	=	6.59	
Iterations	=	14	(307	overall)	
Total	H	=	1.11E+02		
Total	O	=	5.57E+01		

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4357	0.2624		

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.56E-06	2.88E-06	-5.341	-5.541	-0.2	-2.92
	H+	4.54E-09	3.47E-09	-8.343	-8.46	-0.117	0
	H2O	5.55E+01	9.87E-01	1.744	-0.006	0	18.07
Ba	4.53E-06						
	Ba+2	3.26E-06	6.93E-07	-5.487	-6.159	-0.673	-11.21
	BaSO4	1.14E-06	1.29E-06	-5.942	-5.891	0.051	0
	BaHCO3+	8.63E-08	6.33E-08	-7.064	-7.199	-0.135	0
	BaCO3	4.11E-08	4.61E-08	-7.386	-7.336	0.051	-10.7
	BaOH+	9.82E-12	6.68E-12	-11.008	-11.175	-0.167	0
C(4)	2.16E-02						
	HCO3-	1.38E-02	9.53E-03	-1.86	-2.021	-0.16	26.49
	MgHCO3+	2.83E-03	1.84E-03	-2.549	-2.736	-0.187	5.79
	MgCO3	1.80E-03	2.02E-03	-2.744	-2.694	0.051	-17.09
	NaHCO3	1.08E-03	1.21E-03	-2.966	-2.916	0.051	1.8
	NaCO3-	7.41E-04	5.44E-04	-3.13	-3.265	-0.135	1.98
	CO3-2	5.65E-04	1.29E-04	-3.248	-3.89	-0.641	-2.47
	CaCO3	3.68E-04	4.14E-04	-3.434	-3.383	0.051	-14.6
	CaHCO3+	3.29E-04	2.32E-04	-3.483	-3.634	-0.151	9.94
	CO2	6.71E-05	7.53E-05	-4.174	-4.123	0.051	34.43
	Zn(CO3)2-2	2.32E-06	6.70E-07	-5.635	-6.174	-0.538	0
	MnCO3	2.28E-07	2.57E-07	-6.642	-6.591	0.051	0

	ZnCO3	2.16E-07	2.43E-07	-6.665	-6.614	0.051	0
	BaHCO3+	8.63E-08	6.33E-08	-7.064	-7.199	-0.135	0
	BaCO3	4.11E-08	4.61E-08	-7.386	-7.336	0.051	-10.7
	CuCO3	3.80E-08	4.27E-08	-7.42	-7.369	0.051	0
	MnHCO3+	3.13E-08	2.13E-08	-7.505	-7.672	-0.167	0
	Cu(CO3)2-	2.40E-08	6.94E-09	-7.621	-8.159	-0.538	0
	ZnHCO3+	1.55E-08	1.13E-08	-7.811	-7.945	-0.135	0
	FeCO3	8.41E-10	9.45E-10	-9.075	-9.025	0.051	0
	CuHCO3+	4.02E-10	2.95E-10	-9.396	-9.53	-0.135	0
	FeHCO3+	3.97E-10	2.91E-10	-9.401	-9.536	-0.135	0
	(CO2)2	9.27E-11	1.04E-10	-10.033	-9.982	0.051	68.87
Ca	9.17E-03						
	Ca+2	7.36E-03	1.91E-03	-2.133	-2.719	-0.586	-16.84
	CaSO4	1.12E-03	1.26E-03	-2.951	-2.901	0.051	7.5
	CaCO3	3.68E-04	4.14E-04	-3.434	-3.383	0.051	-14.6
	CaHCO3+	3.29E-04	2.32E-04	-3.483	-3.634	-0.151	9.94
	CaOH+	1.23E-07	9.02E-08	-6.91	-7.045	-0.135	0
	CaHSO4+	3.90E-11	2.86E-11	-10.409	-10.543	-0.135	0
Cl	3.36E-01						
	Cl-	3.36E-01	2.18E-01	-0.473	-0.661	-0.188	18.69
	CuCl3-2	7.89E-08	1.69E-08	-7.103	-7.772	-0.669	0
	CuCl2-	7.52E-08	4.88E-08	-7.124	-7.311	-0.187	0
	MnCl+	3.27E-08	2.23E-08	-7.485	-7.652	-0.167	-2.81
	ZnOHCl	1.73E-08	1.95E-08	-7.762	-7.711	0.051	0
	ZnCl+	8.55E-09	5.56E-09	-8.068	-8.255	-0.187	-15.37
	MnCl2	1.89E-09	2.12E-09	-8.724	-8.673	0.051	85.89
	ZnCl2	1.13E-09	1.27E-09	-8.947	-8.896	0.051	102.03
	ZnCl3-	4.79E-10	3.11E-10	-9.32	-9.507	-0.187	13.7
	MnCl3-	1.88E-10	1.28E-10	-9.727	-9.894	-0.167	45.26
	ZnCl4-2	1.59E-10	3.41E-11	-9.799	-10.468	-0.669	149.36
	FeCl+	1.26E-10	9.21E-11	-9.901	-10.036	-0.135	0
	CuCl+	5.58E-11	3.63E-11	-10.253	-10.441	-0.187	1.64
	CuCl2	3.79E-12	4.25E-12	-11.422	-11.371	0.051	31.02
	CuCl3-	5.07E-15	3.30E-15	-14.295	-14.482	-0.187	0
	CuCl4-2	1.68E-17	3.61E-18	-16.774	-17.443	-0.669	0
	FeCl+2	8.98E-18	1.92E-18	-17.047	-17.716	-0.669	0
	FeCl2+	2.76E-18	1.88E-18	-17.559	-17.727	-0.167	0
	FeCl3	3.65E-20	4.10E-20	-19.438	-19.387	0.051	0
Cu(1)	1.54E-07						
	CuCl3-2	7.89E-08	1.69E-08	-7.103	-7.772	-0.669	0
	CuCl2-	7.52E-08	4.88E-08	-7.124	-7.311	-0.187	0
	Cu+	5.49E-12	3.24E-12	-11.261	-11.49	-0.229	0
Cu(2)	1.56E-07						
	Cu(OH)2	9.29E-08	1.04E-07	-7.032	-6.981	0.051	0
	CuCO3	3.80E-08	4.27E-08	-7.42	-7.369	0.051	0
	Cu(CO3)2-	2.40E-08	6.94E-09	-7.621	-8.159	-0.538	0
	CuHCO3+	4.02E-10	2.95E-10	-9.396	-9.53	-0.135	0
	CuOH+	2.70E-10	1.76E-10	-9.568	-9.755	-0.187	0
	Cu+2	2.48E-10	6.17E-11	-9.606	-10.21	-0.604	-25.43
	CuCl+	5.58E-11	3.63E-11	-10.253	-10.441	-0.187	1.64

	CuSO4	4.15E-11	4.66E-11	-10.382	-10.331	0.051	13.09
	CuCl2	3.79E-12	4.25E-12	-11.422	-11.371	0.051	31.02
	Cu(OH)3-	2.44E-12	1.79E-12	-11.613	-11.747	-0.135	0
	CuF+	4.36E-13	3.20E-13	-12.36	-12.495	-0.135	0
	Cu2(OH)2+	4.66E-14	1.35E-14	-13.332	-13.87	-0.538	0
	CuCl3-	5.07E-15	3.30E-15	-14.295	-14.482	-0.187	0
	Cu(OH)4-2	3.51E-16	1.02E-16	-15.455	-15.993	-0.538	0
	CuCl4-2	1.68E-17	3.61E-18	-16.774	-17.443	-0.669	0
F	9.50E-04						
	MgF+	4.66E-04	3.10E-04	-3.332	-3.509	-0.177	-10.27
	F-	4.51E-04	2.85E-04	-3.346	-3.545	-0.2	-0.68
	NaF	3.31E-05	3.72E-05	-4.481	-4.43	0.051	7.26
	HF	1.32E-09	1.48E-09	-8.88	-8.829	0.051	12.5
	MnF+	7.26E-11	4.94E-11	-10.139	-10.306	-0.167	0
	ZnF+	5.19E-11	3.81E-11	-10.285	-10.42	-0.135	0
	HF2-	2.21E-12	1.62E-12	-11.655	-11.79	-0.135	22.7
	FeF+	1.19E-12	8.71E-13	-11.925	-12.06	-0.135	0
	CuF+	4.36E-13	3.20E-13	-12.36	-12.495	-0.135	0
	FeF2+	2.20E-15	1.50E-15	-14.658	-14.825	-0.167	0
	FeF+2	6.15E-16	1.32E-16	-15.211	-15.88	-0.669	0
	FeF3	6.02E-16	6.76E-16	-15.221	-15.17	0.051	0
Fe(2)	2.81E-09						
	Fe+2	1.23E-09	3.06E-10	-8.911	-9.515	-0.604	-20.87
	FeCO3	8.41E-10	9.45E-10	-9.075	-9.025	0.051	0
	FeHCO3+	3.97E-10	2.91E-10	-9.401	-9.536	-0.135	0
	FeSO4	1.79E-10	2.01E-10	-9.747	-9.697	0.051	18.97
	FeCl+	1.26E-10	9.21E-11	-9.901	-10.036	-0.135	0
	FeOH+	4.04E-11	2.75E-11	-10.393	-10.561	-0.167	0
	FeF+	1.19E-12	8.71E-13	-11.925	-12.06	-0.135	0
	Fe(OH)2	5.93E-14	6.66E-14	-13.227	-13.177	0.051	0
	Fe(OH)3-	1.04E-15	7.04E-16	-14.985	-15.152	-0.167	0
	FeHSO4+	6.25E-18	4.58E-18	-17.204	-17.339	-0.135	0
Fe(3)	2.42E-06						
	Fe(OH)3	1.65E-06	1.85E-06	-5.783	-5.732	0.051	0
	Fe(OH)4-	6.95E-07	4.81E-07	-6.158	-6.318	-0.16	0
	Fe(OH)2+	7.31E-08	5.05E-08	-7.136	-7.297	-0.16	0
	FeOH+2	2.50E-12	5.36E-13	-11.602	-12.271	-0.669	0
	FeF2+	2.20E-15	1.50E-15	-14.658	-14.825	-0.167	0
	FeF+2	6.15E-16	1.32E-16	-15.211	-15.88	-0.669	0
	FeF3	6.02E-16	6.76E-16	-15.221	-15.17	0.051	0
	FeSO4+	1.74E-17	1.18E-17	-16.759	-16.927	-0.167	0
	FeCl+2	8.98E-18	1.92E-18	-17.047	-17.716	-0.669	0
	Fe+3	3.29E-18	2.92E-19	-17.483	-18.535	-1.052	0
	FeCl2+	2.76E-18	1.88E-18	-17.559	-17.727	-0.167	0
	Fe(SO4)2-	1.31E-18	9.58E-19	-17.884	-18.019	-0.135	0
	FeCl3	3.65E-20	4.10E-20	-19.438	-19.387	0.051	0
	Fe2(OH)2+	1.10E-21	7.74E-24	-20.958	-23.111	-2.153	0
	FeHSO4+2	3.80E-25	1.10E-25	-24.421	-24.959	-0.538	0
	Fe3(OH)4+	1.89E-25	8.17E-29	-24.723	-28.088	-3.365	0
H(0)	1.52E-28						

	H2	7.58E-29	8.51E-29	-28.121	-28.07	0.051	28.61
K	4.60E-03						
	K+	4.49E-03	2.89E-03	-2.348	-2.54	-0.192	9.56
	KSO4-	1.09E-04	7.51E-05	-3.964	-4.125	-0.16	34.75
Mg	7.41E-02						
	Mg+2	5.62E-02	1.65E-02	-1.25	-1.784	-0.534	-20.55
	MgSO4	1.27E-02	1.43E-02	-1.896	-1.846	0.051	5.84
	MgHCO3+	2.83E-03	1.84E-03	-2.549	-2.736	-0.187	5.79
	MgCO3	1.80E-03	2.02E-03	-2.744	-2.694	0.051	-17.09
	MgF+	4.66E-04	3.10E-04	-3.332	-3.509	-0.177	-10.27
	MgOH+	2.37E-05	1.70E-05	-4.626	-4.77	-0.144	0
Mn(2)	4.10E-07						
	MnCO3	2.28E-07	2.57E-07	-6.642	-6.591	0.051	0
	Mn+2	1.01E-07	2.50E-08	-6.997	-7.601	-0.604	-16.65
	MnCl+	3.27E-08	2.23E-08	-7.485	-7.652	-0.167	-2.81
	MnHCO3+	3.13E-08	2.13E-08	-7.505	-7.672	-0.167	0
	MnSO4	1.47E-08	1.65E-08	-7.834	-7.783	0.051	22.54
	MnCl2	1.89E-09	2.12E-09	-8.724	-8.673	0.051	85.89
	MnOH+	2.69E-10	1.83E-10	-9.57	-9.737	-0.167	0
	MnCl3-	1.88E-10	1.28E-10	-9.727	-9.894	-0.167	45.26
	MnF+	7.26E-11	4.94E-11	-10.139	-10.306	-0.167	0
	Mn(NO3)2	5.86E-15	6.59E-15	-14.232	-14.181	0.051	41.04
	Mn(OH)3-	1.34E-17	9.15E-18	-16.872	-17.039	-0.167	0
Mn(3)	8.72E-29						
	Mn+3	8.72E-29	7.74E-30	-28.059	-29.111	-1.052	0
N(-3)	5.00E-05						
	NH4+	4.45E-05	2.62E-05	-4.352	-4.581	-0.229	18.39
	NH3	3.84E-06	4.31E-06	-5.416	-5.365	0.051	24.42
	NH4SO4-	1.71E-06	1.25E-06	-5.768	-5.903	-0.135	39.47
N(5)	4.20E-04						
	NO3-	4.20E-04	2.57E-04	-3.377	-3.59	-0.213	30.17
	Mn(NO3)2	5.86E-15	6.59E-15	-14.232	-14.181	0.051	41.04
Na	3.24E-01						
	Na+	3.16E-01	2.27E-01	-0.501	-0.645	-0.144	-0.63
	NaSO4-	6.08E-03	4.20E-03	-2.216	-2.377	-0.16	20.12
	NaHCO3	1.08E-03	1.21E-03	-2.966	-2.916	0.051	1.8
	NaCO3-	7.41E-04	5.44E-04	-3.13	-3.265	-0.135	1.98
	NaF	3.31E-05	3.72E-05	-4.481	-4.43	0.051	7.26
	NaOH	5.81E-17	6.52E-17	-16.236	-16.186	0.051	0
O(0)	9.97E-37						
	O2	4.99E-37	5.60E-37	-36.302	-36.252	0.051	30.4
S(6)	3.81E-02						
	SO4-2	1.81E-02	3.70E-03	-1.743	-2.432	-0.689	17.08
	MgSO4	1.27E-02	1.43E-02	-1.896	-1.846	0.051	5.84
	NaSO4-	6.08E-03	4.20E-03	-2.216	-2.377	-0.16	20.12
	CaSO4	1.12E-03	1.26E-03	-2.951	-2.901	0.051	7.5
	KSO4-	1.09E-04	7.51E-05	-3.964	-4.125	-0.16	34.75
	NH4SO4-	1.71E-06	1.25E-06	-5.768	-5.903	-0.135	39.47
	BaSO4	1.14E-06	1.29E-06	-5.942	-5.891	0.051	0
	MnSO4	1.47E-08	1.65E-08	-7.834	-7.783	0.051	22.54

	ZnSO4	7.30E-09	8.20E-09	-8.137	-8.086	0.051	21.71
	HSO4-	1.70E-09	1.25E-09	-8.769	-8.904	-0.135	40.87
	Zn(SO4)2-2	8.52E-10	2.47E-10	-9.07	-9.608	-0.538	-6.81
	FeSO4	1.79E-10	2.01E-10	-9.747	-9.697	0.051	18.97
	CuSO4	4.15E-11	4.66E-11	-10.382	-10.331	0.051	13.09
	CaHSO4+	3.90E-11	2.86E-11	-10.409	-10.543	-0.135	0
	FeSO4+	1.74E-17	1.18E-17	-16.759	-16.927	-0.167	0
	FeHSO4+	6.25E-18	4.58E-18	-17.204	-17.339	-0.135	0
	Fe(SO4)2-	1.31E-18	9.58E-19	-17.884	-18.019	-0.135	0
	FeHSO4+2	3.80E-25	1.10E-25	-24.421	-24.959	-0.538	0
Zn	2.64E-06						
	Zn(CO3)2-2	2.32E-06	6.70E-07	-5.635	-6.174	-0.538	0
	ZnCO3	2.16E-07	2.43E-07	-6.665	-6.614	0.051	0
	Zn+2	4.41E-08	9.45E-09	-7.355	-8.024	-0.669	-24.2
	ZnOHCl	1.73E-08	1.95E-08	-7.762	-7.711	0.051	0
	ZnHCO3+	1.55E-08	1.13E-08	-7.811	-7.945	-0.135	0
	Zn(OH)2	8.58E-09	9.64E-09	-8.067	-8.016	0.051	0
	ZnCl+	8.55E-09	5.56E-09	-8.068	-8.255	-0.187	-15.37
	ZnSO4	7.30E-09	8.20E-09	-8.137	-8.086	0.051	21.71
	ZnOH+	4.02E-09	2.95E-09	-8.396	-8.53	-0.135	0
	ZnCl2	1.13E-09	1.27E-09	-8.947	-8.896	0.051	102.03
	Zn(SO4)2-2	8.52E-10	2.47E-10	-9.07	-9.608	-0.538	-6.81
	ZnCl3-	4.79E-10	3.11E-10	-9.32	-9.507	-0.187	13.7
	ZnCl4-2	1.59E-10	3.41E-11	-9.799	-10.468	-0.669	149.36
	ZnF+	5.19E-11	3.81E-11	-10.285	-10.42	-0.135	0
	Zn(OH)3-	1.18E-11	8.67E-12	-10.927	-11.062	-0.135	0
	Zn(OH)4-2	1.35E-15	3.91E-16	-14.869	-15.408	-0.538	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-0.87	-5.15	-4.28	CaSO4			
Aragonite	1.73	-6.61	-8.34	CaCO3			
Barite	1.25	-8.59	-9.84	BaSO4			
Calcite	1.87	-6.61	-8.48	CaCO3			
CO2(g)	-2.65	-4.12	-1.47	CO2			
Dolomite	4.8	-12.28	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.94	6.83	4.89	Fe(OH)3			
Fluorite	0.79	-9.81	-10.6	CaF2			
Goethite	7.83	6.83	-1	FeOOH			
Gypsum	-0.58	-5.16	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	-0.01	1.5	H2O			
Halite	-2.88	-1.31	1.57	NaCl			
Hausmann	-8.18	52.85	61.03	Mn3O4			
Hematite	17.68	13.67	-4.01	Fe2O3			
Jarosite-K	-3.07	-12.28	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.57	21.77	25.34	MnOOH			
Melanterit	-9.78	-11.99	-2.21	FeSO4:7H2O			

NH3(g)	-7.16	-5.37	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.89	9.31	15.2	Mn(OH)2
Pyrolusite	-7.16	34.22	41.38	MnO2:H2O
Rhodochrc	-0.36	-11.49	-11.13	MnCO3
Siderite	-2.51	-13.4	-10.89	FeCO3
Smithsonit	-1.91	-11.91	-10	ZnCO3
Sylvite	-4.1	-3.2	0.9	KCl
Witherite	-1.49	-10.05	-8.56	BaCO3
Zn(OH)2(e	-2.62	8.88	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 31

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	2.59E-02	2.59E-02
Ba	4.68E-06	4.68E-06
Ca	9.48E-03	9.48E-03
Cl	3.48E-01	3.48E-01
Cu	3.20E-07	3.20E-07
F	9.80E-04	9.80E-04
Fe	2.50E-06	2.50E-06
K	4.76E-03	4.76E-03
Mg	7.65E-02	7.65E-02
Mn	4.20E-07	4.20E-07
N(-3)	5.20E-05	5.20E-05
N(5)	4.40E-04	4.40E-04
Na	3.34E-01	3.34E-01
S(6)	3.94E-02	3.94E-02
Zn	2.73E-06	2.73E-06

#NAME? of solution----------

pH	=	8.46		
pe	=	4		
Specific	Conductan	(µS/cm,	25°C)	= 37906
Density	(g/cm³)	=	1.01856	
Volume	(L)	=	1.0089	
Activity	of	water	=	0.986
Ionic	strength	(mol/kgw)	=	5.22E-01
Mass	of	water	(kg)	= 1.00E+00
Total	carbon	(mol/kg)	=	2.23E-02
Total	CO2	(mol/kg)	=	2.23E-02
Temperatu	(°C)	=	25	
Electrical	balance	(eq)	=	5.77E-02

Percent error, 100*(Cat-|= 6.6
Iterations = 14 (321 overall)
Total H = 1.11E+02
Total O = 5.57E+01

#NAME? couples----------

Redox couple pe Eh (volts)

N(-3)/N(5) 4.4362 0.2624

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.58E-06	2.88E-06	-5.339	-5.541	-0.201	-2.89
	H+	4.55E-09	3.47E-09	-8.343	-8.46	-0.117	0
	H2O	5.55E+01	9.86E-01	1.744	-0.006	0	18.07
Ba	4.68E-06						
	Ba+2	3.37E-06	7.10E-07	-5.473	-6.149	-0.676	-11.19
	BaSO4	1.18E-06	1.33E-06	-5.928	-5.876	0.052	0
	BaHCO3+	9.00E-08	6.61E-08	-7.046	-7.18	-0.134	0
	BaCO3	4.27E-08	4.82E-08	-7.369	-7.317	0.052	-10.7
	BaOH+	1.01E-11	6.84E-12	-10.997	-11.165	-0.168	0
C(4)	2.23E-02						
	HCO3-	1.41E-02	9.72E-03	-1.851	-2.012	-0.161	26.53
	MgHCO3+	2.97E-03	1.93E-03	-2.527	-2.716	-0.189	5.8
	MgCO3	1.88E-03	2.12E-03	-2.725	-2.673	0.052	-17.09
	NaHCO3	1.13E-03	1.28E-03	-2.945	-2.893	0.052	1.8
	NaCO3-	7.80E-04	5.73E-04	-3.108	-3.242	-0.134	2.07
	CO3-2	5.82E-04	1.32E-04	-3.235	-3.881	-0.646	-2.42
	CaCO3	3.84E-04	4.33E-04	-3.415	-3.363	0.052	-14.6
	CaHCO3+	3.45E-04	2.43E-04	-3.462	-3.614	-0.152	9.94
	CO2	6.82E-05	7.69E-05	-4.167	-4.114	0.052	34.43
	Zn(CO3)2-2	2.40E-06	6.98E-07	-5.62	-6.156	-0.536	0
	MnCO3	2.34E-07	2.64E-07	-6.631	-6.579	0.052	0
	ZnCO3	2.20E-07	2.48E-07	-6.657	-6.605	0.052	0
	BaHCO3+	9.00E-08	6.61E-08	-7.046	-7.18	-0.134	0
	BaCO3	4.27E-08	4.82E-08	-7.369	-7.317	0.052	-10.7
	CuCO3	3.82E-08	4.30E-08	-7.419	-7.366	0.052	0
	MnHCO3+	3.22E-08	2.19E-08	-7.492	-7.66	-0.168	0
	Cu(CO3)2-	2.45E-08	7.12E-09	-7.611	-8.147	-0.536	0
	ZnHCO3+	1.58E-08	1.16E-08	-7.802	-7.936	-0.134	0
	FeCO3	8.86E-10	9.99E-10	-9.053	-9	0.052	0
	FeHCO3+	4.19E-10	3.08E-10	-9.378	-9.512	-0.134	0
	CuHCO3+	4.04E-10	2.97E-10	-9.393	-9.528	-0.134	0
	(CO2)2	9.61E-11	1.08E-10	-10.017	-9.965	0.052	68.87
Ca	9.48E-03						
	Ca+2	7.59E-03	1.96E-03	-2.12	-2.708	-0.588	-16.82

	CaSO4	1.16E-03	1.31E-03	-2.936	-2.884	0.052	7.5
	CaCO3	3.84E-04	4.33E-04	-3.415	-3.363	0.052	-14.6
	CaHCO3+	3.45E-04	2.43E-04	-3.462	-3.614	-0.152	9.94
	CaOH+	1.26E-07	9.26E-08	-6.899	-7.034	-0.134	0
	CaHSO4+	4.05E-11	2.98E-11	-10.392	-10.526	-0.134	0
Cl	3.48E-01						
	Cl-	3.48E-01	2.25E-01	-0.459	-0.648	-0.189	18.7
	CuCl3-2	8.60E-08	1.82E-08	-7.065	-7.739	-0.674	0
	CuCl2-	7.90E-08	5.11E-08	-7.102	-7.291	-0.189	0
	MnCl+	3.41E-08	2.31E-08	-7.467	-7.636	-0.168	-2.81
	ZnOHCl	1.78E-08	2.01E-08	-7.75	-7.698	0.052	0
	ZnCl+	8.85E-09	5.73E-09	-8.053	-8.242	-0.189	-15.43
	MnCl2	2.01E-09	2.27E-09	-8.696	-8.644	0.052	85.89
	ZnCl2	1.20E-09	1.35E-09	-8.922	-8.87	0.052	102.03
	ZnCl3-	5.26E-10	3.40E-10	-9.279	-9.468	-0.189	13.59
	MnCl3-	2.07E-10	1.41E-10	-9.683	-9.852	-0.168	45.31
	ZnCl4-2	1.81E-10	3.84E-11	-9.742	-10.416	-0.674	149.46
	FeCl+	1.34E-10	9.83E-11	-9.873	-10.007	-0.134	0
	CuCl+	5.70E-11	3.69E-11	-10.244	-10.433	-0.189	1.66
	CuCl2	3.95E-12	4.45E-12	-11.403	-11.351	0.052	31.02
	CuCl3-	5.49E-15	3.55E-15	-14.26	-14.449	-0.189	0
	CuCl4-2	1.89E-17	4.01E-18	-16.723	-17.397	-0.674	0
	FeCl+2	9.70E-18	2.05E-18	-17.013	-17.687	-0.674	0
	FeCl2+	3.04E-18	2.06E-18	-17.517	-17.685	-0.168	0
	FeCl3	4.12E-20	4.64E-20	-19.386	-19.333	0.052	0
Cu(1)	1.65E-07						
	CuCl3-2	8.60E-08	1.82E-08	-7.065	-7.739	-0.674	0
	CuCl2-	7.90E-08	5.11E-08	-7.102	-7.291	-0.189	0
	Cu+	5.44E-12	3.20E-12	-11.264	-11.495	-0.231	0
Cu(2)	1.55E-07						
	Cu(OH)2	9.13E-08	1.03E-07	-7.039	-6.987	0.052	0
	CuCO3	3.82E-08	4.30E-08	-7.419	-7.366	0.052	0
	Cu(CO3)2-	2.45E-08	7.12E-09	-7.611	-8.147	-0.536	0
	CuHCO3+	4.04E-10	2.97E-10	-9.393	-9.528	-0.134	0
	CuOH+	2.68E-10	1.73E-10	-9.572	-9.761	-0.189	0
	Cu+2	2.47E-10	6.09E-11	-9.607	-10.215	-0.608	-25.42
	CuCl+	5.70E-11	3.69E-11	-10.244	-10.433	-0.189	1.66
	CuSO4	4.13E-11	4.66E-11	-10.384	-10.332	0.052	13.09
	CuCl2	3.95E-12	4.45E-12	-11.403	-11.351	0.052	31.02
	Cu(OH)3-	2.40E-12	1.77E-12	-11.619	-11.753	-0.134	0
	CuF+	4.36E-13	3.20E-13	-12.361	-12.495	-0.134	0
	Cu2(OH)2+	4.52E-14	1.31E-14	-13.345	-13.882	-0.536	0
	CuCl3-	5.49E-15	3.55E-15	-14.26	-14.449	-0.189	0
	Cu(OH)4-2	3.44E-16	1.00E-16	-15.463	-15.999	-0.536	0
	CuCl4-2	1.89E-17	4.01E-18	-16.723	-17.397	-0.674	0
F	9.80E-04						
	MgF+	4.87E-04	3.23E-04	-3.313	-3.491	-0.178	-10.27
	F-	4.59E-04	2.89E-04	-3.338	-3.539	-0.201	-0.67
	NaF	3.45E-05	3.89E-05	-4.463	-4.41	0.052	7.26
	HF	1.33E-09	1.50E-09	-8.876	-8.823	0.052	12.5

	MnF+	7.43E-11	5.04E-11	-10.129	-10.297	-0.168	0
	ZnF+	5.26E-11	3.86E-11	-10.279	-10.413	-0.134	0
	HF2-	2.27E-12	1.66E-12	-11.645	-11.779	-0.134	22.71
	FeF+	1.25E-12	9.15E-13	-11.905	-12.039	-0.134	0
	CuF+	4.36E-13	3.20E-13	-12.361	-12.495	-0.134	0
	FeF2+	2.35E-15	1.59E-15	-14.63	-14.798	-0.168	0
	FeF+2	6.53E-16	1.38E-16	-15.185	-15.859	-0.674	0
	FeF3	6.46E-16	7.28E-16	-15.19	-15.138	0.052	0
Fe(2)	2.95E-09						
	Fe+2	1.28E-09	3.17E-10	-8.891	-9.499	-0.608	-20.85
	FeCO3	8.86E-10	9.99E-10	-9.053	-9	0.052	0
	FeHCO3+	4.19E-10	3.08E-10	-9.378	-9.512	-0.134	0
	FeSO4	1.87E-10	2.11E-10	-9.728	-9.676	0.052	18.97
	FeCl+	1.34E-10	9.83E-11	-9.873	-10.007	-0.134	0
	FeOH+	4.20E-11	2.85E-11	-10.377	-10.545	-0.168	0
	FeF+	1.25E-12	9.15E-13	-11.905	-12.039	-0.134	0
	Fe(OH)2	6.12E-14	6.90E-14	-13.214	-13.161	0.052	0
	Fe(OH)3-	1.07E-15	7.29E-16	-14.969	-15.137	-0.168	0
	FeHSO4+	6.55E-18	4.81E-18	-17.184	-17.318	-0.134	0
Fe(3)	2.50E-06						
	Fe(OH)3	1.70E-06	1.92E-06	-5.77	-5.717	0.052	0
	Fe(OH)4-	7.21E-07	4.97E-07	-6.142	-6.303	-0.161	0
	Fe(OH)2+	7.59E-08	5.23E-08	-7.12	-7.281	-0.161	0
	FeOH+2	2.62E-12	5.55E-13	-11.581	-12.255	-0.674	0
	FeF2+	2.35E-15	1.59E-15	-14.63	-14.798	-0.168	0
	FeF+2	6.53E-16	1.38E-16	-15.185	-15.859	-0.674	0
	FeF3	6.46E-16	7.28E-16	-15.19	-15.138	0.052	0
	FeSO4+	1.83E-17	1.24E-17	-16.737	-16.906	-0.168	0
	FeCl+2	9.70E-18	2.05E-18	-17.013	-17.687	-0.674	0
	Fe+3	3.45E-18	3.02E-19	-17.462	-18.519	-1.057	0
	FeCl2+	3.04E-18	2.06E-18	-17.517	-17.685	-0.168	0
	Fe(SO4)2-	1.39E-18	1.02E-18	-17.858	-17.992	-0.134	0
	FeCl3	4.12E-20	4.64E-20	-19.386	-19.333	0.052	0
	Fe2(OH)2+	1.16E-21	8.30E-24	-20.936	-23.081	-2.145	0
	FeHSO4+2	3.97E-25	1.15E-25	-24.402	-24.938	-0.536	0
	Fe3(OH)4+	2.04E-25	9.07E-29	-24.69	-28.042	-3.352	0
H(0)	1.51E-28						
	H2	7.55E-29	8.51E-29	-28.122	-28.07	0.052	28.61
K	4.76E-03						
	K+	4.65E-03	2.98E-03	-2.333	-2.526	-0.193	9.57
	KSO4-	1.14E-04	7.83E-05	-3.945	-4.106	-0.161	34.76
Mg	7.65E-02						
	Mg+2	5.80E-02	1.69E-02	-1.237	-1.772	-0.535	-20.54
	MgSO4	1.32E-02	1.49E-02	-1.88	-1.828	0.052	5.84
	MgHCO3+	2.97E-03	1.93E-03	-2.527	-2.716	-0.189	5.8
	MgCO3	1.88E-03	2.12E-03	-2.725	-2.673	0.052	-17.09
	MgF+	4.87E-04	3.23E-04	-3.313	-3.491	-0.178	-10.27
	MgOH+	2.44E-05	1.75E-05	-4.613	-4.758	-0.145	0
Mn(2)	4.20E-07						
	MnCO3	2.34E-07	2.64E-07	-6.631	-6.579	0.052	0

	Mn+2	1.02E-07	2.52E-08	-6.99	-7.598	-0.608	-16.62
	MnCl+	3.41E-08	2.31E-08	-7.467	-7.636	-0.168	-2.81
	MnHCO3+	3.22E-08	2.19E-08	-7.492	-7.66	-0.168	0
	MnSO4	1.49E-08	1.68E-08	-7.826	-7.774	0.052	22.54
	MnCl2	2.01E-09	2.27E-09	-8.696	-8.644	0.052	85.89
	MnOH+	2.72E-10	1.85E-10	-9.565	-9.734	-0.168	0
	MnCl3-	2.07E-10	1.41E-10	-9.683	-9.852	-0.168	45.31
	MnF+	7.43E-11	5.04E-11	-10.129	-10.297	-0.168	0
	Mn(NO3)2	6.40E-15	7.22E-15	-14.194	-14.141	0.052	41.04
	Mn(OH)3-	1.36E-17	9.21E-18	-16.867	-17.036	-0.168	0
Mn(3)	8.90E-29						
	Mn+3	8.90E-29	7.80E-30	-28.05	-29.108	-1.057	0
N(-3)	5.20E-05						
	NH4+	4.63E-05	2.72E-05	-4.335	-4.566	-0.231	18.39
	NH3	3.96E-06	4.46E-06	-5.402	-5.35	0.052	24.42
	NH4SO4-	1.79E-06	1.31E-06	-5.748	-5.882	-0.134	39.52
N(5)	4.40E-04						
	NO3-	4.40E-04	2.68E-04	-3.357	-3.572	-0.215	30.19
	Mn(NO3)2	6.40E-15	7.22E-15	-14.194	-14.141	0.052	41.04
Na	3.34E-01						
	Na+	3.26E-01	2.34E-01	-0.487	-0.631	-0.144	-0.61
	NaSO4-	6.37E-03	4.39E-03	-2.196	-2.358	-0.161	20.23
	NaHCO3	1.13E-03	1.28E-03	-2.945	-2.893	0.052	1.8
	NaCO3-	7.80E-04	5.73E-04	-3.108	-3.242	-0.134	2.07
	NaF	3.45E-05	3.89E-05	-4.463	-4.41	0.052	7.26
	NaOH	5.97E-17	6.73E-17	-16.224	-16.172	0.052	0
O(0)	9.93E-37						
	O2	4.96E-37	5.60E-37	-36.304	-36.252	0.052	30.4
S(6)	3.94E-02						
	SO4-2	1.86E-02	3.75E-03	-1.732	-2.426	-0.695	17.12
	MgSO4	1.32E-02	1.49E-02	-1.88	-1.828	0.052	5.84
	NaSO4-	6.37E-03	4.39E-03	-2.196	-2.358	-0.161	20.23
	CaSO4	1.16E-03	1.31E-03	-2.936	-2.884	0.052	7.5
	KSO4-	1.14E-04	7.83E-05	-3.945	-4.106	-0.161	34.76
	NH4SO4-	1.79E-06	1.31E-06	-5.748	-5.882	-0.134	39.52
	BaSO4	1.18E-06	1.33E-06	-5.928	-5.876	0.052	0
	MnSO4	1.49E-08	1.68E-08	-7.826	-7.774	0.052	22.54
	ZnSO4	7.37E-09	8.31E-09	-8.133	-8.08	0.052	21.71
	HSO4-	1.72E-09	1.26E-09	-8.765	-8.899	-0.134	40.88
	Zn(SO4)2-2	8.70E-10	2.53E-10	-9.061	-9.597	-0.536	-6.65
	FeSO4	1.87E-10	2.11E-10	-9.728	-9.676	0.052	18.97
	CuSO4	4.13E-11	4.66E-11	-10.384	-10.332	0.052	13.09
	CaHSO4+	4.05E-11	2.98E-11	-10.392	-10.526	-0.134	0
	FeSO4+	1.83E-17	1.24E-17	-16.737	-16.906	-0.168	0
	FeHSO4+	6.55E-18	4.81E-18	-17.184	-17.318	-0.134	0
	Fe(SO4)2-	1.39E-18	1.02E-18	-17.858	-17.992	-0.134	0
	FeHSO4+2	3.97E-25	1.15E-25	-24.402	-24.938	-0.536	0
Zn	2.73E-06						
	Zn(CO3)2-2	2.40E-06	6.98E-07	-5.62	-6.156	-0.536	0
	ZnCO3	2.20E-07	2.48E-07	-6.657	-6.605	0.052	0

Zn+2	4.47E-08	9.46E-09	-7.35	-8.024	-0.674	-24.19
ZnOHCl	1.78E-08	2.01E-08	-7.75	-7.698	0.052	0
ZnHCO3+	1.58E-08	1.16E-08	-7.802	-7.936	-0.134	0
ZnCl+	8.85E-09	5.73E-09	-8.053	-8.242	-0.189	-15.43
Zn(OH)2	8.55E-09	9.64E-09	-8.068	-8.016	0.052	0
ZnSO4	7.37E-09	8.31E-09	-8.133	-8.08	0.052	21.71
ZnOH+	4.02E-09	2.95E-09	-8.396	-8.53	-0.134	0
ZnCl2	1.20E-09	1.35E-09	-8.922	-8.87	0.052	102.03
Zn(SO4)2-2	8.70E-10	2.53E-10	-9.061	-9.597	-0.536	-6.65
ZnCl3-	5.26E-10	3.40E-10	-9.279	-9.468	-0.189	13.59
ZnCl4-2	1.81E-10	3.84E-11	-9.742	-10.416	-0.674	149.46
ZnF+	5.26E-11	3.86E-11	-10.279	-10.413	-0.134	0
Zn(OH)3-	1.18E-11	8.67E-12	-10.928	-11.062	-0.134	0
Zn(OH)4-2	1.34E-15	3.91E-16	-14.872	-15.408	-0.536	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1	atm)
Anhydrite	-0.86	-5.13	-4.28	CaSO4				
Aragonite	1.75	-6.59	-8.34	CaCO3				
Barite	1.27	-8.58	-9.84	BaSO4				
Calcite	1.89	-6.59	-8.48	CaCO3				
CO2(g)	-2.65	-4.11	-1.47	CO2				
Dolomite	4.84	-12.24	-17.08	CaMg(CO3)2				
Fe(OH)3(a)	1.95	6.84	4.89	Fe(OH)3				
Fluorite	0.81	-9.79	-10.6	CaF2				
Goethite	7.85	6.85	-1	FeOOH				
Gypsum	-0.56	-5.15	-4.58	CaSO4:2H2O				
H2(g)	-24.97	-28.07	-3.1	H2				
H2O(g)	-1.51	-0.01	1.5	H2O				
Halite	-2.85	-1.28	1.57	NaCl				
Hausmann	-8.17	52.86	61.03	Mn3O4				
Hematite	17.71	13.7	-4.01	Fe2O3				
Jarosite-K	-3	-12.21	-9.21	KFe3(SO4)2(OH)6				
Manganite	-3.57	21.77	25.34	MnOOH				
Melanterit	-9.76	-11.97	-2.21	FeSO4:7H2O				
NH3(g)	-7.15	-5.35	1.8	NH3				
O2(g)	-33.36	-36.25	-2.89	O2				
Pyrochroit	-5.89	9.31	15.2	Mn(OH)2				
Pyrolusite	-7.16	34.22	41.38	MnO2:H2O				
Rhodochro	-0.35	-11.48	-11.13	MnCO3				
Siderite	-2.49	-13.38	-10.89	FeCO3				
Smithsonit	-1.91	-11.91	-10	ZnCO3				
Sylvite	-4.07	-3.17	0.9	KCl				
Witherite	-1.47	-10.03	-8.56	BaCO3				
Zn(OH)2(e	-2.62	8.88	11.5	Zn(OH)2				

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

```
Initial     solution          32

 #NAME?  composition-----------------------------

         Elements  Molality   Moles

         Alkalinity   2.67E-02  2.67E-02
         Ba           4.84E-06  4.84E-06
         Ca           9.78E-03  9.78E-03
         Cl           3.59E-01  3.59E-01
         Cu           3.30E-07  3.30E-07
         F            1.01E-03  1.01E-03
         Fe           2.58E-06  2.58E-06
         K            4.91E-03  4.91E-03
         Mg           7.90E-02  7.90E-02
         Mn           4.40E-07  4.40E-07
         N(-3)        5.30E-05  5.30E-05
         N(5)         4.50E-04  4.50E-04
         Na           3.45E-01  3.45E-01
         S(6)         4.06E-02  4.06E-02
         Zn           2.81E-06  2.81E-06

 #NAME?  of          solution----------------------------

         pH          =                 8.46
         pe          =                    4
         Specific    Conductan (µS/cm,    25°C)      =                38934
         Density     (g/cm³)   =            1.01923
         Volume      (L)       =             1.0091
         Activity    of        water      =                 0.986
         Ionic       strength  (mol/kgw) =            5.38E-01
         Mass        of        water      (kg)       =           1.00E+00
         Total       carbon    (mol/kg)   =            2.29E-02
         Total       CO2       (mol/kg)   =            2.29E-02
         Temperatu   (°C)      =                  25
         Electrical  balance   (eq)       =            5.95E-02
         Percent     error,    100*(Cat-|=                   6.6
         Iterations  =                14 (335       overall)
         Total       H         =            1.11E+02
         Total       O         =            5.57E+01

 #NAME?  couples--------------------------------

         Redox       couple    pe         Eh         (volts)

         N(-3)/N(5)     4.4364     0.2624

 #NAME?  of          species----------------------------
```

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.59E-06	2.88E-06	-5.338	-5.541	-0.203	-2.86
	H+	4.55E-09	3.47E-09	-8.342	-8.46	-0.118	0
	H2O	5.55E+01	9.86E-01	1.744	-0.006	0	18.07
Ba	4.84E-06						
	Ba+2	3.48E-06	7.28E-07	-5.458	-6.138	-0.68	-11.16
	BaSO4	1.22E-06	1.38E-06	-5.913	-5.859	0.054	0
	BaHCO3+	9.40E-08	6.91E-08	-7.027	-7.16	-0.133	0
	BaCO3	4.45E-08	5.04E-08	-7.352	-7.298	0.054	-10.7
	BaOH+	1.04E-11	7.01E-12	-10.985	-11.154	-0.17	0
C(4)	2.29E-02						
	HCO3-	1.44E-02	9.91E-03	-1.841	-2.004	-0.163	26.58
	MgHCO3+	3.13E-03	2.02E-03	-2.505	-2.696	-0.19	5.8
	MgCO3	1.96E-03	2.22E-03	-2.707	-2.653	0.054	-17.09
	NaHCO3	1.19E-03	1.34E-03	-2.925	-2.872	0.054	1.8
	NaCO3-	8.19E-04	6.02E-04	-3.087	-3.22	-0.133	2.16
	CO3-2	5.99E-04	1.34E-04	-3.223	-3.873	-0.65	-2.37
	CaCO3	4.00E-04	4.53E-04	-3.398	-3.344	0.054	-14.6
	CaHCO3+	3.62E-04	2.54E-04	-3.442	-3.595	-0.153	9.94
	CO2	6.92E-05	7.84E-05	-4.16	-4.106	0.054	34.43
	Zn(CO3)2-2	2.48E-06	7.24E-07	-5.606	-6.14	-0.534	0
	MnCO3	2.45E-07	2.77E-07	-6.611	-6.557	0.054	0
	ZnCO3	2.23E-07	2.53E-07	-6.651	-6.597	0.054	0
	BaHCO3+	9.40E-08	6.91E-08	-7.027	-7.16	-0.133	0
	BaCO3	4.45E-08	5.04E-08	-7.352	-7.298	0.054	-10.7
	CuCO3	3.82E-08	4.32E-08	-7.418	-7.364	0.054	0
	MnHCO3+	3.40E-08	2.30E-08	-7.469	-7.638	-0.17	0
	Cu(CO3)2-	2.49E-08	7.29E-09	-7.603	-8.137	-0.534	0
	ZnHCO3+	1.60E-08	1.18E-08	-7.795	-7.929	-0.133	0
	FeCO3	9.31E-10	1.05E-09	-9.031	-8.977	0.054	0
	FeHCO3+	4.42E-10	3.25E-10	-9.355	-9.488	-0.133	0
	CuHCO3+	4.06E-10	2.98E-10	-9.392	-9.525	-0.133	0
	(CO2)2	9.96E-11	1.13E-10	-10.002	-9.948	0.054	68.87
Ca	9.78E-03						
	Ca+2	7.82E-03	2.01E-03	-2.107	-2.697	-0.59	-16.81
	CaSO4	1.20E-03	1.36E-03	-2.922	-2.868	0.054	7.5
	CaCO3	4.00E-04	4.53E-04	-3.398	-3.344	0.054	-14.6
	CaHCO3+	3.62E-04	2.54E-04	-3.442	-3.595	-0.153	9.94
	CaOH+	1.29E-07	9.49E-08	-6.889	-7.023	-0.133	0
	CaHSO4+	4.20E-11	3.09E-11	-10.377	-10.51	-0.133	0
Cl	3.59E-01						
	Cl-	3.59E-01	2.31E-01	-0.445	-0.636	-0.19	18.71
	CuCl3-2	9.34E-08	1.96E-08	-7.029	-7.708	-0.679	0
	CuCl2-	8.28E-08	5.34E-08	-7.082	-7.273	-0.19	0
	MnCl+	3.63E-08	2.46E-08	-7.44	-7.61	-0.17	-2.81
	ZnOHCl	1.82E-08	2.06E-08	-7.74	-7.686	0.054	0
	ZnCl+	9.13E-09	5.89E-09	-8.04	-8.23	-0.19	-15.48
	MnCl2	2.19E-09	2.48E-09	-8.659	-8.605	0.054	85.89

	ZnCl2	1.26E-09	1.43E-09	-8.9	-8.846	0.054	102.03
	ZnCl3-	5.74E-10	3.70E-10	-9.241	-9.431	-0.19	13.47
	MnCl3-	2.34E-10	1.58E-10	-9.631	-9.801	-0.17	45.37
	ZnCl4-2	2.05E-10	4.30E-11	-9.688	-10.367	-0.679	149.55
	FeCl+	1.42E-10	1.05E-10	-9.846	-9.98	-0.133	0
	CuCl+	5.80E-11	3.74E-11	-10.237	-10.427	-0.19	1.69
	CuCl2	4.11E-12	4.65E-12	-11.386	-11.333	0.054	31.02
	CuCl3-	5.92E-15	3.82E-15	-14.228	-14.418	-0.19	0
	CuCl4-2	2.11E-17	4.43E-18	-16.675	-17.354	-0.679	0
	FeCl+2	1.04E-17	2.19E-18	-16.981	-17.66	-0.679	0
	FeCl2+	3.34E-18	2.26E-18	-17.476	-17.645	-0.17	0
	FeCl3	4.63E-20	5.24E-20	-19.335	-19.281	0.054	0
Cu(1)	1.76E-07						
	CuCl3-2	9.34E-08	1.96E-08	-7.029	-7.708	-0.679	0
	CuCl2-	8.28E-08	5.34E-08	-7.082	-7.273	-0.19	0
	Cu+	5.40E-12	3.15E-12	-11.268	-11.501	-0.233	0
Cu(2)	1.54E-07						
	Cu(OH)2	8.96E-08	1.01E-07	-7.048	-6.994	0.054	0
	CuCO3	3.82E-08	4.32E-08	-7.418	-7.364	0.054	0
	Cu(CO3)2-	2.49E-08	7.29E-09	-7.603	-8.137	-0.534	0
	CuHCO3+	4.06E-10	2.98E-10	-9.392	-9.525	-0.133	0
	CuOH+	2.65E-10	1.71E-10	-9.577	-9.768	-0.19	0
	Cu+2	2.46E-10	6.01E-11	-9.61	-10.221	-0.612	-25.41
	CuCl+	5.80E-11	3.74E-11	-10.237	-10.427	-0.19	1.69
	CuSO4	4.11E-11	4.65E-11	-10.386	-10.333	0.054	13.09
	CuCl2	4.11E-12	4.65E-12	-11.386	-11.333	0.054	31.02
	Cu(OH)3-	2.36E-12	1.74E-12	-11.626	-11.76	-0.133	0
	CuF+	4.35E-13	3.20E-13	-12.362	-12.496	-0.133	0
	Cu2(OH)2+	4.36E-14	1.28E-14	-13.36	-13.894	-0.534	0
	CuCl3-	5.92E-15	3.82E-15	-14.228	-14.418	-0.19	0
	Cu(OH)4-2	3.37E-16	9.86E-17	-15.472	-16.006	-0.534	0
	CuCl4-2	2.11E-17	4.43E-18	-16.675	-17.354	-0.679	0
F	1.01E-03						
	MgF+	5.08E-04	3.36E-04	-3.294	-3.474	-0.179	-10.27
	F-	4.67E-04	2.92E-04	-3.331	-3.534	-0.203	-0.66
	NaF	3.59E-05	4.06E-05	-4.445	-4.392	0.054	7.26
	HF	1.34E-09	1.52E-09	-8.872	-8.818	0.054	12.5
	MnF+	7.78E-11	5.27E-11	-10.109	-10.278	-0.17	0
	ZnF+	5.31E-11	3.90E-11	-10.275	-10.409	-0.133	0
	HF2-	2.32E-12	1.71E-12	-11.635	-11.768	-0.133	22.72
	FeF+	1.30E-12	9.58E-13	-11.885	-12.018	-0.133	0
	CuF+	4.35E-13	3.20E-13	-12.362	-12.496	-0.133	0
	FeF2+	2.50E-15	1.69E-15	-14.603	-14.773	-0.17	0
	FeF+2	6.92E-16	1.45E-16	-15.16	-15.838	-0.679	0
	FeF3	6.91E-16	7.82E-16	-15.16	-15.107	0.054	0
Fe(2)	3.10E-09						
	Fe+2	1.34E-09	3.28E-10	-8.873	-9.484	-0.612	-20.84
	FeCO3	9.31E-10	1.05E-09	-9.031	-8.977	0.054	0
	FeHCO3+	4.42E-10	3.25E-10	-9.355	-9.488	-0.133	0
	FeSO4	1.95E-10	2.21E-10	-9.709	-9.656	0.054	18.97

	FeCl+	1.42E-10	1.05E-10	-9.846	-9.98	-0.133	0
	FeOH+	4.36E-11	2.95E-11	-10.361	-10.531	-0.17	0
	FeF+	1.30E-12	9.58E-13	-11.885	-12.018	-0.133	0
	Fe(OH)2	6.30E-14	7.13E-14	-13.201	-13.147	0.054	0
	Fe(OH)3-	1.11E-15	7.54E-16	-14.953	-15.123	-0.17	0
	FeHSO4+	6.85E-18	5.04E-18	-17.164	-17.298	-0.133	0
Fe(3)	2.58E-06						
	Fe(OH)3	1.75E-06	1.98E-06	-5.757	-5.703	0.054	0
	Fe(OH)4-	7.47E-07	5.14E-07	-6.127	-6.289	-0.163	0
	Fe(OH)2+	7.87E-08	5.41E-08	-7.104	-7.267	-0.163	0
	FeOH+2	2.74E-12	5.75E-13	-11.562	-12.241	-0.679	0
	FeF2+	2.50E-15	1.69E-15	-14.603	-14.773	-0.17	0
	FeF+2	6.92E-16	1.45E-16	-15.16	-15.838	-0.679	0
	FeF3	6.91E-16	7.82E-16	-15.16	-15.107	0.054	0
	FeSO4+	1.92E-17	1.30E-17	-16.716	-16.886	-0.17	0
	FeCl+2	1.04E-17	2.19E-18	-16.981	-17.66	-0.679	0
	Fe+3	3.62E-18	3.13E-19	-17.442	-18.504	-1.063	0
	FeCl2+	3.34E-18	2.26E-18	-17.476	-17.645	-0.17	0
	Fe(SO4)2-	1.47E-18	1.08E-18	-17.833	-17.967	-0.133	0
	FeCl3	4.63E-20	5.24E-20	-19.335	-19.281	0.054	0
	Fe2(OH)2+	1.22E-21	8.89E-24	-20.915	-23.051	-2.136	0
	FeHSO4+2	4.13E-25	1.21E-25	-24.384	-24.918	-0.534	0
	Fe3(OH)4+	2.19E-25	1.01E-28	-24.66	-27.998	-3.337	0
H(0)	1.50E-28						
	H2	7.52E-29	8.51E-29	-28.124	-28.07	0.054	28.61
K	4.91E-03						
	K+	4.79E-03	3.06E-03	-2.32	-2.514	-0.195	9.58
	KSO4-	1.19E-04	8.15E-05	-3.926	-4.089	-0.163	34.77
Mg	7.90E-02						
	Mg+2	5.97E-02	1.74E-02	-1.224	-1.76	-0.536	-20.53
	MgSO4	1.37E-02	1.55E-02	-1.865	-1.811	0.054	5.84
	MgHCO3+	3.13E-03	2.02E-03	-2.505	-2.696	-0.19	5.8
	MgCO3	1.96E-03	2.22E-03	-2.707	-2.653	0.054	-17.09
	MgF+	5.08E-04	3.36E-04	-3.294	-3.474	-0.179	-10.27
	MgOH+	2.51E-05	1.80E-05	-4.6	-4.746	-0.146	0
Mn(2)	4.40E-07						
	MnCO3	2.45E-07	2.77E-07	-6.611	-6.557	0.054	0
	Mn+2	1.07E-07	2.60E-08	-6.973	-7.584	-0.612	-16.59
	MnCl+	3.63E-08	2.46E-08	-7.44	-7.61	-0.17	-2.81
	MnHCO3+	3.40E-08	2.30E-08	-7.469	-7.638	-0.17	0
	MnSO4	1.55E-08	1.76E-08	-7.809	-7.756	0.054	22.54
	MnCl2	2.19E-09	2.48E-09	-8.659	-8.605	0.054	85.89
	MnOH+	2.81E-10	1.90E-10	-9.551	-9.721	-0.17	0
	MnCl3-	2.34E-10	1.58E-10	-9.631	-9.801	-0.17	45.37
	MnF+	7.78E-11	5.27E-11	-10.109	-10.278	-0.17	0
	Mn(NO3)2	6.82E-15	7.72E-15	-14.166	-14.112	0.054	41.04
	Mn(OH)3-	1.40E-17	9.49E-18	-16.853	-17.023	-0.17	0
Mn(3)	9.29E-29						
	Mn+3	9.29E-29	8.05E-30	-28.032	-29.094	-1.063	0
N(-3)	5.30E-05						

	NH4+	4.72E-05	2.76E-05	-4.326	-4.56	-0.233	18.4
	NH3	4.00E-06	4.53E-06	-5.398	-5.344	0.054	24.42
	NH4SO4-	1.83E-06	1.35E-06	-5.738	-5.871	-0.133	39.57
N(5)	4.50E-04						
	NO3-	4.50E-04	2.73E-04	-3.347	-3.564	-0.217	30.2
	Mn(NO3)2	6.82E-15	7.72E-15	-14.166	-14.112	0.054	41.04
Na	3.45E-01						
	Na+	3.37E-01	2.41E-01	-0.473	-0.618	-0.145	-0.6
	NaSO4-	6.66E-03	4.58E-03	-2.176	-2.339	-0.163	20.34
	NaHCO3	1.19E-03	1.34E-03	-2.925	-2.872	0.054	1.8
	NaCO3-	8.19E-04	6.02E-04	-3.087	-3.22	-0.133	2.16
	NaF	3.59E-05	4.06E-05	-4.445	-4.392	0.054	7.26
	NaOH	6.13E-17	6.94E-17	-16.212	-16.159	0.054	0
O(0)	9.88E-37						
	O2	4.94E-37	5.59E-37	-36.306	-36.252	0.054	30.4
S(6)	4.06E-02						
	SO4-2	1.90E-02	3.79E-03	-1.721	-2.421	-0.7	17.16
	MgSO4	1.37E-02	1.55E-02	-1.865	-1.811	0.054	5.84
	NaSO4-	6.66E-03	4.58E-03	-2.176	-2.339	-0.163	20.34
	CaSO4	1.20E-03	1.36E-03	-2.922	-2.868	0.054	7.5
	KSO4-	1.19E-04	8.15E-05	-3.926	-4.089	-0.163	34.77
	NH4SO4-	1.83E-06	1.35E-06	-5.738	-5.871	-0.133	39.57
	BaSO4	1.22E-06	1.38E-06	-5.913	-5.859	0.054	0
	MnSO4	1.55E-08	1.76E-08	-7.809	-7.756	0.054	22.54
	ZnSO4	7.42E-09	8.40E-09	-8.13	-8.076	0.054	21.71
	HSO4-	1.74E-09	1.28E-09	-8.76	-8.894	-0.133	40.89
	Zn(SO4)2-2	8.85E-10	2.59E-10	-9.053	-9.587	-0.534	-6.49
	FeSO4	1.95E-10	2.21E-10	-9.709	-9.656	0.054	18.97
	CaHSO4+	4.20E-11	3.09E-11	-10.377	-10.51	-0.133	0
	CuSO4	4.11E-11	4.65E-11	-10.386	-10.333	0.054	13.09
	FeSO4+	1.92E-17	1.30E-17	-16.716	-16.886	-0.17	0
	FeHSO4+	6.85E-18	5.04E-18	-17.164	-17.298	-0.133	0
	Fe(SO4)2-	1.47E-18	1.08E-18	-17.833	-17.967	-0.133	0
	FeHSO4+2	4.13E-25	1.21E-25	-24.384	-24.918	-0.534	0
Zn	2.81E-06						
	Zn(CO3)2-2	2.48E-06	7.24E-07	-5.606	-6.14	-0.534	0
	ZnCO3	2.23E-07	2.53E-07	-6.651	-6.597	0.054	0
	Zn+2	4.51E-08	9.45E-09	-7.346	-8.025	-0.679	-24.18
	ZnOHCl	1.82E-08	2.06E-08	-7.74	-7.686	0.054	0
	ZnHCO3+	1.60E-08	1.18E-08	-7.795	-7.929	-0.133	0
	ZnCl+	9.13E-09	5.89E-09	-8.04	-8.23	-0.19	-15.48
	Zn(OH)2	8.50E-09	9.62E-09	-8.071	-8.017	0.054	0
	ZnSO4	7.42E-09	8.40E-09	-8.13	-8.076	0.054	21.71
	ZnOH+	4.01E-09	2.95E-09	-8.397	-8.531	-0.133	0
	ZnCl2	1.26E-09	1.43E-09	-8.9	-8.846	0.054	102.03
	Zn(SO4)2-2	8.85E-10	2.59E-10	-9.053	-9.587	-0.534	-6.49
	ZnCl3-	5.74E-10	3.70E-10	-9.241	-9.431	-0.19	13.47
	ZnCl4-2	2.05E-10	4.30E-11	-9.688	-10.367	-0.679	149.55
	ZnF+	5.31E-11	3.90E-11	-10.275	-10.409	-0.133	0
	Zn(OH)3-	1.18E-11	8.65E-12	-10.93	-11.063	-0.133	0

Zn(OH)4-2	1.33E-15	3.90E-16	-14.875	-15.409	-0.534	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)
Anhydrite	-0.84	-5.12	-4.28 CaSO4
Aragonite	1.77	-6.57	-8.34 CaCO3
Barite	1.28	-8.56	-9.84 BaSO4
Calcite	1.91	-6.57	-8.48 CaCO3
CO2(g)	-2.64	-4.11	-1.47 CO2
Dolomite	4.88	-12.2	-17.08 CaMg(CO3)2
Fe(OH)3(a)	1.97	6.86	4.89 Fe(OH)3
Fluorite	0.83	-9.76	-10.6 CaF2
Goethite	7.86	6.86	-1 FeOOH
Gypsum	-0.55	-5.13	-4.58 CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1 H2
H2O(g)	-1.51	-0.01	1.5 H2O
Halite	-2.82	-1.25	1.57 NaCl
Hausmann	-8.13	52.9	61.03 Mn3O4
Hematite	17.74	13.73	-4.01 Fe2O3
Jarosite-K	-2.94	-12.15	-9.21 KFe3(SO4)2(OH)6
Manganite	-3.56	21.78	25.34 MnOOH
Melanterit	-9.74	-11.95	-2.21 FeSO4:7H2O
NH3(g)	-7.14	-5.34	1.8 NH3
O2(g)	-33.36	-36.25	-2.89 O2
Pyrochroit	-5.88	9.32	15.2 Mn(OH)2
Pyrolusite	-7.14	34.24	41.38 MnO2:H2O
Rhodochro	-0.33	-11.46	-11.13 MnCO3
Siderite	-2.47	-13.36	-10.89 FeCO3
Smithsonit	-1.9	-11.9	-10 ZnCO3
Sylvite	-4.05	-3.15	0.9 KCl
Witherite	-1.45	-10.01	-8.56 BaCO3
Zn(OH)2(e	-2.62	8.88	11.5 Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

End of simulation.

Reading input data for simulation 2

End of Run after 0.222 Seconds.

```
        Input   file:   C:\Users\a Group   Pty   Ltd\EESI   Group   -   2024.00 -   QLD\7240! Tick   hill   model   update\4.  Laboratory ConcHI.pqi
        Output  file:   C:\Users\a Group   Pty   Ltd\EESI   Group   -   2024.00 -   QLD\7240! Tick   hill   model   update\4.  Laboratory ConcHI.pqo
Database file:  C:\Prograr Files   (x86)\USG: Interactive 3.7.3-15968\database\phreeqc.dat

------------------
Reading data   base.
------------------

        SOLUTION_MASTER_SPECIES
        SOLUTION_SPECIES
        PHASES
        EXCHANGE_MASTER_SPECIES
        EXCHANGE_SPECIES
        SURFACE_MASTER_SPECIES
        SURFACE_SPECIES
        RATES
        END
-------------------------------------
Reading input data   for   simulation   1.00
-------------------------------------

        DATABASE C:\Prograr Files   (x86)\USG: Interactive 3.7.3-15968\database\phreeqc.dat
        SOLUTION_SPREAD
```

Na	K	Ca	Mg	Cl	S(6)	F	N(-3)	Alkalinity	N(5)	Ba	Cu	Fe	Mn	Zn	pH
10.79	0.15	0.31	2.47	11.21	1.27	0.030	0.002	0.83	0.01000	0.00015	0.00001	0.00008	0.00001	0.00009	8.46
22.94	0.33	0.65	5.25	23.84	2.70	0.070	0.004	1.77	0.03000	0.00129	0.00002	0.00017	0.00003	0.00019	8.46
36.44	0.52	1.03	8.34	37.87	4.29	0.110	0.006	2.82	0.05000	0.00051	0.00003	0.00027	0.00005	0.0003	8.46
49.94	0.71	1.41	11.43	51.90	5.88	0.150	0.008	3.86	0.07000	0.00060	0.00005	0.00037	0.00006	0.00041	8.46
62.09	0.88	1.76	14.21	64.53	7.31	0.180	0.01	4.80	0.08000	0.00355	0.00006	0.00046	0.00008	0.00051	8.46
75.59	1.08	2.14	17.30	78.56	8.90	0.220	0.012	5.84	0.10000	0.00431	0.00007	0.00056	0.00010	0.00062	8.46
88.68	1.26	2.51	20.29	92.17	10.44	0.260	0.014	6.86	0.12000	0.00507	0.00008	0.00066	0.00011	0.00072	8.46
101.77	1.45	2.88	23.29	105.78	11.98	0.300	0.016	7.87	0.13000	0.00582	0.00010	0.00076	0.00013	0.00083	8.46
114.87	1.63	3.25	26.29	119.39	13.52	0.34	0.018	8.882646	0.15	0.00658	0.00011	0.00086	0.00015	0.00094	8.46
127.96	1.82	3.63	29.28	133	15.07	0.37	0.02	9.89523	0.17	0.00734	0.00012	0.00096	0.00016	0.00104	8.46
141.06	2.01	4	32.28	146.61	16.61	0.41	0.022	10.90781	0.18	0.00809	0.00013	0.00105	0.00018	0.00115	8.46
154.15	2.19	4.37	35.28	160.22	18.15	0.45	0.024	11.9204	0.2	0.00885	0.00015	0.00115	0.0002	0.00126	8.46
167.25	2.38	4.74	38.27	173.83	19.69	0.49	0.026	12.93298	0.22	0.00961	0.00016	0.00125	0.00021	0.00136	8.46
180.34	2.57	5.11	41.27	187.44	21.23	0.53	0.028	13.94557	0.24	0.01036	0.00017	0.00135	0.00023	0.00147	8.46
193.44	2.75	5.48	44.27	201.05	22.77	0.57	0.03	14.95815	0.25	0.01112	0.00018	0.00144	0.00024	0.00158	8.46
206.53	2.94	5.85	47.26	214.66	24.32	0.6	0.032	15.97074	0.27	0.01188	0.0002	0.00154	0.00026	0.00168	8.46
219.63	3.12	6.22	50.26	228.27	25.86	0.64	0.034	16.98332	0.29	0.01263	0.00021	0.00164	0.00028	0.00179	8.46
232.72	3.31	6.59	53.26	241.88	27.4	0.68	0.036	17.9959	0.3	0.01339	0.00022	0.00174	0.00029	0.0019	8.46
245.81	3.5	6.97	56.25	255.49	28.94	0.72	0.038	19.00849	0.32	0.01415	0.00023	0.00184	0.00031	0.002	8.46
258.91	3.68	7.34	59.25	269.1	30.48	0.76	0.04	20.02107	0.34	0.0149	0.00025	0.00193	0.00033	0.00211	8.46
272	3.87	7.71	62.25	282.71	32.02	0.8	0.042	21.03366	0.36	0.01566	0.00026	0.00203	0.00034	0.00222	8.46
285.1	4.06	8.08	65.24	296.32	33.57	0.83	0.044	22.04624	0.37	0.01642	0.00027	0.00213	0.00036	0.00232	8.46
298.19	4.24	8.45	68.24	309.93	35.11	0.87	0.046	23.05883	0.39	0.01717	0.00028	0.00223	0.00038	0.00243	8.46
311.29	4.43	8.82	71.24	323.54	36.65	0.91	0.048	24.07141	0.41	0.01793	0.0003	0.00233	0.00039	0.00254	8.46
324.38	4.61	9.19	74.23	337.15	38.19	0.95	0.05	25.084	0.42	0.01869	0.00031	0.00242	0.00041	0.00264	8.46
337.48	4.8	9.56	77.23	350.76	39.73	0.99	0.052	26.09658	0.44	0.01944	0.00032	0.00252	0.00043	0.00275	8.46
350.57	4.99	9.93	80.23	364.37	41.27	1.03	0.054	27.10916	0.46	0.0202	0.00033	0.00262	0.00044	0.00286	8.46
363.67	5.17	10.3	83.22	377.98	42.82	1.06	0.056	28.12175	0.48	0.02095	0.00034	0.00272	0.00046	0.00296	8.46
376.76	5.36	10.68	86.22	391.59	44.36	1.1	0.058	29.13433	0.49	0.02171	0.00036	0.00281	0.00048	0.00307	8.46
389.86	5.55	11.05	89.22	405.2	45.9	1.14	0.06	30.14692	0.51	0.02247	0.00037	0.00291	0.00049	0.00318	8.46
402.95	5.73	11.42	92.21	418.82	47.44	1.18	0.062	31.1595	0.53	0.02322	0.00038	0.00301	0.00051	0.00328	8.46
416.04	5.92	11.79	95.21	432.43	48.98	1.22	0.064	32.17209	0.54	0.02398	0.00039	0.00311	0.00053	0.00339	8.46

```
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Beginning of initial solution calculations.
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Initial solution 1

 #NAME? composition-----------------------------

        Elements Molality Moles

        Alkalinity 8.34E-04 8.34E-04
        Ba         1.50E-07 1.50E-07
        Ca         3.10E-04 3.10E-04
        Cl         1.12E-02 1.12E-02
        Cu         1.00E-08 1.00E-08
        F          3.00E-05 3.00E-05
        Fe         8.00E-08 8.00E-08
        K          1.50E-04 1.50E-04
        Mg         2.47E-03 2.47E-03
        Mn         1.00E-08 1.00E-08
        N(-3)      2.00E-06 2.00E-06
        N(5)       1.00E-05 1.00E-05
        Na         1.08E-02 1.08E-02
        S(6)       1.27E-03 1.27E-03
        Zn         9.00E-08 9.00E-08

 #NAME? of solution---------------------------

        pH = 8.46
        pe = 4
        Specific Conductan (µS/cm, 25°C) = 1678
        Density (g/cm³) = 0.99776
        Volume (L) = 1.00314
        Activity of water = 1
        Ionic strength (mol/kgw) = 1.86E-02
        Mass of water (kg) = 1.00E+00
        Total carbon (mol/kg) = 8.03E-04
        Total CO2 (mol/kg) = 8.03E-04
        Temperatu (°C) = 25
        Electrical balance (eq) = 1.88E-03
        Percent error, 100*(Cat-|= 6.24
        Iterations = 7
        Total H = 1.11E+02
        Total O = 5.55E+01

 #NAME? couples--------------------------------

        Redox couple pe Eh (volts)

        N(-3)/N(5) 4.4048 0.2606
```

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	3.35E-06	2.92E-06	-5.475	-5.535	-0.06	-3.99
	H+	3.89E-09	3.47E-09	-8.41	-8.46	-0.05	0
	H2O	5.55E+01	1.00E+00	1.744	0	0	18.07
Ba	1.50E-07						
	Ba+2	1.27E-07	7.41E-08	-6.897	-7.13	-0.233	-12.43
	BaSO4	2.24E-08	2.25E-08	-7.649	-7.648	0.002	0
	BaHCO3+	5.35E-10	4.68E-10	-9.271	-9.33	-0.058	0
	BaCO3	3.40E-10	3.41E-10	-9.469	-9.467	0.002	-10.7
	BaOH+	8.25E-13	7.23E-13	-12.084	-12.141	-0.057	0
C(4)	8.03E-04						
	HCO3-	7.50E-04	6.59E-04	-3.125	-3.181	-0.056	24.82
	CO3-2	1.49E-05	8.92E-06	-4.826	-5.05	-0.224	-4.87
	MgHCO3+	1.20E-05	1.05E-05	-4.921	-4.98	-0.059	5.56
	MgCO3	1.15E-05	1.16E-05	-4.939	-4.938	0.002	-17.09
	CO2	5.12E-06	5.14E-06	-5.291	-5.289	0.002	34.43
	NaHCO3	3.48E-06	3.49E-06	-5.459	-5.457	0.002	1.8
	CaCO3	2.56E-06	2.57E-06	-5.592	-5.591	0.002	-14.6
	NaCO3-	1.79E-06	1.56E-06	-5.747	-5.806	-0.058	-0.85
	CaHCO3+	1.64E-06	1.44E-06	-5.786	-5.841	-0.055	9.75
	ZnCO3	2.75E-08	2.76E-08	-7.561	-7.559	0.002	0
	Zn(CO3)2-2	9.00E-09	5.26E-09	-8.046	-8.279	-0.234	0
	MnCO3	2.72E-09	2.73E-09	-8.565	-8.563	0.002	0
	ZnHCO3+	1.47E-09	1.29E-09	-8.832	-8.891	-0.058	0
	BaHCO3+	5.35E-10	4.68E-10	-9.271	-9.33	-0.058	0
	BaCO3	3.40E-10	3.41E-10	-9.469	-9.467	0.002	-10.7
	CuCO3	2.67E-10	2.68E-10	-9.573	-9.571	0.002	0
	MnHCO3+	2.59E-10	2.27E-10	-9.588	-9.644	-0.057	0
	Cu(CO3)2-	5.16E-12	3.01E-12	-11.288	-11.521	-0.234	0
	CuHCO3+	2.12E-12	1.85E-12	-11.674	-11.733	-0.058	0
	FeCO3	2.04E-12	2.05E-12	-11.69	-11.689	0.002	0
	FeHCO3+	7.22E-13	6.31E-13	-12.141	-12.2	-0.058	0
	(CO2)2	4.83E-13	4.85E-13	-12.316	-12.314	0.002	68.87
Ca	3.10E-04						
	Ca+2	2.87E-04	1.71E-04	-3.542	-3.766	-0.224	-17.83
	CaSO4	1.84E-05	1.85E-05	-4.735	-4.733	0.002	7.5
	CaCO3	2.56E-06	2.57E-06	-5.592	-5.591	0.002	-14.6
	CaHCO3+	1.64E-06	1.44E-06	-5.786	-5.841	-0.055	9.75
	CaOH+	9.38E-09	8.20E-09	-8.028	-8.086	-0.058	0
	CaHSO4+	4.82E-13	4.22E-13	-12.317	-12.375	-0.058	0
Cl	1.12E-02						
	Cl-	1.12E-02	9.77E-03	-1.95	-2.01	-0.06	18.17
	ZnOHCl	1.44E-09	1.45E-09	-8.842	-8.84	0.002	0
	ZnCl+	4.67E-10	4.08E-10	-9.331	-9.39	-0.059	-13.89
	MnCl+	1.75E-10	1.54E-10	-9.757	-9.813	-0.057	-3.01

	CuCl2-	1.02E-11	8.88E-12	-10.992	-11.052	-0.059	0
	ZnCl2	4.16E-12	4.17E-12	-11.381	-11.38	0.002	102.03
	MnCl2	6.53E-13	6.56E-13	-12.185	-12.183	0.002	85.89
	CuCl3-2	2.32E-13	1.38E-13	-12.634	-12.861	-0.227	0
	CuCl+	1.69E-13	1.47E-13	-12.773	-12.832	-0.059	0.74
	FeCl+	1.48E-13	1.29E-13	-12.83	-12.889	-0.058	0
	ZnCl3-	5.24E-14	4.58E-14	-13.28	-13.34	-0.059	16.94
	MnCl3-	2.01E-15	1.76E-15	-14.697	-14.753	-0.057	43.49
	CuCl2	7.70E-16	7.74E-16	-15.113	-15.112	0.002	31.02
	ZnCl4-2	3.78E-16	2.24E-16	-15.422	-15.649	-0.227	145.62
	CuCl3-	3.07E-20	2.68E-20	-19.512	-19.571	-0.059	0
	FeCl+2	4.56E-21	2.70E-21	-20.341	-20.569	-0.227	0
	FeCl2+	1.34E-22	1.18E-22	-21.872	-21.929	-0.057	0
	CuCl4-2	2.22E-24	1.31E-24	-23.654	-23.881	-0.227	0
	FeCl3	1.15E-25	1.15E-25	-24.941	-24.939	0.002	0
Cu(1)	1.08E-11						
	CuCl2-	1.02E-11	8.88E-12	-10.992	-11.052	-0.059	0
	Cu+	3.40E-13	2.94E-13	-12.469	-12.532	-0.063	0
	CuCl3-2	2.32E-13	1.38E-13	-12.634	-12.861	-0.227	0
Cu(2)	9.99E-09						
	Cu(OH)2	9.69E-09	9.73E-09	-8.014	-8.012	0.002	0
	CuCO3	2.67E-10	2.68E-10	-9.573	-9.571	0.002	0
	CuOH+	1.85E-11	1.62E-11	-10.733	-10.792	-0.059	0
	Cu+2	9.29E-12	5.60E-12	-11.032	-11.252	-0.219	-26.31
	Cu(CO3)2-	5.16E-12	3.01E-12	-11.288	-11.521	-0.234	0
	CuHCO3+	2.12E-12	1.85E-12	-11.674	-11.733	-0.058	0
	CuSO4	6.91E-13	6.94E-13	-12.16	-12.159	0.002	13.09
	Cu(OH)3-	1.93E-13	1.69E-13	-12.714	-12.772	-0.058	0
	CuCl+	1.69E-13	1.47E-13	-12.773	-12.832	-0.059	0.74
	CuF+	2.79E-15	2.43E-15	-14.555	-14.614	-0.058	0
	CuCl2	7.70E-16	7.74E-16	-15.113	-15.112	0.002	31.02
	Cu2(OH)2+	1.96E-16	1.14E-16	-15.709	-15.943	-0.234	0
	Cu(OH)4-2	1.66E-17	9.72E-18	-16.779	-17.012	-0.234	0
	CuCl3-	3.07E-20	2.68E-20	-19.512	-19.571	-0.059	0
	CuCl4-2	2.22E-24	1.31E-24	-23.654	-23.881	-0.227	0
F	3.00E-05						
	F-	2.74E-05	2.39E-05	-4.562	-4.622	-0.06	-1.22
	MgF+	2.45E-06	2.14E-06	-5.612	-5.669	-0.058	-10.49
	NaF	1.29E-07	1.30E-07	-6.89	-6.888	0.002	7.26
	HF	1.24E-10	1.24E-10	-9.908	-9.906	0.002	12.5
	ZnF+	5.98E-12	5.23E-12	-11.223	-11.282	-0.058	0
	MnF+	7.27E-13	6.38E-13	-12.139	-12.196	-0.057	0
	HF2-	1.30E-14	1.14E-14	-13.886	-13.944	-0.058	22.16
	CuF+	2.79E-15	2.43E-15	-14.555	-14.614	-0.058	0
	FeF+	2.62E-15	2.29E-15	-14.582	-14.641	-0.058	0
	FeF+2	5.84E-19	3.46E-19	-18.233	-18.461	-0.227	0
	FeF2+	3.75E-19	3.29E-19	-18.426	-18.483	-0.057	0
	FeF3	1.24E-20	1.25E-20	-19.907	-19.905	0.002	0
Fe(2)	2.08E-11						
	Fe+2	1.59E-11	9.58E-12	-10.799	-11.019	-0.219	-21.83

	FeCO3	2.04E-12	2.05E-12	-11.69	-11.689	0.002	0
	FeSO4	1.03E-12	1.03E-12	-11.988	-11.986	0.002	18.97
	FeOH+	9.95E-13	8.73E-13	-12.002	-12.059	-0.057	0
	FeHCO3+	7.22E-13	6.31E-13	-12.141	-12.2	-0.058	0
	FeCl+	1.48E-13	1.29E-13	-12.83	-12.889	-0.058	0
	FeF+	2.62E-15	2.29E-15	-14.582	-14.641	-0.058	0
	Fe(OH)2	2.13E-15	2.14E-15	-14.671	-14.669	0.002	0
	Fe(OH)3-	2.62E-17	2.29E-17	-16.583	-16.639	-0.057	0
	FeHSO4+	2.69E-20	2.36E-20	-19.57	-19.628	-0.058	0
Fe(3)	8.00E-08						
	Fe(OH)3	6.01E-08	6.03E-08	-7.221	-7.219	0.002	0
	Fe(OH)4-	1.81E-08	1.59E-08	-7.744	-7.8	-0.056	0
	Fe(OH)2+	1.85E-09	1.63E-09	-8.733	-8.789	-0.056	0
	FeOH+2	2.87E-14	1.70E-14	-13.542	-13.769	-0.227	0
	FeF+2	5.84E-19	3.46E-19	-18.233	-18.461	-0.227	0
	FeF2+	3.75E-19	3.29E-19	-18.426	-18.483	-0.057	0
	FeSO4+	6.94E-20	6.08E-20	-19.159	-19.216	-0.057	0
	Fe+3	2.56E-20	9.15E-21	-19.592	-20.039	-0.446	0
	FeF3	1.24E-20	1.25E-20	-19.907	-19.905	0.002	0
	FeCl+2	4.56E-21	2.70E-21	-20.341	-20.569	-0.227	0
	Fe(SO4)2-	9.24E-22	8.08E-22	-21.034	-21.093	-0.058	0
	FeCl2+	1.34E-22	1.18E-22	-21.872	-21.929	-0.057	0
	FeCl3	1.15E-25	1.15E-25	-24.941	-24.939	0.002	0
	Fe2(OH)2+	6.71E-26	7.80E-27	-25.173	-26.108	-0.935	0
	FeHSO4+2	9.67E-28	5.65E-28	-27.014	-27.248	-0.234	0
	Fe3(OH)4+	7.64E-32	2.65E-33	-31.117	-32.577	-1.46	0
H(0)	1.70E-28						
	H2	8.48E-29	8.51E-29	-28.072	-28.07	0.002	28.61
K	1.50E-04						
	K+	1.49E-04	1.30E-04	-3.826	-3.886	-0.06	9.1
	KSO4-	6.31E-07	5.55E-07	-6.2	-6.256	-0.056	34.2
Mg	2.47E-03						
	Mg+2	2.25E-03	1.36E-03	-2.648	-2.867	-0.22	-21.52
	MgSO4	1.92E-04	1.93E-04	-3.716	-3.714	0.002	5.84
	MgHCO3+	1.20E-05	1.05E-05	-4.921	-4.98	-0.059	5.56
	MgCO3	1.15E-05	1.16E-05	-4.939	-4.938	0.002	-17.09
	MgF+	2.45E-06	2.14E-06	-5.612	-5.669	-0.058	-10.49
	MgOH+	1.61E-06	1.42E-06	-5.794	-5.848	-0.054	0
Mn(2)	1.00E-08						
	Mn+2	6.40E-09	3.86E-09	-8.194	-8.414	-0.219	-19.45
	MnCO3	2.72E-09	2.73E-09	-8.565	-8.563	0.002	0
	MnSO4	4.15E-10	4.16E-10	-9.382	-9.381	0.002	22.54
	MnHCO3+	2.59E-10	2.27E-10	-9.588	-9.644	-0.057	0
	MnCl+	1.75E-10	1.54E-10	-9.757	-9.813	-0.057	-3.01
	MnOH+	3.26E-11	2.86E-11	-10.487	-10.544	-0.057	0
	MnF+	7.27E-13	6.38E-13	-12.139	-12.196	-0.057	0
	MnCl2	6.53E-13	6.56E-13	-12.185	-12.183	0.002	85.89
	MnCl3-	2.01E-15	1.76E-15	-14.697	-14.753	-0.057	43.49
	Mn(OH)3-	1.67E-18	1.47E-18	-17.777	-17.834	-0.057	0
	Mn(NO3)2	1.15E-18	1.16E-18	-17.938	-17.936	0.002	41.04

Mn(3)	3.33E-30						
	Mn+3	3.33E-30	1.19E-30	-29.477	-29.924	-0.446	0
N(-3)	2.00E-06						
	NH4+	1.74E-06	1.51E-06	-5.759	-5.822	-0.063	18.05
	NH3	2.47E-07	2.48E-07	-6.608	-6.606	0.002	24.42
	NH4SO4-	1.35E-08	1.18E-08	-7.871	-7.929	-0.058	37.76
N(5)	1.00E-05						
	NO3-	1.00E-05	8.68E-06	-5	-5.061	-0.061	29.59
	Mn(NO3)2	1.15E-18	1.16E-18	-17.938	-17.936	0.002	41.04
Na	1.08E-02						
	Na+	1.08E-02	9.42E-03	-1.969	-2.026	-0.057	-1.33
	NaSO4-	3.26E-05	2.87E-05	-4.487	-4.543	-0.056	14.65
	NaHCO3	3.48E-06	3.49E-06	-5.459	-5.457	0.002	1.8
	NaCO3-	1.79E-06	1.56E-06	-5.747	-5.806	-0.058	-0.85
	NaF	1.29E-07	1.30E-07	-6.89	-6.888	0.002	7.26
	NaOH	2.74E-18	2.75E-18	-17.563	-17.561	0.002	0
O(0)	1.15E-36						
	O2	5.73E-37	5.75E-37	-36.242	-36.24	0.002	30.4
S(6)	1.27E-03						
	SO4-2	1.03E-03	6.07E-04	-2.989	-3.217	-0.228	14.91
	MgSO4	1.92E-04	1.93E-04	-3.716	-3.714	0.002	5.84
	NaSO4-	3.26E-05	2.87E-05	-4.487	-4.543	-0.056	14.65
	CaSO4	1.84E-05	1.85E-05	-4.735	-4.733	0.002	7.5
	KSO4-	6.31E-07	5.55E-07	-6.2	-6.256	-0.056	34.2
	BaSO4	2.24E-08	2.25E-08	-7.649	-7.648	0.002	0
	NH4SO4-	1.35E-08	1.18E-08	-7.871	-7.929	-0.058	37.76
	ZnSO4	2.20E-09	2.20E-09	-8.659	-8.657	0.002	21.71
	MnSO4	4.15E-10	4.16E-10	-9.382	-9.381	0.002	22.54
	HSO4-	2.34E-10	2.05E-10	-9.631	-9.689	-0.058	40.37
	Zn(SO4)2-2	1.86E-11	1.09E-11	-10.73	-10.964	-0.234	-12.61
	FeSO4	1.03E-12	1.03E-12	-11.988	-11.986	0.002	18.97
	CuSO4	6.91E-13	6.94E-13	-12.16	-12.159	0.002	13.09
	CaHSO4+	4.82E-13	4.22E-13	-12.317	-12.375	-0.058	0
	FeSO4+	6.94E-20	6.08E-20	-19.159	-19.216	-0.057	0
	FeHSO4+	2.69E-20	2.36E-20	-19.57	-19.628	-0.058	0
	Fe(SO4)2-	9.24E-22	8.08E-22	-21.034	-21.093	-0.058	0
	FeHSO4+2	9.67E-28	5.65E-28	-27.014	-27.248	-0.234	0
Zn	9.00E-08						
	ZnCO3	2.75E-08	2.76E-08	-7.561	-7.559	0.002	0
	Zn+2	2.62E-08	1.55E-08	-7.582	-7.81	-0.227	-25.05
	Zn(OH)2	1.62E-08	1.62E-08	-7.792	-7.79	0.002	0
	Zn(CO3)2-2	9.00E-09	5.26E-09	-8.046	-8.279	-0.234	0
	ZnOH+	5.61E-09	4.90E-09	-8.251	-8.31	-0.058	0
	ZnSO4	2.20E-09	2.20E-09	-8.659	-8.657	0.002	21.71
	ZnHCO3+	1.47E-09	1.29E-09	-8.832	-8.891	-0.058	0
	ZnOHCl	1.44E-09	1.45E-09	-8.842	-8.84	0.002	0
	ZnCl+	4.67E-10	4.08E-10	-9.331	-9.39	-0.059	-13.89
	Zn(SO4)2-2	1.86E-11	1.09E-11	-10.73	-10.964	-0.234	-12.61
	Zn(OH)3-	1.69E-11	1.48E-11	-10.772	-10.83	-0.058	0
	ZnF+	5.98E-12	5.23E-12	-11.223	-11.282	-0.058	0

ZnCl2	4.16E-12	4.17E-12	-11.381	-11.38	0.002	102.03
ZnCl3-	5.24E-14	4.58E-14	-13.28	-13.34	-0.059	16.94
Zn(OH)4-2	1.16E-15	6.75E-16	-14.937	-15.17	-0.234	0
ZnCl4-2	3.78E-16	2.24E-16	-15.422	-15.649	-0.227	145.62

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-2.71	-6.98	-4.28	CaSO4
Aragonite	-0.48	-8.82	-8.34	CaCO3
Barite	-0.5	-10.35	-9.84	BaSO4
Calcite	-0.34	-8.82	-8.48	CaCO3
CO2(g)	-3.82	-5.29	-1.47	CO2
Dolomite	0.35	-16.73	-17.08	CaMg(CO3)2
Fe(OH)3(a)	0.45	5.34	4.89	Fe(OH)3
Fluorite	-2.41	-13.01	-10.6	CaF2
Goethite	6.34	5.34	-1	FeOOH
Gypsum	-2.4	-6.98	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-5.61	-4.04	1.57	NaCl
Hausmann	-10.59	50.44	61.03	Mn3O4
Hematite	14.69	10.68	-4.01	Fe2O3
Jarosite-K	-10.47	-19.68	-9.21	KFe3(SO4)2(OH)6
Manganite	-4.37	20.97	25.34	MnOOH
Melanterit	-12.03	-14.24	-2.21	FeSO4:7H2O
NH3(g)	-8.4	-6.61	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.69	8.51	15.2	Mn(OH)2
Pyrolusite	-7.95	33.43	41.38	MnO2:H2O
Rhodochro	-2.33	-13.46	-11.13	MnCO3
Siderite	-5.18	-16.07	-10.89	FeCO3
Smithsonit	-2.86	-12.86	-10	ZnCO3
Sylvite	-6.8	-5.9	0.9	KCl
Witherite	-3.62	-12.18	-8.56	BaCO3
Zn(OH)2(e	-2.39	9.11	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 2

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.77E-03	1.77E-03
Ba	1.29E-06	1.29E-06
Ca	6.50E-04	6.50E-04

Cl	2.38E-02	2.38E-02
Cu	2.00E-08	2.00E-08
F	7.00E-05	7.00E-05
Fe	1.70E-07	1.70E-07
K	3.30E-04	3.30E-04
Mg	5.25E-03	5.25E-03
Mn	3.00E-08	3.00E-08
N(-3)	4.00E-06	4.00E-06
N(5)	3.00E-05	3.00E-05
Na	2.29E-02	2.29E-02
S(6)	2.70E-03	2.70E-03
Zn	1.90E-07	1.90E-07

#NAME? of solution----------

```
pH          =                8.46
pe          =                   4
Specific    Conductan (µS/cm,   25°C)      =                3404
Density     (g/cm³)   =          0.99857
Volume      (L)       =          1.00334
Activity    of        water     =                0.999
Ionic       strength  (mol/kgw) =            3.88E-02
Mass        of        water     (kg)         =          1.00E+00
Total       carbon    (mol/kg)  =            1.69E-03
Total       CO2       (mol/kg)  =            1.69E-03
Temperatu   (°C)      =                  25
Electrical  balance   (eq)      =            3.96E-03
Percent     error,    100*(Cat-|=                6.27
Iterations  =                 7 (14        overall)
Total       H         =          1.11E+02
Total       O         =          5.55E+01
```

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4269	0.2619		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	3.52E-06	2.92E-06	-5.453	-5.535	-0.082	-3.91
H+	4.01E-09	3.47E-09	-8.396	-8.46	-0.064	0
H2O	5.55E+01	9.99E-01	1.744	0	0	18.07
Ba	1.29E-06					
Ba+2	1.03E-06	5.02E-07	-5.986	-6.3	-0.313	-12.27
BaSO4	2.46E-07	2.48E-07	-6.61	-6.606	0.004	0
BaHCO3+	7.39E-09	6.18E-09	-8.131	-8.209	-0.078	0

	BaCO3	4.46E-09	4.50E-09	-8.35	-8.346	0.004	-10.7
	BaOH+	5.83E-12	4.90E-12	-11.234	-11.31	-0.076	0
C(4)	1.69E-03						
	HCO3-	1.53E-03	1.29E-03	-2.817	-2.891	-0.074	24.93
	MgHCO3+	4.29E-05	3.57E-05	-4.368	-4.448	-0.08	5.6
	MgCO3	3.90E-05	3.93E-05	-4.409	-4.405	0.004	-17.09
	CO3-2	3.45E-05	1.74E-05	-4.462	-4.76	-0.298	-4.63
	NaHCO3	1.37E-05	1.38E-05	-4.863	-4.859	0.004	1.8
	CO2	9.94E-06	1.00E-05	-5.003	-4.999	0.004	34.43
	CaCO3	8.53E-06	8.60E-06	-5.069	-5.065	0.004	-14.6
	NaCO3-	7.41E-06	6.19E-06	-5.13	-5.208	-0.078	-0.7
	CaHCO3+	5.71E-06	4.83E-06	-5.244	-5.316	-0.072	9.78
	ZnCO3	6.41E-08	6.47E-08	-7.193	-7.189	0.004	0
	Zn(CO3)2-2	4.93E-08	2.40E-08	-7.307	-7.619	-0.312	0
	MnCO3	1.10E-08	1.11E-08	-7.959	-7.955	0.004	0
	BaHCO3+	7.39E-09	6.18E-09	-8.131	-8.209	-0.078	0
	BaCO3	4.46E-09	4.50E-09	-8.35	-8.346	0.004	-10.7
	ZnHCO3+	3.61E-09	3.02E-09	-8.442	-8.52	-0.078	0
	MnHCO3+	1.10E-09	9.20E-10	-8.96	-9.036	-0.076	0
	CuCO3	1.01E-09	1.02E-09	-8.995	-8.992	0.004	0
	Cu(CO3)2-	4.58E-11	2.23E-11	-10.34	-10.652	-0.312	0
	CuHCO3+	8.42E-12	7.04E-12	-11.075	-11.153	-0.078	0
	FeCO3	8.36E-12	8.43E-12	-11.078	-11.074	0.004	0
	FeHCO3+	3.11E-12	2.60E-12	-11.507	-11.585	-0.078	0
	(CO2)2	1.83E-12	1.85E-12	-11.738	-11.734	0.004	68.87
Ca	6.50E-04						
	Ca+2	5.85E-04	2.95E-04	-3.233	-3.531	-0.297	-17.68
	CaSO4	5.12E-05	5.17E-05	-4.291	-4.287	0.004	7.5
	CaCO3	8.53E-06	8.60E-06	-5.069	-5.065	0.004	-14.6
	CaHCO3+	5.71E-06	4.83E-06	-5.244	-5.316	-0.072	9.78
	CaOH+	1.69E-08	1.41E-08	-7.773	-7.851	-0.078	0
	CaHSO4+	1.41E-12	1.18E-12	-11.851	-11.929	-0.078	0
Cl	2.38E-02						
	Cl-	2.38E-02	1.98E-02	-1.623	-1.703	-0.081	18.23
	ZnOHCl	3.49E-09	3.52E-09	-8.457	-8.453	0.004	0
	ZnCl+	1.20E-09	9.94E-10	-8.923	-9.003	-0.08	-13.92
	MnCl+	7.72E-10	6.48E-10	-9.112	-9.188	-0.076	-2.98
	CuCl2-	8.54E-11	7.11E-11	-10.069	-10.148	-0.08	0
	ZnCl2	2.04E-11	2.06E-11	-10.69	-10.686	0.004	102.03
	MnCl2	5.55E-12	5.60E-12	-11.256	-11.252	0.004	85.89
	CuCl3-2	4.49E-12	2.23E-12	-11.348	-11.652	-0.304	0
	CuCl+	7.00E-13	5.82E-13	-12.155	-12.235	-0.08	0.8
	FeCl+	6.62E-13	5.53E-13	-12.179	-12.257	-0.078	0
	ZnCl3-	5.50E-13	4.58E-13	-12.26	-12.339	-0.08	16.84
	MnCl3-	3.64E-14	3.05E-14	-13.439	-13.515	-0.076	43.6
	ZnCl4-2	9.14E-15	4.54E-15	-14.039	-14.343	-0.304	145.91
	CuCl2	6.13E-15	6.19E-15	-14.212	-14.208	0.004	31.02
	CuCl3-	5.23E-19	4.35E-19	-18.282	-18.362	-0.08	0
	FeCl+2	2.33E-20	1.16E-20	-19.634	-19.937	-0.304	0
	FeCl2+	1.22E-21	1.02E-21	-20.915	-20.991	-0.076	0

	CuCl4-2	8.68E-23	4.31E-23	-22.061	-22.365	-0.304	0
	FeCl3	2.00E-24	2.02E-24	-23.698	-23.694	0.004	0
Cu(1)	9.06E-11						
	CuCl2-	8.54E-11	7.11E-11	-10.069	-10.148	-0.08	0
	CuCl3-2	4.49E-12	2.23E-12	-11.348	-11.652	-0.304	0
	Cu+	7.00E-13	5.73E-13	-12.155	-12.242	-0.087	0
Cu(2)	1.99E-08						
	Cu(OH)2	1.88E-08	1.90E-08	-7.726	-7.722	0.004	0
	CuCO3	1.01E-09	1.02E-09	-8.995	-8.992	0.004	0
	Cu(CO3)2-	4.58E-11	2.23E-11	-10.34	-10.652	-0.312	0
	CuOH+	3.78E-11	3.15E-11	-10.422	-10.502	-0.08	0
	Cu+2	2.13E-11	1.09E-11	-10.672	-10.962	-0.29	-26.17
	CuHCO3+	8.42E-12	7.04E-12	-11.075	-11.153	-0.078	0
	CuSO4	2.18E-12	2.20E-12	-11.662	-11.658	0.004	13.09
	CuCl+	7.00E-13	5.82E-13	-12.155	-12.235	-0.08	0.8
	Cu(OH)3-	3.94E-13	3.29E-13	-12.405	-12.483	-0.078	0
	CuF+	1.19E-14	9.90E-15	-13.926	-14.004	-0.078	0
	CuCl2	6.13E-15	6.19E-15	-14.212	-14.208	0.004	31.02
	Cu2(OH)2+	8.90E-16	4.34E-16	-15.051	-15.363	-0.312	0
	Cu(OH)4-2	3.88E-17	1.89E-17	-16.411	-16.723	-0.312	0
	CuCl3-	5.23E-19	4.35E-19	-18.282	-18.362	-0.08	0
	CuCl4-2	8.68E-23	4.31E-23	-22.061	-22.365	-0.304	0
F	7.00E-05						
	F-	6.01E-05	4.98E-05	-4.221	-4.303	-0.082	-1.16
	MgF+	9.34E-06	7.80E-06	-5.03	-5.108	-0.078	-10.46
	NaF	5.43E-07	5.48E-07	-6.265	-6.261	0.004	7.26
	HF	2.57E-10	2.59E-10	-9.591	-9.587	0.004	12.5
	ZnF+	1.57E-11	1.31E-11	-10.804	-10.882	-0.078	0
	MnF+	3.30E-12	2.77E-12	-11.482	-11.558	-0.076	0
	HF2-	5.92E-14	4.95E-14	-13.228	-13.306	-0.078	22.22
	FeF+	1.21E-14	1.01E-14	-13.919	-13.997	-0.078	0
	CuF+	1.19E-14	9.90E-15	-13.926	-14.004	-0.078	0
	FeF2+	3.60E-18	3.02E-18	-17.444	-17.52	-0.076	0
	FeF+2	3.07E-18	1.53E-18	-17.513	-17.817	-0.304	0
	FeF3	2.36E-19	2.38E-19	-18.627	-18.623	0.004	0
Fe(2)	5.73E-11						
	Fe+2	3.94E-11	2.02E-11	-10.404	-10.694	-0.29	-21.69
	FeCO3	8.36E-12	8.43E-12	-11.078	-11.074	0.004	0
	FeSO4	3.52E-12	3.55E-12	-11.454	-11.45	0.004	18.97
	FeHCO3+	3.11E-12	2.60E-12	-11.507	-11.585	-0.078	0
	FeOH+	2.20E-12	1.84E-12	-11.658	-11.734	-0.076	0
	FeCl+	6.62E-13	5.53E-13	-12.179	-12.257	-0.078	0
	FeF+	1.21E-14	1.01E-14	-13.919	-13.997	-0.078	0
	Fe(OH)2	4.48E-15	4.52E-15	-14.349	-14.345	0.004	0
	Fe(OH)3-	5.76E-17	4.84E-17	-16.239	-16.315	-0.076	0
	FeHSO4+	9.67E-20	8.08E-20	-19.014	-19.092	-0.078	0
Fe(3)	1.70E-07						
	Fe(OH)3	1.26E-07	1.27E-07	-6.899	-6.895	0.004	0
	Fe(OH)4-	3.97E-08	3.35E-08	-7.401	-7.476	-0.074	0
	Fe(OH)2+	4.07E-09	3.43E-09	-8.39	-8.465	-0.074	0

	FeOH+2	7.23E-14	3.60E-14	-13.141	-13.444	-0.304	0
	FeF2+	3.60E-18	3.02E-18	-17.444	-17.52	-0.076	0
	FeF+2	3.07E-18	1.53E-18	-17.513	-17.817	-0.304	0
	FeSO4+	2.49E-19	2.09E-19	-18.604	-18.68	-0.076	0
	FeF3	2.36E-19	2.38E-19	-18.627	-18.623	0.004	0
	Fe+3	7.21E-20	1.93E-20	-19.142	-19.714	-0.572	0
	FeCl+2	2.33E-20	1.16E-20	-19.634	-19.937	-0.304	0
	Fe(SO4)2-	5.39E-21	4.50E-21	-20.268	-20.346	-0.078	0
	FeCl2+	1.22E-21	1.02E-21	-20.915	-20.991	-0.076	0
	FeCl3	2.00E-24	2.02E-24	-23.698	-23.694	0.004	0
	Fe2(OH)2+	6.16E-25	3.48E-26	-24.21	-25.459	-1.248	0
	FeHSO4+2	3.98E-27	1.94E-27	-26.4	-26.712	-0.312	0
	Fe3(OH)4+	2.22E-30	2.49E-32	-29.653	-31.603	-1.951	0
H(0)	1.69E-28						
	H2	8.44E-29	8.51E-29	-28.074	-28.07	0.004	28.61
K	3.30E-04						
	K+	3.28E-04	2.72E-04	-3.484	-3.566	-0.081	9.15
	KSO4-	2.23E-06	1.88E-06	-5.651	-5.725	-0.074	34.26
Mg	5.25E-03						
	Mg+2	4.61E-03	2.37E-03	-2.336	-2.625	-0.289	-21.37
	MgSO4	5.43E-04	5.48E-04	-3.265	-3.261	0.004	5.84
	MgHCO3+	4.29E-05	3.57E-05	-4.368	-4.448	-0.08	5.6
	MgCO3	3.90E-05	3.93E-05	-4.409	-4.405	0.004	-17.09
	MgF+	9.34E-06	7.80E-06	-5.03	-5.108	-0.078	-10.46
	MgOH+	2.92E-06	2.48E-06	-5.534	-5.605	-0.071	0
Mn(2)	3.00E-08						
	Mn+2	1.57E-08	8.04E-09	-7.805	-8.095	-0.29	-18.92
	MnCO3	1.10E-08	1.11E-08	-7.959	-7.955	0.004	0
	MnSO4	1.40E-09	1.41E-09	-8.855	-8.851	0.004	22.54
	MnHCO3+	1.10E-09	9.20E-10	-8.96	-9.036	-0.076	0
	MnCl+	7.72E-10	6.48E-10	-9.112	-9.188	-0.076	-2.98
	MnOH+	7.09E-11	5.95E-11	-10.149	-10.225	-0.076	0
	MnCl2	5.55E-12	5.60E-12	-11.256	-11.252	0.004	85.89
	MnF+	3.30E-12	2.77E-12	-11.482	-11.558	-0.076	0
	MnCl3-	3.64E-14	3.05E-14	-13.439	-13.515	-0.076	43.6
	Mn(NO3)2	1.94E-17	1.96E-17	-16.713	-16.709	0.004	41.04
	Mn(OH)3-	3.63E-18	3.05E-18	-17.44	-17.516	-0.076	0
Mn(3)	9.26E-30						
	Mn+3	9.26E-30	2.48E-30	-29.033	-29.605	-0.572	0
N(-3)	4.00E-06						
	NH4+	3.49E-06	2.86E-06	-5.457	-5.544	-0.087	18.09
	NH3	4.66E-07	4.70E-07	-6.332	-6.328	0.004	24.42
	NH4SO4-	4.35E-08	3.63E-08	-7.362	-7.44	-0.078	37.86
N(5)	3.00E-05						
	NO3-	3.00E-05	2.47E-05	-4.523	-4.607	-0.084	29.65
	Mn(NO3)2	1.94E-17	1.96E-17	-16.713	-16.709	0.004	41.04
Na	2.29E-02						
	Na+	2.28E-02	1.91E-02	-1.642	-1.718	-0.076	-1.25
	NaSO4-	1.12E-04	9.45E-05	-3.95	-4.025	-0.074	15.2
	NaHCO3	1.37E-05	1.38E-05	-4.863	-4.859	0.004	1.8

	NaCO3-	7.41E-06	6.19E-06	-5.13	-5.208	-0.078	-0.7
	NaF	5.43E-07	5.48E-07	-6.265	-6.261	0.004	7.26
	NaOH	5.53E-18	5.58E-18	-17.257	-17.253	0.004	0
O(0)	1.14E-36						
	O2	5.69E-37	5.74E-37	-36.245	-36.241	0.004	30.4
S(6)	2.70E-03						
	SO4-2	1.99E-03	9.86E-04	-2.701	-3.006	-0.305	15.14
	MgSO4	5.43E-04	5.48E-04	-3.265	-3.261	0.004	5.84
	NaSO4-	1.12E-04	9.45E-05	-3.95	-4.025	-0.074	15.2
	CaSO4	5.12E-05	5.17E-05	-4.291	-4.287	0.004	7.5
	KSO4-	2.23E-06	1.88E-06	-5.651	-5.725	-0.074	34.26
	BaSO4	2.46E-07	2.48E-07	-6.61	-6.606	0.004	0
	NH4SO4-	4.35E-08	3.63E-08	-7.362	-7.44	-0.078	37.86
	ZnSO4	4.27E-09	4.31E-09	-8.369	-8.365	0.004	21.71
	MnSO4	1.40E-09	1.41E-09	-8.855	-8.851	0.004	22.54
	HSO4-	3.98E-10	3.32E-10	-9.4	-9.478	-0.078	40.43
	Zn(SO4)2-2	7.09E-11	3.45E-11	-10.15	-10.462	-0.312	-12.23
	FeSO4	3.52E-12	3.55E-12	-11.454	-11.45	0.004	18.97
	CuSO4	2.18E-12	2.20E-12	-11.662	-11.658	0.004	13.09
	CaHSO4+	1.41E-12	1.18E-12	-11.851	-11.929	-0.078	0
	FeSO4+	2.49E-19	2.09E-19	-18.604	-18.68	-0.076	0
	FeHSO4+	9.67E-20	8.08E-20	-19.014	-19.092	-0.078	0
	Fe(SO4)2-	5.39E-21	4.50E-21	-20.268	-20.346	-0.078	0
	FeHSO4+2	3.98E-27	1.94E-27	-26.4	-26.712	-0.312	0
Zn	1.90E-07						
	ZnCO3	6.41E-08	6.47E-08	-7.193	-7.189	0.004	0
	Zn(CO3)2-2	4.93E-08	2.40E-08	-7.307	-7.619	-0.312	0
	Zn+2	3.75E-08	1.87E-08	-7.425	-7.729	-0.304	-24.91
	Zn(OH)2	1.93E-08	1.95E-08	-7.714	-7.71	0.004	0
	ZnOH+	7.05E-09	5.89E-09	-8.152	-8.23	-0.078	0
	ZnSO4	4.27E-09	4.31E-09	-8.369	-8.365	0.004	21.71
	ZnHCO3+	3.61E-09	3.02E-09	-8.442	-8.52	-0.078	0
	ZnOHCl	3.49E-09	3.52E-09	-8.457	-8.453	0.004	0
	ZnCl+	1.20E-09	9.94E-10	-8.923	-9.003	-0.08	-13.92
	Zn(SO4)2-2	7.09E-11	3.45E-11	-10.15	-10.462	-0.312	-12.23
	Zn(OH)3-	2.13E-11	1.78E-11	-10.672	-10.75	-0.078	0
	ZnCl2	2.04E-11	2.06E-11	-10.69	-10.686	0.004	102.03
	ZnF+	1.57E-11	1.31E-11	-10.804	-10.882	-0.078	0
	ZnCl3-	5.50E-13	4.58E-13	-12.26	-12.339	-0.08	16.84
	ZnCl4-2	9.14E-15	4.54E-15	-14.039	-14.343	-0.304	145.91
	Zn(OH)4-2	1.66E-15	8.11E-16	-14.779	-15.091	-0.312	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-2.26	-6.54	-4.28	CaSO4			
Aragonite	0.05	-8.29	-8.34	CaCO3			
Barite	0.54	-9.31	-9.84	BaSO4			
Calcite	0.19	-8.29	-8.48	CaCO3			

CO2(g)	-3.53	-5	-1.47	CO2
Dolomite	1.41	-15.68	-17.08	CaMg(CO3)2
Fe(OH)3(a)	0.77	5.66	4.89	Fe(OH)3
Fluorite	-1.54	-12.14	-10.6	CaF2
Goethite	6.67	5.67	-1	FeOOH
Gypsum	-1.96	-6.54	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-4.99	-3.42	1.57	NaCl
Hausmann	-9.64	51.39	61.03	Mn3O4
Hematite	15.34	11.33	-4.01	Fe2O3
Jarosite-K	-8.75	-17.96	-9.21	KFe3(SO4)2(OH)6
Manganite	-4.06	21.28	25.34	MnOOH
Melanterit	-11.49	-13.7	-2.21	FeSO4:7H2O
NH3(g)	-8.12	-6.33	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.38	8.82	15.2	Mn(OH)2
Pyrolusite	-7.64	33.74	41.38	MnO2:H2O
Rhodochrc	-1.72	-12.85	-11.13	MnCO3
Siderite	-4.56	-15.45	-10.89	FeCO3
Smithsonit	-2.49	-12.49	-10	ZnCO3
Sylvite	-6.17	-5.27	0.9	KCl
Witherite	-2.5	-11.06	-8.56	BaCO3
Zn(OH)2(e	-2.31	9.19	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 3

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	2.82E-03	2.82E-03
Ba	5.10E-07	5.10E-07
Ca	1.03E-03	1.03E-03
Cl	3.79E-02	3.79E-02
Cu	3.00E-08	3.00E-08
F	1.10E-04	1.10E-04
Fe	2.70E-07	2.70E-07
K	5.20E-04	5.20E-04
Mg	8.34E-03	8.34E-03
Mn	5.00E-08	5.00E-08
N(-3)	6.00E-06	6.00E-06
N(5)	5.00E-05	5.00E-05
Na	3.64E-02	3.64E-02
S(6)	4.29E-03	4.29E-03
Zn	3.00E-07	3.00E-07

#NAME? of solution----------

pH	=	8.46		
pe	=	4		
Specific	Conductan	(µS/cm,	25°C)	= 5230
Density	(g/cm³)	=	0.99946	
Volume	(L)	=	1.00357	
Activity	of	water	=	0.998
Ionic	strength	(mol/kgw)	=	6.09E-02
Mass	of	water	(kg)	= 1.00E+00
Total	carbon	(mol/kg)	=	2.65E-03
Total	CO2	(mol/kg)	=	2.65E-03
Temperatu	(°C)	=	25	
Electrical	balance	(eq)	=	6.28E-03
Percent	error,	100*(Cat-|	=	6.31
Iterations	=	8	(22	overall)
Total	H	=	1.11E+02	
Total	O	=	5.55E+01	

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4327	0.2622		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	3.65E-06	2.92E-06	-5.437	-5.535	-0.098	-3.84
H+	4.10E-09	3.47E-09	-8.387	-8.46	-0.073	0
H2O	5.55E+01	9.99E-01	1.744	-0.001	0	18.07
Ba	5.10E-07					
Ba+2	3.96E-07	1.69E-07	-6.402	-6.773	-0.371	-12.15
BaSO4	1.08E-07	1.09E-07	-6.967	-6.961	0.006	0
BaHCO3+	3.80E-09	3.08E-09	-8.42	-8.512	-0.092	0
BaCO3	2.21E-09	2.24E-09	-8.655	-8.649	0.006	-10.7
BaOH+	2.02E-12	1.65E-12	-11.694	-11.784	-0.09	0
C(4)	2.65E-03					
HCO3-	2.33E-03	1.90E-03	-2.633	-2.72	-0.088	25.02
MgHCO3+	9.15E-05	7.35E-05	-4.038	-4.134	-0.095	5.62
MgCO3	8.00E-05	8.11E-05	-4.097	-4.091	0.006	-17.09
CO3-2	5.77E-05	2.57E-05	-4.239	-4.589	-0.35	-4.43
NaHCO3	3.11E-05	3.15E-05	-4.508	-4.502	0.006	1.8
NaCO3-	1.74E-05	1.41E-05	-4.759	-4.851	-0.092	-0.54
CaCO3	1.74E-05	1.76E-05	-4.76	-4.754	0.006	-14.6
CO2	1.47E-05	1.49E-05	-4.834	-4.828	0.006	34.43
CaHCO3+	1.20E-05	9.89E-06	-4.92	-5.005	-0.085	9.81
Zn(CO3)2-2	1.21E-07	5.19E-08	-6.918	-7.285	-0.367	0

	ZnCO3	9.30E-08	9.43E-08	-7.031	-7.025	0.006	0
	MnCO3	2.10E-08	2.13E-08	-7.677	-7.671	0.006	0
	ZnHCO3+	5.43E-09	4.40E-09	-8.265	-8.356	-0.092	0
	BaHCO3+	3.80E-09	3.08E-09	-8.42	-8.512	-0.092	0
	BaCO3	2.21E-09	2.24E-09	-8.655	-8.649	0.006	-10.7
	MnHCO3+	2.17E-09	1.77E-09	-8.663	-8.752	-0.09	0
	CuCO3	2.17E-09	2.20E-09	-8.663	-8.657	0.006	0
	Cu(CO3)2-	1.66E-10	7.14E-11	-9.78	-10.146	-0.367	0
	FeCO3	1.95E-11	1.98E-11	-10.709	-10.703	0.006	0
	CuHCO3+	1.88E-11	1.52E-11	-10.727	-10.818	-0.092	0
	FeHCO3+	7.54E-12	6.10E-12	-11.123	-11.214	-0.092	0
	(CO2)2	4.00E-12	4.05E-12	-11.398	-11.392	0.006	68.87
Ca	1.03E-03						
	Ca+2	9.08E-04	4.07E-04	-3.042	-3.39	-0.348	-17.57
	CaSO4	9.25E-05	9.38E-05	-4.034	-4.028	0.006	7.5
	CaCO3	1.74E-05	1.76E-05	-4.76	-4.754	0.006	-14.6
	CaHCO3+	1.20E-05	9.89E-06	-4.92	-5.005	-0.085	9.81
	CaOH+	2.40E-08	1.95E-08	-7.619	-7.711	-0.092	0
	CaHSO4+	2.64E-12	2.14E-12	-11.578	-11.67	-0.092	0
Cl	3.79E-02						
	Cl-	3.79E-02	3.04E-02	-1.422	-1.518	-0.096	18.28
	ZnOHCl	5.24E-09	5.31E-09	-8.281	-8.275	0.006	0
	ZnCl+	1.87E-09	1.50E-09	-8.729	-8.824	-0.095	-13.97
	MnCl+	1.58E-09	1.29E-09	-8.8	-8.89	-0.09	-2.95
	CuCl2-	3.03E-10	2.43E-10	-9.519	-9.614	-0.095	0
	ZnCl2	4.70E-11	4.77E-11	-10.328	-10.322	0.006	102.03
	CuCl3-2	2.67E-11	1.17E-11	-10.573	-10.932	-0.358	0
	MnCl2	1.68E-11	1.71E-11	-10.774	-10.768	0.006	85.89
	ZnCl3-	2.02E-12	1.62E-12	-11.695	-11.79	-0.095	16.72
	FeCl+	1.66E-12	1.34E-12	-11.78	-11.872	-0.092	0
	CuCl+	1.62E-12	1.30E-12	-11.791	-11.886	-0.095	0.86
	MnCl3-	1.75E-13	1.43E-13	-12.756	-12.846	-0.09	43.7
	ZnCl4-2	5.63E-14	2.47E-14	-13.249	-13.608	-0.358	146.17
	CuCl2	2.09E-14	2.12E-14	-13.68	-13.674	0.006	31.02
	CuCl3-	2.84E-18	2.28E-18	-17.546	-17.642	-0.095	0
	FeCl+2	6.40E-20	2.81E-20	-19.194	-19.552	-0.358	0
	FeCl2+	4.67E-21	3.80E-21	-20.33	-20.42	-0.09	0
	CuCl4-2	7.92E-22	3.47E-22	-21.101	-21.459	-0.358	0
	FeCl3	1.14E-23	1.15E-23	-22.944	-22.938	0.006	0
Cu(1)	3.31E-10						
	CuCl2-	3.03E-10	2.43E-10	-9.519	-9.614	-0.095	0
	CuCl3-2	2.67E-11	1.17E-11	-10.573	-10.932	-0.358	0
	Cu+	1.06E-12	8.36E-13	-11.973	-12.078	-0.105	0
Cu(2)	2.97E-08						
	Cu(OH)2	2.72E-08	2.76E-08	-7.565	-7.559	0.006	0
	CuCO3	2.17E-09	2.20E-09	-8.663	-8.657	0.006	0
	Cu(CO3)2-	1.66E-10	7.14E-11	-9.78	-10.146	-0.367	0
	CuOH+	5.71E-11	4.59E-11	-10.243	-10.338	-0.095	0
	Cu+2	3.48E-11	1.59E-11	-10.459	-10.798	-0.339	-26.07
	CuHCO3+	1.88E-11	1.52E-11	-10.727	-10.818	-0.092	0

	CuSO4	4.15E-12	4.21E-12	-11.382	-11.376	0.006	13.09
	CuCl+	1.62E-12	1.30E-12	-11.791	-11.886	-0.095	0.86
	Cu(OH)3-	5.91E-13	4.79E-13	-12.228	-12.32	-0.092	0
	CuF+	2.56E-14	2.07E-14	-13.592	-13.684	-0.092	0
	CuCl2	2.09E-14	2.12E-14	-13.68	-13.674	0.006	31.02
	Cu2(OH)2+	2.14E-15	9.21E-16	-14.669	-15.036	-0.367	0
	Cu(OH)4-2	6.40E-17	2.75E-17	-16.194	-16.56	-0.367	0
	CuCl3-	2.84E-18	2.28E-18	-17.546	-17.642	-0.095	0
	CuCl4-2	7.92E-22	3.47E-22	-21.101	-21.459	-0.358	0
F	1.10E-04						
	F-	8.95E-05	7.14E-05	-4.048	-4.146	-0.098	-1.11
	MgF+	1.93E-05	1.56E-05	-4.715	-4.807	-0.092	-10.43
	NaF	1.19E-06	1.21E-06	-5.924	-5.917	0.006	7.26
	HF	3.66E-10	3.72E-10	-9.436	-9.43	0.006	12.5
	ZnF+	2.29E-11	1.85E-11	-10.64	-10.732	-0.092	0
	MnF+	6.33E-12	5.15E-12	-11.198	-11.288	-0.09	0
	HF2-	1.26E-13	1.02E-13	-12.9	-12.992	-0.092	22.26
	FeF+	2.83E-14	2.29E-14	-13.548	-13.64	-0.092	0
	CuF+	2.56E-14	2.07E-14	-13.592	-13.684	-0.092	0
	FeF2+	1.21E-17	9.86E-18	-16.917	-17.006	-0.09	0
	FeF+2	7.91E-18	3.47E-18	-17.102	-17.46	-0.358	0
	FeF3	1.10E-18	1.12E-18	-17.958	-17.952	0.006	0
Fe(2)	1.10E-10						
	Fe+2	6.99E-11	3.21E-11	-10.155	-10.494	-0.339	-21.59
	FeCO3	1.95E-11	1.98E-11	-10.709	-10.703	0.006	0
	FeHCO3+	7.54E-12	6.10E-12	-11.123	-11.214	-0.092	0
	FeSO4	7.28E-12	7.38E-12	-11.138	-11.132	0.006	18.97
	FeOH+	3.59E-12	2.92E-12	-11.445	-11.535	-0.09	0
	FeCl+	1.66E-12	1.34E-12	-11.78	-11.872	-0.092	0
	FeF+	2.83E-14	2.29E-14	-13.548	-13.64	-0.092	0
	Fe(OH)2	7.06E-15	7.16E-15	-14.151	-14.145	0.006	0
	Fe(OH)3-	9.41E-17	7.66E-17	-16.026	-16.116	-0.09	0
	FeHSO4+	2.08E-19	1.68E-19	-18.682	-18.774	-0.092	0
Fe(3)	2.70E-07						
	Fe(OH)3	1.99E-07	2.01E-07	-6.702	-6.696	0.006	0
	Fe(OH)4-	6.47E-08	5.29E-08	-7.189	-7.277	-0.088	0
	Fe(OH)2+	6.64E-09	5.43E-09	-8.178	-8.265	-0.088	0
	FeOH+2	1.30E-13	5.69E-14	-12.886	-13.245	-0.358	0
	FeF2+	1.21E-17	9.86E-18	-16.917	-17.006	-0.09	0
	FeF+2	7.91E-18	3.47E-18	-17.102	-17.46	-0.358	0
	FeF3	1.10E-18	1.12E-18	-17.958	-17.952	0.006	0
	FeSO4+	5.34E-19	4.35E-19	-18.272	-18.362	-0.09	0
	Fe+3	1.38E-19	3.06E-20	-18.859	-19.514	-0.655	0
	FeCl+2	6.40E-20	2.81E-20	-19.194	-19.552	-0.358	0
	Fe(SO4)2-	1.52E-20	1.23E-20	-19.818	-19.91	-0.092	0
	FeCl2+	4.67E-21	3.80E-21	-20.33	-20.42	-0.09	0
	FeCl3	1.14E-23	1.15E-23	-22.944	-22.938	0.006	0
	Fe2(OH)2+	2.55E-24	8.72E-26	-23.593	-25.059	-1.466	0
	FeHSO4+2	9.39E-27	4.04E-27	-26.028	-26.394	-0.367	0
	Fe3(OH)4+	1.93E-29	9.89E-32	-28.714	-31.005	-2.291	0

H(0)	1.68E-28						
	H2	8.39E-29	8.51E-29	-28.076	-28.07	0.006	28.61
K	5.20E-04						
	K+	5.15E-04	4.12E-04	-3.288	-3.385	-0.097	9.19
	KSO4-	4.59E-06	3.75E-06	-5.338	-5.426	-0.088	34.31
Mg	8.34E-03						
	Mg+2	7.16E-03	3.30E-03	-2.145	-2.481	-0.336	-21.27
	MgSO4	9.88E-04	1.00E-03	-3.005	-2.999	0.006	5.84
	MgHCO3+	9.15E-05	7.35E-05	-4.038	-4.134	-0.095	5.62
	MgCO3	8.00E-05	8.11E-05	-4.097	-4.091	0.006	-17.09
	MgF+	1.93E-05	1.56E-05	-4.715	-4.807	-0.092	-10.43
	MgOH+	4.17E-06	3.45E-06	-5.38	-5.462	-0.082	0
Mn(2)	5.00E-08						
	Mn+2	2.27E-08	1.04E-08	-7.643	-7.982	-0.339	-18.57
	MnCO3	2.10E-08	2.13E-08	-7.677	-7.671	0.006	0
	MnSO4	2.37E-09	2.40E-09	-8.626	-8.62	0.006	22.54
	MnHCO3+	2.17E-09	1.77E-09	-8.663	-8.752	-0.09	0
	MnCl+	1.58E-09	1.29E-09	-8.8	-8.89	-0.09	-2.95
	MnOH+	9.48E-11	7.72E-11	-10.023	-10.113	-0.09	0
	MnCl2	1.68E-11	1.71E-11	-10.774	-10.768	0.006	85.89
	MnF+	6.33E-12	5.15E-12	-11.198	-11.288	-0.09	0
	MnCl3-	1.75E-13	1.43E-13	-12.756	-12.846	-0.09	43.7
	Mn(NO3)2	6.42E-17	6.51E-17	-16.193	-16.186	0.006	41.04
	Mn(OH)3-	4.85E-18	3.95E-18	-17.314	-17.404	-0.09	0
Mn(3)	1.46E-29						
	Mn+3	1.46E-29	3.22E-30	-28.837	-29.492	-0.655	0
N(-3)	6.00E-06						
	NH4+	5.25E-06	4.12E-06	-5.28	-5.385	-0.105	18.13
	NH3	6.68E-07	6.78E-07	-6.175	-6.169	0.006	24.42
	NH4SO4-	8.49E-08	6.88E-08	-7.071	-7.163	-0.092	37.96
N(5)	5.00E-05						
	NO3-	5.00E-05	3.96E-05	-4.301	-4.402	-0.101	29.7
	Mn(NO3)2	6.42E-17	6.51E-17	-16.193	-16.186	0.006	41.04
Na	3.64E-02						
	Na+	3.62E-02	2.94E-02	-1.442	-1.531	-0.09	-1.18
	NaSO4-	2.34E-04	1.91E-04	-3.632	-3.719	-0.088	15.66
	NaHCO3	3.11E-05	3.15E-05	-4.508	-4.502	0.006	1.8
	NaCO3-	1.74E-05	1.41E-05	-4.759	-4.851	-0.092	-0.54
	NaF	1.19E-06	1.21E-06	-5.924	-5.917	0.006	7.26
	NaOH	8.46E-18	8.57E-18	-17.073	-17.067	0.006	0
O(0)	1.13E-36						
	O2	5.66E-37	5.74E-37	-36.247	-36.241	0.006	30.4
S(6)	4.29E-03						
	SO4-2	2.97E-03	1.30E-03	-2.527	-2.888	-0.361	15.32
	MgSO4	9.88E-04	1.00E-03	-3.005	-2.999	0.006	5.84
	NaSO4-	2.34E-04	1.91E-04	-3.632	-3.719	-0.088	15.66
	CaSO4	9.25E-05	9.38E-05	-4.034	-4.028	0.006	7.5
	KSO4-	4.59E-06	3.75E-06	-5.338	-5.426	-0.088	34.31
	BaSO4	1.08E-07	1.09E-07	-6.967	-6.961	0.006	0
	NH4SO4-	8.49E-08	6.88E-08	-7.071	-7.163	-0.092	37.96

	ZnSO4	5.50E-09	5.58E-09	-8.26	-8.254	0.006	21.71
	MnSO4	2.37E-09	2.40E-09	-8.626	-8.62	0.006	22.54
	HSO4-	5.39E-10	4.37E-10	-9.268	-9.36	-0.092	40.47
	Zn(SO4)2-2	1.36E-10	5.87E-11	-9.865	-10.232	-0.367	-11.88
	FeSO4	7.28E-12	7.38E-12	-11.138	-11.132	0.006	18.97
	CuSO4	4.15E-12	4.21E-12	-11.382	-11.376	0.006	13.09
	CaHSO4+	2.64E-12	2.14E-12	-11.578	-11.67	-0.092	0
	FeSO4+	5.34E-19	4.35E-19	-18.272	-18.362	-0.09	0
	FeHSO4+	2.08E-19	1.68E-19	-18.682	-18.774	-0.092	0
	Fe(SO4)2-	1.52E-20	1.23E-20	-19.818	-19.91	-0.092	0
	FeHSO4+2	9.39E-27	4.04E-27	-26.028	-26.394	-0.367	0
Zn	3.00E-07						
	Zn(CO3)2-2	1.21E-07	5.19E-08	-6.918	-7.285	-0.367	0
	ZnCO3	9.30E-08	9.43E-08	-7.031	-7.025	0.006	0
	Zn+2	4.19E-08	1.84E-08	-7.378	-7.736	-0.358	-24.81
	Zn(OH)2	1.89E-08	1.92E-08	-7.723	-7.717	0.006	0
	ZnOH+	7.16E-09	5.80E-09	-8.145	-8.237	-0.092	0
	ZnSO4	5.50E-09	5.58E-09	-8.26	-8.254	0.006	21.71
	ZnHCO3+	5.43E-09	4.40E-09	-8.265	-8.356	-0.092	0
	ZnOHCl	5.24E-09	5.31E-09	-8.281	-8.275	0.006	0
	ZnCl+	1.87E-09	1.50E-09	-8.729	-8.824	-0.095	-13.97
	Zn(SO4)2-2	1.36E-10	5.87E-11	-9.865	-10.232	-0.367	-11.88
	ZnCl2	4.70E-11	4.77E-11	-10.328	-10.322	0.006	102.03
	ZnF+	2.29E-11	1.85E-11	-10.64	-10.732	-0.092	0
	Zn(OH)3-	2.16E-11	1.75E-11	-10.666	-10.758	-0.092	0
	ZnCl3-	2.02E-12	1.62E-12	-11.695	-11.79	-0.095	16.72
	ZnCl4-2	5.63E-14	2.47E-14	-13.249	-13.608	-0.358	146.17
	Zn(OH)4-2	1.85E-15	7.97E-16	-14.732	-15.099	-0.367	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-2	-6.28	-4.28	CaSO4			
Aragonite	0.36	-7.98	-8.34	CaCO3			
Barite	0.18	-9.66	-9.84	BaSO4			
Calcite	0.5	-7.98	-8.48	CaCO3			
CO2(g)	-3.36	-4.83	-1.47	CO2			
Dolomite	2.03	-15.05	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	0.97	5.86	4.89	Fe(OH)3			
Fluorite	-1.08	-11.68	-10.6	CaF2			
Goethite	6.86	5.86	-1	FeOOH			
Gypsum	-1.7	-6.28	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-4.62	-3.05	1.57	NaCl			
Hausmann	-9.3	51.73	61.03	Mn3O4			
Hematite	15.74	11.73	-4.01	Fe2O3			
Jarosite-K	-7.74	-16.95	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.94	21.4	25.34	MnOOH			

Melanterit	-11.18	-13.39	-2.21	FeSO4:7H2O
NH3(g)	-7.97	-6.17	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.26	8.94	15.2	Mn(OH)2
Pyrolusite	-7.52	33.86	41.38	MnO2:H2O
Rhodochrc	-1.44	-12.57	-11.13	MnCO3
Siderite	-4.19	-15.08	-10.89	FeCO3
Smithsonit	-2.33	-12.33	-10	ZnCO3
Sylvite	-5.8	-4.9	0.9	KCl
Witherite	-2.8	-11.36	-8.56	BaCO3
Zn(OH)2(e	-2.32	9.18	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 4

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	3.86E-03	3.86E-03
Ba	6.00E-07	6.00E-07
Ca	1.41E-03	1.41E-03
Cl	5.19E-02	5.19E-02
Cu	5.00E-08	5.00E-08
F	1.50E-04	1.50E-04
Fe	3.70E-07	3.70E-07
K	7.10E-04	7.10E-04
Mg	1.14E-02	1.14E-02
Mn	6.00E-08	6.00E-08
N(-3)	8.00E-06	8.00E-06
N(5)	7.00E-05	7.00E-05
Na	4.99E-02	4.99E-02
S(6)	5.88E-03	5.88E-03
Zn	4.10E-07	4.10E-07

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 6992
Density (g/cm³) = 1.00035
Volume (L) = 1.0038
Activity of water = 0.998
Ionic strength (mol/kgw) = 8.27E-02
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 3.60E-03
Total CO2 (mol/kg) = 3.60E-03
Temperatu (°C) = 25

```
Electrical balance (eq) = 8.60E-03
Percent error, 100*(Cat-|= 6.34
Iterations = 10 (32 overall)
Total H = 1.11E+02
Total O = 5.55E+01

#NAME? couples--------------------------------

Redox couple pe Eh (volts)

N(-3)/N(5) 4.4355 0.2624

#NAME? of species----------------------------

Log Log Log mole V
Species Molality Activity Molality Activity Gamma cm³/mol

OH- 3.76E-06 2.91E-06 -5.425 -5.536 -0.11 -3.78
H+ 4.16E-09 3.47E-09 -8.381 -8.46 -0.079 0
H2O 5.55E+01 9.98E-01 1.744 -0.001 0 18.07
Ba 6.00E-07
Ba+2 4.58E-07 1.77E-07 -6.34 -6.753 -0.413 -12.06
BaSO4 1.34E-07 1.37E-07 -6.872 -6.864 0.008 0
BaHCO3+ 5.28E-09 4.18E-09 -8.277 -8.379 -0.101 0
BaCO3 2.99E-09 3.05E-09 -8.524 -8.516 0.008 -10.7
BaOH+ 2.17E-12 1.72E-12 -11.664 -11.764 -0.1 0
C(4) 3.60E-03
HCO3- 3.09E-03 2.47E-03 -2.511 -2.608 -0.097 25.11
MgHCO3+ 1.52E-04 1.19E-04 -3.818 -3.925 -0.106 5.64
MgCO3 1.29E-04 1.31E-04 -3.89 -3.882 0.008 -17.09
CO3-2 8.17E-05 3.34E-05 -4.088 -4.477 -0.388 -4.27
NaHCO3 5.36E-05 5.47E-05 -4.271 -4.262 0.008 1.8
NaCO3- 3.09E-05 2.45E-05 -4.51 -4.611 -0.101 -0.4
CaCO3 2.78E-05 2.84E-05 -4.556 -4.548 0.008 -14.6
CaHCO3+ 1.98E-05 1.59E-05 -4.705 -4.798 -0.094 9.82
CO2 1.89E-05 1.93E-05 -4.723 -4.715 0.008 34.43
Zn(CO3)2-2 2.08E-07 8.18E-08 -6.682 -7.087 -0.405 0
ZnCO3 1.13E-07 1.15E-07 -6.949 -6.941 0.008 0
MnCO3 2.72E-08 2.77E-08 -7.565 -7.557 0.008 0
ZnHCO3+ 6.75E-09 5.35E-09 -8.171 -8.272 -0.101 0
BaHCO3+ 5.28E-09 4.18E-09 -8.277 -8.379 -0.101 0
CuCO3 4.53E-09 4.62E-09 -8.344 -8.335 0.008 0
BaCO3 2.99E-09 3.05E-09 -8.524 -8.516 0.008 -10.7
MnHCO3+ 2.89E-09 2.30E-09 -8.539 -8.638 -0.1 0
Cu(CO3)2- 4.93E-10 1.94E-10 -9.307 -9.712 -0.405 0
CuHCO3+ 4.02E-11 3.19E-11 -10.395 -10.497 -0.101 0
FeCO3 3.45E-11 3.52E-11 -10.462 -10.454 0.008 0
FeHCO3+ 1.37E-11 1.08E-11 -10.864 -10.965 -0.101 0
(CO2)2 6.69E-12 6.82E-12 -11.174 -11.166 0.008 68.87
Ca 1.41E-03
```

	Ca+2	1.23E-03	5.06E-04	-2.911	-3.296	-0.385	-17.49
	CaSO4	1.36E-04	1.39E-04	-3.866	-3.858	0.008	7.5
	CaCO3	2.78E-05	2.84E-05	-4.556	-4.548	0.008	-14.6
	CaHCO3+	1.98E-05	1.59E-05	-4.705	-4.798	-0.094	9.82
	CaOH+	3.05E-08	2.42E-08	-7.516	-7.617	-0.101	0
	CaHSO4+	3.99E-12	3.16E-12	-11.399	-11.5	-0.101	0
Cl	5.19E-02						
	Cl-	5.19E-02	4.05E-02	-1.285	-1.393	-0.108	18.31
	ZnOHCl	6.52E-09	6.64E-09	-8.186	-8.178	0.008	0
	ZnCl+	2.40E-09	1.88E-09	-8.62	-8.727	-0.106	-14.03
	MnCl+	2.17E-09	1.73E-09	-8.663	-8.763	-0.1	-2.94
	CuCl2-	8.96E-10	7.01E-10	-9.048	-9.154	-0.106	0
	CuCl3-2	1.13E-10	4.50E-11	-9.948	-10.347	-0.398	0
	ZnCl2	7.80E-11	7.95E-11	-10.108	-10.099	0.008	102.03
	MnCl2	2.99E-11	3.05E-11	-10.524	-10.516	0.008	85.89
	ZnCl3-	4.62E-12	3.61E-12	-11.336	-11.442	-0.106	16.59
	CuCl+	3.59E-12	2.81E-12	-11.445	-11.552	-0.106	0.91
	FeCl+	3.10E-12	2.45E-12	-11.509	-11.61	-0.101	0
	MnCl3-	4.28E-13	3.40E-13	-12.369	-12.468	-0.1	43.8
	ZnCl4-2	1.84E-13	7.33E-14	-12.736	-13.135	-0.398	146.39
	CuCl2	5.99E-14	6.11E-14	-13.222	-13.214	0.008	31.02
	CuCl3-	1.12E-17	8.77E-18	-16.95	-17.057	-0.106	0
	FeCl+2	1.28E-19	5.13E-20	-18.892	-19.29	-0.398	0
	FeCl2+	1.17E-20	9.28E-21	-19.933	-20.033	-0.1	0
	CuCl4-2	4.46E-21	1.78E-21	-20.351	-20.749	-0.398	0
	FeCl3	3.69E-23	3.76E-23	-22.434	-22.425	0.008	0
Cu(1)	1.01E-09						
	CuCl2-	8.96E-10	7.01E-10	-9.048	-9.154	-0.106	0
	CuCl3-2	1.13E-10	4.50E-11	-9.948	-10.347	-0.398	0
	Cu+	1.78E-12	1.35E-12	-11.75	-11.869	-0.119	0
Cu(2)	4.90E-08						
	Cu(OH)2	4.38E-08	4.46E-08	-7.359	-7.351	0.008	0
	CuCO3	4.53E-09	4.62E-09	-8.344	-8.335	0.008	0
	Cu(CO3)2-	4.93E-10	1.94E-10	-9.307	-9.712	-0.405	0
	CuOH+	9.48E-11	7.42E-11	-10.023	-10.13	-0.106	0
	Cu+2	6.10E-11	2.58E-11	-10.214	-10.589	-0.374	-26
	CuHCO3+	4.02E-11	3.19E-11	-10.395	-10.497	-0.101	0
	CuSO4	7.97E-12	8.12E-12	-11.099	-11.09	0.008	13.09
	CuCl+	3.59E-12	2.81E-12	-11.445	-11.552	-0.106	0.91
	Cu(OH)3-	9.77E-13	7.73E-13	-12.01	-12.112	-0.101	0
	CuCl2	5.99E-14	6.11E-14	-13.222	-13.214	0.008	31.02
	CuF+	5.36E-14	4.25E-14	-13.271	-13.372	-0.101	0
	Cu2(OH)2+	6.12E-15	2.41E-15	-14.213	-14.619	-0.405	0
	Cu(OH)4-2	1.13E-16	4.44E-17	-15.947	-16.353	-0.405	0
	CuCl3-	1.12E-17	8.77E-18	-16.95	-17.057	-0.106	0
	CuCl4-2	4.46E-21	1.78E-21	-20.351	-20.749	-0.398	0
F	1.50E-04						
	F-	1.17E-04	9.06E-05	-3.933	-4.043	-0.11	-1.07
	MgF+	3.13E-05	2.47E-05	-4.505	-4.608	-0.103	-10.41
	NaF	2.01E-06	2.05E-06	-5.696	-5.688	0.008	7.26

	HF	4.62E-10	4.71E-10	-9.335	-9.327	0.008	12.5
	ZnF+	2.78E-11	2.20E-11	-10.556	-10.657	-0.101	0
	MnF+	8.24E-12	6.55E-12	-11.084	-11.183	-0.1	0
	HF2-	2.07E-13	1.64E-13	-12.685	-12.786	-0.101	22.3
	CuF+	5.36E-14	4.25E-14	-13.271	-13.372	-0.101	0
	FeF+	5.02E-14	3.98E-14	-13.299	-13.4	-0.101	0
	FeF2+	2.73E-17	2.17E-17	-16.564	-16.663	-0.1	0
	FeF+2	1.51E-17	6.02E-18	-16.822	-17.22	-0.398	0
	FeF3	3.06E-18	3.12E-18	-17.515	-17.506	0.008	0
Fe(2)	1.72E-10						
	Fe+2	1.04E-10	4.39E-11	-9.983	-10.357	-0.374	-21.51
	FeCO3	3.45E-11	3.52E-11	-10.462	-10.454	0.008	0
	FeHCO3+	1.37E-11	1.08E-11	-10.864	-10.965	-0.101	0
	FeSO4	1.18E-11	1.21E-11	-10.927	-10.919	0.008	18.97
	FeOH+	5.03E-12	4.00E-12	-11.299	-11.398	-0.1	0
	FeCl+	3.10E-12	2.45E-12	-11.509	-11.61	-0.101	0
	FeF+	5.02E-14	3.98E-14	-13.299	-13.4	-0.101	0
	Fe(OH)2	9.61E-15	9.79E-15	-14.017	-14.009	0.008	0
	Fe(OH)3-	1.32E-16	1.05E-16	-15.881	-15.98	-0.1	0
	FeHSO4+	3.47E-19	2.75E-19	-18.46	-18.561	-0.101	0
Fe(3)	3.70E-07						
	Fe(OH)3	2.70E-07	2.75E-07	-6.568	-6.56	0.008	0
	Fe(OH)4-	9.04E-08	7.23E-08	-7.044	-7.141	-0.097	0
	Fe(OH)2+	9.29E-09	7.43E-09	-8.032	-8.129	-0.097	0
	FeOH+2	1.95E-13	7.79E-14	-12.71	-13.108	-0.398	0
	FeF2+	2.73E-17	2.17E-17	-16.564	-16.663	-0.1	0
	FeF+2	1.51E-17	6.02E-18	-16.822	-17.22	-0.398	0
	FeF3	3.06E-18	3.12E-18	-17.515	-17.506	0.008	0
	FeSO4+	8.93E-19	7.10E-19	-18.049	-18.149	-0.1	0
	Fe+3	2.17E-19	4.19E-20	-18.664	-19.377	-0.713	0
	FeCl+2	1.28E-19	5.13E-20	-18.892	-19.29	-0.398	0
	Fe(SO4)2-	3.03E-20	2.40E-20	-19.519	-19.62	-0.101	0
	FeCl2+	1.17E-20	9.28E-21	-19.933	-20.033	-0.1	0
	FeCl3	3.69E-23	3.76E-23	-22.434	-22.425	0.008	0
	Fe2(OH)2+	6.82E-24	1.64E-25	-23.166	-24.787	-1.62	0
	FeHSO4+2	1.67E-26	6.59E-27	-25.776	-26.181	-0.405	0
	Fe3(OH)4+	8.62E-29	2.54E-31	-28.064	-30.596	-2.531	0
H(0)	1.67E-28						
	H2	8.35E-29	8.51E-29	-28.078	-28.07	0.008	28.61
K	7.10E-04						
	K+	7.03E-04	5.47E-04	-3.153	-3.262	-0.109	9.22
	KSO4-	7.41E-06	5.93E-06	-5.13	-5.227	-0.097	34.35
Mg	1.14E-02						
	Mg+2	9.65E-03	4.12E-03	-2.015	-2.385	-0.37	-21.19
	MgSO4	1.46E-03	1.49E-03	-2.835	-2.827	0.008	5.84
	MgHCO3+	1.52E-04	1.19E-04	-3.818	-3.925	-0.106	5.64
	MgCO3	1.29E-04	1.31E-04	-3.89	-3.882	0.008	-17.09
	MgF+	3.13E-05	2.47E-05	-4.505	-4.608	-0.103	-10.41
	MgOH+	5.31E-06	4.31E-06	-5.275	-5.366	-0.091	0
Mn(2)	6.00E-08						

	MnCO3	2.72E-08	2.77E-08	-7.565	-7.557	0.008	0
	Mn+2	2.48E-08	1.05E-08	-7.606	-7.98	-0.374	-18.32
	MnHCO3+	2.89E-09	2.30E-09	-8.539	-8.638	-0.1	0
	MnSO4	2.82E-09	2.87E-09	-8.55	-8.542	0.008	22.54
	MnCl+	2.17E-09	1.73E-09	-8.663	-8.763	-0.1	-2.94
	MnOH+	9.73E-11	7.74E-11	-10.012	-10.111	-0.1	0
	MnCl2	2.99E-11	3.05E-11	-10.524	-10.516	0.008	85.89
	MnF+	8.24E-12	6.55E-12	-11.084	-11.183	-0.1	0
	MnCl3-	4.28E-13	3.40E-13	-12.369	-12.468	-0.1	43.8
	Mn(NO3)2	1.18E-16	1.21E-16	-15.927	-15.919	0.008	41.04
	Mn(OH)3-	4.97E-18	3.95E-18	-17.304	-17.403	-0.1	0
Mn(3)	1.67E-29						
	Mn+3	1.67E-29	3.23E-30	-28.777	-29.49	-0.713	0
N(-3)	8.00E-06						
	NH4+	7.01E-06	5.33E-06	-5.155	-5.273	-0.119	18.16
	NH3	8.60E-07	8.76E-07	-6.066	-6.057	0.008	24.42
	NH4SO4-	1.34E-07	1.06E-07	-6.873	-6.975	-0.101	38.05
N(5)	7.00E-05						
	NO3-	7.00E-05	5.38E-05	-4.155	-4.269	-0.114	29.74
	Mn(NO3)2	1.18E-16	1.21E-16	-15.927	-15.919	0.008	41.04
Na	4.99E-02						
	Na+	4.95E-02	3.94E-02	-1.306	-1.405	-0.099	-1.13
	NaSO4-	3.81E-04	3.05E-04	-3.419	-3.516	-0.097	16.04
	NaHCO3	5.36E-05	5.47E-05	-4.271	-4.262	0.008	1.8
	NaCO3-	3.09E-05	2.45E-05	-4.51	-4.611	-0.101	-0.4
	NaF	2.01E-06	2.05E-06	-5.696	-5.688	0.008	7.26
	NaOH	1.13E-17	1.15E-17	-16.949	-16.94	0.008	0
O(0)	1.12E-36						
	O2	5.62E-37	5.73E-37	-36.25	-36.242	0.008	30.4
S(6)	5.88E-03						
	SO4-2	3.89E-03	1.54E-03	-2.41	-2.812	-0.402	15.48
	MgSO4	1.46E-03	1.49E-03	-2.835	-2.827	0.008	5.84
	NaSO4-	3.81E-04	3.05E-04	-3.419	-3.516	-0.097	16.04
	CaSO4	1.36E-04	1.39E-04	-3.866	-3.858	0.008	7.5
	KSO4-	7.41E-06	5.93E-06	-5.13	-5.227	-0.097	34.35
	BaSO4	1.34E-07	1.37E-07	-6.872	-6.864	0.008	0
	NH4SO4-	1.34E-07	1.06E-07	-6.873	-6.975	-0.101	38.05
	ZnSO4	6.11E-09	6.23E-09	-8.214	-8.206	0.008	21.71
	MnSO4	2.82E-09	2.87E-09	-8.55	-8.542	0.008	22.54
	HSO4-	6.57E-10	5.20E-10	-9.183	-9.284	-0.101	40.51
	Zn(SO4)2-2	1.99E-10	7.81E-11	-9.702	-10.107	-0.405	-11.56
	FeSO4	1.18E-11	1.21E-11	-10.927	-10.919	0.008	18.97
	CuSO4	7.97E-12	8.12E-12	-11.099	-11.09	0.008	13.09
	CaHSO4+	3.99E-12	3.16E-12	-11.399	-11.5	-0.101	0
	FeSO4+	8.93E-19	7.10E-19	-18.049	-18.149	-0.1	0
	FeHSO4+	3.47E-19	2.75E-19	-18.46	-18.561	-0.101	0
	Fe(SO4)2-	3.03E-20	2.40E-20	-19.519	-19.62	-0.101	0
	FeHSO4+2	1.67E-26	6.59E-27	-25.776	-26.181	-0.405	0
Zn	4.10E-07						
	Zn(CO3)2-2	2.08E-07	8.18E-08	-6.682	-7.087	-0.405	0

ZnCO3	1.13E-07	1.15E-07	-6.949	-6.941	0.008	0
Zn+2	4.31E-08	1.72E-08	-7.366	-7.764	-0.398	-24.73
Zn(OH)2	1.76E-08	1.80E-08	-7.754	-7.746	0.008	0
ZnOH+	6.86E-09	5.43E-09	-8.164	-8.265	-0.101	0
ZnHCO3+	6.75E-09	5.35E-09	-8.171	-8.272	-0.101	0
ZnOHCl	6.52E-09	6.64E-09	-8.186	-8.178	0.008	0
ZnSO4	6.11E-09	6.23E-09	-8.214	-8.206	0.008	21.71
ZnCl+	2.40E-09	1.88E-09	-8.62	-8.727	-0.106	-14.03
Zn(SO4)2-2	1.99E-10	7.81E-11	-9.702	-10.107	-0.405	-11.56
ZnCl2	7.80E-11	7.95E-11	-10.108	-10.099	0.008	102.03
ZnF+	2.78E-11	2.20E-11	-10.556	-10.657	-0.101	0
Zn(OH)3-	2.06E-11	1.63E-11	-10.686	-10.787	-0.101	0
ZnCl3-	4.62E-12	3.61E-12	-11.336	-11.442	-0.106	16.59
ZnCl4-2	1.84E-13	7.33E-14	-12.736	-13.135	-0.398	146.39
Zn(OH)4-2	1.89E-15	7.45E-16	-14.723	-15.128	-0.405	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-1.83	-6.11	-4.28	CaSO4			
Aragonite	0.56	-7.77	-8.34	CaCO3			
Barite	0.28	-9.56	-9.84	BaSO4			
Calcite	0.71	-7.77	-8.48	CaCO3			
CO2(g)	-3.25	-4.71	-1.47	CO2			
Dolomite	2.45	-14.63	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.11	6	4.89	Fe(OH)3			
Fluorite	-0.78	-11.38	-10.6	CaF2			
Goethite	7	6	-1	FeOOH			
Gypsum	-1.53	-6.11	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-4.37	-2.8	1.57	NaCl			
Hausmann	-9.29	51.74	61.03	Mn3O4			
Hematite	16.01	12	-4.01	Fe2O3			
Jarosite-K	-7.05	-16.26	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.94	21.4	25.34	MnOOH			
Melanterit	-10.97	-13.18	-2.21	FeSO4:7H2O			
NH3(g)	-7.85	-6.06	1.8	NH3			
O2(g)	-33.35	-36.24	-2.89	O2			
Pyrochroit	-6.26	8.94	15.2	Mn(OH)2			
Pyrolusite	-7.52	33.86	41.38	MnO2:H2O			
Rhodochro	-1.33	-12.46	-11.13	MnCO3			
Siderite	-3.94	-14.83	-10.89	FeCO3			
Smithsonit	-2.24	-12.24	-10	ZnCO3			
Sylvite	-5.55	-4.65	0.9	KCl			
Witherite	-2.67	-11.23	-8.56	BaCO3			
Zn(OH)2(e	-2.35	9.15	11.5	Zn(OH)2			

**For a gas, SI = log10(fuga Fugacity = pressure *

```
For ideal gases, phi = 1

Initial solution 5

#NAME? composition-----------------------------

Elements Molality Moles

Alkalinity 4.80E-03 4.80E-03
Ba 3.55E-06 3.55E-06
Ca 1.76E-03 1.76E-03
Cl 6.45E-02 6.45E-02
Cu 6.00E-08 6.00E-08
F 1.80E-04 1.80E-04
Fe 4.60E-07 4.60E-07
K 8.80E-04 8.80E-04
Mg 1.42E-02 1.42E-02
Mn 8.00E-08 8.00E-08
N(-3) 1.00E-05 1.00E-05
N(5) 8.00E-05 8.00E-05
Na 6.21E-02 6.21E-02
S(6) 7.31E-03 7.31E-03
Zn 5.10E-07 5.10E-07

#NAME? of solution----------------------------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 8536
Density (g/cm³) = 1.00114
Volume (L) = 1.004
Activity of water = 0.997
Ionic strength (mol/kgw) = 1.02E-01
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 4.45E-03
Total CO2 (mol/kg) = 4.45E-03
Temperatu (°C) = 25
Electrical balance (eq) = 1.07E-02
Percent error, 100*(Cat-| = 6.38
Iterations = 9 (41 overall)
Total H = 1.11E+02
Total O = 5.55E+01

#NAME? couples--------------------------------

Redox couple pe Eh (volts)

N(-3)/N(5) 4.4307 0.2621

#NAME? of species----------------------------
```

	Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	3.83E-06	2.91E-06	-5.417	-5.536	-0.119	-3.73
	H+	4.21E-09	3.47E-09	-8.376	-8.46	-0.084	0
	H2O	5.55E+01	9.97E-01	1.744	-0.001	0	18.07
Ba	3.55E-06						
	Ba+2	2.68E-06	9.64E-07	-5.572	-6.016	-0.444	-11.99
	BaSO4	8.18E-07	8.38E-07	-6.087	-6.077	0.01	0
	BaHCO3+	3.48E-08	2.72E-08	-7.458	-7.566	-0.108	0
	BaCO3	1.93E-08	1.98E-08	-7.713	-7.703	0.01	-10.7
	BaOH+	1.20E-11	9.40E-12	-10.92	-11.027	-0.107	0
C(4)	4.45E-03						
	HCO3-	3.74E-03	2.94E-03	-2.428	-2.532	-0.104	25.19
	MgHCO3+	2.15E-04	1.65E-04	-3.667	-3.782	-0.115	5.66
	MgCO3	1.78E-04	1.82E-04	-3.75	-3.74	0.01	-17.09
	CO3-2	1.04E-04	3.98E-05	-3.984	-4.401	-0.416	-4.14
	NaHCO3	7.78E-05	7.96E-05	-4.109	-4.099	0.01	1.8
	NaCO3-	4.57E-05	3.57E-05	-4.34	-4.448	-0.108	-0.28
	CaCO3	3.84E-05	3.93E-05	-4.415	-4.405	0.01	-14.6
	CaHCO3+	2.78E-05	2.21E-05	-4.556	-4.656	-0.1	9.84
	CO2	2.24E-05	2.30E-05	-4.649	-4.639	0.01	34.43
	Zn(CO3)2-2	2.94E-07	1.09E-07	-6.532	-6.963	-0.432	0
	ZnCO3	1.25E-07	1.28E-07	-6.903	-6.893	0.01	0
	MnCO3	3.79E-08	3.88E-08	-7.421	-7.411	0.01	0
	BaHCO3+	3.48E-08	2.72E-08	-7.458	-7.566	-0.108	0
	BaCO3	1.93E-08	1.98E-08	-7.713	-7.703	0.01	-10.7
	ZnHCO3+	7.66E-09	5.97E-09	-8.116	-8.224	-0.108	0
	CuCO3	6.27E-09	6.42E-09	-8.203	-8.193	0.01	0
	MnHCO3+	4.12E-09	3.22E-09	-8.385	-8.492	-0.107	0
	Cu(CO3)2-	8.68E-10	3.21E-10	-9.061	-9.493	-0.432	0
	CuHCO3+	5.68E-11	4.43E-11	-10.246	-10.354	-0.108	0
	FeCO3	5.09E-11	5.21E-11	-10.293	-10.283	0.01	0
	FeHCO3+	2.06E-11	1.61E-11	-10.686	-10.794	-0.108	0
	(CO2)2	9.47E-12	9.69E-12	-11.024	-11.014	0.01	68.87
Ca	1.76E-03						
	Ca+2	1.52E-03	5.89E-04	-2.819	-3.23	-0.411	-17.43
	CaSO4	1.77E-04	1.82E-04	-3.751	-3.741	0.01	7.5
	CaCO3	3.84E-05	3.93E-05	-4.415	-4.405	0.01	-14.6
	CaHCO3+	2.78E-05	2.21E-05	-4.556	-4.656	-0.1	9.84
	CaOH+	3.60E-08	2.81E-08	-7.443	-7.551	-0.108	0
	CaHSO4+	5.31E-12	4.14E-12	-11.275	-11.383	-0.108	0
Cl	6.45E-02						
	Cl-	6.45E-02	4.94E-02	-1.19	-1.307	-0.116	18.34
	ZnOHCl	7.41E-09	7.59E-09	-8.13	-8.12	0.01	0
	MnCl+	3.16E-09	2.47E-09	-8.5	-8.607	-0.107	-2.92
	ZnCl+	2.79E-09	2.15E-09	-8.554	-8.669	-0.115	-14.08
	CuCl2-	1.58E-09	1.22E-09	-8.8	-8.915	-0.115	0
	CuCl3-2	2.55E-10	9.51E-11	-9.594	-10.022	-0.428	0

	ZnCl2	1.08E-10	1.11E-10	-9.965	-9.955	0.01	102.03
	MnCl2	5.21E-11	5.33E-11	-10.283	-10.273	0.01	85.89
	ZnCl3-	8.00E-12	6.14E-12	-11.097	-11.212	-0.115	16.47
	CuCl+	5.20E-12	3.99E-12	-11.284	-11.399	-0.115	0.95
	FeCl+	4.77E-12	3.72E-12	-11.321	-11.429	-0.108	0
	MnCl3-	9.27E-13	7.25E-13	-12.033	-12.14	-0.107	43.87
	ZnCl4-2	4.07E-13	1.52E-13	-12.391	-12.818	-0.428	146.58
	CuCl2	1.03E-13	1.06E-13	-12.985	-12.975	0.01	31.02
	CuCl3-	2.42E-17	1.86E-17	-16.617	-16.732	-0.115	0
	FeCl+2	2.08E-19	7.78E-20	-18.682	-19.109	-0.428	0
	FeCl2+	2.19E-20	1.72E-20	-19.659	-19.766	-0.107	0
	CuCl4-2	1.23E-20	4.59E-21	-19.911	-20.338	-0.428	0
	FeCl3	8.27E-23	8.47E-23	-22.082	-22.072	0.01	0
Cu(1)	1.84E-09						
	CuCl2-	1.58E-09	1.22E-09	-8.8	-8.915	-0.115	0
	CuCl3-2	2.55E-10	9.51E-11	-9.594	-10.022	-0.428	0
	Cu+	2.12E-12	1.58E-12	-11.673	-11.802	-0.129	0
Cu(2)	5.82E-08						
	Cu(OH)2	5.08E-08	5.20E-08	-7.294	-7.284	0.01	0
	CuCO3	6.27E-09	6.42E-09	-8.203	-8.193	0.01	0
	Cu(CO3)2-	8.68E-10	3.21E-10	-9.061	-9.493	-0.432	0
	CuOH+	1.13E-10	8.65E-11	-9.948	-10.063	-0.115	0
	Cu+2	7.55E-11	3.01E-11	-10.122	-10.522	-0.4	-25.95
	CuHCO3+	5.68E-11	4.43E-11	-10.246	-10.354	-0.108	0
	CuSO4	1.04E-11	1.06E-11	-10.983	-10.973	0.01	13.09
	CuCl+	5.20E-12	3.99E-12	-11.284	-11.399	-0.115	0.95
	Cu(OH)3-	1.16E-12	9.01E-13	-11.937	-12.045	-0.108	0
	CuCl2	1.03E-13	1.06E-13	-12.985	-12.975	0.01	31.02
	CuF+	7.20E-14	5.62E-14	-13.142	-13.25	-0.108	0
	Cu2(OH)2+	8.84E-15	3.27E-15	-14.054	-14.485	-0.432	0
	Cu(OH)4-2	1.40E-16	5.17E-17	-15.855	-16.287	-0.432	0
	CuCl3-	2.42E-17	1.86E-17	-16.617	-16.732	-0.115	0
	CuCl4-2	1.23E-20	4.59E-21	-19.911	-20.338	-0.428	0
F	1.80E-04						
	F-	1.35E-04	1.03E-04	-3.869	-3.988	-0.119	-1.04
	MgF+	4.20E-05	3.26E-05	-4.376	-4.487	-0.111	-10.4
	NaF	2.78E-06	2.85E-06	-5.556	-5.546	0.01	7.26
	HF	5.22E-10	5.34E-10	-9.283	-9.272	0.01	12.5
	ZnF+	3.00E-11	2.34E-11	-10.522	-10.63	-0.108	0
	MnF+	1.12E-11	8.74E-12	-10.952	-11.058	-0.107	0
	HF2-	2.70E-13	2.11E-13	-12.569	-12.677	-0.108	22.33
	CuF+	7.20E-14	5.62E-14	-13.142	-13.25	-0.108	0
	FeF+	7.19E-14	5.61E-14	-13.143	-13.251	-0.108	0
	FeF2+	4.44E-17	3.47E-17	-16.352	-16.459	-0.107	0
	FeF+2	2.27E-17	8.49E-18	-16.643	-17.071	-0.428	0
	FeF3	5.52E-18	5.66E-18	-17.258	-17.248	0.01	0
Fe(2)	2.36E-10						
	Fe+2	1.37E-10	5.46E-11	-9.863	-10.263	-0.4	-21.46
	FeCO3	5.09E-11	5.21E-11	-10.293	-10.283	0.01	0
	FeHCO3+	2.06E-11	1.61E-11	-10.686	-10.794	-0.108	0

	FeSO4	1.65E-11	1.68E-11	-10.784	-10.774	0.01	18.97
	FeOH+	6.36E-12	4.97E-12	-11.197	-11.304	-0.107	0
	FeCl+	4.77E-12	3.72E-12	-11.321	-11.429	-0.108	0
	FeF+	7.19E-14	5.61E-14	-13.143	-13.251	-0.108	0
	Fe(OH)2	1.19E-14	1.22E-14	-13.925	-13.915	0.01	0
	Fe(OH)3-	1.66E-16	1.30E-16	-15.779	-15.886	-0.107	0
	FeHSO4+	4.92E-19	3.84E-19	-18.308	-18.416	-0.108	0
Fe(3)	4.60E-07						
	Fe(OH)3	3.34E-07	3.42E-07	-6.476	-6.466	0.01	0
	Fe(OH)4-	1.14E-07	8.97E-08	-6.943	-7.047	-0.104	0
	Fe(OH)2+	1.17E-08	9.23E-09	-7.931	-8.035	-0.104	0
	FeOH+2	2.59E-13	9.69E-14	-12.586	-13.014	-0.428	0
	FeF2+	4.44E-17	3.47E-17	-16.352	-16.459	-0.107	0
	FeF+2	2.27E-17	8.49E-18	-16.643	-17.071	-0.428	0
	FeF3	5.52E-18	5.66E-18	-17.258	-17.248	0.01	0
	FeSO4+	1.27E-18	9.92E-19	-17.897	-18.004	-0.107	0
	Fe+3	2.96E-19	5.22E-20	-18.528	-19.283	-0.754	0
	FeCl+2	2.08E-19	7.78E-20	-18.682	-19.109	-0.428	0
	Fe(SO4)2-	4.82E-20	3.76E-20	-19.317	-19.425	-0.108	0
	FeCl2+	2.19E-20	1.72E-20	-19.659	-19.766	-0.107	0
	FeCl3	8.27E-23	8.47E-23	-22.082	-22.072	0.01	0
	Fe2(OH)2+	1.35E-23	2.53E-25	-22.871	-24.597	-1.727	0
	FeHSO4+2	2.49E-26	9.21E-27	-25.604	-26.036	-0.432	0
	Fe3(OH)4+	2.43E-28	4.87E-31	-27.615	-30.312	-2.698	0
H(0)	1.66E-28						
	H2	8.31E-29	8.51E-29	-28.08	-28.07	0.01	28.61
K	8.80E-04						
	K+	8.70E-04	6.63E-04	-3.061	-3.178	-0.118	9.24
	KSO4-	1.03E-05	8.08E-06	-4.989	-5.093	-0.104	34.38
Mg	1.42E-02						
	Mg+2	1.19E-02	4.80E-03	-1.926	-2.319	-0.393	-21.13
	MgSO4	1.91E-03	1.95E-03	-2.72	-2.71	0.01	5.84
	MgHCO3+	2.15E-04	1.65E-04	-3.667	-3.782	-0.115	5.66
	MgCO3	1.78E-04	1.82E-04	-3.75	-3.74	0.01	-17.09
	MgF+	4.20E-05	3.26E-05	-4.376	-4.487	-0.111	-10.4
	MgOH+	6.27E-06	5.01E-06	-5.203	-5.3	-0.097	0
Mn(2)	8.00E-08						
	MnCO3	3.79E-08	3.88E-08	-7.421	-7.411	0.01	0
	Mn+2	3.09E-08	1.23E-08	-7.51	-7.91	-0.4	-18.14
	MnHCO3+	4.12E-09	3.22E-09	-8.385	-8.492	-0.107	0
	MnSO4	3.70E-09	3.79E-09	-8.431	-8.421	0.01	22.54
	MnCl+	3.16E-09	2.47E-09	-8.5	-8.607	-0.107	-2.92
	MnOH+	1.16E-10	9.09E-11	-9.934	-10.041	-0.107	0
	MnCl2	5.21E-11	5.33E-11	-10.283	-10.273	0.01	85.89
	MnF+	1.12E-11	8.74E-12	-10.952	-11.058	-0.107	0
	MnCl3-	9.27E-13	7.25E-13	-12.033	-12.14	-0.107	43.87
	Mn(NO3)2	1.73E-16	1.77E-16	-15.762	-15.752	0.01	41.04
	Mn(OH)3-	5.93E-18	4.64E-18	-17.227	-17.334	-0.107	0
Mn(3)	2.16E-29						
	Mn+3	2.16E-29	3.80E-30	-28.666	-29.42	-0.754	0

N(-3)	1.00E-05						
	NH4+	8.77E-06	6.51E-06	-5.057	-5.186	-0.129	18.18
	NH3	1.05E-06	1.07E-06	-5.981	-5.97	0.01	24.42
	NH4SO4-	1.87E-07	1.45E-07	-6.729	-6.837	-0.108	38.13
N(5)	8.00E-05						
	NO3-	8.00E-05	6.01E-05	-4.097	-4.221	-0.124	29.77
	Mn(NO3)2	1.73E-16	1.77E-16	-15.762	-15.752	0.01	41.04
Na	6.21E-02						
	Na+	6.14E-02	4.82E-02	-1.212	-1.317	-0.106	-1.09
	NaSO4-	5.32E-04	4.18E-04	-3.274	-3.378	-0.104	16.34
	NaHCO3	7.78E-05	7.96E-05	-4.109	-4.099	0.01	1.8
	NaCO3-	4.57E-05	3.57E-05	-4.34	-4.448	-0.108	-0.28
	NaF	2.78E-06	2.85E-06	-5.556	-5.546	0.01	7.26
	NaOH	1.37E-17	1.40E-17	-16.863	-16.853	0.01	0
O(0)	1.12E-36						
	O2	5.59E-37	5.73E-37	-36.252	-36.242	0.01	30.4
S(6)	7.31E-03						
	SO4-2	4.68E-03	1.73E-03	-2.329	-2.761	-0.432	15.6
	MgSO4	1.91E-03	1.95E-03	-2.72	-2.71	0.01	5.84
	NaSO4-	5.32E-04	4.18E-04	-3.274	-3.378	-0.104	16.34
	CaSO4	1.77E-04	1.82E-04	-3.751	-3.741	0.01	7.5
	KSO4-	1.03E-05	8.08E-06	-4.989	-5.093	-0.104	34.38
	BaSO4	8.18E-07	8.38E-07	-6.087	-6.077	0.01	0
	NH4SO4-	1.87E-07	1.45E-07	-6.729	-6.837	-0.108	38.13
	ZnSO4	6.41E-09	6.56E-09	-8.193	-8.183	0.01	21.71
	MnSO4	3.70E-09	3.79E-09	-8.431	-8.421	0.01	22.54
	HSO4-	7.49E-10	5.84E-10	-9.125	-9.233	-0.108	40.54
	Zn(SO4)2-2	2.50E-10	9.24E-11	-9.603	-10.034	-0.432	-11.3
	FeSO4	1.65E-11	1.68E-11	-10.784	-10.774	0.01	18.97
	CuSO4	1.04E-11	1.06E-11	-10.983	-10.973	0.01	13.09
	CaHSO4+	5.31E-12	4.14E-12	-11.275	-11.383	-0.108	0
	FeSO4+	1.27E-18	9.92E-19	-17.897	-18.004	-0.107	0
	FeHSO4+	4.92E-19	3.84E-19	-18.308	-18.416	-0.108	0
	Fe(SO4)2-	4.82E-20	3.76E-20	-19.317	-19.425	-0.108	0
	FeHSO4+2	2.49E-26	9.21E-27	-25.604	-26.036	-0.432	0
Zn	5.10E-07						
	Zn(CO3)2-2	2.94E-07	1.09E-07	-6.532	-6.963	-0.432	0
	ZnCO3	1.25E-07	1.28E-07	-6.903	-6.893	0.01	0
	Zn+2	4.32E-08	1.61E-08	-7.364	-7.792	-0.428	-24.68
	Zn(OH)2	1.64E-08	1.68E-08	-7.785	-7.774	0.01	0
	ZnHCO3+	7.66E-09	5.97E-09	-8.116	-8.224	-0.108	0
	ZnOHCl	7.41E-09	7.59E-09	-8.13	-8.12	0.01	0
	ZnOH+	6.53E-09	5.09E-09	-8.185	-8.293	-0.108	0
	ZnSO4	6.41E-09	6.56E-09	-8.193	-8.183	0.01	21.71
	ZnCl+	2.79E-09	2.15E-09	-8.554	-8.669	-0.115	-14.08
	Zn(SO4)2-2	2.50E-10	9.24E-11	-9.603	-10.034	-0.432	-11.3
	ZnCl2	1.08E-10	1.11E-10	-9.965	-9.955	0.01	102.03
	ZnF+	3.00E-11	2.34E-11	-10.522	-10.63	-0.108	0
	Zn(OH)3-	1.96E-11	1.53E-11	-10.708	-10.815	-0.108	0
	ZnCl3-	8.00E-12	6.14E-12	-11.097	-11.212	-0.115	16.47

ZnCl4-2	4.07E-13	1.52E-13	-12.391	-12.818	-0.428	146.58
Zn(OH)4-2	1.88E-15	6.97E-16	-14.725	-15.157	-0.432	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-1.71	-5.99	-4.28	CaSO4
Aragonite	0.71	-7.63	-8.34	CaCO3
Barite	1.07	-8.78	-9.84	BaSO4
Calcite	0.85	-7.63	-8.48	CaCO3
CO2(g)	-3.17	-4.64	-1.47	CO2
Dolomite	2.73	-14.35	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.2	6.09	4.89	Fe(OH)3
Fluorite	-0.61	-11.21	-10.6	CaF2
Goethite	7.1	6.1	-1	FeOOH
Gypsum	-1.41	-5.99	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-4.19	-2.62	1.57	NaCl
Hausmann	-9.09	51.94	61.03	Mn3O4
Hematite	16.2	12.19	-4.01	Fe2O3
Jarosite-K	-6.59	-15.8	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.87	21.47	25.34	MnOOH
Melanterit	-10.82	-13.03	-2.21	FeSO4:7H2O
NH3(g)	-7.77	-5.97	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.19	9.01	15.2	Mn(OH)2
Pyrolusite	-7.45	33.93	41.38	MnO2:H2O
Rhodochro	-1.18	-12.31	-11.13	MnCO3
Siderite	-3.77	-14.66	-10.89	FeCO3
Smithsonit	-2.19	-12.19	-10	ZnCO3
Sylvite	-5.38	-4.48	0.9	KCl
Witherite	-1.85	-10.42	-8.56	BaCO3
Zn(OH)2(e	-2.37	9.13	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 6

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	5.85E-03	5.85E-03
Ba	4.31E-06	4.31E-06
Ca	2.14E-03	2.14E-03
Cl	7.86E-02	7.86E-02
Cu	7.00E-08	7.00E-08

F	2.20E-04	2.20E-04
Fe	5.60E-07	5.60E-07
K	1.08E-03	1.08E-03
Mg	1.73E-02	1.73E-02
Mn	1.00E-07	1.00E-07
N(-3)	1.20E-05	1.20E-05
N(5)	1.00E-04	1.00E-04
Na	7.56E-02	7.56E-02
S(6)	8.90E-03	8.90E-03
Zn	6.20E-07	6.20E-07

#NAME? of solution----------

pH	=	8.46			
pe	=	4			
Specific	Conductan	(µS/cm,	25°C)	=	10213
Density	(g/cm³)	=	1.00202		
Volume	(L)	=	1.00423		
Activity	of	water	=	0.997	
Ionic	strength	(mol/kgw)	=	1.24E-01	
Mass	of	water	(kg)	=	1.00E+00
Total	carbon	(mol/kg)	=	5.38E-03	
Total	CO2	(mol/kg)	=	5.38E-03	
Temperatu	(°C)	=	25		
Electrical	balance	(eq)	=	1.31E-02	
Percent	error,	100*(Cat-|	=	6.4	
Iterations	=	9	(50	overall)	
Total	H	=	1.11E+02		
Total	O	=	5.56E+01		

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4331	0.2622		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	3.91E-06	2.91E-06	-5.408	-5.536	-0.128	-3.67
H+	4.25E-09	3.47E-09	-8.372	-8.46	-0.088	0
H2O	5.55E+01	9.97E-01	1.744	-0.001	0	18.07
Ba	4.31E-06					
Ba+2	3.22E-06	1.09E-06	-5.492	-5.964	-0.472	-11.92
BaSO4	1.02E-06	1.05E-06	-5.993	-5.98	0.012	0
BaHCO3+	4.65E-08	3.58E-08	-7.333	-7.446	-0.114	0
BaCO3	2.53E-08	2.61E-08	-7.596	-7.584	0.012	-10.7
BaOH+	1.38E-11	1.06E-11	-10.861	-10.975	-0.114	0

C(4)	5.38E-03						
	HCO3-	4.43E-03	3.43E-03	-2.354	-2.464	-0.11	25.27
	MgHCO3+	2.94E-04	2.21E-04	-3.532	-3.655	-0.123	5.67
	MgCO3	2.37E-04	2.44E-04	-3.625	-3.612	0.012	-17.09
	CO3-2	1.28E-04	4.64E-05	-3.891	-4.333	-0.442	-4.01
	NaHCO3	1.08E-04	1.12E-04	-3.965	-3.953	0.012	1.8
	NaCO3-	6.49E-05	4.99E-05	-4.188	-4.302	-0.114	-0.15
	CaCO3	5.10E-05	5.25E-05	-4.293	-4.28	0.012	-14.6
	CaHCO3+	3.76E-05	2.95E-05	-4.425	-4.531	-0.106	9.85
	CO2	2.61E-05	2.69E-05	-4.583	-4.571	0.012	34.43
	Zn(CO3)2-2	3.94E-07	1.38E-07	-6.405	-6.86	-0.455	0
	ZnCO3	1.35E-07	1.39E-07	-6.869	-6.857	0.012	0
	MnCO3	4.91E-08	5.06E-08	-7.309	-7.296	0.012	0
	BaHCO3+	4.65E-08	3.58E-08	-7.333	-7.446	-0.114	0
	BaCO3	2.53E-08	2.61E-08	-7.596	-7.584	0.012	-10.7
	ZnHCO3+	8.43E-09	6.49E-09	-8.074	-8.188	-0.114	0
	CuCO3	8.22E-09	8.46E-09	-8.085	-8.073	0.012	0
	MnHCO3+	5.45E-09	4.19E-09	-8.264	-8.377	-0.114	0
	Cu(CO3)2-	1.41E-09	4.94E-10	-8.851	-9.306	-0.455	0
	CuHCO3+	7.58E-11	5.84E-11	-10.12	-10.234	-0.114	0
	FeCO3	7.21E-11	7.42E-11	-10.142	-10.13	0.012	0
	FeHCO3+	2.97E-11	2.29E-11	-10.527	-10.641	-0.114	0
	(CO2)2	1.29E-11	1.32E-11	-10.891	-10.878	0.012	68.87
Ca	2.14E-03						
	Ca+2	1.83E-03	6.72E-04	-2.738	-3.172	-0.434	-17.37
	CaSO4	2.23E-04	2.30E-04	-3.651	-3.639	0.012	7.5
	CaCO3	5.10E-05	5.25E-05	-4.293	-4.28	0.012	-14.6
	CaHCO3+	3.76E-05	2.95E-05	-4.425	-4.531	-0.106	9.85
	CaOH+	4.17E-08	3.21E-08	-7.38	-7.494	-0.114	0
	CaHSO4+	6.80E-12	5.23E-12	-11.167	-11.281	-0.114	0
Cl	7.86E-02						
	Cl-	7.86E-02	5.90E-02	-1.105	-1.229	-0.124	18.37
	ZnOHCl	8.20E-09	8.44E-09	-8.086	-8.074	0.012	0
	MnCl+	4.28E-09	3.30E-09	-8.368	-8.482	-0.114	-2.91
	ZnCl+	3.16E-09	2.39E-09	-8.5	-8.622	-0.123	-14.14
	CuCl2-	2.60E-09	1.96E-09	-8.585	-8.708	-0.123	0
	CuCl3-2	5.22E-10	1.83E-10	-9.282	-9.737	-0.455	0
	ZnCl2	1.43E-10	1.47E-10	-9.844	-9.832	0.012	102.03
	MnCl2	8.25E-11	8.49E-11	-10.084	-10.071	0.012	85.89
	ZnCl3-	1.29E-11	9.76E-12	-10.888	-11.011	-0.123	16.33
	CuCl+	7.15E-12	5.39E-12	-11.146	-11.269	-0.123	1
	FeCl+	7.05E-12	5.42E-12	-11.152	-11.266	-0.114	0
	MnCl3-	1.79E-12	1.38E-12	-11.747	-11.86	-0.114	43.96
	ZnCl4-2	8.22E-13	2.89E-13	-12.085	-12.54	-0.455	146.77
	CuCl2	1.66E-13	1.71E-13	-12.78	-12.768	0.012	31.02
	CuCl3-	4.74E-17	3.58E-17	-16.324	-16.447	-0.123	0
	FeCl+2	3.23E-19	1.13E-19	-18.491	-18.946	-0.455	0
	FeCl2+	3.88E-20	2.99E-20	-19.411	-19.525	-0.114	0
	CuCl4-2	3.01E-20	1.06E-20	-19.521	-19.976	-0.455	0
	FeCl3	1.71E-22	1.76E-22	-21.766	-21.754	0.012	0

Cu(1)	3.13E-09						
	CuCl2-	2.60E-09	1.96E-09	-8.585	-8.708	-0.123	0
	CuCl3-2	5.22E-10	1.83E-10	-9.282	-9.737	-0.455	0
	Cu+	2.45E-12	1.78E-12	-11.61	-11.75	-0.139	0
Cu(2)	6.69E-08						
	Cu(OH)2	5.69E-08	5.86E-08	-7.245	-7.232	0.012	0
	CuCO3	8.22E-09	8.46E-09	-8.085	-8.073	0.012	0
	Cu(CO3)2-	1.41E-09	4.94E-10	-8.851	-9.306	-0.455	0
	CuOH+	1.29E-10	9.75E-11	-9.888	-10.011	-0.123	0
	Cu+2	9.00E-11	3.39E-11	-10.046	-10.47	-0.424	-25.9
	CuHCO3+	7.58E-11	5.84E-11	-10.12	-10.234	-0.114	0
	CuSO4	1.29E-11	1.33E-11	-10.889	-10.876	0.012	13.09
	CuCl+	7.15E-12	5.39E-12	-11.146	-11.269	-0.123	1
	Cu(OH)3-	1.32E-12	1.02E-12	-11.88	-11.994	-0.114	0
	CuCl2	1.66E-13	1.71E-13	-12.78	-12.768	0.012	31.02
	CuF+	9.53E-14	7.33E-14	-13.021	-13.135	-0.114	0
	Cu2(OH)2+	1.19E-14	4.16E-15	-13.926	-14.381	-0.455	0
	Cu(OH)4-2	1.66E-16	5.82E-17	-15.78	-16.235	-0.455	0
	CuCl3-	4.74E-17	3.58E-17	-16.324	-16.447	-0.123	0
	CuCl4-2	3.01E-20	1.06E-20	-19.521	-19.976	-0.455	0
F	2.20E-04						
	F-	1.59E-04	1.19E-04	-3.797	-3.925	-0.128	-1.01
	MgF+	5.68E-05	4.33E-05	-4.246	-4.364	-0.118	-10.38
	NaF	3.84E-06	3.95E-06	-5.416	-5.404	0.012	7.26
	HF	6.00E-10	6.18E-10	-9.222	-9.209	0.012	12.5
	ZnF+	3.28E-11	2.52E-11	-10.485	-10.599	-0.114	0
	MnF+	1.46E-11	1.13E-11	-10.835	-10.948	-0.114	0
	HF2-	3.66E-13	2.82E-13	-12.437	-12.55	-0.114	22.36
	FeF+	1.03E-13	7.91E-14	-12.988	-13.102	-0.114	0
	CuF+	9.53E-14	7.33E-14	-13.021	-13.135	-0.114	0
	FeF2+	7.36E-17	5.66E-17	-16.133	-16.247	-0.114	0
	FeF+2	3.41E-17	1.20E-17	-16.467	-16.922	-0.455	0
	FeF3	1.04E-17	1.07E-17	-16.985	-16.972	0.012	0
Fe(2)	3.16E-10						
	Fe+2	1.77E-10	6.66E-11	-9.753	-10.177	-0.424	-21.4
	FeCO3	7.21E-11	7.42E-11	-10.142	-10.13	0.012	0
	FeHCO3+	2.97E-11	2.29E-11	-10.527	-10.641	-0.114	0
	FeSO4	2.21E-11	2.27E-11	-10.656	-10.643	0.012	18.97
	FeOH+	7.87E-12	6.05E-12	-11.104	-11.218	-0.114	0
	FeCl+	7.05E-12	5.42E-12	-11.152	-11.266	-0.114	0
	FeF+	1.03E-13	7.91E-14	-12.988	-13.102	-0.114	0
	Fe(OH)2	1.44E-14	1.48E-14	-13.842	-13.829	0.012	0
	Fe(OH)3-	2.06E-16	1.58E-16	-15.687	-15.801	-0.114	0
	FeHSO4+	6.73E-19	5.18E-19	-18.172	-18.286	-0.114	0
Fe(3)	5.60E-07						
	Fe(OH)3	4.05E-07	4.16E-07	-6.393	-6.381	0.012	0
	Fe(OH)4-	1.41E-07	1.09E-07	-6.852	-6.962	-0.11	0
	Fe(OH)2+	1.45E-08	1.12E-08	-7.839	-7.949	-0.11	0
	FeOH+2	3.36E-13	1.18E-13	-12.473	-12.928	-0.455	0
	FeF2+	7.36E-17	5.66E-17	-16.133	-16.247	-0.114	0

	FeF+2	3.41E-17	1.20E-17	-16.467	-16.922	-0.455	0
	FeF3	1.04E-17	1.07E-17	-16.985	-16.972	0.012	0
	FeSO4+	1.74E-18	1.34E-18	-17.76	-17.873	-0.114	0
	Fe+3	3.93E-19	6.36E-20	-18.405	-19.197	-0.791	0
	FeCl+2	3.23E-19	1.13E-19	-18.491	-18.946	-0.455	0
	Fe(SO4)2-	7.31E-20	5.62E-20	-19.136	-19.25	-0.114	0
	FeCl2+	3.88E-20	2.99E-20	-19.411	-19.525	-0.114	0
	FeCl3	1.71E-22	1.76E-22	-21.766	-21.754	0.012	0
	Fe2(OH)2+	2.48E-23	3.75E-25	-22.606	-24.426	-1.82	0
	FeHSO4+2	3.55E-26	1.24E-26	-25.45	-25.906	-0.455	0
	Fe3(OH)4+	6.15E-28	8.80E-31	-27.211	-30.055	-2.844	0
H(0)	1.65E-28						
	H2	8.27E-29	8.51E-29	-28.082	-28.07	0.012	28.61
K	1.08E-03						
	K+	1.07E-03	7.98E-04	-2.972	-3.098	-0.126	9.27
	KSO4-	1.39E-05	1.08E-05	-4.858	-4.968	-0.11	34.41
Mg	1.73E-02						
	Mg+2	1.43E-02	5.51E-03	-1.845	-2.259	-0.414	-21.07
	MgSO4	2.41E-03	2.48E-03	-2.618	-2.605	0.012	5.84
	MgHCO3+	2.94E-04	2.21E-04	-3.532	-3.655	-0.123	5.67
	MgCO3	2.37E-04	2.44E-04	-3.625	-3.612	0.012	-17.09
	MgF+	5.68E-05	4.33E-05	-4.246	-4.364	-0.118	-10.38
	MgOH+	7.28E-06	5.75E-06	-5.138	-5.24	-0.102	0
Mn(2)	1.00E-07						
	MnCO3	4.91E-08	5.06E-08	-7.309	-7.296	0.012	0
	Mn+2	3.64E-08	1.37E-08	-7.439	-7.863	-0.424	-17.97
	MnHCO3+	5.45E-09	4.19E-09	-8.264	-8.377	-0.114	0
	MnSO4	4.55E-09	4.68E-09	-8.342	-8.33	0.012	22.54
	MnCl+	4.28E-09	3.30E-09	-8.368	-8.482	-0.114	-2.91
	MnOH+	1.32E-10	1.01E-10	-9.881	-9.994	-0.114	0
	MnCl2	8.25E-11	8.49E-11	-10.084	-10.071	0.012	85.89
	MnF+	1.46E-11	1.13E-11	-10.835	-10.948	-0.114	0
	MnCl3-	1.79E-12	1.38E-12	-11.747	-11.86	-0.114	43.96
	Mn(NO3)2	2.87E-16	2.96E-16	-15.542	-15.529	0.012	41.04
	Mn(OH)3-	6.71E-18	5.16E-18	-17.173	-17.287	-0.114	0
Mn(3)	2.62E-29						
	Mn+3	2.62E-29	4.24E-30	-28.582	-29.373	-0.791	0
N(-3)	1.20E-05						
	NH4+	1.05E-05	7.65E-06	-4.977	-5.117	-0.139	18.19
	NH3	1.22E-06	1.26E-06	-5.913	-5.901	0.012	24.42
	NH4SO4-	2.46E-07	1.89E-07	-6.61	-6.723	-0.114	38.21
N(5)	1.00E-04						
	NO3-	1.00E-04	7.36E-05	-4	-4.133	-0.133	29.8
	Mn(NO3)2	2.87E-16	2.96E-16	-15.542	-15.529	0.012	41.04
Na	7.56E-02						
	Na+	7.47E-02	5.78E-02	-1.127	-1.238	-0.112	-1.05
	NaSO4-	7.17E-04	5.56E-04	-3.145	-3.255	-0.11	16.64
	NaHCO3	1.08E-04	1.12E-04	-3.965	-3.953	0.012	1.8
	NaCO3-	6.49E-05	4.99E-05	-4.188	-4.302	-0.114	-0.15
	NaF	3.84E-06	3.95E-06	-5.416	-5.404	0.012	7.26

	NaOH	1.63E-17	1.68E-17	-16.787	-16.775	0.012	0
O(0)	1.11E-36						
	O2	5.56E-37	5.72E-37	-36.255	-36.243	0.012	30.4
S(6)	8.90E-03						
	SO4-2	5.53E-03	1.92E-03	-2.257	-2.717	-0.46	15.72
	MgSO4	2.41E-03	2.48E-03	-2.618	-2.605	0.012	5.84
	NaSO4-	7.17E-04	5.56E-04	-3.145	-3.255	-0.11	16.64
	CaSO4	2.23E-04	2.30E-04	-3.651	-3.639	0.012	7.5
	KSO4-	1.39E-05	1.08E-05	-4.858	-4.968	-0.11	34.41
	BaSO4	1.02E-06	1.05E-06	-5.993	-5.98	0.012	0
	NH4SO4-	2.46E-07	1.89E-07	-6.61	-6.723	-0.114	38.21
	ZnSO4	6.57E-09	6.76E-09	-8.182	-8.17	0.012	21.71
	MnSO4	4.55E-09	4.68E-09	-8.342	-8.33	0.012	22.54
	HSO4-	8.41E-10	6.47E-10	-9.075	-9.189	-0.114	40.57
	Zn(SO4)2-2	3.01E-10	1.06E-10	-9.522	-9.977	-0.455	-11.01
	FeSO4	2.21E-11	2.27E-11	-10.656	-10.643	0.012	18.97
	CuSO4	1.29E-11	1.33E-11	-10.889	-10.876	0.012	13.09
	CaHSO4+	6.80E-12	5.23E-12	-11.167	-11.281	-0.114	0
	FeSO4+	1.74E-18	1.34E-18	-17.76	-17.873	-0.114	0
	FeHSO4+	6.73E-19	5.18E-19	-18.172	-18.286	-0.114	0
	Fe(SO4)2-	7.31E-20	5.62E-20	-19.136	-19.25	-0.114	0
	FeHSO4+2	3.55E-26	1.24E-26	-25.45	-25.906	-0.455	0
Zn	6.20E-07						
	Zn(CO3)2-2	3.94E-07	1.38E-07	-6.405	-6.86	-0.455	0
	ZnCO3	1.35E-07	1.39E-07	-6.869	-6.857	0.012	0
	Zn+2	4.28E-08	1.50E-08	-7.369	-7.823	-0.455	-24.62
	Zn(OH)2	1.52E-08	1.56E-08	-7.819	-7.806	0.012	0
	ZnHCO3+	8.43E-09	6.49E-09	-8.074	-8.188	-0.114	0
	ZnOHCl	8.20E-09	8.44E-09	-8.086	-8.074	0.012	0
	ZnSO4	6.57E-09	6.76E-09	-8.182	-8.17	0.012	21.71
	ZnOH+	6.15E-09	4.73E-09	-8.211	-8.325	-0.114	0
	ZnCl+	3.16E-09	2.39E-09	-8.5	-8.622	-0.123	-14.14
	Zn(SO4)2-2	3.01E-10	1.06E-10	-9.522	-9.977	-0.455	-11.01
	ZnCl2	1.43E-10	1.47E-10	-9.844	-9.832	0.012	102.03
	ZnF+	3.28E-11	2.52E-11	-10.485	-10.599	-0.114	0
	Zn(OH)3-	1.85E-11	1.42E-11	-10.734	-10.848	-0.114	0
	ZnCl3-	1.29E-11	9.76E-12	-10.888	-11.011	-0.123	16.33
	ZnCl4-2	8.22E-13	2.89E-13	-12.085	-12.54	-0.455	146.77
	Zn(OH)4-2	1.85E-15	6.47E-16	-14.734	-15.189	-0.455	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-1.61	-5.89	-4.28	CaSO4
Aragonite	0.83	-7.51	-8.34	CaCO3
Barite	1.16	-8.68	-9.84	BaSO4
Calcite	0.97	-7.51	-8.48	CaCO3
CO2(g)	-3.1	-4.57	-1.47	CO2
Dolomite	2.99	-14.1	-17.08	CaMg(CO3)2

Fe(OH)3(a)	1.29	6.18	4.89	Fe(OH)3
Fluorite	-0.42	-11.02	-10.6	CaF2
Goethite	7.18	6.18	-1	FeOOH
Gypsum	-1.31	-5.89	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-4.04	-2.47	1.57	NaCl
Hausmann	-8.94	52.09	61.03	Mn3O4
Hematite	16.37	12.36	-4.01	Fe2O3
Jarosite-K	-6.16	-15.37	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.83	21.51	25.34	MnOOH
Melanterit	-10.69	-12.9	-2.21	FeSO4:7H2O
NH3(g)	-7.7	-5.9	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.15	9.05	15.2	Mn(OH)2
Pyrolusite	-7.41	33.97	41.38	MnO2:H2O
Rhodochrc	-1.07	-12.2	-11.13	MnCO3
Siderite	-3.62	-14.51	-10.89	FeCO3
Smithsonit	-2.16	-12.16	-10	ZnCO3
Sylvite	-5.23	-4.33	0.9	KCl
Witherite	-1.74	-10.3	-8.56	BaCO3
Zn(OH)2(e	-2.41	9.09	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 7

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	6.86E-03	6.86E-03
Ba	5.07E-06	5.07E-06
Ca	2.51E-03	2.51E-03
Cl	9.22E-02	9.22E-02
Cu	8.00E-08	8.00E-08
F	2.60E-04	2.60E-04
Fe	6.60E-07	6.60E-07
K	1.26E-03	1.26E-03
Mg	2.03E-02	2.03E-02
Mn	1.10E-07	1.10E-07
N(-3)	1.40E-05	1.40E-05
N(5)	1.20E-04	1.20E-04
Na	8.87E-02	8.87E-02
S(6)	1.04E-02	1.04E-02
Zn	7.20E-07	7.20E-07

#NAME? of solution----------

```
pH          =          8.46
pe          =             4
Specific    Conductan (µS/cm,    25°C)     =          11804
Density     (g/cm³)   =          1.00287
Volume      (L)       =          1.00446
Activity    of        water      =          0.996
Ionic       strength  (mol/kgw)  =          1.44E-01
Mass        of        water      (kg)      =          1.00E+00
Total       carbon    (mol/kg)   =          6.27E-03
Total       CO2       (mol/kg)   =          6.27E-03
Temperatu   (°C)      =                 25
Electrical  balance   (eq)       =          1.53E-02
Percent     error,    100*(Cat-| =          6.41
Iterations  =                 9 (59       overall)
Total       H         =          1.11E+02
Total       O         =          5.56E+01

#NAME?  couples--------------------------------

        Redox     couple    pe        Eh        (volts)

        N(-3)/N(5)   4.4347    0.2623

#NAME?  of        species----------------------------

        Log       Log       Log       mole      V
        Species   Molality  Activity  Molality  Activity  Gamma   cm³/mol

        OH-       3.97E-06  2.91E-06  -5.401    -5.536    -0.135  -3.62
        H+        4.28E-09  3.47E-09  -8.369    -8.46     -0.091  0
        H2O       5.55E+01  9.96E-01  1.744     -0.002    0       18.07
Ba        5.07E-06
        Ba+2      3.76E-06  1.20E-06  -5.424    -5.919    -0.495  -11.86
        BaSO4     1.22E-06  1.26E-06  -5.915    -5.901    0.014   0
        BaHCO3+   5.89E-08  4.48E-08  -7.23     -7.348    -0.118  0
        BaCO3     3.16E-08  3.27E-08  -7.5      -7.486    0.014   -10.7
        BaOH+     1.54E-11  1.17E-11  -10.812   -10.931   -0.119  0
C(4)      6.27E-03
        HCO3-     5.07E-03  3.88E-03  -2.295    -2.411    -0.116  25.34
        MgHCO3+   3.77E-04  2.80E-04  -3.423    -3.553    -0.129  5.69
        MgCO3     2.99E-04  3.09E-04  -3.524    -3.51     0.014   -17.09
        CO3-2     1.53E-04  5.25E-05  -3.816    -4.28     -0.463  -3.89
        NaHCO3    1.41E-04  1.46E-04  -3.85     -3.835    0.014   1.8
        NaCO3-    8.60E-05  6.55E-05  -4.066    -4.184    -0.118  -0.03
        CaCO3     6.40E-05  6.62E-05  -4.194    -4.179    0.014   -14.6
        CaHCO3+   4.79E-05  3.71E-05  -4.319    -4.43     -0.111  9.86
        CO2       2.94E-05  3.04E-05  -4.532    -4.517    0.014   34.43
        Zn(CO3)2-2 4.89E-07 1.64E-07  -6.311    -6.785    -0.473  0
        ZnCO3     1.42E-07  1.46E-07  -6.849    -6.835    0.014   0
        BaHCO3+   5.89E-08  4.48E-08  -7.23     -7.348    -0.118  0
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	MnCO3	5.54E-08	5.73E-08	-7.256	-7.242	0.014	0
	BaCO3	3.16E-08	3.27E-08	-7.5	-7.486	0.014	-10.7
	CuCO3	1.02E-08	1.06E-08	-7.99	-7.976	0.014	0
	ZnHCO3+	8.96E-09	6.82E-09	-8.048	-8.166	-0.118	0
	MnHCO3+	6.26E-09	4.75E-09	-8.204	-8.323	-0.119	0
	Cu(CO3)2-	2.08E-09	6.99E-10	-8.682	-9.156	-0.473	0
	FeCO3	9.58E-11	9.91E-11	-10.019	-10.004	0.014	0
	CuHCO3+	9.58E-11	7.29E-11	-10.019	-10.137	-0.118	0
	FeHCO3+	4.01E-11	3.05E-11	-10.397	-10.515	-0.118	0
	(CO2)2	1.64E-11	1.70E-11	-10.785	-10.771	0.014	68.87
Ca	2.51E-03						
	Ca+2	2.13E-03	7.50E-04	-2.672	-3.125	-0.454	-17.32
	CaSO4	2.68E-04	2.77E-04	-3.571	-3.557	0.014	7.5
	CaCO3	6.40E-05	6.62E-05	-4.194	-4.179	0.014	-14.6
	CaHCO3+	4.79E-05	3.71E-05	-4.319	-4.43	-0.111	9.86
	CaOH+	4.69E-08	3.57E-08	-7.328	-7.447	-0.118	0
	CaHSO4+	8.30E-12	6.32E-12	-11.081	-11.199	-0.118	0
Cl	9.22E-02						
	Cl-	9.22E-02	6.82E-02	-1.035	-1.166	-0.131	18.4
	ZnOHCl	8.76E-09	9.05E-09	-8.058	-8.043	0.014	0
	MnCl+	5.02E-09	3.81E-09	-8.299	-8.419	-0.119	-2.9
	CuCl2-	3.89E-09	2.89E-09	-8.41	-8.539	-0.129	0
	ZnCl+	3.45E-09	2.56E-09	-8.462	-8.592	-0.129	-14.2
	CuCl3-2	9.37E-10	3.12E-10	-9.028	-9.505	-0.477	0
	ZnCl2	1.77E-10	1.83E-10	-9.752	-9.738	0.014	102.03
	MnCl2	1.10E-10	1.14E-10	-9.959	-9.945	0.014	85.89
	ZnCl3-	1.88E-11	1.40E-11	-10.725	-10.854	-0.129	16.2
	FeCl+	9.72E-12	7.40E-12	-11.013	-11.131	-0.118	0
	CuCl+	9.26E-12	6.87E-12	-11.034	-11.163	-0.129	1.04
	MnCl3-	2.81E-12	2.13E-12	-11.552	-11.671	-0.119	44.04
	ZnCl4-2	1.43E-12	4.78E-13	-11.843	-12.321	-0.477	146.94
	CuCl2	2.43E-13	2.52E-13	-12.614	-12.599	0.014	31.02
	CuCl3-	8.20E-17	6.09E-17	-16.086	-16.215	-0.129	0
	FeCl+2	4.64E-19	1.55E-19	-18.334	-18.811	-0.477	0
	CuCl4-2	6.25E-20	2.08E-20	-19.204	-19.682	-0.477	0
	FeCl2+	6.20E-20	4.71E-20	-19.208	-19.327	-0.119	0
	FeCl3	3.11E-22	3.21E-22	-21.508	-21.494	0.014	0
Cu(1)	4.83E-09						
	CuCl2-	3.89E-09	2.89E-09	-8.41	-8.539	-0.129	0
	CuCl3-2	9.37E-10	3.12E-10	-9.028	-9.505	-0.477	0
	Cu+	2.76E-12	1.97E-12	-11.559	-11.706	-0.148	0
Cu(2)	7.52E-08						
	Cu(OH)2	6.25E-08	6.46E-08	-7.204	-7.19	0.014	0
	CuCO3	1.02E-08	1.06E-08	-7.99	-7.976	0.014	0
	Cu(CO3)2-	2.08E-09	6.99E-10	-8.682	-9.156	-0.473	0
	CuOH+	1.45E-10	1.08E-10	-9.839	-9.968	-0.129	0
	Cu+2	1.04E-10	3.75E-11	-9.983	-10.426	-0.443	-25.85
	CuHCO3+	9.58E-11	7.29E-11	-10.019	-10.137	-0.118	0
	CuSO4	1.54E-11	1.59E-11	-10.813	-10.798	0.014	13.09
	CuCl+	9.26E-12	6.87E-12	-11.034	-11.163	-0.129	1.04

	Cu(OH)3-	1.47E-12	1.12E-12	-11.833	-11.951	-0.118	0
	CuCl2	2.43E-13	2.52E-13	-12.614	-12.599	0.014	31.02
	CuF+	1.20E-13	9.12E-14	-12.922	-13.04	-0.118	0
	Cu2(OH)2+	1.51E-14	5.07E-15	-13.822	-14.295	-0.473	0
	Cu(OH)4-2	1.91E-16	6.41E-17	-15.72	-16.193	-0.473	0
	CuCl3-	8.20E-17	6.09E-17	-16.086	-16.215	-0.129	0
	CuCl4-2	6.25E-20	2.08E-20	-19.204	-19.682	-0.477	0
F	2.60E-04						
	F-	1.83E-04	1.34E-04	-3.739	-3.874	-0.135	-0.99
	MgF+	7.25E-05	5.45E-05	-4.14	-4.264	-0.124	-10.37
	NaF	4.98E-06	5.15E-06	-5.302	-5.288	0.014	7.26
	HF	6.73E-10	6.96E-10	-9.172	-9.158	0.014	12.5
	ZnF+	3.46E-11	2.64E-11	-10.461	-10.579	-0.118	0
	MnF+	1.67E-11	1.27E-11	-10.777	-10.896	-0.119	0
	HF2-	4.69E-13	3.57E-13	-12.329	-12.447	-0.118	22.39
	FeF+	1.38E-13	1.05E-13	-12.86	-12.978	-0.118	0
	CuF+	1.20E-13	9.12E-14	-12.922	-13.04	-0.118	0
	FeF2+	1.12E-16	8.48E-17	-15.952	-16.072	-0.119	0
	FeF+2	4.78E-17	1.59E-17	-16.321	-16.798	-0.477	0
	FeF3	1.74E-17	1.80E-17	-16.76	-16.745	0.014	0
Fe(2)	4.02E-10						
	Fe+2	2.18E-10	7.86E-11	-9.661	-10.105	-0.443	-21.35
	FeCO3	9.58E-11	9.91E-11	-10.019	-10.004	0.014	0
	FeHCO3+	4.01E-11	3.05E-11	-10.397	-10.515	-0.118	0
	FeSO4	2.82E-11	2.91E-11	-10.551	-10.536	0.014	18.97
	FeCl+	9.72E-12	7.40E-12	-11.013	-11.131	-0.118	0
	FeOH+	9.40E-12	7.14E-12	-11.027	-11.146	-0.119	0
	FeF+	1.38E-13	1.05E-13	-12.86	-12.978	-0.118	0
	Fe(OH)2	1.69E-14	1.75E-14	-13.772	-13.758	0.014	0
	Fe(OH)3-	2.46E-16	1.87E-16	-15.61	-15.729	-0.119	0
	FeHSO4+	8.71E-19	6.63E-19	-18.06	-18.178	-0.118	0
Fe(3)	6.60E-07						
	Fe(OH)3	4.75E-07	4.91E-07	-6.324	-6.309	0.014	0
	Fe(OH)4-	1.68E-07	1.29E-07	-6.775	-6.891	-0.116	0
	Fe(OH)2+	1.73E-08	1.33E-08	-7.762	-7.878	-0.116	0
	FeOH+2	4.18E-13	1.39E-13	-12.379	-12.856	-0.477	0
	FeF2+	1.12E-16	8.48E-17	-15.952	-16.072	-0.119	0
	FeF+2	4.78E-17	1.59E-17	-16.321	-16.798	-0.477	0
	FeF3	1.74E-17	1.80E-17	-16.76	-16.745	0.014	0
	FeSO4+	2.26E-18	1.71E-18	-17.647	-17.766	-0.119	0
	Fe+3	4.98E-19	7.51E-20	-18.303	-19.125	-0.821	0
	FeCl+2	4.64E-19	1.55E-19	-18.334	-18.811	-0.477	0
	Fe(SO4)2-	1.03E-19	7.80E-20	-18.989	-19.108	-0.118	0
	FeCl2+	6.20E-20	4.71E-20	-19.208	-19.327	-0.119	0
	FeCl3	3.11E-22	3.21E-22	-21.508	-21.494	0.014	0
	Fe2(OH)2+	4.09E-23	5.22E-25	-22.389	-24.282	-1.894	0
	FeHSO4+2	4.73E-26	1.59E-26	-25.325	-25.798	-0.473	0
	Fe3(OH)4+	1.31E-27	1.45E-30	-26.881	-29.84	-2.959	0
H(0)	1.65E-28						
	H2	8.23E-29	8.51E-29	-28.084	-28.07	0.014	28.61

K	1.26E-03						
	K+	1.24E-03	9.15E-04	-2.906	-3.038	-0.133	9.29
	KSO4-	1.75E-05	1.34E-05	-4.758	-4.873	-0.116	34.43
Mg	2.03E-02						
	Mg+2	1.66E-02	6.17E-03	-1.779	-2.21	-0.431	-21.03
	MgSO4	2.91E-03	3.01E-03	-2.536	-2.522	0.014	5.84
	MgHCO3+	3.77E-04	2.80E-04	-3.423	-3.553	-0.129	5.69
	MgCO3	2.99E-04	3.09E-04	-3.524	-3.51	0.014	-17.09
	MgF+	7.25E-05	5.45E-05	-4.14	-4.264	-0.124	-10.37
	MgOH+	8.23E-06	6.43E-06	-5.085	-5.192	-0.107	0
Mn(2)	1.10E-07						
	MnCO3	5.54E-08	5.73E-08	-7.256	-7.242	0.014	0
	Mn+2	3.81E-08	1.37E-08	-7.419	-7.862	-0.443	-17.84
	MnHCO3+	6.26E-09	4.75E-09	-8.204	-8.323	-0.119	0
	MnCl+	5.02E-09	3.81E-09	-8.299	-8.419	-0.119	-2.9
	MnSO4	4.92E-09	5.08E-09	-8.308	-8.294	0.014	22.54
	MnOH+	1.34E-10	1.01E-10	-9.875	-9.994	-0.119	0
	MnCl2	1.10E-10	1.14E-10	-9.959	-9.945	0.014	85.89
	MnF+	1.67E-11	1.27E-11	-10.777	-10.896	-0.119	0
	MnCl3-	2.81E-12	2.13E-12	-11.552	-11.671	-0.119	44.04
	Mn(NO3)2	3.98E-16	4.11E-16	-15.4	-15.386	0.014	41.04
	Mn(OH)3-	6.80E-18	5.16E-18	-17.168	-17.287	-0.119	0
Mn(3)	2.81E-29						
	Mn+3	2.81E-29	4.24E-30	-28.551	-29.372	-0.821	0
N(-3)	1.40E-05						
	NH4+	1.23E-05	8.75E-06	-4.91	-5.058	-0.148	18.21
	NH3	1.39E-06	1.44E-06	-5.856	-5.842	0.014	24.42
	NH4SO4-	3.08E-07	2.35E-07	-6.511	-6.629	-0.118	38.29
N(5)	1.20E-04						
	NO3-	1.20E-04	8.67E-05	-3.921	-4.062	-0.141	29.83
	Mn(NO3)2	3.98E-16	4.11E-16	-15.4	-15.386	0.014	41.04
Na	8.87E-02						
	Na+	8.75E-02	6.69E-02	-1.058	-1.174	-0.117	-1.01
	NaSO4-	9.12E-04	6.98E-04	-3.04	-3.156	-0.116	16.91
	NaHCO3	1.41E-04	1.46E-04	-3.85	-3.835	0.014	1.8
	NaCO3-	8.60E-05	6.55E-05	-4.066	-4.184	-0.118	-0.03
	NaF	4.98E-06	5.15E-06	-5.302	-5.288	0.014	7.26
	NaOH	1.88E-17	1.95E-17	-16.725	-16.711	0.014	0
O(0)	1.11E-36						
	O2	5.53E-37	5.71E-37	-36.258	-36.243	0.014	30.4
S(6)	1.04E-02						
	SO4-2	6.33E-03	2.08E-03	-2.199	-2.682	-0.483	15.83
	MgSO4	2.91E-03	3.01E-03	-2.536	-2.522	0.014	5.84
	NaSO4-	9.12E-04	6.98E-04	-3.04	-3.156	-0.116	16.91
	CaSO4	2.68E-04	2.77E-04	-3.571	-3.557	0.014	7.5
	KSO4-	1.75E-05	1.34E-05	-4.758	-4.873	-0.116	34.43
	BaSO4	1.22E-06	1.26E-06	-5.915	-5.901	0.014	0
	NH4SO4-	3.08E-07	2.35E-07	-6.511	-6.629	-0.118	38.29
	ZnSO4	6.59E-09	6.81E-09	-8.181	-8.167	0.014	21.71
	MnSO4	4.92E-09	5.08E-09	-8.308	-8.294	0.014	22.54

	HSO4-	9.22E-10	7.02E-10	-9.035	-9.154	-0.118	40.59
	Zn(SO4)2-2	3.43E-10	1.15E-10	-9.465	-9.939	-0.473	-10.75
	FeSO4	2.82E-11	2.91E-11	-10.551	-10.536	0.014	18.97
	CuSO4	1.54E-11	1.59E-11	-10.813	-10.798	0.014	13.09
	CaHSO4+	8.30E-12	6.32E-12	-11.081	-11.199	-0.118	0
	FeSO4+	2.26E-18	1.71E-18	-17.647	-17.766	-0.119	0
	FeHSO4+	8.71E-19	6.63E-19	-18.06	-18.178	-0.118	0
	Fe(SO4)2-	1.03E-19	7.80E-20	-18.989	-19.108	-0.118	0
	FeHSO4+2	4.73E-26	1.59E-26	-25.325	-25.798	-0.473	0
Zn	7.20E-07						
	Zn(CO3)2-2	4.89E-07	1.64E-07	-6.311	-6.785	-0.473	0
	ZnCO3	1.42E-07	1.46E-07	-6.849	-6.835	0.014	0
	Zn+2	4.19E-08	1.40E-08	-7.378	-7.855	-0.477	-24.58
	Zn(OH)2	1.40E-08	1.45E-08	-7.853	-7.839	0.014	0
	ZnHCO3+	8.96E-09	6.82E-09	-8.048	-8.166	-0.118	0
	ZnOHCl	8.76E-09	9.05E-09	-8.058	-8.043	0.014	0
	ZnSO4	6.59E-09	6.81E-09	-8.181	-8.167	0.014	21.71
	ZnOH+	5.77E-09	4.40E-09	-8.239	-8.357	-0.118	0
	ZnCl+	3.45E-09	2.56E-09	-8.462	-8.592	-0.129	-14.2
	Zn(SO4)2-2	3.43E-10	1.15E-10	-9.465	-9.939	-0.473	-10.75
	ZnCl2	1.77E-10	1.83E-10	-9.752	-9.738	0.014	102.03
	ZnF+	3.46E-11	2.64E-11	-10.461	-10.579	-0.118	0
	ZnCl3-	1.88E-11	1.40E-11	-10.725	-10.854	-0.129	16.2
	Zn(OH)3-	1.73E-11	1.32E-11	-10.762	-10.88	-0.118	0
	ZnCl4-2	1.43E-12	4.78E-13	-11.843	-12.321	-0.477	146.94
	Zn(OH)4-2	1.79E-15	6.00E-16	-14.748	-15.222	-0.473	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-1.53	-5.81	-4.28	CaSO4			
Aragonite	0.93	-7.4	-8.34	CaCO3			
Barite	1.24	-8.6	-9.84	BaSO4			
Calcite	1.08	-7.4	-8.48	CaCO3			
CO2(g)	-3.05	-4.52	-1.47	CO2			
Dolomite	3.19	-13.89	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.36	6.25	4.89	Fe(OH)3			
Fluorite	-0.27	-10.87	-10.6	CaF2			
Goethite	7.25	6.25	-1	FeOOH			
Gypsum	-1.23	-5.81	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-3.91	-2.34	1.57	NaCl			
Hausmann	-8.94	52.09	61.03	Mn3O4			
Hematite	16.51	12.51	-4.01	Fe2O3			
Jarosite-K	-5.81	-15.02	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.83	21.51	25.34	MnOOH			
Melanterit	-10.59	-12.8	-2.21	FeSO4:7H2O			
NH3(g)	-7.64	-5.84	1.8	NH3			

O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.15	9.05	15.2	Mn(OH)2
Pyrolusite	-7.41	33.97	41.38	MnO2:H2O
Rhodochrc	-1.01	-12.14	-11.13	MnCO3
Siderite	-3.49	-14.38	-10.89	FeCO3
Smithsonit	-2.13	-12.13	-10	ZnCO3
Sylvite	-5.1	-4.2	0.9	KCl
Witherite	-1.64	-10.2	-8.56	BaCO3
Zn(OH)2(e	-2.44	9.06	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 8

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	7.87E-03	7.87E-03
Ba	5.82E-06	5.82E-06
Ca	2.88E-03	2.88E-03
Cl	1.06E-01	1.06E-01
Cu	1.00E-07	1.00E-07
F	3.00E-04	3.00E-04
Fe	7.60E-07	7.60E-07
K	1.45E-03	1.45E-03
Mg	2.33E-02	2.33E-02
Mn	1.30E-07	1.30E-07
N(-3)	1.60E-05	1.60E-05
N(5)	1.30E-04	1.30E-04
Na	1.02E-01	1.02E-01
S(6)	1.20E-02	1.20E-02
Zn	8.30E-07	8.30E-07

#NAME? of solution----------

pH	=	8.46		
pe	=	4		
Specific	Conductan	(µS/cm,	25°C)	= 13367
Density	(g/cm³)	=	1.00372	
Volume	(L)	=	1.00469	
Activity	of	water	=	0.996
Ionic	strength	(mol/kgw)	=	1.65E-01
Mass	of	water	(kg)	= 1.00E+00
Total	carbon	(mol/kg)	=	7.16E-03
Total	CO2	(mol/kg)	=	7.16E-03
Temperatu	(°C)	=	25	
Electrical	balance	(eq)	=	1.76E-02
Percent	error,	100*(Cat-|	=	6.43

```
        Iterations  =                 10 (69          overall)
        Total       H           =          1.11E+02
        Total       O           =          5.56E+01

#NAME?  couples--------------------------------

        Redox       couple      pe          Eh          (volts)

        N(-3)/N(5)     4.4319      0.2622

#NAME?  of          species----------------------------

        Log         Log         Log         mole        V
        Species     Molality    Activity    Molality    Activity    Gamma     cm³/mol

        OH-          4.02E-06   2.91E-06     -5.395      -5.537     -0.141      -3.57
        H+           4.31E-09   3.47E-09     -8.366       -8.46     -0.094          0
        H2O          5.55E+01   9.96E-01      1.744      -0.002          0      18.07
Ba       5.82E-06
        Ba+2         4.30E-06   1.31E-06     -5.367      -5.882     -0.515     -11.81
        BaSO4        1.41E-06   1.47E-06      -5.85      -5.834      0.017          0
        BaHCO3+      7.19E-08   5.43E-08     -7.143      -7.265     -0.122          0
        BaCO3        3.81E-08   3.96E-08     -7.419      -7.403      0.017       -10.7
        BaOH+        1.70E-11   1.28E-11    -10.769     -10.894     -0.124          0
C(4)     7.16E-03
        HCO3-        5.69E-03   4.31E-03     -2.245      -2.365      -0.12      25.42
        MgHCO3+      4.68E-04   3.43E-04      -3.33      -3.465     -0.135        5.7
        MgCO3        3.64E-04   3.78E-04     -3.439      -3.422      0.017     -17.09
        NaHCO3       1.78E-04   1.84E-04     -3.751      -3.734      0.017        1.8
        CO3-2        1.77E-04   5.83E-05     -3.752      -4.234     -0.482      -3.78
        NaCO3-       1.09E-04   8.26E-05     -3.961      -4.083     -0.122        0.1
        CaCO3        7.77E-05   8.07E-05      -4.11      -4.093      0.017      -14.6
        CaHCO3+      5.90E-05   4.53E-05     -4.229      -4.344     -0.115       9.87
        CO2          3.25E-05   3.38E-05     -4.488      -4.472      0.017      34.43
        Zn(CO3)2-:   5.91E-07   1.92E-07     -6.228      -6.716     -0.488          0
        ZnCO3        1.48E-07   1.54E-07     -6.829      -6.812      0.017          0
        BaHCO3+      7.19E-08   5.43E-08     -7.143      -7.265     -0.122          0
        MnCO3        6.68E-08   6.94E-08     -7.175      -7.159      0.017          0
        BaCO3        3.81E-08   3.96E-08     -7.419      -7.403      0.017       -10.7
        CuCO3        1.36E-08   1.41E-08     -7.866      -7.849      0.017          0
        ZnHCO3+      9.52E-09   7.19E-09     -8.021      -8.143     -0.122          0
        MnHCO3+      7.66E-09   5.76E-09     -8.116       -8.24     -0.124          0
        Cu(CO3)2-    3.20E-09   1.04E-09     -8.495      -8.984     -0.488          0
        CuHCO3+      1.29E-10   9.76E-11     -9.889     -10.011     -0.122          0
        FeCO3        1.22E-10   1.27E-10     -9.913      -9.896      0.017          0
        FeHCO3+      5.18E-11   3.91E-11    -10.286     -10.408     -0.122          0
        (CO2)2       2.01E-11   2.09E-11    -10.696     -10.679      0.017      68.87
Ca       2.88E-03
        Ca+2         2.43E-03   8.23E-04     -2.615      -3.084      -0.47     -17.28
        CaSO4        3.14E-04   3.26E-04     -3.503      -3.487      0.017        7.5
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	CaCO3	7.77E-05	8.07E-05	-4.11	-4.093	0.017	-14.6
	CaHCO3+	5.90E-05	4.53E-05	-4.229	-4.344	-0.115	9.87
	CaOH+	5.20E-08	3.92E-08	-7.284	-7.406	-0.122	0
	CaHSO4+	9.85E-12	7.43E-12	-11.007	-11.129	-0.122	0
Cl	1.06E-01						
	Cl-	1.06E-01	7.72E-02	-0.976	-1.112	-0.137	18.42
	ZnOHCl	9.36E-09	9.72E-09	-8.029	-8.012	0.017	0
	MnCl+	6.27E-09	4.71E-09	-8.203	-8.327	-0.124	-2.89
	CuCl2-	6.10E-09	4.47E-09	-8.215	-8.35	-0.135	0
	ZnCl+	3.75E-09	2.75E-09	-8.425	-8.561	-0.135	-14.27
	CuCl3-2	1.72E-09	5.46E-10	-8.765	-9.262	-0.497	0
	ZnCl2	2.14E-10	2.22E-10	-9.669	-9.653	0.017	102.03
	MnCl2	1.53E-10	1.59E-10	-9.816	-9.799	0.017	85.89
	ZnCl3-	2.63E-11	1.93E-11	-10.58	-10.715	-0.135	16.06
	CuCl+	1.28E-11	9.38E-12	-10.893	-11.028	-0.135	1.08
	FeCl+	1.28E-11	9.67E-12	-10.893	-11.015	-0.122	0
	MnCl3-	4.49E-12	3.38E-12	-11.347	-11.472	-0.124	44.12
	ZnCl4-2	2.34E-12	7.45E-13	-11.631	-12.128	-0.497	147.11
	CuCl2	3.75E-13	3.89E-13	-12.427	-12.41	0.017	31.02
	CuCl3-	1.45E-16	1.07E-16	-15.837	-15.972	-0.135	0
	FeCl+2	6.34E-19	2.02E-19	-18.198	-18.695	-0.497	0
	CuCl4-2	1.30E-19	4.12E-20	-18.888	-19.385	-0.497	0
	FeCl2+	9.27E-20	6.97E-20	-19.033	-19.157	-0.124	0
	FeCl3	5.18E-22	5.38E-22	-21.286	-21.269	0.017	0
Cu(1)	7.82E-09						
	CuCl2-	6.10E-09	4.47E-09	-8.215	-8.35	-0.135	0
	CuCl3-2	1.72E-09	5.46E-10	-8.765	-9.262	-0.497	0
	Cu+	3.39E-12	2.37E-12	-11.47	-11.625	-0.155	0
Cu(2)	9.22E-08						
	Cu(OH)2	7.49E-08	7.78E-08	-7.126	-7.109	0.017	0
	CuCO3	1.36E-08	1.41E-08	-7.866	-7.849	0.017	0
	Cu(CO3)2-	3.20E-09	1.04E-09	-8.495	-8.984	-0.488	0
	CuOH+	1.77E-10	1.30E-10	-9.752	-9.887	-0.135	0
	Cu+2	1.30E-10	4.52E-11	-9.885	-10.345	-0.46	-25.81
	CuHCO3+	1.29E-10	9.76E-11	-9.889	-10.011	-0.122	0
	CuSO4	1.98E-11	2.05E-11	-10.704	-10.687	0.017	13.09
	CuCl+	1.28E-11	9.38E-12	-10.893	-11.028	-0.135	1.08
	Cu(OH)3-	1.78E-12	1.35E-12	-11.749	-11.871	-0.122	0
	CuCl2	3.75E-13	3.89E-13	-12.427	-12.41	0.017	31.02
	CuF+	1.61E-13	1.21E-13	-12.794	-12.916	-0.122	0
	Cu2(OH)2+	2.27E-14	7.36E-15	-13.645	-14.133	-0.488	0
	Cu(OH)4-2	2.38E-16	7.72E-17	-15.624	-16.113	-0.488	0
	CuCl3-	1.45E-16	1.07E-16	-15.837	-15.972	-0.135	0
	CuCl4-2	1.30E-19	4.12E-20	-18.888	-19.385	-0.497	0
F	3.00E-04						
	F-	2.04E-04	1.48E-04	-3.689	-3.831	-0.141	-0.96
	MgF+	8.94E-05	6.63E-05	-4.049	-4.178	-0.129	-10.36
	NaF	6.22E-06	6.46E-06	-5.206	-5.19	0.017	7.26
	HF	7.39E-10	7.68E-10	-9.131	-9.115	0.017	12.5
	ZnF+	3.66E-11	2.76E-11	-10.437	-10.559	-0.122	0

	MnF+	2.04E-11	1.53E-11	-10.691	-10.815	-0.124	0
	HF2-	5.76E-13	4.35E-13	-12.239	-12.361	-0.122	22.41
	FeF+	1.77E-13	1.34E-13	-12.751	-12.873	-0.122	0
	CuF+	1.61E-13	1.21E-13	-12.794	-12.916	-0.122	0
	FeF2+	1.59E-16	1.19E-16	-15.8	-15.924	-0.124	0
	FeF+2	6.37E-17	2.03E-17	-16.196	-16.693	-0.497	0
	FeF3	2.69E-17	2.79E-17	-16.571	-16.555	0.017	0
Fe(2)	4.94E-10						
	Fe+2	2.62E-10	9.07E-11	-9.582	-10.042	-0.46	-21.31
	FeCO3	1.22E-10	1.27E-10	-9.913	-9.896	0.017	0
	FeHCO3+	5.18E-11	3.91E-11	-10.286	-10.408	-0.122	0
	FeSO4	3.46E-11	3.59E-11	-10.461	-10.445	0.017	18.97
	FeCl+	1.28E-11	9.67E-12	-10.893	-11.015	-0.122	0
	FeOH+	1.10E-11	8.24E-12	-10.96	-11.084	-0.124	0
	FeF+	1.77E-13	1.34E-13	-12.751	-12.873	-0.122	0
	Fe(OH)2	1.94E-14	2.01E-14	-13.713	-13.696	0.017	0
	Fe(OH)3-	2.86E-16	2.15E-16	-15.544	-15.668	-0.124	0
	FeHSO4+	1.09E-18	8.19E-19	-17.965	-18.087	-0.122	0
Fe(3)	7.60E-07						
	Fe(OH)3	5.44E-07	5.65E-07	-6.264	-6.248	0.017	0
	Fe(OH)4-	1.95E-07	1.48E-07	-6.709	-6.83	-0.12	0
	Fe(OH)2+	2.02E-08	1.53E-08	-7.696	-7.816	-0.12	0
	FeOH+2	5.05E-13	1.61E-13	-12.297	-12.794	-0.497	0
	FeF2+	1.59E-16	1.19E-16	-15.8	-15.924	-0.124	0
	FeF+2	6.37E-17	2.03E-17	-16.196	-16.693	-0.497	0
	FeF3	2.69E-17	2.79E-17	-16.571	-16.555	0.017	0
	FeSO4+	2.82E-18	2.12E-18	-17.55	-17.675	-0.124	0
	FeCl+2	6.34E-19	2.02E-19	-18.198	-18.695	-0.497	0
	Fe+3	6.09E-19	8.66E-20	-18.215	-19.062	-0.847	0
	Fe(SO4)2-	1.37E-19	1.03E-19	-18.865	-18.987	-0.122	0
	FeCl2+	9.27E-20	6.97E-20	-19.033	-19.157	-0.124	0
	FeCl3	5.18E-22	5.38E-22	-21.286	-21.269	0.017	0
	Fe2(OH)2+	6.24E-23	6.94E-25	-22.205	-24.158	-1.953	0
	FeHSO4+2	6.05E-26	1.97E-26	-25.218	-25.707	-0.488	0
	Fe3(OH)4+	2.50E-27	2.22E-30	-26.602	-29.654	-3.052	0
H(0)	1.64E-28						
	H2	8.19E-29	8.51E-29	-28.087	-28.07	0.017	28.61
K	1.45E-03						
	K+	1.43E-03	1.04E-03	-2.845	-2.984	-0.139	9.31
	KSO4-	2.14E-05	1.62E-05	-4.669	-4.789	-0.12	34.46
Mg	2.33E-02						
	Mg+2	1.89E-02	6.80E-03	-1.723	-2.168	-0.445	-20.98
	MgSO4	3.42E-03	3.55E-03	-2.466	-2.45	0.017	5.84
	MgHCO3+	4.68E-04	3.43E-04	-3.33	-3.465	-0.135	5.7
	MgCO3	3.64E-04	3.78E-04	-3.439	-3.422	0.017	-17.09
	MgF+	8.94E-05	6.63E-05	-4.049	-4.178	-0.129	-10.36
	MgOH+	9.15E-06	7.09E-06	-5.038	-5.149	-0.111	0
Mn(2)	1.30E-07						
	MnCO3	6.68E-08	6.94E-08	-7.175	-7.159	0.017	0
	Mn+2	4.32E-08	1.50E-08	-7.364	-7.825	-0.46	-17.72

	MnHCO3+	7.66E-09	5.76E-09	-8.116	-8.24	-0.124	0
	MnCl+	6.27E-09	4.71E-09	-8.203	-8.327	-0.124	-2.89
	MnSO4	5.71E-09	5.93E-09	-8.243	-8.227	0.017	22.54
	MnCl2	1.53E-10	1.59E-10	-9.816	-9.799	0.017	85.89
	MnOH+	1.47E-10	1.11E-10	-9.832	-9.956	-0.124	0
	MnF+	2.04E-11	1.53E-11	-10.691	-10.815	-0.124	0
	MnCl3-	4.49E-12	3.38E-12	-11.347	-11.472	-0.124	44.12
	Mn(NO3)2	4.91E-16	5.10E-16	-15.309	-15.293	0.017	41.04
	Mn(OH)3-	7.49E-18	5.62E-18	-17.126	-17.25	-0.124	0
Mn(3)	3.26E-29						
	Mn+3	3.26E-29	4.63E-30	-28.487	-29.335	-0.847	0
N(-3)	1.60E-05						
	NH4+	1.41E-05	9.84E-06	-4.852	-5.007	-0.155	18.23
	NH3	1.56E-06	1.62E-06	-5.808	-5.791	0.017	24.42
	NH4SO4-	3.74E-07	2.82E-07	-6.427	-6.549	-0.122	38.36
N(5)	1.30E-04						
	NO3-	1.30E-04	9.25E-05	-3.886	-4.034	-0.148	29.86
	Mn(NO3)2	4.91E-16	5.10E-16	-15.309	-15.293	0.017	41.04
Na	1.02E-01						
	Na+	1.00E-01	7.60E-02	-0.998	-1.119	-0.121	-0.98
	NaSO4-	1.12E-03	8.49E-04	-2.951	-3.071	-0.12	17.16
	NaHCO3	1.78E-04	1.84E-04	-3.751	-3.734	0.017	1.8
	NaCO3-	1.09E-04	8.26E-05	-3.961	-4.083	-0.122	0.1
	NaF	6.22E-06	6.46E-06	-5.206	-5.19	0.017	7.26
	NaOH	2.13E-17	2.21E-17	-16.672	-16.656	0.017	0
O(0)	1.10E-36						
	O2	5.49E-37	5.71E-37	-36.26	-36.244	0.017	30.4
S(6)	1.20E-02						
	SO4-2	7.11E-03	2.23E-03	-2.148	-2.652	-0.504	15.93
	MgSO4	3.42E-03	3.55E-03	-2.466	-2.45	0.017	5.84
	NaSO4-	1.12E-03	8.49E-04	-2.951	-3.071	-0.12	17.16
	CaSO4	3.14E-04	3.26E-04	-3.503	-3.487	0.017	7.5
	KSO4-	2.14E-05	1.62E-05	-4.669	-4.789	-0.12	34.46
	BaSO4	1.41E-06	1.47E-06	-5.85	-5.834	0.017	0
	NH4SO4-	3.74E-07	2.82E-07	-6.427	-6.549	-0.122	38.36
	ZnSO4	6.66E-09	6.91E-09	-8.177	-8.16	0.017	21.71
	MnSO4	5.71E-09	5.93E-09	-8.243	-8.227	0.017	22.54
	HSO4-	9.95E-10	7.51E-10	-9.002	-9.124	-0.122	40.62
	Zn(SO4)2-2	3.85E-10	1.25E-10	-9.414	-9.903	-0.488	-10.5
	FeSO4	3.46E-11	3.59E-11	-10.461	-10.445	0.017	18.97
	CuSO4	1.98E-11	2.05E-11	-10.704	-10.687	0.017	13.09
	CaHSO4+	9.85E-12	7.43E-12	-11.007	-11.129	-0.122	0
	FeSO4+	2.82E-18	2.12E-18	-17.55	-17.675	-0.124	0
	FeHSO4+	1.09E-18	8.19E-19	-17.965	-18.087	-0.122	0
	Fe(SO4)2-	1.37E-19	1.03E-19	-18.865	-18.987	-0.122	0
	FeHSO4+2	6.05E-26	1.97E-26	-25.218	-25.707	-0.488	0
Zn	8.30E-07						
	Zn(CO3)2-2	5.91E-07	1.92E-07	-6.228	-6.716	-0.488	0
	ZnCO3	1.48E-07	1.54E-07	-6.829	-6.812	0.017	0
	Zn+2	4.16E-08	1.32E-08	-7.381	-7.878	-0.497	-24.54

Zn(OH)2	1.32E-08	1.37E-08	-7.878	-7.862	0.017	0
ZnHCO3+	9.52E-09	7.19E-09	-8.021	-8.143	-0.122	0
ZnOHCl	9.36E-09	9.72E-09	-8.029	-8.012	0.017	0
ZnSO4	6.66E-09	6.91E-09	-8.177	-8.16	0.017	21.71
ZnOH+	5.52E-09	4.17E-09	-8.258	-8.38	-0.122	0
ZnCl+	3.75E-09	2.75E-09	-8.425	-8.561	-0.135	-14.27
Zn(SO4)2-2	3.85E-10	1.25E-10	-9.414	-9.903	-0.488	-10.5
ZnCl2	2.14E-10	2.22E-10	-9.669	-9.653	0.017	102.03
ZnF+	3.66E-11	2.76E-11	-10.437	-10.559	-0.122	0
ZnCl3-	2.63E-11	1.93E-11	-10.58	-10.715	-0.135	16.06
Zn(OH)3-	1.65E-11	1.25E-11	-10.782	-10.904	-0.122	0
ZnCl4-2	2.34E-12	7.45E-13	-11.631	-12.128	-0.497	147.11
Zn(OH)4-2	1.75E-15	5.68E-16	-14.757	-15.246	-0.488	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-1.46	-5.74	-4.28	CaSO4			
Aragonite	1.02	-7.32	-8.34	CaCO3			
Barite	1.31	-8.53	-9.84	BaSO4			
Calcite	1.16	-7.32	-8.48	CaCO3			
CO2(g)	-3	-4.47	-1.47	CO2			
Dolomite	3.36	-13.72	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.42	6.31	4.89	Fe(OH)3			
Fluorite	-0.15	-10.75	-10.6	CaF2			
Goethite	7.31	6.31	-1	FeOOH			
Gypsum	-1.16	-5.74	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-3.8	-2.23	1.57	NaCl			
Hausmann	-8.83	52.2	61.03	Mn3O4			
Hematite	16.64	12.63	-4.01	Fe2O3			
Jarosite-K	-5.52	-14.73	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.79	21.55	25.34	MnOOH			
Melanterit	-10.5	-12.71	-2.21	FeSO4:7H2O			
NH3(g)	-7.59	-5.79	1.8	NH3			
O2(g)	-33.35	-36.24	-2.89	O2			
Pyrochroit	-6.11	9.09	15.2	Mn(OH)2			
Pyrolusite	-7.37	34.01	41.38	MnO2:H2O			
Rhodochro	-0.93	-12.06	-11.13	MnCO3			
Siderite	-3.39	-14.28	-10.89	FeCO3			
Smithsonit	-2.11	-12.11	-10	ZnCO3			
Sylvite	-5	-4.1	0.9	KCl			
Witherite	-1.55	-10.12	-8.56	BaCO3			
Zn(OH)2(e	-2.46	9.04	11.5	Zn(OH)2			

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

```
Initial     solution          9

 #NAME?  composition-----------------------------

         Elements  Molality   Moles

         Alkalinity  8.88E-03  8.88E-03
         Ba          6.58E-06  6.58E-06
         Ca          3.25E-03  3.25E-03
         Cl          1.19E-01  1.19E-01
         Cu          1.10E-07  1.10E-07
         F           3.40E-04  3.40E-04
         Fe          8.60E-07  8.60E-07
         K           1.63E-03  1.63E-03
         Mg          2.63E-02  2.63E-02
         Mn          1.50E-07  1.50E-07
         N(-3)       1.80E-05  1.80E-05
         N(5)        1.50E-04  1.50E-04
         Na          1.15E-01  1.15E-01
         S(6)        1.35E-02  1.35E-02
         Zn          9.40E-07  9.40E-07

 #NAME?  of        solution----------------------------

         pH        =              8.46
         pe        =                 4
         Specific  Conductan (µS/cm,  25°C)     =            14903
         Density   (g/cm³)   =          1.00457
         Volume    (L)       =          1.00492
         Activity  of        water    =            0.995
         Ionic     strength  (mol/kgw) =          1.86E-01
         Mass      of        water    (kg)      =          1.00E+00
         Total     carbon    (mol/kg) =          8.04E-03
         Total     CO2       (mol/kg) =          8.04E-03
         Temperatu (°C)      =              25
         Electrical balance  (eq)     =          1.98E-02
         Percent   error,    100*(Cat-|=            6.45
         Iterations =             11 (80       overall)
         Total     H         =          1.11E+02
         Total     O         =          5.56E+01

 #NAME?  couples--------------------------------

         Redox     couple    pe        Eh        (volts)

         N(-3)/N(5)   4.4334    0.2623

 #NAME?  of        species----------------------------

         Log       Log       Log       mole      V
```

	Species	Molality	Activity	Molality	Activity	Gamma	cm³/mol
	OH-	4.08E-06	2.91E-06	-5.39	-5.537	-0.147	-3.53
	H+	4.33E-09	3.47E-09	-8.363	-8.46	-0.097	0
	H2O	5.55E+01	9.95E-01	1.744	-0.002	0	18.07
Ba	6.58E-06						
	Ba+2	4.84E-06	1.42E-06	-5.315	-5.848	-0.533	-11.76
	BaSO4	1.61E-06	1.68E-06	-5.793	-5.775	0.019	0
	BaHCO3+	8.57E-08	6.42E-08	-7.067	-7.192	-0.125	0
	BaCO3	4.49E-08	4.68E-08	-7.348	-7.33	0.019	-10.7
	BaOH+	1.86E-11	1.38E-11	-10.731	-10.86	-0.129	0
C(4)	8.04E-03						
	HCO3-	6.29E-03	4.72E-03	-2.201	-2.326	-0.125	25.49
	MgHCO3+	5.66E-04	4.10E-04	-3.247	-3.388	-0.14	5.71
	MgCO3	4.33E-04	4.52E-04	-3.364	-3.345	0.019	-17.09
	NaHCO3	2.16E-04	2.26E-04	-3.665	-3.646	0.019	1.8
	CO3-2	2.01E-04	6.38E-05	-3.697	-4.195	-0.498	-3.68
	NaCO3-	1.35E-04	1.01E-04	-3.87	-3.995	-0.125	0.22
	CaCO3	9.19E-05	9.59E-05	-4.037	-4.018	0.019	-14.6
	CaHCO3+	7.08E-05	5.39E-05	-4.15	-4.269	-0.119	9.87
	CO2	3.54E-05	3.70E-05	-4.451	-4.432	0.019	34.43
	Zn(CO3)2-2	6.95E-07	2.20E-07	-6.158	-6.659	-0.501	0
	ZnCO3	1.54E-07	1.61E-07	-6.812	-6.794	0.019	0
	BaHCO3+	8.57E-08	6.42E-08	-7.067	-7.192	-0.125	0
	MnCO3	7.83E-08	8.17E-08	-7.106	-7.088	0.019	0
	BaCO3	4.49E-08	4.68E-08	-7.348	-7.33	0.019	-10.7
	CuCO3	1.57E-08	1.64E-08	-7.804	-7.785	0.019	0
	ZnHCO3+	1.00E-08	7.50E-09	-8	-8.125	-0.125	0
	MnHCO3+	9.12E-09	6.78E-09	-8.04	-8.169	-0.129	0
	Cu(CO3)2-	4.17E-09	1.32E-09	-8.38	-8.88	-0.501	0
	FeCO3	1.51E-10	1.58E-10	-9.821	-9.803	0.019	0
	CuHCO3+	1.51E-10	1.13E-10	-9.821	-9.947	-0.125	0
	FeHCO3+	6.48E-11	4.86E-11	-10.188	-10.314	-0.125	0
	(CO2)2	2.40E-11	2.51E-11	-10.619	-10.6	0.019	68.87
Ca	3.25E-03						
	Ca+2	2.73E-03	8.95E-04	-2.564	-3.048	-0.484	-17.24
	CaSO4	3.60E-04	3.76E-04	-3.444	-3.425	0.019	7.5
	CaCO3	9.19E-05	9.59E-05	-4.037	-4.018	0.019	-14.6
	CaHCO3+	7.08E-05	5.39E-05	-4.15	-4.269	-0.119	9.87
	CaOH+	5.69E-08	4.26E-08	-7.245	-7.37	-0.125	0
	CaHSO4+	1.14E-11	8.56E-12	-10.942	-11.067	-0.125	0
Cl	1.19E-01						
	Cl-	1.19E-01	8.61E-02	-0.923	-1.065	-0.142	18.44
	ZnOHCl	9.90E-09	1.03E-08	-8.004	-7.986	0.019	0
	CuCl2-	8.12E-09	5.88E-09	-8.09	-8.231	-0.14	0
	MnCl+	7.60E-09	5.65E-09	-8.119	-8.248	-0.129	-2.88
	ZnCl+	4.04E-09	2.93E-09	-8.393	-8.534	-0.14	-14.33
	CuCl3-2	2.63E-09	8.02E-10	-8.581	-9.096	-0.515	0
	ZnCl2	2.53E-10	2.64E-10	-9.597	-9.579	0.019	102.03
	MnCl2	2.04E-10	2.12E-10	-9.692	-9.673	0.019	85.89

	ZnCl3-	3.52E-11	2.55E-11	-10.454	-10.594	-0.14	15.92
	FeCl+	1.63E-11	1.22E-11	-10.787	-10.913	-0.125	0
	CuCl+	1.53E-11	1.11E-11	-10.815	-10.956	-0.14	1.11
	MnCl3-	6.77E-12	5.04E-12	-11.169	-11.298	-0.129	44.19
	ZnCl4-2	3.60E-12	1.10E-12	-11.444	-11.959	-0.515	147.27
	CuCl2	4.91E-13	5.12E-13	-12.309	-12.291	0.019	31.02
	CuCl3-	2.16E-16	1.57E-16	-15.665	-15.806	-0.14	0
	FeCl+2	8.36E-19	2.56E-19	-18.078	-18.593	-0.515	0
	CuCl4-2	2.21E-19	6.75E-20	-18.656	-19.171	-0.515	0
	FeCl2+	1.32E-19	9.82E-20	-18.879	-19.008	-0.129	0
	FeCl3	8.10E-22	8.46E-22	-21.091	-21.073	0.019	0
Cu(1)	1.08E-08						
	CuCl2-	8.12E-09	5.88E-09	-8.09	-8.231	-0.14	0
	CuCl3-2	2.63E-09	8.02E-10	-8.581	-9.096	-0.515	0
	Cu+	3.65E-12	2.51E-12	-11.438	-11.601	-0.162	0
Cu(2)	9.93E-08						
	Cu(OH)2	7.89E-08	8.23E-08	-7.103	-7.085	0.019	0
	CuCO3	1.57E-08	1.64E-08	-7.804	-7.785	0.019	0
	Cu(CO3)2-	4.17E-09	1.32E-09	-8.38	-8.88	-0.501	0
	CuOH+	1.90E-10	1.37E-10	-9.722	-9.863	-0.14	0
	CuHCO3+	1.51E-10	1.13E-10	-9.821	-9.947	-0.125	0
	Cu+2	1.43E-10	4.78E-11	-9.845	-10.321	-0.475	-25.78
	CuSO4	2.21E-11	2.31E-11	-10.656	-10.637	0.019	13.09
	CuCl+	1.53E-11	1.11E-11	-10.815	-10.956	-0.14	1.11
	Cu(OH)3-	1.90E-12	1.42E-12	-11.722	-11.847	-0.125	0
	CuCl2	4.91E-13	5.12E-13	-12.309	-12.291	0.019	31.02
	CuF+	1.86E-13	1.40E-13	-12.73	-12.855	-0.125	0
	Cu2(OH)2+	2.61E-14	8.24E-15	-13.583	-14.084	-0.501	0
	Cu(OH)4-2	2.58E-16	8.15E-17	-15.588	-16.089	-0.501	0
	CuCl3-	2.16E-16	1.57E-16	-15.665	-15.806	-0.14	0
	CuCl4-2	2.21E-19	6.75E-20	-18.656	-19.171	-0.515	0
F	3.40E-04						
	F-	2.25E-04	1.61E-04	-3.647	-3.794	-0.147	-0.94
	MgF+	1.07E-04	7.87E-05	-3.97	-4.104	-0.134	-10.35
	NaF	7.53E-06	7.86E-06	-5.123	-5.105	0.019	7.26
	HF	8.00E-10	8.35E-10	-9.097	-9.078	0.019	12.5
	ZnF+	3.82E-11	2.87E-11	-10.418	-10.543	-0.125	0
	MnF+	2.41E-11	1.79E-11	-10.618	-10.747	-0.129	0
	HF2-	6.87E-13	5.15E-13	-12.163	-12.288	-0.125	22.44
	FeF+	2.21E-13	1.65E-13	-12.657	-12.782	-0.125	0
	CuF+	1.86E-13	1.40E-13	-12.73	-12.855	-0.125	0
	FeF2+	2.15E-16	1.60E-16	-15.667	-15.796	-0.129	0
	FeF+2	8.18E-17	2.50E-17	-16.087	-16.602	-0.515	0
	FeF3	3.90E-17	4.07E-17	-16.409	-16.39	0.019	0
Fe(2)	5.94E-10						
	Fe+2	3.07E-10	1.03E-10	-9.512	-9.988	-0.475	-21.27
	FeCO3	1.51E-10	1.58E-10	-9.821	-9.803	0.019	0
	FeHCO3+	6.48E-11	4.86E-11	-10.188	-10.314	-0.125	0
	FeSO4	4.14E-11	4.32E-11	-10.383	-10.364	0.019	18.97
	FeCl+	1.63E-11	1.22E-11	-10.787	-10.913	-0.125	0

	FeOH+	1.26E-11	9.34E-12	-10.901	-11.03	-0.129	0
	FeF+	2.21E-13	1.65E-13	-12.657	-12.782	-0.125	0
	Fe(OH)2	2.19E-14	2.28E-14	-13.66	-13.642	0.019	0
	Fe(OH)3-	3.27E-16	2.43E-16	-15.485	-15.614	-0.129	0
	FeHSO4+	1.31E-18	9.85E-19	-17.881	-18.007	-0.125	0
Fe(3)	8.59E-07						
	Fe(OH)3	6.13E-07	6.40E-07	-6.212	-6.194	0.019	0
	Fe(OH)4-	2.23E-07	1.68E-07	-6.651	-6.776	-0.125	0
	Fe(OH)2+	2.31E-08	1.73E-08	-7.637	-7.762	-0.125	0
	FeOH+2	5.96E-13	1.82E-13	-12.225	-12.74	-0.515	0
	FeF2+	2.15E-16	1.60E-16	-15.667	-15.796	-0.129	0
	FeF+2	8.18E-17	2.50E-17	-16.087	-16.602	-0.515	0
	FeF3	3.90E-17	4.07E-17	-16.409	-16.39	0.019	0
	FeSO4+	3.42E-18	2.54E-18	-17.466	-17.594	-0.129	0
	FeCl+2	8.36E-19	2.56E-19	-18.078	-18.593	-0.515	0
	Fe+3	7.28E-19	9.83E-20	-18.138	-19.008	-0.87	0
	Fe(SO4)2-	1.75E-19	1.32E-19	-18.756	-18.881	-0.125	0
	FeCl2+	1.32E-19	9.82E-20	-18.879	-19.008	-0.129	0
	FeCl3	8.10E-22	8.46E-22	-21.091	-21.073	0.019	0
	Fe2(OH)2+	8.98E-23	8.93E-25	-22.047	-24.049	-2.003	0
	FeHSO4+2	7.48E-26	2.36E-26	-25.126	-25.627	-0.501	0
	Fe3(OH)4+	4.35E-27	3.23E-30	-26.362	-29.491	-3.129	0
H(0)	1.63E-28						
	H2	8.16E-29	8.51E-29	-28.089	-28.07	0.019	28.61
K	1.63E-03						
	K+	1.61E-03	1.15E-03	-2.795	-2.939	-0.144	9.33
	KSO4-	2.55E-05	1.91E-05	-4.594	-4.719	-0.125	34.48
Mg	2.63E-02						
	Mg+2	2.12E-02	7.41E-03	-1.673	-2.13	-0.457	-20.95
	MgSO4	3.93E-03	4.11E-03	-2.405	-2.387	0.019	5.84
	MgHCO3+	5.66E-04	4.10E-04	-3.247	-3.388	-0.14	5.71
	MgCO3	4.33E-04	4.52E-04	-3.364	-3.345	0.019	-17.09
	MgF+	1.07E-04	7.87E-05	-3.97	-4.104	-0.134	-10.35
	MgOH+	1.01E-05	7.73E-06	-4.998	-5.112	-0.114	0
Mn(2)	1.50E-07						
	MnCO3	7.83E-08	8.17E-08	-7.106	-7.088	0.019	0
	Mn+2	4.81E-08	1.61E-08	-7.318	-7.793	-0.475	-17.61
	MnHCO3+	9.12E-09	6.78E-09	-8.04	-8.169	-0.129	0
	MnCl+	7.60E-09	5.65E-09	-8.119	-8.248	-0.129	-2.88
	MnSO4	6.48E-09	6.77E-09	-8.188	-8.17	0.019	22.54
	MnCl2	2.04E-10	2.12E-10	-9.692	-9.673	0.019	85.89
	MnOH+	1.60E-10	1.19E-10	-9.796	-9.925	-0.129	0
	MnF+	2.41E-11	1.79E-11	-10.618	-10.747	-0.129	0
	MnCl3-	6.77E-12	5.04E-12	-11.169	-11.298	-0.129	44.19
	Mn(NO3)2	6.80E-16	7.09E-16	-15.168	-15.149	0.019	41.04
	Mn(OH)3-	8.12E-18	6.04E-18	-17.09	-17.219	-0.129	0
Mn(3)	3.69E-29						
	Mn+3	3.69E-29	4.98E-30	-28.433	-29.303	-0.87	0
N(-3)	1.80E-05						
	NH4+	1.58E-05	1.09E-05	-4.8	-4.963	-0.162	18.24

	NH3	1.72E-06	1.79E-06	-5.765	-5.747	0.019	24.42
	NH4SO4-	4.42E-07	3.32E-07	-6.354	-6.479	-0.125	38.44
N(5)	1.50E-04						
	NO3-	1.50E-04	1.05E-04	-3.824	-3.978	-0.154	29.88
	Mn(NO3)2	6.80E-16	7.09E-16	-15.168	-15.149	0.019	41.04
Na	1.15E-01						
	Na+	1.13E-01	8.51E-02	-0.946	-1.07	-0.124	-0.95
	NaSO4-	1.34E-03	1.01E-03	-2.873	-2.997	-0.125	17.4
	NaHCO3	2.16E-04	2.26E-04	-3.665	-3.646	0.019	1.8
	NaCO3-	1.35E-04	1.01E-04	-3.87	-3.995	-0.125	0.22
	NaF	7.53E-06	7.86E-06	-5.123	-5.105	0.019	7.26
	NaOH	2.37E-17	2.47E-17	-16.626	-16.607	0.019	0
O(0)	1.09E-36						
	O2	5.46E-37	5.70E-37	-36.263	-36.244	0.019	30.4
S(6)	1.35E-02						
	SO4-2	7.86E-03	2.36E-03	-2.105	-2.627	-0.522	16.02
	MgSO4	3.93E-03	4.11E-03	-2.405	-2.387	0.019	5.84
	NaSO4-	1.34E-03	1.01E-03	-2.873	-2.997	-0.125	17.4
	CaSO4	3.60E-04	3.76E-04	-3.444	-3.425	0.019	7.5
	KSO4-	2.55E-05	1.91E-05	-4.594	-4.719	-0.125	34.48
	BaSO4	1.61E-06	1.68E-06	-5.793	-5.775	0.019	0
	NH4SO4-	4.42E-07	3.32E-07	-6.354	-6.479	-0.125	38.44
	ZnSO4	6.70E-09	6.99E-09	-8.174	-8.156	0.019	21.71
	MnSO4	6.48E-09	6.77E-09	-8.188	-8.17	0.019	22.54
	HSO4-	1.06E-09	7.96E-10	-8.974	-9.099	-0.125	40.64
	Zn(SO4)2-2	4.25E-10	1.34E-10	-9.372	-9.872	-0.501	-10.25
	FeSO4	4.14E-11	4.32E-11	-10.383	-10.364	0.019	18.97
	CuSO4	2.21E-11	2.31E-11	-10.656	-10.637	0.019	13.09
	CaHSO4+	1.14E-11	8.56E-12	-10.942	-11.067	-0.125	0
	FeSO4+	3.42E-18	2.54E-18	-17.466	-17.594	-0.129	0
	FeHSO4+	1.31E-18	9.85E-19	-17.881	-18.007	-0.125	0
	Fe(SO4)2-	1.75E-19	1.32E-19	-18.756	-18.881	-0.125	0
	FeHSO4+2	7.48E-26	2.36E-26	-25.126	-25.627	-0.501	0
Zn	9.40E-07						
	Zn(CO3)2-2	6.95E-07	2.20E-07	-6.158	-6.659	-0.501	0
	ZnCO3	1.54E-07	1.61E-07	-6.812	-6.794	0.019	0
	Zn+2	4.13E-08	1.26E-08	-7.384	-7.899	-0.515	-24.51
	Zn(OH)2	1.26E-08	1.31E-08	-7.901	-7.883	0.019	0
	ZnHCO3+	1.00E-08	7.50E-09	-8	-8.125	-0.125	0
	ZnOHCl	9.90E-09	1.03E-08	-8.004	-7.986	0.019	0
	ZnSO4	6.70E-09	6.99E-09	-8.174	-8.156	0.019	21.71
	ZnOH+	5.30E-09	3.97E-09	-8.276	-8.401	-0.125	0
	ZnCl+	4.04E-09	2.93E-09	-8.393	-8.534	-0.14	-14.33
	Zn(SO4)2-2	4.25E-10	1.34E-10	-9.372	-9.872	-0.501	-10.25
	ZnCl2	2.53E-10	2.64E-10	-9.597	-9.579	0.019	102.03
	ZnF+	3.82E-11	2.87E-11	-10.418	-10.543	-0.125	0
	ZnCl3-	3.52E-11	2.55E-11	-10.454	-10.594	-0.14	15.92
	Zn(OH)3-	1.59E-11	1.19E-11	-10.8	-10.925	-0.125	0
	ZnCl4-2	3.60E-12	1.10E-12	-11.444	-11.959	-0.515	147.27
	Zn(OH)4-2	1.71E-15	5.41E-16	-14.766	-15.267	-0.501	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1	atm)
Anhydrite	-1.4	-5.68	-4.28	CaSO4				
Aragonite	1.09	-7.24	-8.34	CaCO3				
Barite	1.37	-8.47	-9.84	BaSO4				
Calcite	1.24	-7.24	-8.48	CaCO3				
CO2(g)	-2.96	-4.43	-1.47	CO2				
Dolomite	3.52	-13.57	-17.08	CaMg(CO3)2				
Fe(OH)3(a)	1.48	6.37	4.89	Fe(OH)3				
Fluorite	-0.04	-10.64	-10.6	CaF2				
Goethite	7.37	6.37	-1	FeOOH				
Gypsum	-1.1	-5.68	-4.58	CaSO4:2H2O				
H2(g)	-24.97	-28.07	-3.1	H2				
H2O(g)	-1.5	0	1.5	H2O				
Halite	-3.71	-2.14	1.57	NaCl				
Hausmann	-8.74	52.29	61.03	Mn3O4				
Hematite	16.75	12.74	-4.01	Fe2O3				
Jarosite-K	-5.26	-14.47	-9.21	KFe3(SO4)2(OH)6				
Manganite	-3.76	21.58	25.34	MnOOH				
Melanterit	-10.42	-12.63	-2.21	FeSO4:7H2O				
NH3(g)	-7.54	-5.75	1.8	NH3				
O2(g)	-33.35	-36.24	-2.89	O2				
Pyrochroit	-6.08	9.12	15.2	Mn(OH)2				
Pyrolusite	-7.34	34.04	41.38	MnO2:H2O				
Rhodochro	-0.86	-11.99	-11.13	MnCO3				
Siderite	-3.29	-14.18	-10.89	FeCO3				
Smithsonit	-2.09	-12.09	-10	ZnCO3				
Sylvite	-4.9	-4	0.9	KCl				
Witherite	-1.48	-10.04	-8.56	BaCO3				
Zn(OH)2(e	-2.48	9.02	11.5	Zn(OH)2				

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 10

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	9.90E-03	9.90E-03
Ba	7.34E-06	7.34E-06
Ca	3.63E-03	3.63E-03
Cl	1.33E-01	1.33E-01
Cu	1.20E-07	1.20E-07
F	3.70E-04	3.70E-04
Fe	9.60E-07	9.60E-07

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            K            1.82E-03   1.82E-03
            Mg           2.93E-02   2.93E-02
            Mn           1.60E-07   1.60E-07
            N(-3)        2.00E-05   2.00E-05
            N(5)         1.70E-04   1.70E-04
            Na           1.28E-01   1.28E-01
            S(6)         1.51E-02   1.51E-02
            Zn           1.04E-06   1.04E-06

#NAME?      of           solution----------------------------

            pH           =                  8.46
            pe           =                     4
            Specific     Conductan (µS/cm,    25°C)      =                16416
            Density      (g/cm³)   =            1.00542
            Volume       (L)       =            1.00515
            Activity     of        water      =                 0.995
            Ionic        strength  (mol/kgw)  =             2.06E-01
            Mass         of        water      (kg)       =            1.00E+00
            Total        carbon    (mol/kg)   =             8.92E-03
            Total        CO2       (mol/kg)   =             8.92E-03
            Temperatu    (°C)      =                   25
            Electrical   balance   (eq)       =             2.21E-02
            Percent      error,    100*(Cat-| =                 6.46
            Iterations   =                 12 (92         overall)
            Total        H         =            1.11E+02
            Total        O         =            5.56E+01

#NAME?      couples--------------------------------

            Redox        couple    pe         Eh         (volts)

            N(-3)/N(5)     4.4347     0.2623

#NAME?      of           species----------------------------

            Log          Log       Log        mole       V
            Species      Molality  Activity   Molality   Activity   Gamma    cm³/mol

            OH-          4.12E-06  2.90E-06     -5.385     -5.537   -0.152     -3.49
            H+           4.35E-09  3.47E-09     -8.361      -8.46   -0.099         0
            H2O          5.55E+01  9.95E-01      1.744     -0.002        0      18.07
Ba            7.34E-06
            Ba+2         5.38E-06  1.52E-06     -5.269     -5.818   -0.549    -11.71
            BaSO4        1.81E-06  1.90E-06     -5.743     -5.722    0.021         0
            BaHCO3+      1.00E-07  7.45E-08         -7     -7.128   -0.128         0
            BaCO3        5.18E-08  5.43E-08     -7.286     -7.265    0.021      -10.7
            BaOH+        2.01E-11  1.48E-11    -10.697     -10.83   -0.133         0
C(4)          8.92E-03
            HCO3-        6.87E-03  5.11E-03     -2.163     -2.292   -0.128      25.55
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	MgHCO3+	6.69E-04	4.79E-04	-3.175	-3.32	-0.145	5.72
	MgCO3	5.04E-04	5.29E-04	-3.298	-3.277	0.021	-17.09
	NaHCO3	2.58E-04	2.70E-04	-3.589	-3.568	0.021	1.8
	CO3-2	2.25E-04	6.91E-05	-3.647	-4.16	-0.513	-3.58
	NaCO3-	1.62E-04	1.21E-04	-3.79	-3.917	-0.128	0.33
	CaCO3	1.07E-04	1.12E-04	-3.971	-3.95	0.021	-14.6
	CaHCO3+	8.35E-05	6.30E-05	-4.078	-4.201	-0.122	9.88
	CO2	3.82E-05	4.01E-05	-4.418	-4.397	0.021	34.43
	Zn(CO3)2-2	7.92E-07	2.44E-07	-6.101	-6.612	-0.511	0
	ZnCO3	1.58E-07	1.65E-07	-6.802	-6.782	0.021	0
	BaHCO3+	1.00E-07	7.45E-08	-7	-7.128	-0.128	0
	MnCO3	8.45E-08	8.86E-08	-7.073	-7.052	0.021	0
	BaCO3	5.18E-08	5.43E-08	-7.286	-7.265	0.021	-10.7
	CuCO3	1.77E-08	1.86E-08	-7.751	-7.73	0.021	0
	ZnHCO3+	1.04E-08	7.71E-09	-7.985	-8.113	-0.128	0
	MnHCO3+	9.98E-09	7.35E-09	-8.001	-8.133	-0.133	0
	Cu(CO3)2-	5.25E-09	1.62E-09	-8.28	-8.791	-0.511	0
	FeCO3	1.82E-10	1.91E-10	-9.74	-9.719	0.021	0
	CuHCO3+	1.72E-10	1.28E-10	-9.764	-9.892	-0.128	0
	FeHCO3+	7.90E-11	5.88E-11	-10.103	-10.23	-0.128	0
	(CO2)2	2.81E-11	2.94E-11	-10.552	-10.531	0.021	68.87
Ca	3.63E-03						
	Ca+2	3.03E-03	9.66E-04	-2.518	-3.015	-0.497	-17.2
	CaSO4	4.08E-04	4.27E-04	-3.39	-3.369	0.021	7.5
	CaCO3	1.07E-04	1.12E-04	-3.971	-3.95	0.021	-14.6
	CaHCO3+	8.35E-05	6.30E-05	-4.078	-4.201	-0.122	9.88
	CaOH+	6.17E-08	4.60E-08	-7.209	-7.337	-0.128	0
	CaHSO4+	1.31E-11	9.74E-12	-10.884	-11.011	-0.128	0
Cl	1.33E-01						
	Cl-	1.33E-01	9.49E-02	-0.876	-1.023	-0.147	18.46
	CuCl2-	1.05E-08	7.49E-09	-7.981	-8.126	-0.145	0
	ZnOHCl	1.03E-08	1.08E-08	-7.987	-7.966	0.021	0
	MnCl+	8.47E-09	6.24E-09	-8.072	-8.205	-0.133	-2.87
	ZnCl+	4.28E-09	3.06E-09	-8.369	-8.514	-0.145	-14.39
	CuCl3-2	3.82E-09	1.13E-09	-8.418	-8.949	-0.531	0
	ZnCl2	2.90E-10	3.04E-10	-9.537	-9.517	0.021	102.03
	MnCl2	2.47E-10	2.58E-10	-9.608	-9.588	0.021	85.89
	ZnCl3-	4.52E-11	3.24E-11	-10.345	-10.49	-0.145	15.79
	FeCl+	2.02E-11	1.51E-11	-10.694	-10.822	-0.128	0
	CuCl+	1.79E-11	1.28E-11	-10.748	-10.893	-0.145	1.15
	MnCl3-	9.17E-12	6.75E-12	-11.038	-11.171	-0.133	44.26
	ZnCl4-2	5.22E-12	1.54E-12	-11.282	-11.813	-0.531	147.42
	CuCl2	6.22E-13	6.52E-13	-12.206	-12.186	0.021	31.02
	CuCl3-	3.06E-16	2.19E-16	-15.514	-15.659	-0.145	0
	FeCl+2	1.07E-18	3.15E-19	-17.971	-18.502	-0.531	0
	CuCl4-2	3.54E-19	1.04E-19	-18.451	-18.982	-0.531	0
	FeCl2+	1.81E-19	1.34E-19	-18.742	-18.874	-0.133	0
	FeCl3	1.21E-21	1.27E-21	-20.918	-20.897	0.021	0
Cu(1)	1.43E-08						
	CuCl2-	1.05E-08	7.49E-09	-7.981	-8.126	-0.145	0

	CuCl3-2	3.82E-09	1.13E-09	-8.418	-8.949	-0.531	0
	Cu+	3.88E-12	2.63E-12	-11.411	-11.58	-0.169	0
Cu(2)	1.06E-07						
	Cu(OH)2	8.22E-08	8.62E-08	-7.085	-7.065	0.021	0
	CuCO3	1.77E-08	1.86E-08	-7.751	-7.73	0.021	0
	Cu(CO3)2-	5.25E-09	1.62E-09	-8.28	-8.791	-0.511	0
	CuOH+	2.01E-10	1.44E-10	-9.697	-9.842	-0.145	0
	CuHCO3+	1.72E-10	1.28E-10	-9.764	-9.892	-0.128	0
	Cu+2	1.54E-10	5.01E-11	-9.811	-10.3	-0.489	-25.75
	CuSO4	2.43E-11	2.55E-11	-10.615	-10.594	0.021	13.09
	CuCl+	1.79E-11	1.28E-11	-10.748	-10.893	-0.145	1.15
	Cu(OH)3-	2.00E-12	1.49E-12	-11.699	-11.827	-0.128	0
	CuCl2	6.22E-13	6.52E-13	-12.206	-12.186	0.021	31.02
	CuF+	2.06E-13	1.53E-13	-12.686	-12.814	-0.128	0
	Cu2(OH)2+	2.93E-14	9.04E-15	-13.533	-14.044	-0.511	0
	CuCl3-	3.06E-16	2.19E-16	-15.514	-15.659	-0.145	0
	Cu(OH)4-2	2.76E-16	8.53E-17	-15.558	-16.069	-0.511	0
	CuCl4-2	3.54E-19	1.04E-19	-18.451	-18.982	-0.531	0
F	3.70E-04						
	F-	2.39E-04	1.68E-04	-3.622	-3.774	-0.152	-0.92
	MgF+	1.23E-04	8.91E-05	-3.912	-4.05	-0.139	-10.35
	NaF	8.68E-06	9.10E-06	-5.062	-5.041	0.021	7.26
	HF	8.34E-10	8.75E-10	-9.079	-9.058	0.021	12.5
	ZnF+	3.82E-11	2.85E-11	-10.418	-10.545	-0.128	0
	MnF+	2.55E-11	1.88E-11	-10.593	-10.726	-0.133	0
	HF2-	7.58E-13	5.65E-13	-12.121	-12.248	-0.128	22.46
	FeF+	2.60E-13	1.94E-13	-12.585	-12.713	-0.128	0
	CuF+	2.06E-13	1.53E-13	-12.686	-12.814	-0.128	0
	FeF2+	2.67E-16	1.96E-16	-15.574	-15.707	-0.133	0
	FeF+2	9.95E-17	2.93E-17	-16.002	-16.533	-0.531	0
	FeF3	4.99E-17	5.24E-17	-16.302	-16.281	0.021	0
Fe(2)	6.99E-10						
	Fe+2	3.55E-10	1.15E-10	-9.45	-9.939	-0.489	-21.24
	FeCO3	1.82E-10	1.91E-10	-9.74	-9.719	0.021	0
	FeHCO3+	7.90E-11	5.88E-11	-10.103	-10.23	-0.128	0
	FeSO4	4.86E-11	5.09E-11	-10.314	-10.293	0.021	18.97
	FeCl+	2.02E-11	1.51E-11	-10.694	-10.822	-0.128	0
	FeOH+	1.42E-11	1.05E-11	-10.848	-10.981	-0.133	0
	FeF+	2.60E-13	1.94E-13	-12.585	-12.713	-0.128	0
	Fe(OH)2	2.43E-14	2.55E-14	-13.614	-13.593	0.021	0
	Fe(OH)3-	3.69E-16	2.72E-16	-15.433	-15.566	-0.133	0
	FeHSO4+	1.56E-18	1.16E-18	-17.808	-17.935	-0.128	0
Fe(3)	9.59E-07						
	Fe(OH)3	6.82E-07	7.15E-07	-6.166	-6.146	0.021	0
	Fe(OH)4-	2.51E-07	1.87E-07	-6.6	-6.728	-0.128	0
	Fe(OH)2+	2.60E-08	1.94E-08	-7.585	-7.713	-0.128	0
	FeOH+2	6.91E-13	2.04E-13	-12.16	-12.691	-0.531	0
	FeF2+	2.67E-16	1.96E-16	-15.574	-15.707	-0.133	0
	FeF+2	9.95E-17	2.93E-17	-16.002	-16.533	-0.531	0
	FeF3	4.99E-17	5.24E-17	-16.302	-16.281	0.021	0

	FeSO4+	4.07E-18	3.00E-18	-17.39	-17.523	-0.133	0
	FeCl+2	1.07E-18	3.15E-19	-17.971	-18.502	-0.531	0
	Fe+3	8.53E-19	1.10E-19	-18.069	-18.959	-0.89	0
	Fe(SO4)2-	2.19E-19	1.63E-19	-18.66	-18.787	-0.128	0
	FeCl2+	1.81E-19	1.34E-19	-18.742	-18.874	-0.133	0
	FeCl3	1.21E-21	1.27E-21	-20.918	-20.897	0.021	0
	Fe2(OH)2+	1.23E-22	1.12E-24	-21.909	-23.952	-2.043	0
	FeHSO4+2	9.03E-26	2.79E-26	-25.044	-25.555	-0.511	0
	Fe3(OH)4+	7.04E-27	4.52E-30	-26.153	-29.345	-3.193	0
H(0)	1.62E-28						
	H2	8.12E-29	8.51E-29	-28.091	-28.07	0.021	28.61
K	1.82E-03						
	K+	1.79E-03	1.27E-03	-2.747	-2.896	-0.149	9.35
	KSO4-	2.98E-05	2.22E-05	-4.525	-4.654	-0.128	34.5
Mg	2.93E-02						
	Mg+2	2.35E-02	8.01E-03	-1.629	-2.096	-0.468	-20.91
	MgSO4	4.46E-03	4.67E-03	-2.351	-2.331	0.021	5.84
	MgHCO3+	6.69E-04	4.79E-04	-3.175	-3.32	-0.145	5.72
	MgCO3	5.04E-04	5.29E-04	-3.298	-3.277	0.021	-17.09
	MgF+	1.23E-04	8.91E-05	-3.912	-4.05	-0.139	-10.35
	MgOH+	1.09E-05	8.35E-06	-4.961	-5.079	-0.118	0
Mn(2)	1.60E-07						
	MnCO3	8.45E-08	8.86E-08	-7.073	-7.052	0.021	0
	Mn+2	4.98E-08	1.62E-08	-7.303	-7.792	-0.489	-17.51
	MnHCO3+	9.98E-09	7.35E-09	-8.001	-8.133	-0.133	0
	MnCl+	8.47E-09	6.24E-09	-8.072	-8.205	-0.133	-2.87
	MnSO4	6.81E-09	7.14E-09	-8.167	-8.146	0.021	22.54
	MnCl2	2.47E-10	2.58E-10	-9.608	-9.588	0.021	85.89
	MnOH+	1.62E-10	1.19E-10	-9.792	-9.924	-0.133	0
	MnF+	2.55E-11	1.88E-11	-10.593	-10.726	-0.133	0
	MnCl3-	9.17E-12	6.75E-12	-11.038	-11.171	-0.133	44.26
	Mn(NO3)2	8.48E-16	8.89E-16	-15.072	-15.051	0.021	41.04
	Mn(OH)3-	8.20E-18	6.04E-18	-17.086	-17.219	-0.133	0
Mn(3)	3.87E-29						
	Mn+3	3.87E-29	4.99E-30	-28.412	-29.302	-0.89	0
N(-3)	2.00E-05						
	NH4+	1.76E-05	1.20E-05	-4.754	-4.923	-0.169	18.25
	NH3	1.87E-06	1.96E-06	-5.728	-5.707	0.021	24.42
	NH4SO4-	5.14E-07	3.83E-07	-6.289	-6.417	-0.128	38.51
N(5)	1.70E-04						
	NO3-	1.70E-04	1.18E-04	-3.77	-3.93	-0.16	29.91
	Mn(NO3)2	8.48E-16	8.89E-16	-15.072	-15.051	0.021	41.04
Na	1.28E-01						
	Na+	1.26E-01	9.40E-02	-0.9	-1.027	-0.127	-0.92
	NaSO4-	1.57E-03	1.17E-03	-2.803	-2.931	-0.128	17.62
	NaHCO3	2.58E-04	2.70E-04	-3.589	-3.568	0.021	1.8
	NaCO3-	1.62E-04	1.21E-04	-3.79	-3.917	-0.128	0.33
	NaF	8.68E-06	9.10E-06	-5.062	-5.041	0.021	7.26
	NaOH	2.60E-17	2.73E-17	-16.585	-16.564	0.021	0
O(0)	1.09E-36						

	O2	5.43E-37	5.69E-37	-36.265	-36.245	0.021	30.4
S(6)	1.51E-02						
	SO4-2	8.60E-03	2.49E-03	-2.065	-2.604	-0.539	16.11
	MgSO4	4.46E-03	4.67E-03	-2.351	-2.331	0.021	5.84
	NaSO4-	1.57E-03	1.17E-03	-2.803	-2.931	-0.128	17.62
	CaSO4	4.08E-04	4.27E-04	-3.39	-3.369	0.021	7.5
	KSO4-	2.98E-05	2.22E-05	-4.525	-4.654	-0.128	34.5
	BaSO4	1.81E-06	1.90E-06	-5.743	-5.722	0.021	0
	NH4SO4-	5.14E-07	3.83E-07	-6.289	-6.417	-0.128	38.51
	MnSO4	6.81E-09	7.14E-09	-8.167	-8.146	0.021	22.54
	ZnSO4	6.67E-09	6.99E-09	-8.176	-8.155	0.021	21.71
	HSO4-	1.13E-09	8.39E-10	-8.949	-9.077	-0.128	40.66
	Zn(SO4)2-2	4.58E-10	1.41E-10	-9.339	-9.85	-0.511	-10.01
	FeSO4	4.86E-11	5.09E-11	-10.314	-10.293	0.021	18.97
	CuSO4	2.43E-11	2.55E-11	-10.615	-10.594	0.021	13.09
	CaHSO4+	1.31E-11	9.74E-12	-10.884	-11.011	-0.128	0
	FeSO4+	4.07E-18	3.00E-18	-17.39	-17.523	-0.133	0
	FeHSO4+	1.56E-18	1.16E-18	-17.808	-17.935	-0.128	0
	Fe(SO4)2-	2.19E-19	1.63E-19	-18.66	-18.787	-0.128	0
	FeHSO4+2	9.03E-26	2.79E-26	-25.044	-25.555	-0.511	0
Zn	1.04E-06						
	Zn(CO3)2-2	7.92E-07	2.44E-07	-6.101	-6.612	-0.511	0
	ZnCO3	1.58E-07	1.65E-07	-6.802	-6.782	0.021	0
	Zn+2	4.07E-08	1.20E-08	-7.391	-7.921	-0.531	-24.48
	Zn(OH)2	1.19E-08	1.24E-08	-7.926	-7.906	0.021	0
	ZnHCO3+	1.04E-08	7.71E-09	-7.985	-8.113	-0.128	0
	ZnOHCl	1.03E-08	1.08E-08	-7.987	-7.966	0.021	0
	ZnSO4	6.67E-09	6.99E-09	-8.176	-8.155	0.021	21.71
	ZnOH+	5.06E-09	3.77E-09	-8.296	-8.423	-0.128	0
	ZnCl+	4.28E-09	3.06E-09	-8.369	-8.514	-0.145	-14.39
	Zn(SO4)2-2	4.58E-10	1.41E-10	-9.339	-9.85	-0.511	-10.01
	ZnCl2	2.90E-10	3.04E-10	-9.537	-9.517	0.021	102.03
	ZnCl3-	4.52E-11	3.24E-11	-10.345	-10.49	-0.145	15.79
	ZnF+	3.82E-11	2.85E-11	-10.418	-10.545	-0.128	0
	Zn(OH)3-	1.51E-11	1.13E-11	-10.82	-10.948	-0.128	0
	ZnCl4-2	5.22E-12	1.54E-12	-11.282	-11.813	-0.531	147.42
	Zn(OH)4-2	1.66E-15	5.12E-16	-14.78	-15.29	-0.511	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-1.34	-5.62	-4.28	CaSO4			
Aragonite	1.16	-7.18	-8.34	CaCO3			
Barite	1.42	-8.42	-9.84	BaSO4			
Calcite	1.3	-7.18	-8.48	CaCO3			
CO2(g)	-2.93	-4.4	-1.47	CO2			
Dolomite	3.65	-13.43	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.52	6.41	4.89	Fe(OH)3			
Fluorite	0.04	-10.56	-10.6	CaF2			

Goethite	7.42	6.42	-1	FeOOH
Gypsum	-1.04	-5.62	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O
Halite	-3.62	-2.05	1.57	NaCl
Hausmann	-8.73	52.3	61.03	Mn3O4
Hematite	16.84	12.84	-4.01	Fe2O3
Jarosite-K	-5.02	-14.23	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.76	21.58	25.34	MnOOH
Melanterit	-10.35	-12.56	-2.21	FeSO4:7H2O
NH3(g)	-7.5	-5.71	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.08	9.12	15.2	Mn(OH)2
Pyrolusite	-7.34	34.04	41.38	MnO2:H2O
Rhodochrc	-0.82	-11.95	-11.13	MnCO3
Siderite	-3.21	-14.1	-10.89	FeCO3
Smithsonit	-2.08	-12.08	-10	ZnCO3
Sylvite	-4.82	-3.92	0.9	KCl
Witherite	-1.42	-9.98	-8.56	BaCO3
Zn(OH)2(e	-2.51	8.99	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 11

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.09E-02	1.09E-02
Ba	8.09E-06	8.09E-06
Ca	4.00E-03	4.00E-03
Cl	1.47E-01	1.47E-01
Cu	1.30E-07	1.30E-07
F	4.10E-04	4.10E-04
Fe	1.05E-06	1.05E-06
K	2.01E-03	2.01E-03
Mg	3.23E-02	3.23E-02
Mn	1.80E-07	1.80E-07
N(-3)	2.20E-05	2.20E-05
N(5)	1.80E-04	1.80E-04
Na	1.41E-01	1.41E-01
S(6)	1.66E-02	1.66E-02
Zn	1.15E-06	1.15E-06

#NAME? of solution----------

pH = 8.46
pe = 4

```
Specific    Conductan (µS/cm,    25°C)      =          17905
Density     (g/cm³)   =          1.00626
Volume      (L)       =          1.00538
Activity    of        water      =          0.994
Ionic       strength  (mol/kgw)  =          2.27E-01
Mass        of        water      (kg)       =          1.00E+00
Total       carbon    (mol/kg)   =          9.79E-03
Total       CO2       (mol/kg)   =          9.79E-03
Temperatu   (°C)      =                 25
Electrical  balance   (eq)       =          2.43E-02
Percent     error,    100*(Cat-| =                6.48
Iterations  =                10 (102       overall)
Total       H         =          1.11E+02
Total       O         =          5.56E+01

#NAME?  couples--------------------------------

        Redox     couple    pe        Eh        (volts)

        N(-3)/N(5)   4.4327    0.2622

#NAME?  of        species----------------------------

        Log       Log       Log       mole      V
        Species   Molality  Activity  Molality  Activity  Gamma   cm³/mol

        OH-       4.17E-06  2.90E-06    -5.38    -5.537   -0.157    -3.44
        H+        4.37E-09  3.47E-09   -8.359     -8.46   -0.101        0
        H2O       5.55E+01  9.94E-01    1.744    -0.003        0    18.07
Ba       8.09E-06
        Ba+2      5.91E-06  1.62E-06   -5.228    -5.791   -0.563   -11.67
        BaSO4     2.00E-06  2.11E-06   -5.698    -5.676    0.023        0
        BaHCO3+   1.15E-07  8.51E-08    -6.94     -7.07    -0.13        0
        BaCO3     5.89E-08  6.20E-08    -7.23    -7.208    0.023     -10.7
        BaOH+     2.15E-11  1.57E-11  -10.667   -10.803   -0.136        0
C(4)     9.79E-03
        HCO3-     7.43E-03  5.48E-03   -2.129    -2.261   -0.132    25.62
        MgHCO3+   7.79E-04  5.52E-04   -3.109    -3.258   -0.149     5.72
        MgCO3     5.78E-04  6.09E-04   -3.238    -3.215    0.023   -17.09
        NaHCO3    3.01E-04  3.17E-04   -3.521    -3.498    0.023      1.8
        CO3-2     2.49E-04  7.42E-05   -3.603     -4.13   -0.526    -3.49
        NaCO3-    1.92E-04  1.42E-04   -3.717    -3.847    -0.13     0.45
        CaCO3     1.22E-04  1.29E-04   -3.913     -3.89    0.023    -14.6
        CaHCO3+   9.65E-05  7.23E-05   -4.015    -4.141   -0.125     9.89
        CO2       4.08E-05  4.30E-05   -4.389    -4.367    0.023    34.43
        Zn(CO3)2-2 8.97E-07 2.71E-07   -6.047    -6.566   -0.519        0
        ZnCO3     1.62E-07  1.71E-07   -6.789    -6.767    0.023        0
        BaHCO3+   1.15E-07  8.51E-08    -6.94     -7.07    -0.13        0
        MnCO3     9.61E-08  1.01E-07   -7.017    -6.995    0.023        0
        BaCO3     5.89E-08  6.20E-08    -7.23    -7.208    0.023     -10.7
```

	CuCO3	1.97E-08	2.07E-08	-7.706	-7.683	0.023	0
	MnHCO3+	1.15E-08	8.40E-09	-7.94	-8.076	-0.136	0
	ZnHCO3+	1.08E-08	7.98E-09	-7.968	-8.098	-0.13	0
	Cu(CO3)2-	6.40E-09	1.94E-09	-8.194	-8.713	-0.519	0
	FeCO3	2.13E-10	2.25E-10	-9.671	-9.648	0.023	0
	CuHCO3+	1.93E-10	1.43E-10	-9.715	-9.844	-0.13	0
	FeHCO3+	9.34E-11	6.93E-11	-10.03	-10.16	-0.13	0
	(CO2)2	3.22E-11	3.39E-11	-10.492	-10.469	0.023	68.87
Ca	4.00E-03						
	Ca+2	3.33E-03	1.03E-03	-2.478	-2.986	-0.508	-17.17
	CaSO4	4.54E-04	4.78E-04	-3.343	-3.32	0.023	7.5
	CaCO3	1.22E-04	1.29E-04	-3.913	-3.89	0.023	-14.6
	CaHCO3+	9.65E-05	7.23E-05	-4.015	-4.141	-0.125	9.89
	CaOH+	6.63E-08	4.92E-08	-7.178	-7.308	-0.13	0
	CaHSO4+	1.47E-11	1.09E-11	-10.833	-10.962	-0.13	0
Cl	1.47E-01						
	Cl-	1.47E-01	1.04E-01	-0.834	-0.985	-0.151	18.48
	CuCl2-	1.31E-08	9.27E-09	-7.884	-8.033	-0.149	0
	ZnOHCl	1.08E-08	1.14E-08	-7.967	-7.944	0.023	0
	MnCl+	9.92E-09	7.25E-09	-8.004	-8.14	-0.136	-2.87
	CuCl3-2	5.33E-09	1.52E-09	-8.273	-8.818	-0.545	0
	ZnCl+	4.55E-09	3.22E-09	-8.342	-8.492	-0.149	-14.46
	ZnCl2	3.32E-10	3.50E-10	-9.479	-9.457	0.023	102.03
	MnCl2	3.11E-10	3.28E-10	-9.507	-9.485	0.023	85.89
	ZnCl3-	5.73E-11	4.06E-11	-10.242	-10.391	-0.149	15.65
	FeCl+	2.43E-11	1.81E-11	-10.614	-10.743	-0.13	0
	CuCl+	2.05E-11	1.45E-11	-10.689	-10.838	-0.149	1.19
	MnCl3-	1.28E-11	9.34E-12	-10.893	-11.03	-0.136	44.34
	ZnCl4-2	7.39E-12	2.11E-12	-11.131	-11.676	-0.545	147.57
	CuCl2	7.66E-13	8.07E-13	-12.116	-12.093	0.023	31.02
	CuCl3-	4.18E-16	2.97E-16	-15.379	-15.528	-0.149	0
	FeCl+2	1.32E-18	3.77E-19	-17.878	-18.423	-0.545	0
	CuCl4-2	5.40E-19	1.54E-19	-18.268	-18.813	-0.545	0
	FeCl2+	2.39E-19	1.75E-19	-18.622	-18.758	-0.136	0
	FeCl3	1.72E-21	1.81E-21	-20.766	-20.743	0.023	0
Cu(1)	1.84E-08						
	CuCl2-	1.31E-08	9.27E-09	-7.884	-8.033	-0.149	0
	CuCl3-2	5.33E-09	1.52E-09	-8.273	-8.818	-0.545	0
	Cu+	4.08E-12	2.73E-12	-11.389	-11.563	-0.175	0
Cu(2)	1.12E-07						
	Cu(OH)2	8.49E-08	8.94E-08	-7.071	-7.049	0.023	0
	CuCO3	1.97E-08	2.07E-08	-7.706	-7.683	0.023	0
	Cu(CO3)2-	6.40E-09	1.94E-09	-8.194	-8.713	-0.519	0
	CuOH+	2.11E-10	1.49E-10	-9.677	-9.826	-0.149	0
	CuHCO3+	1.93E-10	1.43E-10	-9.715	-9.844	-0.13	0
	Cu+2	1.65E-10	5.21E-11	-9.782	-10.283	-0.501	-25.72
	CuSO4	2.63E-11	2.77E-11	-10.581	-10.558	0.023	13.09
	CuCl+	2.05E-11	1.45E-11	-10.689	-10.838	-0.149	1.19
	Cu(OH)3-	2.08E-12	1.55E-12	-11.681	-11.811	-0.13	0
	CuCl2	7.66E-13	8.07E-13	-12.116	-12.093	0.023	31.02

	CuF+	2.30E-13	1.70E-13	-12.639	-12.769	-0.13	0
	Cu2(OH)2+	3.22E-14	9.75E-15	-13.492	-14.011	-0.519	0
	CuCl3-	4.18E-16	2.97E-16	-15.379	-15.528	-0.149	0
	Cu(OH)4-2	2.92E-16	8.84E-17	-15.534	-16.054	-0.519	0
	CuCl4-2	5.40E-19	1.54E-19	-18.268	-18.813	-0.545	0
F	4.10E-04						
	F-	2.58E-04	1.80E-04	-3.588	-3.745	-0.157	-0.9
	MgF+	1.42E-04	1.02E-04	-3.848	-3.991	-0.142	-10.34
	NaF	1.01E-05	1.07E-05	-4.995	-4.973	0.023	7.26
	HF	8.87E-10	9.35E-10	-9.052	-9.029	0.023	12.5
	ZnF+	3.96E-11	2.94E-11	-10.402	-10.532	-0.13	0
	MnF+	2.92E-11	2.14E-11	-10.534	-10.67	-0.136	0
	HF2-	8.70E-13	6.45E-13	-12.061	-12.19	-0.13	22.48
	FeF+	3.06E-13	2.27E-13	-12.514	-12.644	-0.13	0
	CuF+	2.30E-13	1.70E-13	-12.639	-12.769	-0.13	0
	FeF2+	3.37E-16	2.46E-16	-15.473	-15.609	-0.136	0
	FeF+2	1.21E-16	3.44E-17	-15.919	-16.464	-0.545	0
	FeF3	6.65E-17	7.01E-17	-16.177	-16.154	0.023	0
Fe(2)	8.03E-10						
	Fe+2	4.00E-10	1.26E-10	-9.398	-9.899	-0.501	-21.2
	FeCO3	2.13E-10	2.25E-10	-9.671	-9.648	0.023	0
	FeHCO3+	9.34E-11	6.93E-11	-10.03	-10.16	-0.13	0
	FeSO4	5.55E-11	5.85E-11	-10.256	-10.233	0.023	18.97
	FeCl+	2.43E-11	1.81E-11	-10.614	-10.743	-0.13	0
	FeOH+	1.57E-11	1.15E-11	-10.805	-10.941	-0.136	0
	FeF+	3.06E-13	2.27E-13	-12.514	-12.644	-0.13	0
	Fe(OH)2	2.65E-14	2.80E-14	-13.576	-13.554	0.023	0
	Fe(OH)3-	4.07E-16	2.98E-16	-15.39	-15.526	-0.136	0
	FeHSO4+	1.80E-18	1.33E-18	-17.746	-17.875	-0.13	0
Fe(3)	1.05E-06						
	Fe(OH)3	7.43E-07	7.83E-07	-6.129	-6.106	0.023	0
	Fe(OH)4-	2.77E-07	2.05E-07	-6.557	-6.689	-0.132	0
	Fe(OH)2+	2.87E-08	2.12E-08	-7.542	-7.674	-0.132	0
	FeOH+2	7.83E-13	2.23E-13	-12.106	-12.651	-0.545	0
	FeF2+	3.37E-16	2.46E-16	-15.473	-15.609	-0.136	0
	FeF+2	1.21E-16	3.44E-17	-15.919	-16.464	-0.545	0
	FeF3	6.65E-17	7.01E-17	-16.177	-16.154	0.023	0
	FeSO4+	4.71E-18	3.44E-18	-17.327	-17.463	-0.136	0
	FeCl+2	1.32E-18	3.77E-19	-17.878	-18.423	-0.545	0
	Fe+3	9.75E-19	1.21E-19	-18.011	-18.919	-0.908	0
	Fe(SO4)2-	2.64E-19	1.96E-19	-18.578	-18.708	-0.13	0
	FeCl2+	2.39E-19	1.75E-19	-18.622	-18.758	-0.136	0
	FeCl3	1.72E-21	1.81E-21	-20.766	-20.743	0.023	0
	Fe2(OH)2+	1.60E-22	1.34E-24	-21.795	-23.872	-2.077	0
	FeHSO4+2	1.06E-25	3.20E-26	-24.976	-25.495	-0.519	0
	Fe3(OH)4+	1.05E-26	5.94E-30	-25.981	-29.226	-3.245	0
H(0)	1.62E-28						
	H2	8.08E-29	8.51E-29	-28.093	-28.07	0.023	28.61
K	2.01E-03						
	K+	1.98E-03	1.39E-03	-2.704	-2.858	-0.153	9.37

	KSO4-	3.44E-05	2.54E-05	-4.464	-4.596	-0.132	34.52
Mg	3.23E-02						
	Mg+2	2.58E-02	8.60E-03	-1.589	-2.065	-0.477	-20.88
	MgSO4	4.98E-03	5.25E-03	-2.303	-2.28	0.023	5.84
	MgHCO3+	7.79E-04	5.52E-04	-3.109	-3.258	-0.149	5.72
	MgCO3	5.78E-04	6.09E-04	-3.238	-3.215	0.023	-17.09
	MgF+	1.42E-04	1.02E-04	-3.848	-3.991	-0.142	-10.34
	MgOH+	1.18E-05	8.96E-06	-4.927	-5.048	-0.12	0
Mn(2)	1.80E-07						
	MnCO3	9.61E-08	1.01E-07	-7.017	-6.995	0.023	0
	Mn+2	5.45E-08	1.72E-08	-7.264	-7.765	-0.501	-17.43
	MnHCO3+	1.15E-08	8.40E-09	-7.94	-8.076	-0.136	0
	MnCl+	9.92E-09	7.25E-09	-8.004	-8.14	-0.136	-2.87
	MnSO4	7.55E-09	7.95E-09	-8.122	-8.1	0.023	22.54
	MnCl2	3.11E-10	3.28E-10	-9.507	-9.485	0.023	85.89
	MnOH+	1.73E-10	1.27E-10	-9.761	-9.898	-0.136	0
	MnF+	2.92E-11	2.14E-11	-10.534	-10.67	-0.136	0
	MnCl3-	1.28E-11	9.34E-12	-10.893	-11.03	-0.136	44.34
	Mn(NO3)2	9.83E-16	1.04E-15	-15.008	-14.985	0.023	41.04
	Mn(OH)3-	8.78E-18	6.42E-18	-17.056	-17.193	-0.136	0
Mn(3)	4.29E-29						
	Mn+3	4.29E-29	5.31E-30	-28.367	-29.275	-0.908	0
N(-3)	2.20E-05						
	NH4+	1.94E-05	1.30E-05	-4.712	-4.887	-0.175	18.27
	NH3	2.02E-06	2.13E-06	-5.694	-5.671	0.023	24.42
	NH4SO4-	5.86E-07	4.35E-07	-6.232	-6.362	-0.13	38.58
N(5)	1.80E-04						
	NO3-	1.80E-04	1.23E-04	-3.745	-3.91	-0.165	29.93
	Mn(NO3)2	9.83E-16	1.04E-15	-15.008	-14.985	0.023	41.04
Na	1.41E-01						
	Na+	1.39E-01	1.03E-01	-0.858	-0.987	-0.13	-0.9
	NaSO4-	1.82E-03	1.34E-03	-2.74	-2.872	-0.132	17.83
	NaHCO3	3.01E-04	3.17E-04	-3.521	-3.498	0.023	1.8
	NaCO3-	1.92E-04	1.42E-04	-3.717	-3.847	-0.13	0.45
	NaF	1.01E-05	1.07E-05	-4.995	-4.973	0.023	7.26
	NaOH	2.84E-17	2.99E-17	-16.547	-16.525	0.023	0
O(0)	1.08E-36						
	O2	5.40E-37	5.69E-37	-36.268	-36.245	0.023	30.4
S(6)	1.66E-02						
	SO4-2	9.32E-03	2.60E-03	-2.031	-2.585	-0.554	16.19
	MgSO4	4.98E-03	5.25E-03	-2.303	-2.28	0.023	5.84
	NaSO4-	1.82E-03	1.34E-03	-2.74	-2.872	-0.132	17.83
	CaSO4	4.54E-04	4.78E-04	-3.343	-3.32	0.023	7.5
	KSO4-	3.44E-05	2.54E-05	-4.464	-4.596	-0.132	34.52
	BaSO4	2.00E-06	2.11E-06	-5.698	-5.676	0.023	0
	NH4SO4-	5.86E-07	4.35E-07	-6.232	-6.362	-0.13	38.58
	MnSO4	7.55E-09	7.95E-09	-8.122	-8.1	0.023	22.54
	ZnSO4	6.70E-09	7.06E-09	-8.174	-8.152	0.023	21.71
	HSO4-	1.18E-09	8.77E-10	-8.927	-9.057	-0.13	40.68
	Zn(SO4)2-2	4.93E-10	1.49E-10	-9.307	-9.826	-0.519	-9.78

	FeSO4	5.55E-11	5.85E-11	-10.256	-10.233	0.023	18.97
	CuSO4	2.63E-11	2.77E-11	-10.581	-10.558	0.023	13.09
	CaHSO4+	1.47E-11	1.09E-11	-10.833	-10.962	-0.13	0
	FeSO4+	4.71E-18	3.44E-18	-17.327	-17.463	-0.136	0
	FeHSO4+	1.80E-18	1.33E-18	-17.746	-17.875	-0.13	0
	Fe(SO4)2-	2.64E-19	1.96E-19	-18.578	-18.708	-0.13	0
	FeHSO4+2	1.06E-25	3.20E-26	-24.976	-25.495	-0.519	0
Zn	1.15E-06						
	Zn(CO3)2-2	8.97E-07	2.71E-07	-6.047	-6.566	-0.519	0
	ZnCO3	1.62E-07	1.71E-07	-6.789	-6.767	0.023	0
	Zn+2	4.06E-08	1.16E-08	-7.392	-7.937	-0.545	-24.45
	Zn(OH)2	1.14E-08	1.20E-08	-7.945	-7.922	0.023	0
	ZnOHCl	1.08E-08	1.14E-08	-7.967	-7.944	0.023	0
	ZnHCO3+	1.08E-08	7.98E-09	-7.968	-8.098	-0.13	0
	ZnSO4	6.70E-09	7.06E-09	-8.174	-8.152	0.023	21.71
	ZnOH+	4.90E-09	3.64E-09	-8.31	-8.439	-0.13	0
	ZnCl+	4.55E-09	3.22E-09	-8.342	-8.492	-0.149	-14.46
	Zn(SO4)2-2	4.93E-10	1.49E-10	-9.307	-9.826	-0.519	-9.78
	ZnCl2	3.32E-10	3.50E-10	-9.479	-9.457	0.023	102.03
	ZnCl3-	5.73E-11	4.06E-11	-10.242	-10.391	-0.149	15.65
	ZnF+	3.96E-11	2.94E-11	-10.402	-10.532	-0.13	0
	Zn(OH)3-	1.46E-11	1.09E-11	-10.835	-10.965	-0.13	0
	ZnCl4-2	7.39E-12	2.11E-12	-11.131	-11.676	-0.545	147.57
	Zn(OH)4-2	1.63E-15	4.93E-16	-14.788	-15.307	-0.519	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-1.29	-5.57	-4.28	CaSO4			
Aragonite	1.22	-7.12	-8.34	CaCO3			
Barite	1.47	-8.38	-9.84	BaSO4			
Calcite	1.36	-7.12	-8.48	CaCO3			
CO2(g)	-2.9	-4.37	-1.47	CO2			
Dolomite	3.77	-13.31	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.56	6.45	4.89	Fe(OH)3			
Fluorite	0.12	-10.48	-10.6	CaF2			
Goethite	7.46	6.46	-1	FeOOH			
Gypsum	-0.99	-5.58	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	0	1.5	H2O			
Halite	-3.54	-1.97	1.57	NaCl			
Hausmann	-8.66	52.37	61.03	Mn3O4			
Hematite	16.92	12.92	-4.01	Fe2O3			
Jarosite-K	-4.83	-14.04	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.73	21.61	25.34	MnOOH			
Melanterit	-10.29	-12.5	-2.21	FeSO4:7H2O			
NH3(g)	-7.47	-5.67	1.8	NH3			
O2(g)	-33.35	-36.25	-2.89	O2			
Pyrochroit	-6.05	9.15	15.2	Mn(OH)2			

Pyrolusite	-7.31	34.07	41.38	MnO2:H2O
Rhodochrc	-0.76	-11.89	-11.13	MnCO3
Siderite	-3.14	-14.03	-10.89	FeCO3
Smithsonit	-2.07	-12.07	-10	ZnCO3
Sylvite	-4.74	-3.84	0.9	KCl
Witherite	-1.36	-9.92	-8.56	BaCO3
Zn(OH)2(e	-2.52	8.98	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 12

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.19E-02	1.19E-02
Ba	8.85E-06	8.85E-06
Ca	4.37E-03	4.37E-03
Cl	1.60E-01	1.60E-01
Cu	1.50E-07	1.50E-07
F	4.50E-04	4.50E-04
Fe	1.15E-06	1.15E-06
K	2.19E-03	2.19E-03
Mg	3.53E-02	3.53E-02
Mn	2.00E-07	2.00E-07
N(-3)	2.40E-05	2.40E-05
N(5)	2.00E-04	2.00E-04
Na	1.54E-01	1.54E-01
S(6)	1.82E-02	1.82E-02
Zn	1.26E-06	1.26E-06

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 19372
Density (g/cm³) = 1.0071
Volume (L) = 1.00561
Activity of water = 0.994
Ionic strength (mol/kgw) = 2.47E-01
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 1.07E-02
Total CO2 (mol/kg) = 1.07E-02
Temperatu (°C) = 25
Electrical balance (eq) = 2.66E-02
Percent error, 100*(Cat-| = 6.49
Iterations = 10 (112 overall)
Total H = 1.11E+02

Total O = 5.56E+01

#NAME? couples----------

Redox couple pe Eh (volts)

N(-3)/N(5) 4.4338 0.2623

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.21E-06	2.90E-06	-5.376	-5.538	-0.161	-3.4
	H+	4.39E-09	3.47E-09	-8.357	-8.46	-0.103	0
	H2O	5.55E+01	9.94E-01	1.744	-0.003	0	18.07
Ba	8.85E-06						
	Ba+2	6.45E-06	1.72E-06	-5.19	-5.766	-0.575	-11.63
	BaSO4	2.20E-06	2.33E-06	-5.657	-5.633	0.025	0
	BaHCO3+	1.30E-07	9.61E-08	-6.886	-7.018	-0.132	0
	BaCO3	6.62E-08	7.00E-08	-7.179	-7.155	0.025	-10.7
	BaOH+	2.30E-11	1.67E-11	-10.639	-10.779	-0.14	0
C(4)	1.07E-02						
	HCO3-	7.97E-03	5.84E-03	-2.099	-2.233	-0.135	25.69
	MgHCO3+	8.94E-04	6.28E-04	-3.049	-3.202	-0.153	5.73
	MgCO3	6.54E-04	6.93E-04	-3.184	-3.16	0.025	-17.09
	NaHCO3	3.47E-04	3.67E-04	-3.46	-3.435	0.025	1.8
	CO3-2	2.73E-04	7.90E-05	-3.563	-4.102	-0.539	-3.4
	NaCO3-	2.23E-04	1.65E-04	-3.652	-3.784	-0.132	0.57
	CaCO3	1.38E-04	1.46E-04	-3.86	-3.836	0.025	-14.6
	CaHCO3+	1.10E-04	8.20E-05	-3.958	-4.086	-0.128	9.89
	CO2	4.33E-05	4.58E-05	-4.363	-4.339	0.025	34.43
	Zn(CO3)2-2	1.00E-06	2.98E-07	-5.999	-6.525	-0.526	0
	ZnCO3	1.67E-07	1.77E-07	-6.778	-6.753	0.025	0
	BaHCO3+	1.30E-07	9.61E-08	-6.886	-7.018	-0.132	0
	MnCO3	1.08E-07	1.14E-07	-6.968	-6.943	0.025	0
	BaCO3	6.62E-08	7.00E-08	-7.179	-7.155	0.025	-10.7
	CuCO3	2.31E-08	2.44E-08	-7.637	-7.612	0.025	0
	MnHCO3+	1.30E-08	9.45E-09	-7.885	-8.025	-0.14	0
	ZnHCO3+	1.12E-08	8.24E-09	-7.953	-8.084	-0.132	0
	Cu(CO3)2-	8.16E-09	2.43E-09	-8.088	-8.615	-0.526	0
	FeCO3	2.49E-10	2.63E-10	-9.605	-9.58	0.025	0
	CuHCO3+	2.28E-10	1.69E-10	-9.642	-9.773	-0.132	0
	FeHCO3+	1.10E-10	8.11E-11	-9.96	-10.091	-0.132	0
	(CO2)2	3.64E-11	3.86E-11	-10.438	-10.414	0.025	68.87
Ca	4.37E-03						
	Ca+2	3.62E-03	1.10E-03	-2.441	-2.959	-0.517	-17.13
	CaSO4	5.01E-04	5.30E-04	-3.3	-3.276	0.025	7.5
	CaCO3	1.38E-04	1.46E-04	-3.86	-3.836	0.025	-14.6
	CaHCO3+	1.10E-04	8.20E-05	-3.958	-4.086	-0.128	9.89

	CaOH+	7.08E-08	5.23E-08	-7.15	-7.281	-0.132	0
	CaHSO4+	1.64E-11	1.21E-11	-10.786	-10.918	-0.132	0
Cl	1.60E-01						
	Cl-	1.60E-01	1.12E-01	-0.795	-0.95	-0.155	18.5
	CuCl2-	1.71E-08	1.20E-08	-7.767	-7.921	-0.153	0
	MnCl+	1.14E-08	8.29E-09	-7.942	-8.081	-0.14	-2.86
	ZnOHCl	1.13E-08	1.19E-08	-7.948	-7.924	0.025	0
	CuCl3-2	7.72E-09	2.13E-09	-8.113	-8.671	-0.558	0
	ZnCl+	4.81E-09	3.38E-09	-8.318	-8.471	-0.153	-14.52
	MnCl2	3.84E-10	4.06E-10	-9.416	-9.392	0.025	85.89
	ZnCl2	3.75E-10	3.97E-10	-9.426	-9.401	0.025	102.03
	ZnCl3-	7.11E-11	5.00E-11	-10.148	-10.301	-0.153	15.51
	FeCl+	2.91E-11	2.15E-11	-10.536	-10.668	-0.132	0
	CuCl+	2.47E-11	1.74E-11	-10.607	-10.76	-0.153	1.22
	MnCl3-	1.73E-11	1.25E-11	-10.762	-10.902	-0.14	44.41
	ZnCl4-2	1.02E-11	2.81E-12	-10.993	-11.552	-0.558	147.72
	CuCl2	9.88E-13	1.05E-12	-12.005	-11.981	0.025	31.02
	CuCl3-	5.92E-16	4.16E-16	-15.227	-15.381	-0.153	0
	FeCl+2	1.62E-18	4.49E-19	-17.79	-18.348	-0.558	0
	CuCl4-2	8.46E-19	2.34E-19	-18.073	-18.631	-0.558	0
	FeCl2+	3.10E-19	2.25E-19	-18.509	-18.648	-0.14	0
	FeCl3	2.38E-21	2.52E-21	-20.623	-20.598	0.025	0
Cu(1)	2.48E-08						
	CuCl2-	1.71E-08	1.20E-08	-7.767	-7.921	-0.153	0
	CuCl3-2	7.72E-09	2.13E-09	-8.113	-8.671	-0.558	0
	Cu+	4.57E-12	3.02E-12	-11.34	-11.52	-0.18	0
Cu(2)	1.25E-07						
	Cu(OH)2	9.33E-08	9.87E-08	-7.03	-7.006	0.025	0
	CuCO3	2.31E-08	2.44E-08	-7.637	-7.612	0.025	0
	Cu(CO3)2-	8.16E-09	2.43E-09	-8.088	-8.615	-0.526	0
	CuOH+	2.35E-10	1.65E-10	-9.63	-9.783	-0.153	0
	CuHCO3+	2.28E-10	1.69E-10	-9.642	-9.773	-0.132	0
	Cu+2	1.87E-10	5.75E-11	-9.728	-10.24	-0.512	-25.69
	CuSO4	3.01E-11	3.18E-11	-10.522	-10.497	0.025	13.09
	CuCl+	2.47E-11	1.74E-11	-10.607	-10.76	-0.153	1.22
	Cu(OH)3-	2.31E-12	1.70E-12	-11.637	-11.768	-0.132	0
	CuCl2	9.88E-13	1.05E-12	-12.005	-11.981	0.025	31.02
	CuF+	2.70E-13	2.00E-13	-12.568	-12.7	-0.132	0
	Cu2(OH)2+	3.99E-14	1.19E-14	-13.399	-13.925	-0.526	0
	CuCl3-	5.92E-16	4.16E-16	-15.227	-15.381	-0.153	0
	Cu(OH)4-2	3.27E-16	9.75E-17	-15.485	-16.011	-0.526	0
	CuCl4-2	8.46E-19	2.34E-19	-18.073	-18.631	-0.558	0
F	4.50E-04						
	F-	2.76E-04	1.91E-04	-3.558	-3.72	-0.161	-0.88
	MgF+	1.62E-04	1.16E-04	-3.791	-3.937	-0.146	-10.33
	NaF	1.16E-05	1.23E-05	-4.936	-4.911	0.025	7.26
	HF	9.37E-10	9.92E-10	-9.028	-9.004	0.025	12.5
	ZnF+	4.08E-11	3.02E-11	-10.389	-10.52	-0.132	0
	MnF+	3.30E-11	2.39E-11	-10.481	-10.621	-0.14	0
	HF2-	9.82E-13	7.25E-13	-12.008	-12.139	-0.132	22.5

	FeF+	3.58E-13	2.65E-13	-12.446	-12.577	-0.132	0
	CuF+	2.70E-13	2.00E-13	-12.568	-12.7	-0.132	0
	FeF2+	4.19E-16	3.04E-16	-15.378	-15.517	-0.14	0
	FeF+2	1.45E-16	4.00E-17	-15.839	-16.397	-0.558	0
	FeF3	8.68E-17	9.19E-17	-16.062	-16.037	0.025	0
Fe(2)	9.19E-10						
	Fe+2	4.51E-10	1.39E-10	-9.346	-9.858	-0.512	-21.17
	FeCO3	2.49E-10	2.63E-10	-9.605	-9.58	0.025	0
	FeHCO3+	1.10E-10	8.11E-11	-9.96	-10.091	-0.132	0
	FeSO4	6.32E-11	6.69E-11	-10.199	-10.175	0.025	18.97
	FeCl+	2.91E-11	2.15E-11	-10.536	-10.668	-0.132	0
	FeOH+	1.73E-11	1.26E-11	-10.761	-10.901	-0.14	0
	FeF+	3.58E-13	2.65E-13	-12.446	-12.577	-0.132	0
	Fe(OH)2	2.90E-14	3.07E-14	-13.538	-13.513	0.025	0
	Fe(OH)3-	4.50E-16	3.27E-16	-15.347	-15.486	-0.14	0
	FeHSO4+	2.06E-18	1.52E-18	-17.686	-17.817	-0.132	0
Fe(3)	1.15E-06						
	Fe(OH)3	8.11E-07	8.59E-07	-6.091	-6.066	0.025	0
	Fe(OH)4-	3.06E-07	2.24E-07	-6.514	-6.649	-0.135	0
	Fe(OH)2+	3.17E-08	2.33E-08	-7.499	-7.633	-0.135	0
	FeOH+2	8.86E-13	2.45E-13	-12.052	-12.611	-0.558	0
	FeF2+	4.19E-16	3.04E-16	-15.378	-15.517	-0.14	0
	FeF+2	1.45E-16	4.00E-17	-15.839	-16.397	-0.558	0
	FeF3	8.68E-17	9.19E-17	-16.062	-16.037	0.025	0
	FeSO4+	5.43E-18	3.94E-18	-17.265	-17.405	-0.14	0
	FeCl+2	1.62E-18	4.49E-19	-17.79	-18.348	-0.558	0
	Fe+3	1.11E-18	1.33E-19	-17.954	-18.878	-0.924	0
	Fe(SO4)2-	3.16E-19	2.33E-19	-18.5	-18.632	-0.132	0
	FeCl2+	3.10E-19	2.25E-19	-18.509	-18.648	-0.14	0
	FeCl3	2.38E-21	2.52E-21	-20.623	-20.598	0.025	0
	Fe2(OH)2+	2.06E-22	1.62E-24	-21.687	-23.791	-2.104	0
	FeHSO4+2	1.23E-25	3.66E-26	-24.911	-25.437	-0.526	0
	Fe3(OH)4+	1.53E-26	7.86E-30	-25.816	-29.104	-3.288	0
H(0)	1.61E-28						
	H2	8.04E-29	8.51E-29	-28.095	-28.07	0.025	28.61
K	2.19E-03						
	K+	2.15E-03	1.50E-03	-2.667	-2.825	-0.158	9.38
	KSO4-	3.89E-05	2.85E-05	-4.41	-4.545	-0.135	34.54
Mg	3.53E-02						
	Mg+2	2.80E-02	9.19E-03	-1.552	-2.037	-0.485	-20.85
	MgSO4	5.51E-03	5.84E-03	-2.259	-2.234	0.025	5.84
	MgHCO3+	8.94E-04	6.28E-04	-3.049	-3.202	-0.153	5.73
	MgCO3	6.54E-04	6.93E-04	-3.184	-3.16	0.025	-17.09
	MgF+	1.62E-04	1.16E-04	-3.791	-3.937	-0.146	-10.33
	MgOH+	1.27E-05	9.56E-06	-4.897	-5.02	-0.123	0
Mn(2)	2.00E-07						
	MnCO3	1.08E-07	1.14E-07	-6.968	-6.943	0.025	0
	Mn+2	5.90E-08	1.82E-08	-7.229	-7.741	-0.512	-17.35
	MnHCO3+	1.30E-08	9.45E-09	-7.885	-8.025	-0.14	0
	MnCl+	1.14E-08	8.29E-09	-7.942	-8.081	-0.14	-2.86

	MnSO4	8.26E-09	8.75E-09	-8.083	-8.058	0.025	22.54
	MnCl2	3.84E-10	4.06E-10	-9.416	-9.392	0.025	85.89
	MnOH+	1.84E-10	1.34E-10	-9.734	-9.874	-0.14	0
	MnF+	3.30E-11	2.39E-11	-10.481	-10.621	-0.14	0
	MnCl3-	1.73E-11	1.25E-11	-10.762	-10.902	-0.14	44.41
	Mn(NO3)2	1.25E-15	1.32E-15	-14.904	-14.879	0.025	41.04
	Mn(OH)3-	9.33E-18	6.77E-18	-17.03	-17.169	-0.14	0
Mn(3)	4.71E-29						
	Mn+3	4.71E-29	5.61E-30	-28.327	-29.251	-0.924	0
N(-3)	2.40E-05						
	NH4+	2.12E-05	1.40E-05	-4.674	-4.854	-0.18	18.28
	NH3	2.17E-06	2.30E-06	-5.663	-5.639	0.025	24.42
	NH4SO4-	6.61E-07	4.88E-07	-6.18	-6.311	-0.132	38.65
N(5)	2.00E-04						
	NO3-	2.00E-04	1.35E-04	-3.699	-3.869	-0.17	29.95
	Mn(NO3)2	1.25E-15	1.32E-15	-14.904	-14.879	0.025	41.04
Na	1.54E-01						
	Na+	1.52E-01	1.12E-01	-0.82	-0.951	-0.132	-0.87
	NaSO4-	2.07E-03	1.52E-03	-2.684	-2.818	-0.135	18.03
	NaHCO3	3.47E-04	3.67E-04	-3.46	-3.435	0.025	1.8
	NaCO3-	2.23E-04	1.65E-04	-3.652	-3.784	-0.132	0.57
	NaF	1.16E-05	1.23E-05	-4.936	-4.911	0.025	7.26
	NaOH	3.06E-17	3.24E-17	-16.514	-16.489	0.025	0
O(0)	1.07E-36						
	O2	5.37E-37	5.68E-37	-36.27	-36.246	0.025	30.4
S(6)	1.82E-02						
	SO4-2	1.00E-02	2.71E-03	-1.999	-2.567	-0.568	16.27
	MgSO4	5.51E-03	5.84E-03	-2.259	-2.234	0.025	5.84
	NaSO4-	2.07E-03	1.52E-03	-2.684	-2.818	-0.135	18.03
	CaSO4	5.01E-04	5.30E-04	-3.3	-3.276	0.025	7.5
	KSO4-	3.89E-05	2.85E-05	-4.41	-4.545	-0.135	34.54
	BaSO4	2.20E-06	2.33E-06	-5.657	-5.633	0.025	0
	NH4SO4-	6.61E-07	4.88E-07	-6.18	-6.311	-0.132	38.65
	MnSO4	8.26E-09	8.75E-09	-8.083	-8.058	0.025	22.54
	ZnSO4	6.72E-09	7.12E-09	-8.172	-8.148	0.025	21.71
	HSO4-	1.24E-09	9.14E-10	-8.908	-9.039	-0.132	40.69
	Zn(SO4)2-2	5.26E-10	1.57E-10	-9.279	-9.805	-0.526	-9.55
	FeSO4	6.32E-11	6.69E-11	-10.199	-10.175	0.025	18.97
	CuSO4	3.01E-11	3.18E-11	-10.522	-10.497	0.025	13.09
	CaHSO4+	1.64E-11	1.21E-11	-10.786	-10.918	-0.132	0
	FeSO4+	5.43E-18	3.94E-18	-17.265	-17.405	-0.14	0
	FeHSO4+	2.06E-18	1.52E-18	-17.686	-17.817	-0.132	0
	Fe(SO4)2-	3.16E-19	2.33E-19	-18.5	-18.632	-0.132	0
	FeHSO4+2	1.23E-25	3.66E-26	-24.911	-25.437	-0.526	0
Zn	1.26E-06						
	Zn(CO3)2-2	1.00E-06	2.98E-07	-5.999	-6.525	-0.526	0
	ZnCO3	1.67E-07	1.77E-07	-6.778	-6.753	0.025	0
	Zn+2	4.05E-08	1.12E-08	-7.393	-7.951	-0.558	-24.42
	ZnOHCl	1.13E-08	1.19E-08	-7.948	-7.924	0.025	0
	ZnHCO3+	1.12E-08	8.24E-09	-7.953	-8.084	-0.132	0

Zn(OH)2	1.09E-08	1.16E-08	-7.961	-7.936	0.025	0
ZnSO4	6.72E-09	7.12E-09	-8.172	-8.148	0.025	21.71
ZnCl+	4.81E-09	3.38E-09	-8.318	-8.471	-0.153	-14.52
ZnOH+	4.76E-09	3.52E-09	-8.322	-8.454	-0.132	0
Zn(SO4)2-2	5.26E-10	1.57E-10	-9.279	-9.805	-0.526	-9.55
ZnCl2	3.75E-10	3.97E-10	-9.426	-9.401	0.025	102.03
ZnCl3-	7.11E-11	5.00E-11	-10.148	-10.301	-0.153	15.51
ZnF+	4.08E-11	3.02E-11	-10.389	-10.52	-0.132	0
Zn(OH)3-	1.42E-11	1.05E-11	-10.848	-10.979	-0.132	0
ZnCl4-2	1.02E-11	2.81E-12	-10.993	-11.552	-0.558	147.72
Zn(OH)4-2	1.60E-15	4.77E-16	-14.796	-15.322	-0.526	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-1.25	-5.53	-4.28	CaSO4			
Aragonite	1.28	-7.06	-8.34	CaCO3			
Barite	1.51	-8.33	-9.84	BaSO4			
Calcite	1.42	-7.06	-8.48	CaCO3			
CO2(g)	-2.87	-4.34	-1.47	CO2			
Dolomite	3.88	-13.2	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.6	6.49	4.89	Fe(OH)3			
Fluorite	0.2	-10.4	-10.6	CaF2			
Goethite	7.5	6.5	-1	FeOOH			
Gypsum	-0.95	-5.53	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	0	1.5	H2O			
Halite	-3.47	-1.9	1.57	NaCl			
Hausmann	-8.58	52.45	61.03	Mn3O4			
Hematite	17	13	-4.01	Fe2O3			
Jarosite-K	-4.64	-13.85	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.71	21.63	25.34	MnOOH			
Melanterit	-10.23	-12.44	-2.21	FeSO4:7H2O			
NH3(g)	-7.43	-5.64	1.8	NH3			
O2(g)	-33.35	-36.25	-2.89	O2			
Pyrochroit	-6.03	9.17	15.2	Mn(OH)2			
Pyrolusite	-7.29	34.09	41.38	MnO2:H2O			
Rhodochro	-0.71	-11.84	-11.13	MnCO3			
Siderite	-3.07	-13.96	-10.89	FeCO3			
Smithsonit	-2.05	-12.05	-10	ZnCO3			
Sylvite	-4.68	-3.78	0.9	KCl			
Witherite	-1.31	-9.87	-8.56	BaCO3			
Zn(OH)2(e	-2.54	8.96	11.5	Zn(OH)2			

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 13

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.29E-02	1.29E-02
Ba	9.61E-06	9.61E-06
Ca	4.74E-03	4.74E-03
Cl	1.74E-01	1.74E-01
Cu	1.60E-07	1.60E-07
F	4.90E-04	4.90E-04
Fe	1.25E-06	1.25E-06
K	2.38E-03	2.38E-03
Mg	3.83E-02	3.83E-02
Mn	2.10E-07	2.10E-07
N(-3)	2.60E-05	2.60E-05
N(5)	2.20E-04	2.20E-04
Na	1.67E-01	1.67E-01
S(6)	1.97E-02	1.97E-02
Zn	1.36E-06	1.36E-06

#NAME? of solution----------

pH	=	8.46			
pe	=	4			
Specific	Conductan	(µS/cm,	25°C)	=	20821
Density	(g/cm³)	=	1.00795		
Volume	(L)	=	1.00585		
Activity	of	water	=	0.993	
Ionic	strength	(mol/kgw)	=	2.67E-01	
Mass	of	water	(kg)	=	1.00E+00
Total	carbon	(mol/kg)	=	1.15E-02	
Total	CO2	(mol/kg)	=	1.15E-02	
Temperatu	(°C)	=	25		
Electrical	balance	(eq)	=	2.89E-02	
Percent	error,	100*(Cat-|	=	6.5	
Iterations	=	10	(122	overall)	
Total	H	=	1.11E+02		
Total	O	=	5.56E+01		

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4348	0.2623		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol

	OH-	4.24E-06	2.90E-06	-5.372	-5.538	-0.165	-3.36
	H+	4.41E-09	3.47E-09	-8.356	-8.46	-0.104	0
	H2O	5.55E+01	9.93E-01	1.744	-0.003	0	18.07
Ba	9.61E-06						
	Ba+2	6.99E-06	1.81E-06	-5.155	-5.742	-0.587	-11.59
	BaSO4	2.40E-06	2.55E-06	-5.62	-5.593	0.027	0
	BaHCO3+	1.46E-07	1.07E-07	-6.836	-6.969	-0.133	0
	BaCO3	7.36E-08	7.82E-08	-7.133	-7.107	0.027	-10.7
	BaOH+	2.44E-11	1.76E-11	-10.613	-10.755	-0.143	0
C(4)	1.15E-02						
	HCO3-	8.49E-03	6.19E-03	-2.071	-2.208	-0.138	25.75
	MgHCO3+	1.01E-03	7.07E-04	-2.994	-3.151	-0.157	5.74
	MgCO3	7.33E-04	7.79E-04	-3.135	-3.108	0.027	-17.09
	NaHCO3	3.95E-04	4.20E-04	-3.403	-3.377	0.027	1.8
	CO3-2	2.97E-04	8.37E-05	-3.527	-4.077	-0.55	-3.31
	NaCO3-	2.56E-04	1.88E-04	-3.593	-3.726	-0.133	0.68
	CaCO3	1.54E-04	1.64E-04	-3.812	-3.786	0.027	-14.6
	CaHCO3+	1.24E-04	9.20E-05	-3.906	-4.036	-0.131	9.9
	CO2	4.57E-05	4.86E-05	-4.34	-4.314	0.027	34.43
	Zn(CO3)2-2	1.10E-06	3.23E-07	-5.959	-6.491	-0.532	0
	ZnCO3	1.70E-07	1.81E-07	-6.77	-6.743	0.027	0
	BaHCO3+	1.46E-07	1.07E-07	-6.836	-6.969	-0.133	0
	MnCO3	1.14E-07	1.21E-07	-6.944	-6.917	0.027	0
	BaCO3	7.36E-08	7.82E-08	-7.133	-7.107	0.027	-10.7
	CuCO3	2.48E-08	2.64E-08	-7.606	-7.579	0.027	0
	MnHCO3+	1.39E-08	1.00E-08	-7.856	-7.998	-0.143	0
	ZnHCO3+	1.14E-08	8.42E-09	-7.942	-8.075	-0.133	0
	Cu(CO3)2-	9.45E-09	2.78E-09	-8.024	-8.556	-0.532	0
	FeCO3	2.86E-10	3.04E-10	-9.544	-9.518	0.027	0
	CuHCO3+	2.47E-10	1.82E-10	-9.607	-9.74	-0.133	0
	FeHCO3+	1.27E-10	9.36E-11	-9.896	-10.029	-0.133	0
	(CO2)2	4.07E-11	4.33E-11	-10.39	-10.363	0.027	68.87
Ca	4.74E-03						
	Ca+2	3.91E-03	1.17E-03	-2.407	-2.934	-0.526	-17.1
	CaSO4	5.48E-04	5.83E-04	-3.261	-3.235	0.027	7.5
	CaCO3	1.54E-04	1.64E-04	-3.812	-3.786	0.027	-14.6
	CaHCO3+	1.24E-04	9.20E-05	-3.906	-4.036	-0.131	9.9
	CaOH+	7.52E-08	5.54E-08	-7.124	-7.257	-0.133	0
	CaHSO4+	1.80E-11	1.33E-11	-10.744	-10.877	-0.133	0
Cl	1.74E-01						
	Cl-	1.74E-01	1.21E-01	-0.76	-0.918	-0.159	18.52
	CuCl2-	2.04E-08	1.42E-08	-7.691	-7.848	-0.157	0
	MnCl+	1.24E-08	8.95E-09	-7.906	-8.048	-0.143	-2.86
	ZnOHCl	1.16E-08	1.24E-08	-7.934	-7.908	0.027	0
	CuCl3-2	1.01E-08	2.71E-09	-7.997	-8.567	-0.57	0
	ZnCl+	5.04E-09	3.51E-09	-8.298	-8.455	-0.157	-14.59
	MnCl2	4.43E-10	4.71E-10	-9.353	-9.327	0.027	85.89
	ZnCl2	4.17E-10	4.44E-10	-9.38	-9.353	0.027	102.03
	ZnCl3-	8.62E-11	6.01E-11	-10.064	-10.221	-0.157	15.37
	FeCl+	3.42E-11	2.52E-11	-10.466	-10.599	-0.133	0

	CuCl+	2.74E-11	1.91E-11	-10.563	-10.72	-0.157	1.25
	MnCl3-	2.18E-11	1.57E-11	-10.663	-10.805	-0.143	44.48
	ZnCl4-2	1.35E-11	3.63E-12	-10.87	-11.44	-0.57	147.86
	CuCl2	1.16E-12	1.24E-12	-11.935	-11.908	0.027	31.02
	CuCl3-	7.59E-16	5.29E-16	-15.12	-15.277	-0.157	0
	FeCl+2	1.96E-18	5.26E-19	-17.708	-18.279	-0.57	0
	CuCl4-2	1.19E-18	3.20E-19	-17.925	-18.495	-0.57	0
	FeCl2+	3.94E-19	2.84E-19	-18.405	-18.547	-0.143	0
	FeCl3	3.22E-21	3.42E-21	-20.492	-20.466	0.027	0
Cu(1)	3.04E-08						
	CuCl2-	2.04E-08	1.42E-08	-7.691	-7.848	-0.157	0
	CuCl3-2	1.01E-08	2.71E-09	-7.997	-8.567	-0.57	0
	Cu+	4.72E-12	3.08E-12	-11.326	-11.512	-0.185	0
Cu(2)	1.30E-07						
	Cu(OH)2	9.46E-08	1.01E-07	-7.024	-6.998	0.027	0
	CuCO3	2.48E-08	2.64E-08	-7.606	-7.579	0.027	0
	Cu(CO3)2-	9.45E-09	2.78E-09	-8.024	-8.556	-0.532	0
	CuHCO3+	2.47E-10	1.82E-10	-9.607	-9.74	-0.133	0
	CuOH+	2.41E-10	1.68E-10	-9.618	-9.775	-0.157	0
	Cu+2	1.95E-10	5.87E-11	-9.709	-10.232	-0.522	-25.67
	CuSO4	3.17E-11	3.37E-11	-10.499	-10.473	0.027	13.09
	CuCl+	2.74E-11	1.91E-11	-10.563	-10.72	-0.157	1.25
	Cu(OH)3-	2.36E-12	1.74E-12	-11.628	-11.761	-0.133	0
	CuCl2	1.16E-12	1.24E-12	-11.935	-11.908	0.027	31.02
	CuF+	2.91E-13	2.15E-13	-12.535	-12.668	-0.133	0
	Cu2(OH)2+	4.20E-14	1.24E-14	-13.376	-13.908	-0.532	0
	CuCl3-	7.59E-16	5.29E-16	-15.12	-15.277	-0.157	0
	Cu(OH)4-2	3.37E-16	9.92E-17	-15.472	-16.004	-0.532	0
	CuCl4-2	1.19E-18	3.20E-19	-17.925	-18.495	-0.57	0
F	4.90E-04						
	F-	2.94E-04	2.01E-04	-3.531	-3.697	-0.165	-0.86
	MgF+	1.83E-04	1.30E-04	-3.738	-3.888	-0.149	-10.33
	NaF	1.31E-05	1.40E-05	-4.882	-4.855	0.027	7.26
	HF	9.83E-10	1.05E-09	-9.008	-8.981	0.027	12.5
	ZnF+	4.17E-11	3.07E-11	-10.38	-10.513	-0.133	0
	MnF+	3.51E-11	2.53E-11	-10.454	-10.597	-0.143	0
	HF2-	1.10E-12	8.06E-13	-11.961	-12.094	-0.133	22.52
	FeF+	4.13E-13	3.04E-13	-12.384	-12.517	-0.133	0
	CuF+	2.91E-13	2.15E-13	-12.535	-12.668	-0.133	0
	FeF2+	5.11E-16	3.68E-16	-15.291	-15.434	-0.143	0
	FeF+2	1.71E-16	4.60E-17	-15.767	-16.337	-0.57	0
	FeF3	1.10E-16	1.17E-16	-15.957	-15.931	0.027	0
Fe(2)	1.04E-09						
	Fe+2	5.04E-10	1.51E-10	-9.298	-9.82	-0.522	-21.14
	FeCO3	2.86E-10	3.04E-10	-9.544	-9.518	0.027	0
	FeHCO3+	1.27E-10	9.36E-11	-9.896	-10.029	-0.133	0
	FeSO4	7.11E-11	7.56E-11	-10.148	-10.121	0.027	18.97
	FeCl+	3.42E-11	2.52E-11	-10.466	-10.599	-0.133	0
	FeOH+	1.90E-11	1.37E-11	-10.721	-10.863	-0.143	0
	FeF+	4.13E-13	3.04E-13	-12.384	-12.517	-0.133	0

	Fe(OH)2	3.14E-14	3.34E-14	-13.503	-13.476	0.027	0
	Fe(OH)3-	4.94E-16	3.55E-16	-15.307	-15.449	-0.143	0
	FeHSO4+	2.34E-18	1.72E-18	-17.631	-17.764	-0.133	0
Fe(3)	1.25E-06						
	Fe(OH)3	8.79E-07	9.35E-07	-6.056	-6.029	0.027	0
	Fe(OH)4-	3.35E-07	2.44E-07	-6.475	-6.612	-0.138	0
	Fe(OH)2+	3.48E-08	2.53E-08	-7.459	-7.596	-0.138	0
	FeOH+2	9.93E-13	2.67E-13	-12.003	-12.573	-0.57	0
	FeF2+	5.11E-16	3.68E-16	-15.291	-15.434	-0.143	0
	FeF+2	1.71E-16	4.60E-17	-15.767	-16.337	-0.57	0
	FeF3	1.10E-16	1.17E-16	-15.957	-15.931	0.027	0
	FeSO4+	6.18E-18	4.45E-18	-17.209	-17.351	-0.143	0
	FeCl+2	1.96E-18	5.26E-19	-17.708	-18.279	-0.57	0
	Fe+3	1.25E-18	1.45E-19	-17.902	-18.84	-0.938	0
	FeCl2+	3.94E-19	2.84E-19	-18.405	-18.547	-0.143	0
	Fe(SO4)2-	3.72E-19	2.74E-19	-18.429	-18.562	-0.133	0
	FeCl3	3.22E-21	3.42E-21	-20.492	-20.466	0.027	0
	Fe2(OH)2+	2.57E-22	1.92E-24	-21.59	-23.717	-2.127	0
	FeHSO4+2	1.41E-25	4.14E-26	-24.852	-25.384	-0.532	0
	Fe3(OH)4+	2.14E-26	1.02E-29	-25.67	-28.993	-3.323	0
H(0)	1.60E-28						
	H2	8.00E-29	8.51E-29	-28.097	-28.07	0.027	28.61
K	2.38E-03						
	K+	2.34E-03	1.61E-03	-2.631	-2.793	-0.161	9.4
	KSO4-	4.37E-05	3.18E-05	-4.36	-4.497	-0.138	34.56
Mg	3.83E-02						
	Mg+2	3.03E-02	9.76E-03	-1.519	-2.011	-0.492	-20.82
	MgSO4	6.05E-03	6.43E-03	-2.218	-2.192	0.027	5.84
	MgHCO3+	1.01E-03	7.07E-04	-2.994	-3.151	-0.157	5.74
	MgCO3	7.33E-04	7.79E-04	-3.135	-3.108	0.027	-17.09
	MgF+	1.83E-04	1.30E-04	-3.738	-3.888	-0.149	-10.33
	MgOH+	1.35E-05	1.02E-05	-4.868	-4.994	-0.125	0
Mn(2)	2.10E-07						
	MnCO3	1.14E-07	1.21E-07	-6.944	-6.917	0.027	0
	Mn+2	6.06E-08	1.82E-08	-7.218	-7.74	-0.522	-17.27
	MnHCO3+	1.39E-08	1.00E-08	-7.856	-7.998	-0.143	0
	MnCl+	1.24E-08	8.95E-09	-7.906	-8.048	-0.143	-2.86
	MnSO4	8.56E-09	9.10E-09	-8.068	-8.041	0.027	22.54
	MnCl2	4.43E-10	4.71E-10	-9.353	-9.327	0.027	85.89
	MnOH+	1.86E-10	1.34E-10	-9.73	-9.873	-0.143	0
	MnF+	3.51E-11	2.53E-11	-10.454	-10.597	-0.143	0
	MnCl3-	2.18E-11	1.57E-11	-10.663	-10.805	-0.143	44.48
	Mn(NO3)2	1.48E-15	1.57E-15	-14.831	-14.804	0.027	41.04
	Mn(OH)3-	9.41E-18	6.78E-18	-17.026	-17.169	-0.143	0
Mn(3)	4.88E-29						
	Mn+3	4.88E-29	5.63E-30	-28.311	-29.25	-0.938	0
N(-3)	2.60E-05						
	NH4+	2.30E-05	1.50E-05	-4.639	-4.824	-0.185	18.29
	NH3	2.32E-06	2.46E-06	-5.635	-5.609	0.027	24.42
	NH4SO4-	7.37E-07	5.43E-07	-6.132	-6.265	-0.133	38.71

N(5)	2.20E-04						
	NO3-	2.20E-04	1.47E-04	-3.658	-3.832	-0.175	29.97
	Mn(NO3)2	1.48E-15	1.57E-15	-14.831	-14.804	0.027	41.04
Na	1.67E-01						
	Na+	1.64E-01	1.21E-01	-0.784	-0.918	-0.134	-0.85
	NaSO4-	2.33E-03	1.70E-03	-2.632	-2.769	-0.138	18.23
	NaHCO3	3.95E-04	4.20E-04	-3.403	-3.377	0.027	1.8
	NaCO3-	2.56E-04	1.88E-04	-3.593	-3.726	-0.133	0.68
	NaF	1.31E-05	1.40E-05	-4.882	-4.855	0.027	7.26
	NaOH	3.29E-17	3.50E-17	-16.483	-16.456	0.027	0
O(0)	1.07E-36						
	O2	5.34E-37	5.68E-37	-36.273	-36.246	0.027	30.4
S(6)	1.97E-02						
	SO4-2	1.07E-02	2.81E-03	-1.97	-2.551	-0.581	16.34
	MgSO4	6.05E-03	6.43E-03	-2.218	-2.192	0.027	5.84
	NaSO4-	2.33E-03	1.70E-03	-2.632	-2.769	-0.138	18.23
	CaSO4	5.48E-04	5.83E-04	-3.261	-3.235	0.027	7.5
	KSO4-	4.37E-05	3.18E-05	-4.36	-4.497	-0.138	34.56
	BaSO4	2.40E-06	2.55E-06	-5.62	-5.593	0.027	0
	NH4SO4-	7.37E-07	5.43E-07	-6.132	-6.265	-0.133	38.71
	MnSO4	8.56E-09	9.10E-09	-8.068	-8.041	0.027	22.54
	ZnSO4	6.70E-09	7.13E-09	-8.174	-8.147	0.027	21.71
	HSO4-	1.29E-09	9.48E-10	-8.89	-9.023	-0.133	40.71
	Zn(SO4)2-2	5.54E-10	1.63E-10	-9.257	-9.788	-0.532	-9.32
	FeSO4	7.11E-11	7.56E-11	-10.148	-10.121	0.027	18.97
	CuSO4	3.17E-11	3.37E-11	-10.499	-10.473	0.027	13.09
	CaHSO4+	1.80E-11	1.33E-11	-10.744	-10.877	-0.133	0
	FeSO4+	6.18E-18	4.45E-18	-17.209	-17.351	-0.143	0
	FeHSO4+	2.34E-18	1.72E-18	-17.631	-17.764	-0.133	0
	Fe(SO4)2-	3.72E-19	2.74E-19	-18.429	-18.562	-0.133	0
	FeHSO4+2	1.41E-25	4.14E-26	-24.852	-25.384	-0.532	0
Zn	1.36E-06						
	Zn(CO3)2-2	1.10E-06	3.23E-07	-5.959	-6.491	-0.532	0
	ZnCO3	1.70E-07	1.81E-07	-6.77	-6.743	0.027	0
	Zn+2	4.02E-08	1.08E-08	-7.396	-7.966	-0.57	-24.4
	ZnOHCl	1.16E-08	1.24E-08	-7.934	-7.908	0.027	0
	ZnHCO3+	1.14E-08	8.42E-09	-7.942	-8.075	-0.133	0
	Zn(OH)2	1.05E-08	1.12E-08	-7.979	-7.952	0.027	0
	ZnSO4	6.70E-09	7.13E-09	-8.174	-8.147	0.027	21.71
	ZnCl+	5.04E-09	3.51E-09	-8.298	-8.455	-0.157	-14.59
	ZnOH+	4.61E-09	3.40E-09	-8.336	-8.469	-0.133	0
	Zn(SO4)2-2	5.54E-10	1.63E-10	-9.257	-9.788	-0.532	-9.32
	ZnCl2	4.17E-10	4.44E-10	-9.38	-9.353	0.027	102.03
	ZnCl3-	8.62E-11	6.01E-11	-10.064	-10.221	-0.157	15.37
	ZnF+	4.17E-11	3.07E-11	-10.38	-10.513	-0.133	0
	Zn(OH)3-	1.37E-11	1.01E-11	-10.862	-10.995	-0.133	0
	ZnCl4-2	1.35E-11	3.63E-12	-10.87	-11.44	-0.57	147.86
	Zn(OH)4-2	1.56E-15	4.59E-16	-14.807	-15.338	-0.532	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-1.21	-5.48	-4.28	CaSO4
Aragonite	1.33	-7.01	-8.34	CaCO3
Barite	1.55	-8.29	-9.84	BaSO4
Calcite	1.47	-7.01	-8.48	CaCO3
CO2(g)	-2.85	-4.31	-1.47	CO2
Dolomite	3.99	-13.1	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.64	6.53	4.89	Fe(OH)3
Fluorite	0.27	-10.33	-10.6	CaF2
Goethite	7.53	6.53	-1	FeOOH
Gypsum	-0.91	-5.49	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O
Halite	-3.41	-1.84	1.57	NaCl
Hausmann	-8.58	52.45	61.03	Mn3O4
Hematite	17.08	13.07	-4.01	Fe2O3
Jarosite-K	-4.46	-13.67	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.71	21.63	25.34	MnOOH
Melanterit	-10.18	-12.39	-2.21	FeSO4:7H2O
NH3(g)	-7.4	-5.61	1.8	NH3
O2(g)	-33.35	-36.25	-2.89	O2
Pyrochroit	-6.03	9.17	15.2	Mn(OH)2
Pyrolusite	-7.29	34.09	41.38	MnO2:H2O
Rhodochro	-0.69	-11.82	-11.13	MnCO3
Siderite	-3.01	-13.9	-10.89	FeCO3
Smithsonit	-2.04	-12.04	-10	ZnCO3
Sylvite	-4.61	-3.71	0.9	KCl
Witherite	-1.26	-9.82	-8.56	BaCO3
Zn(OH)2(e	-2.55	8.95	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 14

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.40E-02	1.40E-02
Ba	1.04E-05	1.04E-05
Ca	5.11E-03	5.11E-03
Cl	1.87E-01	1.87E-01
Cu	1.70E-07	1.70E-07
F	5.30E-04	5.30E-04
Fe	1.35E-06	1.35E-06
K	2.57E-03	2.57E-03
Mg	4.13E-02	4.13E-02

```
        Mn          2.30E-07   2.30E-07
        N(-3)       2.80E-05   2.80E-05
        N(5)        2.40E-04   2.40E-04
        Na          1.80E-01   1.80E-01
        S(6)        2.12E-02   2.12E-02
        Zn          1.47E-06   1.47E-06

#NAME?  of          solution----------------------------

        pH          =                 8.46
        pe          =                    4
        Specific    Conductan (µS/cm,     25°C)      =                22250
        Density     (g/cm³)   =             1.00879
        Volume      (L)       =             1.00608
        Activity    of        water       =                 0.993
        Ionic       strength  (mol/kgw)   =             2.87E-01
        Mass        of        water       (kg)       =            1.00E+00
        Total       carbon    (mol/kg)    =             1.24E-02
        Total       CO2       (mol/kg)    =             1.24E-02
        Temperatu   (°C)      =                   25
        Electrical  balance   (eq)        =             3.11E-02
        Percent     error,    100*(Cat-|  =                 6.51
        Iterations  =                 10  (132       overall)
        Total       H         =            1.11E+02
        Total       O         =            5.56E+01

#NAME?  couples--------------------------------

        Redox       couple    pe          Eh          (volts)

        N(-3)/N(5)     4.4356     0.2624

#NAME?  of          species----------------------------

        Log         Log       Log         mole        V
        Species     Molality  Activity    Molality    Activity    Gamma    cm³/mol

        OH-          4.28E-06  2.90E-06     -5.369      -5.538     -0.169      -3.32
        H+           4.42E-09  3.47E-09     -8.354       -8.46     -0.106          0
        H2O         5.55E+01  9.93E-01      1.744      -0.003          0      18.07
Ba        1.04E-05
        Ba+2         7.53E-06  1.90E-06     -5.123      -5.721     -0.598     -11.55
        BaSO4        2.59E-06  2.77E-06     -5.586      -5.558      0.029          0
        BaHCO3+      1.62E-07  1.19E-07     -6.791      -6.925     -0.134          0
        BaCO3        8.11E-08  8.66E-08     -7.091      -7.063      0.029       -10.7
        BaOH+        2.58E-11  1.84E-11    -10.589     -10.734     -0.145          0
C(4)      1.24E-02
        HCO3-        9.01E-03  6.52E-03     -2.046      -2.186      -0.14      25.82
        MgHCO3+      1.14E-03  7.88E-04     -2.943      -3.104      -0.16       5.74
        MgCO3        8.14E-04  8.69E-04      -3.09      -3.061      0.029     -17.09
```

	NaHCO3	4.45E-04	4.75E-04	-3.352	-3.323	0.029	1.8
	CO3-2	3.21E-04	8.82E-05	-3.494	-4.055	-0.561	-3.23
	NaCO3-	2.90E-04	2.13E-04	-3.538	-3.672	-0.134	0.79
	CaCO3	1.71E-04	1.82E-04	-3.768	-3.74	0.029	-14.6
	CaHCO3+	1.39E-04	1.02E-04	-3.857	-3.99	-0.133	9.9
	CO2	4.79E-05	5.12E-05	-4.319	-4.291	0.029	34.43
	Zn(CO3)2-2	1.20E-06	3.50E-07	-5.919	-6.455	-0.536	0
	ZnCO3	1.74E-07	1.86E-07	-6.76	-6.731	0.029	0
	BaHCO3+	1.62E-07	1.19E-07	-6.791	-6.925	-0.134	0
	MnCO3	1.25E-07	1.34E-07	-6.902	-6.873	0.029	0
	BaCO3	8.11E-08	8.66E-08	-7.091	-7.063	0.029	-10.7
	CuCO3	2.64E-08	2.82E-08	-7.579	-7.55	0.029	0
	MnHCO3+	1.55E-08	1.11E-08	-7.809	-7.954	-0.145	0
	ZnHCO3+	1.18E-08	8.67E-09	-7.928	-8.062	-0.134	0
	Cu(CO3)2-	1.08E-08	3.13E-09	-7.968	-8.504	-0.536	0
	FeCO3	3.25E-10	3.47E-10	-9.489	-9.46	0.029	0
	CuHCO3+	2.65E-10	1.95E-10	-9.577	-9.711	-0.134	0
	FeHCO3+	1.46E-10	1.07E-10	-9.837	-9.971	-0.134	0
	(CO2)2	4.51E-11	4.82E-11	-10.346	-10.317	0.029	68.87
Ca	5.11E-03						
	Ca+2	4.21E-03	1.23E-03	-2.376	-2.91	-0.534	-17.08
	CaSO4	5.95E-04	6.36E-04	-3.226	-3.197	0.029	7.5
	CaCO3	1.71E-04	1.82E-04	-3.768	-3.74	0.029	-14.6
	CaHCO3+	1.39E-04	1.02E-04	-3.857	-3.99	-0.133	9.9
	CaOH+	7.95E-08	5.84E-08	-7.1	-7.234	-0.134	0
	CaHSO4+	1.97E-11	1.45E-11	-10.705	-10.839	-0.134	0
Cl	1.87E-01						
	Cl-	1.87E-01	1.29E-01	-0.727	-0.889	-0.162	18.54
	CuCl2-	2.38E-08	1.65E-08	-7.623	-7.783	-0.16	0
	MnCl+	1.41E-08	1.01E-08	-7.852	-7.998	-0.145	-2.85
	CuCl3-2	1.29E-08	3.37E-09	-7.891	-8.472	-0.582	0
	ZnOHCl	1.21E-08	1.29E-08	-7.917	-7.889	0.029	0
	ZnCl+	5.31E-09	3.67E-09	-8.275	-8.435	-0.16	-14.65
	MnCl2	5.30E-10	5.67E-10	-9.275	-9.247	0.029	85.89
	ZnCl2	4.64E-10	4.96E-10	-9.333	-9.305	0.029	102.03
	ZnCl3-	1.04E-10	7.19E-11	-9.983	-10.144	-0.16	15.23
	FeCl+	3.98E-11	2.92E-11	-10.4	-10.534	-0.134	0
	CuCl+	2.99E-11	2.07E-11	-10.524	-10.684	-0.16	1.29
	MnCl3-	2.82E-11	2.02E-11	-10.55	-10.696	-0.145	44.55
	ZnCl4-2	1.77E-11	4.65E-12	-10.751	-11.333	-0.582	148
	CuCl2	1.34E-12	1.43E-12	-11.872	-11.843	0.029	31.02
	CuCl3-	9.51E-16	6.57E-16	-15.022	-15.182	-0.16	0
	FeCl+2	2.33E-18	6.10E-19	-17.633	-18.214	-0.582	0
	CuCl4-2	1.62E-18	4.25E-19	-17.79	-18.371	-0.582	0
	FeCl2+	4.92E-19	3.52E-19	-18.308	-18.454	-0.145	0
	FeCl3	4.25E-21	4.54E-21	-20.371	-20.343	0.029	0
Cu(1)	3.67E-08						
	CuCl2-	2.38E-08	1.65E-08	-7.623	-7.783	-0.16	0
	CuCl3-2	1.29E-08	3.37E-09	-7.891	-8.472	-0.582	0
	Cu+	4.84E-12	3.12E-12	-11.315	-11.505	-0.19	0

Cu(2)	1.33E-07						
	Cu(OH)2	9.54E-08	1.02E-07	-7.021	-6.992	0.029	0
	CuCO3	2.64E-08	2.82E-08	-7.579	-7.55	0.029	0
	Cu(CO3)2-	1.08E-08	3.13E-09	-7.968	-8.504	-0.536	0
	CuHCO3+	2.65E-10	1.95E-10	-9.577	-9.711	-0.134	0
	CuOH+	2.47E-10	1.70E-10	-9.608	-9.769	-0.16	0
	Cu+2	2.03E-10	5.95E-11	-9.694	-10.225	-0.532	-25.64
	CuSO4	3.31E-11	3.53E-11	-10.481	-10.452	0.029	13.09
	CuCl+	2.99E-11	2.07E-11	-10.524	-10.684	-0.16	1.29
	Cu(OH)3-	2.39E-12	1.76E-12	-11.621	-11.755	-0.134	0
	CuCl2	1.34E-12	1.43E-12	-11.872	-11.843	0.029	31.02
	CuF+	3.11E-13	2.28E-13	-12.508	-12.642	-0.134	0
	Cu2(OH)2+	4.37E-14	1.27E-14	-13.36	-13.896	-0.536	0
	CuCl3-	9.51E-16	6.57E-16	-15.022	-15.182	-0.16	0
	Cu(OH)4-2	3.45E-16	1.00E-16	-15.462	-15.998	-0.536	0
	CuCl4-2	1.62E-18	4.25E-19	-17.79	-18.371	-0.582	0
F	5.30E-04						
	F-	3.11E-04	2.11E-04	-3.507	-3.676	-0.169	-0.84
	MgF+	2.04E-04	1.44E-04	-3.69	-3.842	-0.153	-10.32
	NaF	1.47E-05	1.57E-05	-4.833	-4.804	0.029	7.26
	HF	1.03E-09	1.10E-09	-8.989	-8.96	0.029	12.5
	ZnF+	4.28E-11	3.14E-11	-10.369	-10.503	-0.134	0
	MnF+	3.89E-11	2.79E-11	-10.41	-10.555	-0.145	0
	HF2-	1.21E-12	8.86E-13	-11.919	-12.053	-0.134	22.54
	FeF+	4.70E-13	3.45E-13	-12.328	-12.462	-0.134	0
	CuF+	3.11E-13	2.28E-13	-12.508	-12.642	-0.134	0
	FeF2+	6.13E-16	4.39E-16	-15.213	-15.358	-0.145	0
	FeF+2	1.99E-16	5.23E-17	-15.7	-16.282	-0.582	0
	FeF3	1.37E-16	1.46E-16	-15.863	-15.834	0.029	0
Fe(2)	1.17E-09						
	Fe+2	5.58E-10	1.64E-10	-9.254	-9.785	-0.532	-21.11
	FeCO3	3.25E-10	3.47E-10	-9.489	-9.46	0.029	0
	FeHCO3+	1.46E-10	1.07E-10	-9.837	-9.971	-0.134	0
	FeSO4	7.93E-11	8.47E-11	-10.101	-10.072	0.029	18.97
	FeCl+	3.98E-11	2.92E-11	-10.4	-10.534	-0.134	0
	FeOH+	2.07E-11	1.48E-11	-10.683	-10.829	-0.145	0
	FeF+	4.70E-13	3.45E-13	-12.328	-12.462	-0.134	0
	Fe(OH)2	3.38E-14	3.62E-14	-13.471	-13.442	0.029	0
	Fe(OH)3-	5.37E-16	3.84E-16	-15.27	-15.415	-0.145	0
	FeHSO4+	2.63E-18	1.93E-18	-17.58	-17.714	-0.134	0
Fe(3)	1.35E-06						
	Fe(OH)3	9.46E-07	1.01E-06	-6.024	-5.995	0.029	0
	Fe(OH)4-	3.65E-07	2.64E-07	-6.438	-6.578	-0.14	0
	Fe(OH)2+	3.79E-08	2.74E-08	-7.422	-7.562	-0.14	0
	FeOH+2	1.10E-12	2.89E-13	-11.957	-12.539	-0.582	0
	FeF2+	6.13E-16	4.39E-16	-15.213	-15.358	-0.145	0
	FeF+2	1.99E-16	5.23E-17	-15.7	-16.282	-0.582	0
	FeF3	1.37E-16	1.46E-16	-15.863	-15.834	0.029	0
	FeSO4+	6.97E-18	4.99E-18	-17.157	-17.302	-0.145	0
	FeCl+2	2.33E-18	6.10E-19	-17.633	-18.214	-0.582	0

	Fe+3	1.40E-18	1.57E-19	-17.853	-18.805	-0.952	0
	FeCl2+	4.92E-19	3.52E-19	-18.308	-18.454	-0.145	0
	Fe(SO4)2-	4.32E-19	3.17E-19	-18.364	-18.499	-0.134	0
	FeCl3	4.25E-21	4.54E-21	-20.371	-20.343	0.029	0
	Fe2(OH)2+	3.14E-22	2.25E-24	-21.503	-23.647	-2.144	0
	FeHSO4+2	1.59E-25	4.63E-26	-24.798	-25.334	-0.536	0
	Fe3(OH)4+	2.89E-26	1.29E-29	-25.539	-28.889	-3.351	0
H(0)	1.59E-28						
	H2	7.97E-29	8.51E-29	-28.099	-28.07	0.029	28.61
K	2.57E-03						
	K+	2.52E-03	1.73E-03	-2.598	-2.763	-0.165	9.41
	KSO4-	4.87E-05	3.52E-05	-4.313	-4.453	-0.14	34.58
Mg	4.13E-02						
	Mg+2	3.25E-02	1.03E-02	-1.488	-1.986	-0.498	-20.79
	MgSO4	6.59E-03	7.04E-03	-2.181	-2.153	0.029	5.84
	MgHCO3+	1.14E-03	7.88E-04	-2.943	-3.104	-0.16	5.74
	MgCO3	8.14E-04	8.69E-04	-3.09	-3.061	0.029	-17.09
	MgF+	2.04E-04	1.44E-04	-3.69	-3.842	-0.153	-10.32
	MgOH+	1.44E-05	1.07E-05	-4.842	-4.969	-0.127	0
Mn(2)	2.30E-07						
	MnCO3	1.25E-07	1.34E-07	-6.902	-6.873	0.029	0
	Mn+2	6.50E-08	1.91E-08	-7.187	-7.719	-0.532	-17.2
	MnHCO3+	1.55E-08	1.11E-08	-7.809	-7.954	-0.145	0
	MnCl+	1.41E-08	1.01E-08	-7.852	-7.998	-0.145	-2.85
	MnSO4	9.25E-09	9.88E-09	-8.034	-8.005	0.029	22.54
	MnCl2	5.30E-10	5.67E-10	-9.275	-9.247	0.029	85.89
	MnOH+	1.97E-10	1.41E-10	-9.706	-9.852	-0.145	0
	MnF+	3.89E-11	2.79E-11	-10.41	-10.555	-0.145	0
	MnCl3-	2.82E-11	2.02E-11	-10.55	-10.696	-0.145	44.55
	Mn(NO3)2	1.80E-15	1.92E-15	-14.745	-14.716	0.029	41.04
	Mn(OH)3-	9.93E-18	7.11E-18	-17.003	-17.148	-0.145	0
Mn(3)	5.29E-29						
	Mn+3	5.29E-29	5.91E-30	-28.277	-29.229	-0.952	0
N(-3)	2.80E-05						
	NH4+	2.47E-05	1.60E-05	-4.607	-4.797	-0.19	18.3
	NH3	2.46E-06	2.63E-06	-5.61	-5.581	0.029	24.42
	NH4SO4-	8.14E-07	5.98E-07	-6.089	-6.223	-0.134	38.78
N(5)	2.40E-04						
	NO3-	2.40E-04	1.59E-04	-3.62	-3.799	-0.179	29.99
	Mn(NO3)2	1.80E-15	1.92E-15	-14.745	-14.716	0.029	41.04
Na	1.80E-01						
	Na+	1.77E-01	1.30E-01	-0.752	-0.888	-0.136	-0.83
	NaSO4-	2.61E-03	1.89E-03	-2.584	-2.724	-0.14	18.41
	NaHCO3	4.45E-04	4.75E-04	-3.352	-3.323	0.029	1.8
	NaCO3-	2.90E-04	2.13E-04	-3.538	-3.672	-0.134	0.79
	NaF	1.47E-05	1.57E-05	-4.833	-4.804	0.029	7.26
	NaOH	3.51E-17	3.75E-17	-16.454	-16.426	0.029	0
O(0)	1.06E-36						
	O2	5.31E-37	5.67E-37	-36.275	-36.246	0.029	30.4
S(6)	2.12E-02						

SO4-2	1.14E-02	2.91E-03	-1.943	-2.537	-0.593	16.42
MgSO4	6.59E-03	7.04E-03	-2.181	-2.153	0.029	5.84
NaSO4-	2.61E-03	1.89E-03	-2.584	-2.724	-0.14	18.41
CaSO4	5.95E-04	6.36E-04	-3.226	-3.197	0.029	7.5
KSO4-	4.87E-05	3.52E-05	-4.313	-4.453	-0.14	34.58
BaSO4	2.59E-06	2.77E-06	-5.586	-5.558	0.029	0
NH4SO4-	8.14E-07	5.98E-07	-6.089	-6.223	-0.134	38.78
MnSO4	9.25E-09	9.88E-09	-8.034	-8.005	0.029	22.54
ZnSO4	6.74E-09	7.20E-09	-8.172	-8.143	0.029	21.71
HSO4-	1.33E-09	9.80E-10	-8.875	-9.009	-0.134	40.73
Zn(SO4)2-2	5.84E-10	1.70E-10	-9.233	-9.769	-0.536	-9.1
FeSO4	7.93E-11	8.47E-11	-10.101	-10.072	0.029	18.97
CuSO4	3.31E-11	3.53E-11	-10.481	-10.452	0.029	13.09
CaHSO4+	1.97E-11	1.45E-11	-10.705	-10.839	-0.134	0
FeSO4+	6.97E-18	4.99E-18	-17.157	-17.302	-0.145	0
FeHSO4+	2.63E-18	1.93E-18	-17.58	-17.714	-0.134	0
Fe(SO4)2-	4.32E-19	3.17E-19	-18.364	-18.499	-0.134	0
FeHSO4+2	1.59E-25	4.63E-26	-24.798	-25.334	-0.536	0
Zn 1.47E-06						
Zn(CO3)2-2	1.20E-06	3.50E-07	-5.919	-6.455	-0.536	0
ZnCO3	1.74E-07	1.86E-07	-6.76	-6.731	0.029	0
Zn+2	4.03E-08	1.06E-08	-7.395	-7.976	-0.582	-24.38
ZnOHCl	1.21E-08	1.29E-08	-7.917	-7.889	0.029	0
ZnHCO3+	1.18E-08	8.67E-09	-7.928	-8.062	-0.134	0
Zn(OH)2	1.02E-08	1.09E-08	-7.992	-7.963	0.029	0
ZnSO4	6.74E-09	7.20E-09	-8.172	-8.143	0.029	21.71
ZnCl+	5.31E-09	3.67E-09	-8.275	-8.435	-0.16	-14.65
ZnOH+	4.51E-09	3.31E-09	-8.346	-8.48	-0.134	0
Zn(SO4)2-2	5.84E-10	1.70E-10	-9.233	-9.769	-0.536	-9.1
ZnCl2	4.64E-10	4.96E-10	-9.333	-9.305	0.029	102.03
ZnCl3-	1.04E-10	7.19E-11	-9.983	-10.144	-0.16	15.23
ZnF+	4.28E-11	3.14E-11	-10.369	-10.503	-0.134	0
ZnCl4-2	1.77E-11	4.65E-12	-10.751	-11.333	-0.582	148
Zn(OH)3-	1.34E-11	9.86E-12	-10.872	-11.006	-0.134	0
Zn(OH)4-2	1.54E-15	4.47E-16	-14.813	-15.349	-0.536	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-1.17	-5.45	-4.28	CaSO4			
Aragonite	1.37	-6.96	-8.34	CaCO3			
Barite	1.59	-8.26	-9.84	BaSO4			
Calcite	1.52	-6.96	-8.48	CaCO3			
CO2(g)	-2.82	-4.29	-1.47	CO2			
Dolomite	4.08	-13.01	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.67	6.56	4.89	Fe(OH)3			
Fluorite	0.34	-10.26	-10.6	CaF2			
Goethite	7.57	6.57	-1	FeOOH			
Gypsum	-0.87	-5.45	-4.58	CaSO4:2H2O			

H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O
Halite	-3.35	-1.78	1.57	NaCl
Hausmann	-8.52	52.51	61.03	Mn3O4
Hematite	17.15	13.14	-4.01	Fe2O3
Jarosite-K	-4.3	-13.51	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.69	21.65	25.34	MnOOH
Melanterit	-10.14	-12.34	-2.21	FeSO4:7H2O
NH3(g)	-7.38	-5.58	1.8	NH3
O2(g)	-33.35	-36.25	-2.89	O2
Pyrochroit	-6.01	9.19	15.2	Mn(OH)2
Pyrolusite	-7.27	34.11	41.38	MnO2:H2O
Rhodochrc	-0.64	-11.77	-11.13	MnCO3
Siderite	-2.95	-13.84	-10.89	FeCO3
Smithsonit	-2.03	-12.03	-10	ZnCO3
Sylvite	-4.55	-3.65	0.9	KCl
Witherite	-1.21	-9.78	-8.56	BaCO3
Zn(OH)2(e	-2.56	8.94	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 15

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.50E-02	1.50E-02
Ba	1.11E-05	1.11E-05
Ca	5.48E-03	5.48E-03
Cl	2.01E-01	2.01E-01
Cu	1.80E-07	1.80E-07
F	5.70E-04	5.70E-04
Fe	1.44E-06	1.44E-06
K	2.75E-03	2.75E-03
Mg	4.43E-02	4.43E-02
Mn	2.40E-07	2.40E-07
N(-3)	3.00E-05	3.00E-05
N(5)	2.50E-04	2.50E-04
Na	1.93E-01	1.93E-01
S(6)	2.28E-02	2.28E-02
Zn	1.58E-06	1.58E-06

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 23661
Density (g/cm³) = 1.00962

```
Volume (L) = 1.00632
Activity of water = 0.992
Ionic strength (mol/kgw) = 3.08E-01
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 1.32E-02
Total CO2 (mol/kg) = 1.32E-02
Temperatu (°C) = 25
Electrical balance (eq) = 3.34E-02
Percent error, 100*(Cat-| = 6.52
Iterations = 10 (142 overall)
Total H = 1.11E+02
Total O = 5.56E+01

#NAME? couples--------------------------------

Redox couple pe Eh (volts)

N(-3)/N(5) 4.4342 0.2623

#NAME? of species----------------------------
```

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.31E-06	2.90E-06	-5.366	-5.538	-0.173	-3.28
H+	4.44E-09	3.47E-09	-8.353	-8.46	-0.107	0
H2O	5.55E+01	9.92E-01	1.744	-0.003	0	18.07
Ba 1.11E-05						
Ba+2	8.07E-06	1.99E-06	-5.093	-5.701	-0.607	-11.51
BaSO4	2.79E-06	2.99E-06	-5.555	-5.524	0.031	0
BaHCO3+	1.78E-07	1.31E-07	-6.749	-6.884	-0.135	0
BaCO3	8.87E-08	9.52E-08	-7.052	-7.021	0.031	-10.7
BaOH+	2.72E-11	1.93E-11	-10.566	-10.714	-0.148	0
C(4) 1.32E-02						
HCO3-	9.50E-03	6.84E-03	-2.022	-2.165	-0.143	25.88
MgHCO3+	1.27E-03	8.72E-04	-2.896	-3.059	-0.164	5.75
MgCO3	8.96E-04	9.62E-04	-3.048	-3.017	0.031	-17.09
NaHCO3	4.96E-04	5.32E-04	-3.304	-3.274	0.031	1.8
CO3-2	3.44E-04	9.25E-05	-3.463	-4.034	-0.57	-3.15
NaCO3-	3.25E-04	2.39E-04	-3.488	-3.623	-0.135	0.91
CaCO3	1.87E-04	2.01E-04	-3.728	-3.697	0.031	-14.6
CaHCO3+	1.54E-04	1.13E-04	-3.812	-3.947	-0.135	9.91
CO2	5.01E-05	5.38E-05	-4.3	-4.269	0.031	34.43
Zn(CO3)2-2	1.31E-06	3.78E-07	-5.883	-6.423	-0.54	0
BaHCO3+	1.78E-07	1.31E-07	-6.749	-6.884	-0.135	0
ZnCO3	1.78E-07	1.91E-07	-6.75	-6.719	0.031	0
MnCO3	1.31E-07	1.41E-07	-6.881	-6.851	0.031	0
BaCO3	8.87E-08	9.52E-08	-7.052	-7.021	0.031	-10.7
CuCO3	2.78E-08	2.99E-08	-7.556	-7.525	0.031	0
MnHCO3+	1.65E-08	1.17E-08	-7.784	-7.932	-0.148	0

	ZnHCO3+	1.22E-08	8.91E-09	-7.915	-8.05	-0.135	0
	Cu(CO3)2-	1.21E-08	3.48E-09	-7.919	-8.458	-0.54	0
	FeCO3	3.63E-10	3.89E-10	-9.44	-9.41	0.031	0
	CuHCO3+	2.81E-10	2.06E-10	-9.551	-9.686	-0.135	0
	FeHCO3+	1.64E-10	1.20E-10	-9.786	-9.921	-0.135	0
	(CO2)2	4.94E-11	5.31E-11	-10.306	-10.275	0.031	68.87
Ca	5.48E-03						
	Ca+2	4.50E-03	1.29E-03	-2.347	-2.888	-0.541	-17.05
	CaSO4	6.42E-04	6.89E-04	-3.192	-3.162	0.031	7.5
	CaCO3	1.87E-04	2.01E-04	-3.728	-3.697	0.031	-14.6
	CaHCO3+	1.54E-04	1.13E-04	-3.812	-3.947	-0.135	9.91
	CaOH+	8.38E-08	6.14E-08	-7.077	-7.212	-0.135	0
	CaHSO4+	2.14E-11	1.57E-11	-10.669	-10.804	-0.135	0
Cl	2.01E-01						
	Cl-	2.01E-01	1.38E-01	-0.697	-0.862	-0.165	18.55
	CuCl2-	2.75E-08	1.89E-08	-7.561	-7.725	-0.164	0
	CuCl3-2	1.61E-08	4.11E-09	-7.794	-8.386	-0.592	0
	MnCl+	1.51E-08	1.08E-08	-7.821	-7.969	-0.148	-2.85
	ZnOHCl	1.26E-08	1.35E-08	-7.901	-7.871	0.031	0
	ZnCl+	5.58E-09	3.83E-09	-8.253	-8.417	-0.164	-14.72
	MnCl2	6.01E-10	6.45E-10	-9.221	-9.19	0.031	85.89
	ZnCl2	5.13E-10	5.51E-10	-9.29	-9.259	0.031	102.03
	ZnCl3-	1.24E-10	8.50E-11	-9.907	-10.07	-0.164	15.09
	FeCl+	4.54E-11	3.33E-11	-10.343	-10.478	-0.135	0
	MnCl3-	3.44E-11	2.44E-11	-10.464	-10.612	-0.148	44.62
	CuCl+	3.24E-11	2.22E-11	-10.489	-10.653	-0.164	1.32
	ZnCl4-2	2.29E-11	5.86E-12	-10.64	-11.232	-0.592	148.13
	CuCl2	1.53E-12	1.64E-12	-11.815	-11.785	0.031	31.02
	CuCl3-	1.17E-15	8.01E-16	-14.933	-15.096	-0.164	0
	FeCl+2	2.72E-18	6.96E-19	-17.566	-18.158	-0.592	0
	CuCl4-2	2.16E-18	5.52E-19	-17.666	-18.258	-0.592	0
	FeCl2+	6.01E-19	4.27E-19	-18.221	-18.369	-0.148	0
	FeCl3	5.47E-21	5.87E-21	-20.262	-20.231	0.031	0
Cu(1)	4.36E-08						
	CuCl2-	2.75E-08	1.89E-08	-7.561	-7.725	-0.164	0
	CuCl3-2	1.61E-08	4.11E-09	-7.794	-8.386	-0.592	0
	Cu+	4.93E-12	3.15E-12	-11.307	-11.501	-0.194	0
Cu(2)	1.37E-07						
	Cu(OH)2	9.58E-08	1.03E-07	-7.019	-6.988	0.031	0
	CuCO3	2.78E-08	2.99E-08	-7.556	-7.525	0.031	0
	Cu(CO3)2-	1.21E-08	3.48E-09	-7.919	-8.458	-0.54	0
	CuHCO3+	2.81E-10	2.06E-10	-9.551	-9.686	-0.135	0
	CuOH+	2.51E-10	1.72E-10	-9.601	-9.765	-0.164	0
	Cu+2	2.09E-10	6.01E-11	-9.681	-10.221	-0.541	-25.62
	CuSO4	3.43E-11	3.68E-11	-10.465	-10.434	0.031	13.09
	CuCl+	3.24E-11	2.22E-11	-10.489	-10.653	-0.164	1.32
	Cu(OH)3-	2.42E-12	1.77E-12	-11.617	-11.752	-0.135	0
	CuCl2	1.53E-12	1.64E-12	-11.815	-11.785	0.031	31.02
	CuF+	3.28E-13	2.41E-13	-12.484	-12.619	-0.135	0
	Cu2(OH)2+	4.48E-14	1.29E-14	-13.349	-13.888	-0.54	0

	CuCl3-	1.17E-15	8.01E-16	-14.933	-15.096	-0.164	0
	Cu(OH)4-2	3.50E-16	1.01E-16	-15.455	-15.995	-0.54	0
	CuCl4-2	2.16E-18	5.52E-19	-17.666	-18.258	-0.592	0
F	5.70E-04						
	F-	3.27E-04	2.20E-04	-3.485	-3.658	-0.173	-0.82
	MgF+	2.26E-04	1.58E-04	-3.645	-3.801	-0.155	-10.31
	NaF	1.63E-05	1.75E-05	-4.787	-4.757	0.031	7.26
	HF	1.07E-09	1.14E-09	-8.972	-8.942	0.031	12.5
	ZnF+	4.38E-11	3.21E-11	-10.358	-10.493	-0.135	0
	MnF+	4.11E-11	2.92E-11	-10.387	-10.535	-0.148	0
	HF2-	1.32E-12	9.65E-13	-11.881	-12.015	-0.135	22.55
	FeF+	5.26E-13	3.86E-13	-12.279	-12.414	-0.135	0
	CuF+	3.28E-13	2.41E-13	-12.484	-12.619	-0.135	0
	FeF2+	7.19E-16	5.11E-16	-15.143	-15.291	-0.148	0
	FeF+2	2.28E-16	5.84E-17	-15.642	-16.234	-0.592	0
	FeF3	1.66E-16	1.78E-16	-15.78	-15.749	0.031	0
Fe(2)	1.29E-09						
	Fe+2	6.09E-10	1.75E-10	-9.215	-9.756	-0.541	-21.09
	FeCO3	3.63E-10	3.89E-10	-9.44	-9.41	0.031	0
	FeHCO3+	1.64E-10	1.20E-10	-9.786	-9.921	-0.135	0
	FeSO4	8.71E-11	9.35E-11	-10.06	-10.029	0.031	18.97
	FeCl+	4.54E-11	3.33E-11	-10.343	-10.478	-0.135	0
	FeOH+	2.23E-11	1.59E-11	-10.651	-10.799	-0.148	0
	FeF+	5.26E-13	3.86E-13	-12.279	-12.414	-0.135	0
	Fe(OH)2	3.60E-14	3.86E-14	-13.444	-13.413	0.031	0
	Fe(OH)3-	5.78E-16	4.11E-16	-15.238	-15.386	-0.148	0
	FeHSO4+	2.91E-18	2.13E-18	-17.537	-17.671	-0.135	0
Fe(3)	1.44E-06						
	Fe(OH)3	1.01E-06	1.08E-06	-5.997	-5.966	0.031	0
	Fe(OH)4-	3.92E-07	2.82E-07	-6.407	-6.55	-0.143	0
	Fe(OH)2+	4.07E-08	2.93E-08	-7.39	-7.533	-0.143	0
	FeOH+2	1.21E-12	3.09E-13	-11.917	-12.509	-0.592	0
	FeF2+	7.19E-16	5.11E-16	-15.143	-15.291	-0.148	0
	FeF+2	2.28E-16	5.84E-17	-15.642	-16.234	-0.592	0
	FeF3	1.66E-16	1.78E-16	-15.78	-15.749	0.031	0
	FeSO4+	7.74E-18	5.51E-18	-17.111	-17.259	-0.148	0
	FeCl+2	2.72E-18	6.96E-19	-17.566	-18.158	-0.592	0
	Fe+3	1.54E-18	1.68E-19	-17.812	-18.776	-0.964	0
	FeCl2+	6.01E-19	4.27E-19	-18.221	-18.369	-0.148	0
	Fe(SO4)2-	4.93E-19	3.61E-19	-18.308	-18.442	-0.135	0
	FeCl3	5.47E-21	5.87E-21	-20.262	-20.231	0.031	0
	Fe2(OH)2+	3.71E-22	2.58E-24	-21.431	-23.589	-2.158	0
	FeHSO4+2	1.77E-25	5.11E-26	-24.752	-25.291	-0.54	0
	Fe3(OH)4+	3.72E-26	1.58E-29	-25.43	-28.802	-3.372	0
H(0)	1.59E-28						
	H2	7.93E-29	8.51E-29	-28.101	-28.07	0.031	28.61
K	2.75E-03						
	K+	2.70E-03	1.83E-03	-2.569	-2.737	-0.168	9.43
	KSO4-	5.36E-05	3.86E-05	-4.271	-4.414	-0.143	34.6
Mg	4.43E-02						

	Mg+2	3.47E-02	1.09E-02	-1.459	-1.963	-0.504	-20.77
	MgSO4	7.13E-03	7.65E-03	-2.147	-2.116	0.031	5.84
	MgHCO3+	1.27E-03	8.72E-04	-2.896	-3.059	-0.164	5.75
	MgCO3	8.96E-04	9.62E-04	-3.048	-3.017	0.031	-17.09
	MgF+	2.26E-04	1.58E-04	-3.645	-3.801	-0.155	-10.31
	MgOH+	1.52E-05	1.13E-05	-4.817	-4.946	-0.129	0
Mn(2)	2.40E-07						
	MnCO3	1.31E-07	1.41E-07	-6.881	-6.851	0.031	0
	Mn+2	6.66E-08	1.92E-08	-7.176	-7.717	-0.541	-17.14
	MnHCO3+	1.65E-08	1.17E-08	-7.784	-7.932	-0.148	0
	MnCl+	1.51E-08	1.08E-08	-7.821	-7.969	-0.148	-2.85
	MnSO4	9.53E-09	1.02E-08	-8.021	-7.99	0.031	22.54
	MnCl2	6.01E-10	6.45E-10	-9.221	-9.19	0.031	85.89
	MnOH+	1.98E-10	1.41E-10	-9.702	-9.85	-0.148	0
	MnF+	4.11E-11	2.92E-11	-10.387	-10.535	-0.148	0
	MnCl3-	3.44E-11	2.44E-11	-10.464	-10.612	-0.148	44.62
	Mn(NO3)2	1.92E-15	2.06E-15	-14.718	-14.687	0.031	41.04
	Mn(OH)3-	1.00E-17	7.12E-18	-16.999	-17.147	-0.148	0
Mn(3)	5.46E-29						
	Mn+3	5.46E-29	5.93E-30	-28.263	-29.227	-0.964	0
N(-3)	3.00E-05						
	NH4+	2.65E-05	1.70E-05	-4.577	-4.771	-0.194	18.31
	NH3	2.60E-06	2.79E-06	-5.586	-5.555	0.031	24.42
	NH4SO4-	8.93E-07	6.54E-07	-6.049	-6.184	-0.135	38.85
N(5)	2.50E-04						
	NO3-	2.50E-04	1.64E-04	-3.602	-3.785	-0.183	30.01
	Mn(NO3)2	1.92E-15	2.06E-15	-14.718	-14.687	0.031	41.04
Na	1.93E-01						
	Na+	1.90E-01	1.38E-01	-0.722	-0.859	-0.137	-0.81
	NaSO4-	2.89E-03	2.08E-03	-2.54	-2.682	-0.143	18.59
	NaHCO3	4.96E-04	5.32E-04	-3.304	-3.274	0.031	1.8
	NaCO3-	3.25E-04	2.39E-04	-3.488	-3.623	-0.135	0.91
	NaF	1.63E-05	1.75E-05	-4.787	-4.757	0.031	7.26
	NaOH	3.73E-17	4.01E-17	-16.428	-16.397	0.031	0
O(0)	1.06E-36						
	O2	5.28E-37	5.66E-37	-36.278	-36.247	0.031	30.4
S(6)	2.28E-02						
	SO4-2	1.21E-02	3.00E-03	-1.919	-2.523	-0.604	16.49
	MgSO4	7.13E-03	7.65E-03	-2.147	-2.116	0.031	5.84
	NaSO4-	2.89E-03	2.08E-03	-2.54	-2.682	-0.143	18.59
	CaSO4	6.42E-04	6.89E-04	-3.192	-3.162	0.031	7.5
	KSO4-	5.36E-05	3.86E-05	-4.271	-4.414	-0.143	34.6
	BaSO4	2.79E-06	2.99E-06	-5.555	-5.524	0.031	0
	NH4SO4-	8.93E-07	6.54E-07	-6.049	-6.184	-0.135	38.85
	MnSO4	9.53E-09	1.02E-08	-8.021	-7.99	0.031	22.54
	ZnSO4	6.77E-09	7.27E-09	-8.169	-8.139	0.031	21.71
	HSO4-	1.38E-09	1.01E-09	-8.861	-8.995	-0.135	40.74
	Zn(SO4)2-2	6.13E-10	1.77E-10	-9.212	-9.752	-0.54	-8.88
	FeSO4	8.71E-11	9.35E-11	-10.06	-10.029	0.031	18.97
	CuSO4	3.43E-11	3.68E-11	-10.465	-10.434	0.031	13.09

	CaHSO4+	2.14E-11	1.57E-11	-10.669	-10.804	-0.135	0
	FeSO4+	7.74E-18	5.51E-18	-17.111	-17.259	-0.148	0
	FeHSO4+	2.91E-18	2.13E-18	-17.537	-17.671	-0.135	0
	Fe(SO4)2-	4.93E-19	3.61E-19	-18.308	-18.442	-0.135	0
	FeHSO4+2	1.77E-25	5.11E-26	-24.752	-25.291	-0.54	0
Zn	1.58E-06						
	Zn(CO3)2-2	1.31E-06	3.78E-07	-5.883	-6.423	-0.54	0
	ZnCO3	1.78E-07	1.91E-07	-6.75	-6.719	0.031	0
	Zn+2	4.04E-08	1.03E-08	-7.393	-7.985	-0.592	-24.36
	ZnOHCl	1.26E-08	1.35E-08	-7.901	-7.871	0.031	0
	ZnHCO3+	1.22E-08	8.91E-09	-7.915	-8.05	-0.135	0
	Zn(OH)2	9.93E-09	1.07E-08	-8.003	-7.972	0.031	0
	ZnSO4	6.77E-09	7.27E-09	-8.169	-8.139	0.031	21.71
	ZnCl+	5.58E-09	3.83E-09	-8.253	-8.417	-0.164	-14.72
	ZnOH+	4.43E-09	3.25E-09	-8.354	-8.489	-0.135	0
	Zn(SO4)2-2	6.13E-10	1.77E-10	-9.212	-9.752	-0.54	-8.88
	ZnCl2	5.13E-10	5.51E-10	-9.29	-9.259	0.031	102.03
	ZnCl3-	1.24E-10	8.50E-11	-9.907	-10.07	-0.164	15.09
	ZnF+	4.38E-11	3.21E-11	-10.358	-10.493	-0.135	0
	ZnCl4-2	2.29E-11	5.86E-12	-10.64	-11.232	-0.592	148.13
	Zn(OH)3-	1.32E-11	9.64E-12	-10.881	-11.016	-0.135	0
	Zn(OH)4-2	1.52E-15	4.37E-16	-14.82	-15.359	-0.54	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-1.13	-5.41	-4.28	CaSO4			
Aragonite	1.41	-6.92	-8.34	CaCO3			
Barite	1.62	-8.22	-9.84	BaSO4			
Calcite	1.56	-6.92	-8.48	CaCO3			
CO2(g)	-2.8	-4.27	-1.47	CO2			
Dolomite	4.17	-12.92	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.7	6.59	4.89	Fe(OH)3			
Fluorite	0.4	-10.2	-10.6	CaF2			
Goethite	7.6	6.6	-1	FeOOH			
Gypsum	-0.84	-5.42	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	0	1.5	H2O			
Halite	-3.29	-1.72	1.57	NaCl			
Hausmann	-8.51	52.52	61.03	Mn3O4			
Hematite	17.21	13.2	-4.01	Fe2O3			
Jarosite-K	-4.16	-13.37	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.68	21.66	25.34	MnOOH			
Melanterit	-10.09	-12.3	-2.21	FeSO4:7H2O			
NH3(g)	-7.35	-5.56	1.8	NH3			
O2(g)	-33.35	-36.25	-2.89	O2			
Pyrochroit	-6	9.2	15.2	Mn(OH)2			
Pyrolusite	-7.27	34.11	41.38	MnO2:H2O			
Rhodochro	-0.62	-11.75	-11.13	MnCO3			

Siderite	-2.9	-13.79	-10.89	FeCO3
Smithsonit	-2.02	-12.02	-10	ZnCO3
Sylvite	-4.5	-3.6	0.9	KCl
Witherite	-1.17	-9.73	-8.56	BaCO3
Zn(OH)2(e	-2.57	8.93	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 16

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.60E-02	1.60E-02
Ba	1.19E-05	1.19E-05
Ca	5.85E-03	5.85E-03
Cl	2.15E-01	2.15E-01
Cu	2.00E-07	2.00E-07
F	6.00E-04	6.00E-04
Fe	1.54E-06	1.54E-06
K	2.94E-03	2.94E-03
Mg	4.73E-02	4.73E-02
Mn	2.60E-07	2.60E-07
N(-3)	3.20E-05	3.20E-05
N(5)	2.70E-04	2.70E-04
Na	2.07E-01	2.07E-01
S(6)	2.43E-02	2.43E-02
Zn	1.68E-06	1.68E-06

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 25056
Density (g/cm³) = 1.01046
Volume (L) = 1.00655
Activity of water = 0.991
Ionic strength (mol/kgw) = 3.28E-01
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 1.41E-02
Total CO2 (mol/kg) = 1.41E-02
Temperatu (°C) = 25
Electrical balance (eq) = 3.56E-02
Percent error, 100*(Cat-| = 6.53
Iterations = 10 (152 overall)
Total H = 1.11E+02
Total O = 5.56E+01

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.435	0.2624		

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.34E-06	2.89E-06	-5.362	-5.538	-0.176	-3.24
	H+	4.45E-09	3.47E-09	-8.352	-8.46	-0.108	0
	H2O	5.55E+01	9.92E-01	1.744	-0.004	0	18.07
Ba	1.19E-05						
	Ba+2	8.60E-06	2.08E-06	-5.065	-5.682	-0.616	-11.48
	BaSO4	2.98E-06	3.22E-06	-5.525	-5.492	0.033	0
	BaHCO3+	1.95E-07	1.43E-07	-6.71	-6.846	-0.136	0
	BaCO3	9.65E-08	1.04E-07	-7.016	-6.983	0.033	-10.7
	BaOH+	2.85E-11	2.02E-11	-10.545	-10.695	-0.15	0
C(4)	1.41E-02						
	HCO3-	9.99E-03	7.15E-03	-2.001	-2.146	-0.145	25.95
	MgHCO3+	1.41E-03	9.58E-04	-2.852	-3.018	-0.167	5.76
	MgCO3	9.80E-04	1.06E-03	-3.009	-2.976	0.033	-17.09
	NaHCO3	5.49E-04	5.92E-04	-3.26	-3.228	0.033	1.8
	CO3-2	3.67E-04	9.67E-05	-3.435	-4.014	-0.579	-3.08
	NaCO3-	3.62E-04	2.65E-04	-3.441	-3.576	-0.136	1.02
	CaCO3	2.04E-04	2.20E-04	-3.69	-3.657	0.033	-14.6
	CaHCO3+	1.70E-04	1.24E-04	-3.77	-3.908	-0.137	9.91
	CO2	5.22E-05	5.62E-05	-4.283	-4.25	0.033	34.43
	Zn(CO3)2-2	1.41E-06	4.03E-07	-5.852	-6.394	-0.542	0
	BaHCO3+	1.95E-07	1.43E-07	-6.71	-6.846	-0.136	0
	ZnCO3	1.81E-07	1.95E-07	-6.743	-6.71	0.033	0
	MnCO3	1.43E-07	1.54E-07	-6.845	-6.812	0.033	0
	BaCO3	9.65E-08	1.04E-07	-7.016	-6.983	0.033	-10.7
	CuCO3	3.06E-08	3.31E-08	-7.514	-7.481	0.033	0
	MnHCO3+	1.81E-08	1.28E-08	-7.743	-7.893	-0.15	0
	Cu(CO3)2-	1.40E-08	4.03E-09	-7.853	-8.395	-0.542	0
	ZnHCO3+	1.24E-08	9.10E-09	-7.906	-8.041	-0.136	0
	FeCO3	4.05E-10	4.37E-10	-9.392	-9.36	0.033	0
	CuHCO3+	3.12E-10	2.28E-10	-9.507	-9.642	-0.136	0
	FeHCO3+	1.84E-10	1.35E-10	-9.735	-9.871	-0.136	0
	(CO2)2	5.38E-11	5.81E-11	-10.269	-10.236	0.033	68.87
Ca	5.85E-03						
	Ca+2	4.79E-03	1.36E-03	-2.32	-2.868	-0.548	-17.02
	CaSO4	6.90E-04	7.44E-04	-3.161	-3.129	0.033	7.5
	CaCO3	2.04E-04	2.20E-04	-3.69	-3.657	0.033	-14.6
	CaHCO3+	1.70E-04	1.24E-04	-3.77	-3.908	-0.137	9.91
	CaOH+	8.79E-08	6.43E-08	-7.056	-7.192	-0.136	0
	CaHSO4+	2.32E-11	1.70E-11	-10.635	-10.771	-0.136	0

Cl	2.15E-01						
	Cl-	2.15E-01	1.46E-01	-0.668	-0.836	-0.168	18.57
	CuCl2-	3.29E-08	2.24E-08	-7.482	-7.649	-0.167	0
	CuCl3-2	2.07E-08	5.19E-09	-7.683	-8.285	-0.602	0
	MnCl+	1.69E-08	1.19E-08	-7.773	-7.924	-0.15	-2.84
	ZnOHCl	1.29E-08	1.40E-08	-7.888	-7.855	0.033	0
	ZnCl+	5.82E-09	3.97E-09	-8.235	-8.402	-0.167	-14.78
	MnCl2	7.03E-10	7.58E-10	-9.153	-9.12	0.033	85.89
	ZnCl2	5.61E-10	6.05E-10	-9.251	-9.218	0.033	102.03
	ZnCl3-	1.45E-10	9.91E-11	-9.838	-10.004	-0.167	14.95
	FeCl+	5.18E-11	3.79E-11	-10.286	-10.422	-0.136	0
	MnCl3-	4.31E-11	3.05E-11	-10.366	-10.516	-0.15	44.68
	CuCl+	3.66E-11	2.50E-11	-10.436	-10.603	-0.167	1.35
	ZnCl4-2	2.89E-11	7.24E-12	-10.538	-11.14	-0.602	148.26
	CuCl2	1.81E-12	1.96E-12	-11.742	-11.709	0.033	31.02
	CuCl3-	1.48E-15	1.01E-15	-14.828	-14.995	-0.167	0
	FeCl+2	3.17E-18	7.92E-19	-17.5	-18.102	-0.602	0
	CuCl4-2	2.96E-18	7.39E-19	-17.529	-18.131	-0.602	0
	FeCl2+	7.29E-19	5.16E-19	-18.137	-18.288	-0.15	0
	FeCl3	6.97E-21	7.52E-21	-20.157	-20.124	0.033	0
Cu(1)	5.37E-08						
	CuCl2-	3.29E-08	2.24E-08	-7.482	-7.649	-0.167	0
	CuCl3-2	2.07E-08	5.19E-09	-7.683	-8.285	-0.602	0
	Cu+	5.27E-12	3.34E-12	-11.278	-11.477	-0.199	0
Cu(2)	1.46E-07						
	Cu(OH)2	1.01E-07	1.09E-07	-6.997	-6.964	0.033	0
	CuCO3	3.06E-08	3.31E-08	-7.514	-7.481	0.033	0
	Cu(CO3)2-	1.40E-08	4.03E-09	-7.853	-8.395	-0.542	0
	CuHCO3+	3.12E-10	2.28E-10	-9.507	-9.642	-0.136	0
	CuOH+	2.67E-10	1.82E-10	-9.574	-9.74	-0.167	0
	Cu+2	2.25E-10	6.36E-11	-9.648	-10.197	-0.549	-25.6
	CuSO4	3.72E-11	4.01E-11	-10.43	-10.397	0.033	13.09
	CuCl+	3.66E-11	2.50E-11	-10.436	-10.603	-0.167	1.35
	Cu(OH)3-	2.56E-12	1.87E-12	-11.592	-11.728	-0.136	0
	CuCl2	1.81E-12	1.96E-12	-11.742	-11.709	0.033	31.02
	CuF+	3.56E-13	2.60E-13	-12.449	-12.584	-0.136	0
	Cu2(OH)2+	5.04E-14	1.45E-14	-13.297	-13.839	-0.542	0
	CuCl3-	1.48E-15	1.01E-15	-14.828	-14.995	-0.167	0
	Cu(OH)4-2	3.72E-16	1.07E-16	-15.429	-15.971	-0.542	0
	CuCl4-2	2.96E-18	7.39E-19	-17.529	-18.131	-0.602	0
F	6.00E-04						
	F-	3.37E-04	2.25E-04	-3.472	-3.648	-0.176	-0.81
	MgF+	2.45E-04	1.70E-04	-3.611	-3.769	-0.158	-10.31
	NaF	1.77E-05	1.91E-05	-4.753	-4.72	0.033	7.26
	HF	1.09E-09	1.17E-09	-8.965	-8.932	0.033	12.5
	MnF+	4.41E-11	3.12E-11	-10.355	-10.506	-0.15	0
	ZnF+	4.39E-11	3.21E-11	-10.358	-10.494	-0.136	0
	HF2-	1.38E-12	1.01E-12	-11.86	-11.996	-0.136	22.57
	FeF+	5.78E-13	4.23E-13	-12.238	-12.373	-0.136	0
	CuF+	3.56E-13	2.60E-13	-12.449	-12.584	-0.136	0

	FeF2+	8.11E-16	5.74E-16	-15.091	-15.241	-0.15	0
	FeF+2	2.56E-16	6.41E-17	-15.591	-16.193	-0.602	0
	FeF3	1.90E-16	2.05E-16	-15.722	-15.689	0.033	0
Fe(2)	1.43E-09						
	Fe+2	6.66E-10	1.88E-10	-9.177	-9.725	-0.549	-21.06
	FeCO3	4.05E-10	4.37E-10	-9.392	-9.36	0.033	0
	FeHCO3+	1.84E-10	1.35E-10	-9.735	-9.871	-0.136	0
	FeSO4	9.57E-11	1.03E-10	-10.019	-9.986	0.033	18.97
	FeCl+	5.18E-11	3.79E-11	-10.286	-10.422	-0.136	0
	FeOH+	2.41E-11	1.70E-11	-10.619	-10.769	-0.15	0
	FeF+	5.78E-13	4.23E-13	-12.238	-12.373	-0.136	0
	Fe(OH)2	3.84E-14	4.14E-14	-13.416	-13.383	0.033	0
	Fe(OH)3-	6.22E-16	4.40E-16	-15.206	-15.356	-0.15	0
	FeHSO4+	3.22E-18	2.35E-18	-17.493	-17.628	-0.136	0
Fe(3)	1.54E-06						
	Fe(OH)3	1.07E-06	1.16E-06	-5.969	-5.936	0.033	0
	Fe(OH)4-	4.21E-07	3.02E-07	-6.375	-6.52	-0.145	0
	Fe(OH)2+	4.39E-08	3.14E-08	-7.358	-7.503	-0.145	0
	FeOH+2	1.33E-12	3.32E-13	-11.877	-12.479	-0.602	0
	FeF2+	8.11E-16	5.74E-16	-15.091	-15.241	-0.15	0
	FeF+2	2.56E-16	6.41E-17	-15.591	-16.193	-0.602	0
	FeF3	1.90E-16	2.05E-16	-15.722	-15.689	0.033	0
	FeSO4+	8.60E-18	6.08E-18	-17.066	-17.216	-0.15	0
	FeCl+2	3.17E-18	7.92E-19	-17.5	-18.102	-0.602	0
	Fe+3	1.70E-18	1.80E-19	-17.769	-18.745	-0.976	0
	FeCl2+	7.29E-19	5.16E-19	-18.137	-18.288	-0.15	0
	Fe(SO4)2-	5.61E-19	4.10E-19	-18.251	-18.387	-0.136	0
	FeCl3	6.97E-21	7.52E-21	-20.157	-20.124	0.033	0
	Fe2(OH)2+	4.37E-22	2.96E-24	-21.36	-23.528	-2.169	0
	FeHSO4+2	1.97E-25	5.65E-26	-24.706	-25.248	-0.542	0
	Fe3(OH)4+	4.76E-26	1.95E-29	-25.323	-28.711	-3.388	0
H(0)	1.58E-28						
	H2	7.89E-29	8.51E-29	-28.103	-28.07	0.033	28.61
K	2.94E-03						
	K+	2.88E-03	1.94E-03	-2.54	-2.712	-0.171	9.44
	KSO4-	5.88E-05	4.21E-05	-4.231	-4.376	-0.145	34.62
Mg	4.73E-02						
	Mg+2	3.69E-02	1.15E-02	-1.433	-1.941	-0.509	-20.74
	MgSO4	7.68E-03	8.28E-03	-2.115	-2.082	0.033	5.84
	MgHCO3+	1.41E-03	9.58E-04	-2.852	-3.018	-0.167	5.76
	MgCO3	9.80E-04	1.06E-03	-3.009	-2.976	0.033	-17.09
	MgF+	2.45E-04	1.70E-04	-3.611	-3.769	-0.158	-10.31
	MgOH+	1.61E-05	1.19E-05	-4.793	-4.925	-0.131	0
Mn(2)	2.60E-07						
	MnCO3	1.43E-07	1.54E-07	-6.845	-6.812	0.033	0
	Mn+2	7.10E-08	2.01E-08	-7.149	-7.698	-0.549	-17.08
	MnHCO3+	1.81E-08	1.28E-08	-7.743	-7.893	-0.15	0
	MnCl+	1.69E-08	1.19E-08	-7.773	-7.924	-0.15	-2.84
	MnSO4	1.02E-08	1.10E-08	-7.991	-7.959	0.033	22.54
	MnCl2	7.03E-10	7.58E-10	-9.153	-9.12	0.033	85.89

	MnOH+	2.08E-10	1.47E-10	-9.681	-9.831	-0.15	0
	MnF+	4.41E-11	3.12E-11	-10.355	-10.506	-0.15	0
	MnCl3-	4.31E-11	3.05E-11	-10.366	-10.516	-0.15	44.68
	Mn(NO3)2	2.29E-15	2.46E-15	-14.641	-14.608	0.033	41.04
	Mn(OH)3-	1.05E-17	7.43E-18	-16.978	-17.129	-0.15	0
Mn(3)	5.86E-29						
	Mn+3	5.86E-29	6.20E-30	-28.232	-29.208	-0.976	0
N(-3)	3.20E-05						
	NH4+	2.83E-05	1.79E-05	-4.548	-4.747	-0.199	18.32
	NH3	2.73E-06	2.94E-06	-5.564	-5.531	0.033	24.42
	NH4SO4-	9.73E-07	7.12E-07	-6.012	-6.148	-0.136	38.91
N(5)	2.70E-04						
	NO3-	2.70E-04	1.76E-04	-3.569	-3.755	-0.187	30.03
	Mn(NO3)2	2.29E-15	2.46E-15	-14.641	-14.608	0.033	41.04
Na	2.07E-01						
	Na+	2.02E-01	1.47E-01	-0.694	-0.832	-0.138	-0.78
	NaSO4-	3.18E-03	2.28E-03	-2.498	-2.643	-0.145	18.76
	NaHCO3	5.49E-04	5.92E-04	-3.26	-3.228	0.033	1.8
	NaCO3-	3.62E-04	2.65E-04	-3.441	-3.576	-0.136	1.02
	NaF	1.77E-05	1.91E-05	-4.753	-4.72	0.033	7.26
	NaOH	3.95E-17	4.26E-17	-16.403	-16.371	0.033	0
O(0)	1.05E-36						
	O2	5.25E-37	5.66E-37	-36.28	-36.247	0.033	30.4
S(6)	2.43E-02						
	SO4-2	1.27E-02	3.09E-03	-1.896	-2.511	-0.615	16.55
	MgSO4	7.68E-03	8.28E-03	-2.115	-2.082	0.033	5.84
	NaSO4-	3.18E-03	2.28E-03	-2.498	-2.643	-0.145	18.76
	CaSO4	6.90E-04	7.44E-04	-3.161	-3.129	0.033	7.5
	KSO4-	5.88E-05	4.21E-05	-4.231	-4.376	-0.145	34.62
	BaSO4	2.98E-06	3.22E-06	-5.525	-5.492	0.033	0
	NH4SO4-	9.73E-07	7.12E-07	-6.012	-6.148	-0.136	38.91
	MnSO4	1.02E-08	1.10E-08	-7.991	-7.959	0.033	22.54
	ZnSO4	6.78E-09	7.31E-09	-8.169	-8.136	0.033	21.71
	HSO4-	1.42E-09	1.04E-09	-8.847	-8.983	-0.136	40.76
	Zn(SO4)2-2	6.38E-10	1.83E-10	-9.195	-9.737	-0.542	-8.66
	FeSO4	9.57E-11	1.03E-10	-10.019	-9.986	0.033	18.97
	CuSO4	3.72E-11	4.01E-11	-10.43	-10.397	0.033	13.09
	CaHSO4+	2.32E-11	1.70E-11	-10.635	-10.771	-0.136	0
	FeSO4+	8.60E-18	6.08E-18	-17.066	-17.216	-0.15	0
	FeHSO4+	3.22E-18	2.35E-18	-17.493	-17.628	-0.136	0
	Fe(SO4)2-	5.61E-19	4.10E-19	-18.251	-18.387	-0.136	0
	FeHSO4+2	1.97E-25	5.65E-26	-24.706	-25.248	-0.542	0
Zn	1.68E-06						
	Zn(CO3)2-2	1.41E-06	4.03E-07	-5.852	-6.394	-0.542	0
	ZnCO3	1.81E-07	1.95E-07	-6.743	-6.71	0.033	0
	Zn+2	4.04E-08	1.01E-08	-7.394	-7.996	-0.602	-24.34
	ZnOHCl	1.29E-08	1.40E-08	-7.888	-7.855	0.033	0
	ZnHCO3+	1.24E-08	9.10E-09	-7.906	-8.041	-0.136	0
	Zn(OH)2	9.64E-09	1.04E-08	-8.016	-7.983	0.033	0
	ZnSO4	6.78E-09	7.31E-09	-8.169	-8.136	0.033	21.71

ZnCl+	5.82E-09	3.97E-09	-8.235	-8.402	-0.167	-14.78
ZnOH+	4.33E-09	3.17E-09	-8.364	-8.499	-0.136	0
Zn(SO4)2-2	6.38E-10	1.83E-10	-9.195	-9.737	-0.542	-8.66
ZnCl2	5.61E-10	6.05E-10	-9.251	-9.218	0.033	102.03
ZnCl3-	1.45E-10	9.91E-11	-9.838	-10.004	-0.167	14.95
ZnF+	4.39E-11	3.21E-11	-10.358	-10.494	-0.136	0
ZnCl4-2	2.89E-11	7.24E-12	-10.538	-11.14	-0.602	148.26
Zn(OH)3-	1.29E-11	9.40E-12	-10.891	-11.027	-0.136	0
Zn(OH)4-2	1.49E-15	4.26E-16	-14.828	-15.37	-0.542	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)
Anhydrite	-1.1	-5.38	-4.28 CaSO4
Aragonite	1.45	-6.88	-8.34 CaCO3
Barite	1.65	-8.19	-9.84 BaSO4
Calcite	1.6	-6.88	-8.48 CaCO3
CO2(g)	-2.78	-4.25	-1.47 CO2
Dolomite	4.25	-12.84	-17.08 CaMg(CO3)2
Fe(OH)3(a)	1.73	6.62	4.89 Fe(OH)3
Fluorite	0.44	-10.16	-10.6 CaF2
Goethite	7.63	6.63	-1 FeOOH
Gypsum	-0.8	-5.39	-4.58 CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1 H2
H2O(g)	-1.51	0	1.5 H2O
Halite	-3.24	-1.67	1.57 NaCl
Hausmann	-8.46	52.57	61.03 Mn3O4
Hematite	17.27	13.26	-4.01 Fe2O3
Jarosite-K	-4.02	-13.23	-9.21 KFe3(SO4)2(OH)6
Manganite	-3.67	21.67	25.34 MnOOH
Melanterit	-10.05	-12.26	-2.21 FeSO4:7H2O
NH3(g)	-7.33	-5.53	1.8 NH3
O2(g)	-33.36	-36.25	-2.89 O2
Pyrochroit	-5.99	9.21	15.2 Mn(OH)2
Pyrolusite	-7.25	34.13	41.38 MnO2:H2O
Rhodochro	-0.58	-11.71	-11.13 MnCO3
Siderite	-2.85	-13.74	-10.89 FeCO3
Smithsonit	-2.01	-12.01	-10 ZnCO3
Sylvite	-4.45	-3.55	0.9 KCl
Witherite	-1.13	-9.7	-8.56 BaCO3
Zn(OH)2(e	-2.58	8.92	11.5 Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 17

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.70E-02	1.70E-02
Ba	1.26E-05	1.26E-05
Ca	6.22E-03	6.22E-03
Cl	2.28E-01	2.28E-01
Cu	2.10E-07	2.10E-07
F	6.40E-04	6.40E-04
Fe	1.64E-06	1.64E-06
K	3.12E-03	3.12E-03
Mg	5.03E-02	5.03E-02
Mn	2.80E-07	2.80E-07
N(-3)	3.40E-05	3.40E-05
N(5)	2.90E-04	2.90E-04
Na	2.20E-01	2.20E-01
S(6)	2.59E-02	2.59E-02
Zn	1.79E-06	1.79E-06

#NAME? of solution----------

pH	=	8.46			
pe	=	4			
Specific	Conductan	(µS/cm,	25°C)	=	26434
Density	(g/cm³)	=	1.01129		
Volume	(L)	=	1.00679		
Activity	of	water	=	0.991	
Ionic	strength	(mol/kgw)	=	3.48E-01	
Mass	of	water	(kg)	=	1.00E+00
Total	carbon	(mol/kg)	=	1.49E-02	
Total	CO2	(mol/kg)	=	1.49E-02	
Temperatu	(°C)	=	25		
Electrical	balance	(eq)	=	3.79E-02	
Percent	error,	100*(Cat-|	=	6.54	
Iterations	=	10	(162	overall)	
Total	H	=	1.11E+02		
Total	O	=	5.57E+01		

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4357	0.2624		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.37E-06	2.89E-06	-5.359	-5.539	-0.179	-3.2
H+	4.46E-09	3.47E-09	-8.35	-8.46	-0.11	0

	H2O	5.55E+01	9.91E-01	1.744	-0.004	0	18.07
Ba	1.26E-05						
	Ba+2	9.14E-06	2.17E-06	-5.039	-5.664	-0.625	-11.44
	BaSO4	3.18E-06	3.44E-06	-5.498	-5.463	0.035	0
	BaHCO3+	2.12E-07	1.55E-07	-6.674	-6.81	-0.136	0
	BaCO3	1.04E-07	1.13E-07	-6.982	-6.947	0.035	-10.7
	BaOH+	2.99E-11	2.10E-11	-10.525	-10.678	-0.153	0
C(4)	1.49E-02						
	HCO3-	1.05E-02	7.45E-03	-1.981	-2.128	-0.147	26.01
	MgHCO3+	1.55E-03	1.05E-03	-2.81	-2.98	-0.169	5.76
	MgCO3	1.07E-03	1.16E-03	-2.972	-2.937	0.035	-17.09
	NaHCO3	6.04E-04	6.54E-04	-3.219	-3.184	0.035	1.8
	NaCO3-	4.01E-04	2.93E-04	-3.397	-3.533	-0.136	1.13
	CO3-2	3.90E-04	1.01E-04	-3.409	-3.997	-0.588	-3
	CaCO3	2.22E-04	2.40E-04	-3.654	-3.62	0.035	-14.6
	CaHCO3+	1.86E-04	1.35E-04	-3.731	-3.87	-0.139	9.92
	CO2	5.41E-05	5.86E-05	-4.267	-4.232	0.035	34.43
	Zn(CO3)2-2	1.51E-06	4.32E-07	-5.821	-6.365	-0.544	0
	BaHCO3+	2.12E-07	1.55E-07	-6.674	-6.81	-0.136	0
	ZnCO3	1.85E-07	2.00E-07	-6.733	-6.698	0.035	0
	MnCO3	1.54E-07	1.67E-07	-6.811	-6.777	0.035	0
	BaCO3	1.04E-07	1.13E-07	-6.982	-6.947	0.035	-10.7
	CuCO3	3.18E-08	3.44E-08	-7.498	-7.463	0.035	0
	MnHCO3+	1.97E-08	1.39E-08	-7.705	-7.858	-0.153	0
	Cu(CO3)2-	1.53E-08	4.37E-09	-7.816	-8.36	-0.544	0
	ZnHCO3+	1.28E-08	9.34E-09	-7.894	-8.03	-0.136	0
	FeCO3	4.49E-10	4.86E-10	-9.348	-9.313	0.035	0
	CuHCO3+	3.25E-10	2.37E-10	-9.489	-9.625	-0.136	0
	FeHCO3+	2.05E-10	1.50E-10	-9.688	-9.824	-0.136	0
	(CO2)2	5.82E-11	6.31E-11	-10.235	-10.2	0.035	68.87
Ca	6.22E-03						
	Ca+2	5.08E-03	1.42E-03	-2.295	-2.848	-0.554	-17
	CaSO4	7.37E-04	7.99E-04	-3.133	-3.098	0.035	7.5
	CaCO3	2.22E-04	2.40E-04	-3.654	-3.62	0.035	-14.6
	CaHCO3+	1.86E-04	1.35E-04	-3.731	-3.87	-0.139	9.92
	CaOH+	9.20E-08	6.73E-08	-7.036	-7.172	-0.136	0
	CaHSO4+	2.49E-11	1.82E-11	-10.604	-10.74	-0.136	0
Cl	2.28E-01						
	Cl-	2.28E-01	1.54E-01	-0.642	-0.812	-0.171	18.59
	CuCl2-	3.70E-08	2.50E-08	-7.432	-7.601	-0.169	0
	CuCl3-2	2.50E-08	6.12E-09	-7.602	-8.214	-0.611	0
	MnCl+	1.86E-08	1.31E-08	-7.729	-7.882	-0.153	-2.84
	ZnOHCl	1.34E-08	1.45E-08	-7.873	-7.838	0.035	0
	ZnCl+	6.10E-09	4.13E-09	-8.215	-8.384	-0.169	-14.85
	MnCl2	8.14E-10	8.82E-10	-9.089	-9.054	0.035	85.89
	ZnCl2	6.15E-10	6.66E-10	-9.211	-9.176	0.035	102.03
	ZnCl3-	1.70E-10	1.15E-10	-9.769	-9.939	-0.169	14.81
	FeCl+	5.85E-11	4.28E-11	-10.233	-10.369	-0.136	0
	MnCl3-	5.32E-11	3.74E-11	-10.274	-10.427	-0.153	44.75
	CuCl+	3.89E-11	2.64E-11	-10.41	-10.579	-0.169	1.39

	ZnCl4-2	3.63E-11	8.90E-12	-10.44	-11.051	-0.611	148.4
	CuCl2	2.01E-12	2.18E-12	-11.696	-11.661	0.035	31.02
	CuCl3-	1.76E-15	1.19E-15	-14.754	-14.924	-0.169	0
	CuCl4-2	3.76E-18	9.21E-19	-17.425	-18.036	-0.611	0
	FeCl+2	3.65E-18	8.94E-19	-17.438	-18.049	-0.611	0
	FeCl2+	8.75E-19	6.15E-19	-18.058	-18.211	-0.153	0
	FeCl3	8.75E-21	9.48E-21	-20.058	-20.023	0.035	0
Cu(1)	6.20E-08						
	CuCl2-	3.70E-08	2.50E-08	-7.432	-7.601	-0.169	0
	CuCl3-2	2.50E-08	6.12E-09	-7.602	-8.214	-0.611	0
	Cu+	5.32E-12	3.34E-12	-11.274	-11.477	-0.203	0
Cu(2)	1.48E-07						
	Cu(OH)2	1.00E-07	1.08E-07	-7	-6.965	0.035	0
	CuCO3	3.18E-08	3.44E-08	-7.498	-7.463	0.035	0
	Cu(CO3)2-	1.53E-08	4.37E-09	-7.816	-8.36	-0.544	0
	CuHCO3+	3.25E-10	2.37E-10	-9.489	-9.625	-0.136	0
	CuOH+	2.68E-10	1.82E-10	-9.571	-9.741	-0.169	0
	Cu+2	2.29E-10	6.36E-11	-9.641	-10.197	-0.556	-25.57
	CuCl+	3.89E-11	2.64E-11	-10.41	-10.579	-0.169	1.39
	CuSO4	3.79E-11	4.11E-11	-10.421	-10.386	0.035	13.09
	Cu(OH)3-	2.55E-12	1.87E-12	-11.593	-11.729	-0.136	0
	CuCl2	2.01E-12	2.18E-12	-11.696	-11.661	0.035	31.02
	CuF+	3.69E-13	2.70E-13	-12.433	-12.569	-0.136	0
	Cu2(OH)2+	5.05E-14	1.44E-14	-13.297	-13.841	-0.544	0
	CuCl3-	1.76E-15	1.19E-15	-14.754	-14.924	-0.169	0
	Cu(OH)4-2	3.73E-16	1.07E-16	-15.429	-15.973	-0.544	0
	CuCl4-2	3.76E-18	9.21E-19	-17.425	-18.036	-0.611	0
F	6.40E-04						
	F-	3.53E-04	2.33E-04	-3.453	-3.632	-0.179	-0.79
	MgF+	2.68E-04	1.85E-04	-3.572	-3.732	-0.161	-10.3
	NaF	1.93E-05	2.10E-05	-4.714	-4.679	0.035	7.26
	HF	1.12E-09	1.21E-09	-8.951	-8.916	0.035	12.5
	MnF+	4.80E-11	3.37E-11	-10.319	-10.472	-0.153	0
	ZnF+	4.49E-11	3.28E-11	-10.348	-10.484	-0.136	0
	HF2-	1.49E-12	1.09E-12	-11.828	-11.964	-0.136	22.59
	FeF+	6.42E-13	4.69E-13	-12.193	-12.329	-0.136	0
	CuF+	3.69E-13	2.70E-13	-12.433	-12.569	-0.136	0
	FeF2+	9.38E-16	6.60E-16	-15.028	-15.181	-0.153	0
	FeF+2	2.90E-16	7.10E-17	-15.537	-16.149	-0.611	0
	FeF3	2.25E-16	2.44E-16	-15.647	-15.613	0.035	0
Fe(2)	1.57E-09						
	Fe+2	7.24E-10	2.01E-10	-9.14	-9.697	-0.556	-21.04
	FeCO3	4.49E-10	4.86E-10	-9.348	-9.313	0.035	0
	FeHCO3+	2.05E-10	1.50E-10	-9.688	-9.824	-0.136	0
	FeSO4	1.05E-10	1.13E-10	-9.981	-9.946	0.035	18.97
	FeCl+	5.85E-11	4.28E-11	-10.233	-10.369	-0.136	0
	FeOH+	2.58E-11	1.82E-11	-10.588	-10.74	-0.153	0
	FeF+	6.42E-13	4.69E-13	-12.193	-12.329	-0.136	0
	Fe(OH)2	4.08E-14	4.42E-14	-13.389	-13.354	0.035	0
	Fe(OH)3-	6.67E-16	4.70E-16	-15.176	-15.328	-0.153	0

	FeHSO4+	3.53E-18	2.58E-18	-17.452	-17.588	-0.136	0
Fe(3)	1.64E-06						
	Fe(OH)3	1.14E-06	1.24E-06	-5.943	-5.908	0.035	0
	Fe(OH)4-	4.52E-07	3.22E-07	-6.345	-6.492	-0.147	0
	Fe(OH)2+	4.71E-08	3.35E-08	-7.327	-7.474	-0.147	0
	FeOH+2	1.45E-12	3.54E-13	-11.839	-12.45	-0.611	0
	FeF2+	9.38E-16	6.60E-16	-15.028	-15.181	-0.153	0
	FeF+2	2.90E-16	7.10E-17	-15.537	-16.149	-0.611	0
	FeF3	2.25E-16	2.44E-16	-15.647	-15.613	0.035	0
	FeSO4+	9.48E-18	6.67E-18	-17.023	-17.176	-0.153	0
	FeCl+2	3.65E-18	8.94E-19	-17.438	-18.049	-0.611	0
	Fe+3	1.86E-18	1.92E-19	-17.73	-18.717	-0.987	0
	FeCl2+	8.75E-19	6.15E-19	-18.058	-18.211	-0.153	0
	Fe(SO4)2-	6.32E-19	4.62E-19	-18.199	-18.335	-0.136	0
	FeCl3	8.75E-21	9.48E-21	-20.058	-20.023	0.035	0
	Fe2(OH)2+	5.07E-22	3.38E-24	-21.295	-23.471	-2.176	0
	FeHSO4+2	2.17E-25	6.19E-26	-24.664	-25.208	-0.544	0
	Fe3(OH)4+	5.95E-26	2.37E-29	-25.226	-28.625	-3.4	0
H(0)	1.57E-28						
	H2	7.86E-29	8.51E-29	-28.105	-28.07	0.035	28.61
K	3.12E-03						
	K+	3.06E-03	2.05E-03	-2.515	-2.689	-0.174	9.46
	KSO4-	6.39E-05	4.55E-05	-4.195	-4.342	-0.147	34.63
Mg	5.03E-02						
	Mg+2	3.91E-02	1.20E-02	-1.407	-1.92	-0.513	-20.72
	MgSO4	8.23E-03	8.92E-03	-2.085	-2.05	0.035	5.84
	MgHCO3+	1.55E-03	1.05E-03	-2.81	-2.98	-0.169	5.76
	MgCO3	1.07E-03	1.16E-03	-2.972	-2.937	0.035	-17.09
	MgF+	2.68E-04	1.85E-04	-3.572	-3.732	-0.161	-10.3
	MgOH+	1.69E-05	1.25E-05	-4.771	-4.904	-0.133	0
Mn(2)	2.80E-07						
	MnCO3	1.54E-07	1.67E-07	-6.811	-6.777	0.035	0
	Mn+2	7.52E-08	2.09E-08	-7.124	-7.68	-0.556	-17.02
	MnHCO3+	1.97E-08	1.39E-08	-7.705	-7.858	-0.153	0
	MnCl+	1.86E-08	1.31E-08	-7.729	-7.882	-0.153	-2.84
	MnSO4	1.09E-08	1.18E-08	-7.964	-7.929	0.035	22.54
	MnCl2	8.14E-10	8.82E-10	-9.089	-9.054	0.035	85.89
	MnOH+	2.18E-10	1.54E-10	-9.661	-9.814	-0.153	0
	MnCl3-	5.32E-11	3.74E-11	-10.274	-10.427	-0.153	44.75
	MnF+	4.80E-11	3.37E-11	-10.319	-10.472	-0.153	0
	Mn(NO3)2	2.69E-15	2.91E-15	-14.57	-14.536	0.035	41.04
	Mn(OH)3-	1.10E-17	7.73E-18	-16.959	-17.112	-0.153	0
Mn(3)	6.26E-29						
	Mn+3	6.26E-29	6.46E-30	-28.203	-29.19	-0.987	0
N(-3)	3.40E-05						
	NH4+	3.01E-05	1.89E-05	-4.522	-4.724	-0.203	18.33
	NH3	2.86E-06	3.10E-06	-5.543	-5.508	0.035	24.42
	NH4SO4-	1.05E-06	7.70E-07	-5.978	-6.114	-0.136	38.98
N(5)	2.90E-04						
	NO3-	2.90E-04	1.87E-04	-3.538	-3.728	-0.19	30.05

	Mn(NO3)2	2.69E-15	2.91E-15	-14.57	-14.536	0.035	41.04
Na	2.20E-01						
	Na+	2.15E-01	1.56E-01	-0.667	-0.807	-0.139	-0.76
	NaSO4-	3.47E-03	2.48E-03	-2.459	-2.606	-0.147	18.93
	NaHCO3	6.04E-04	6.54E-04	-3.219	-3.184	0.035	1.8
	NaCO3-	4.01E-04	2.93E-04	-3.397	-3.533	-0.136	1.13
	NaF	1.93E-05	2.10E-05	-4.714	-4.679	0.035	7.26
	NaOH	4.17E-17	4.51E-17	-16.38	-16.345	0.035	0
O(0)	1.04E-36						
	O2	5.22E-37	5.65E-37	-36.283	-36.248	0.035	30.4
S(6)	2.59E-02						
	SO4-2	1.34E-02	3.17E-03	-1.874	-2.499	-0.625	16.62
	MgSO4	8.23E-03	8.92E-03	-2.085	-2.05	0.035	5.84
	NaSO4-	3.47E-03	2.48E-03	-2.459	-2.606	-0.147	18.93
	CaSO4	7.37E-04	7.99E-04	-3.133	-3.098	0.035	7.5
	KSO4-	6.39E-05	4.55E-05	-4.195	-4.342	-0.147	34.63
	BaSO4	3.18E-06	3.44E-06	-5.498	-5.463	0.035	0
	NH4SO4-	1.05E-06	7.70E-07	-5.978	-6.114	-0.136	38.98
	MnSO4	1.09E-08	1.18E-08	-7.964	-7.929	0.035	22.54
	ZnSO4	6.82E-09	7.39E-09	-8.166	-8.131	0.035	21.71
	HSO4-	1.46E-09	1.07E-09	-8.836	-8.972	-0.136	40.77
	Zn(SO4)2-2	6.66E-10	1.90E-10	-9.177	-9.721	-0.544	-8.45
	FeSO4	1.05E-10	1.13E-10	-9.981	-9.946	0.035	18.97
	CuSO4	3.79E-11	4.11E-11	-10.421	-10.386	0.035	13.09
	CaHSO4+	2.49E-11	1.82E-11	-10.604	-10.74	-0.136	0
	FeSO4+	9.48E-18	6.67E-18	-17.023	-17.176	-0.153	0
	FeHSO4+	3.53E-18	2.58E-18	-17.452	-17.588	-0.136	0
	Fe(SO4)2-	6.32E-19	4.62E-19	-18.199	-18.335	-0.136	0
	FeHSO4+2	2.17E-25	6.19E-26	-24.664	-25.208	-0.544	0
Zn	1.79E-06						
	Zn(CO3)2-2	1.51E-06	4.32E-07	-5.821	-6.365	-0.544	0
	ZnCO3	1.85E-07	2.00E-07	-6.733	-6.698	0.035	0
	Zn+2	4.07E-08	9.96E-09	-7.391	-8.002	-0.611	-24.32
	ZnOHCl	1.34E-08	1.45E-08	-7.873	-7.838	0.035	0
	ZnHCO3+	1.28E-08	9.34E-09	-7.894	-8.03	-0.136	0
	Zn(OH)2	9.45E-09	1.02E-08	-8.025	-7.99	0.035	0
	ZnSO4	6.82E-09	7.39E-09	-8.166	-8.131	0.035	21.71
	ZnCl+	6.10E-09	4.13E-09	-8.215	-8.384	-0.169	-14.85
	ZnOH+	4.27E-09	3.12E-09	-8.37	-8.506	-0.136	0
	Zn(SO4)2-2	6.66E-10	1.90E-10	-9.177	-9.721	-0.544	-8.45
	ZnCl2	6.15E-10	6.66E-10	-9.211	-9.176	0.035	102.03
	ZnCl3-	1.70E-10	1.15E-10	-9.769	-9.939	-0.169	14.81
	ZnF+	4.49E-11	3.28E-11	-10.348	-10.484	-0.136	0
	ZnCl4-2	3.63E-11	8.90E-12	-10.44	-11.051	-0.611	148.4
	Zn(OH)3-	1.27E-11	9.25E-12	-10.898	-11.034	-0.136	0
	Zn(OH)4-2	1.47E-15	4.19E-16	-14.834	-15.378	-0.544	0

#NAME? indices----------

Phase SI** log IAP log K(298 K, 1 atm)

Anhydrite	-1.07	-5.35	-4.28	CaSO4
Aragonite	1.49	-6.84	-8.34	CaCO3
Barite	1.68	-8.16	-9.84	BaSO4
Calcite	1.64	-6.84	-8.48	CaCO3
CO2(g)	-2.76	-4.23	-1.47	CO2
Dolomite	4.32	-12.76	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.76	6.65	4.89	Fe(OH)3
Fluorite	0.49	-10.11	-10.6	CaF2
Goethite	7.66	6.66	-1	FeOOH
Gypsum	-0.77	-5.36	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O
Halite	-3.19	-1.62	1.57	NaCl
Hausmann	-8.41	52.62	61.03	Mn3O4
Hematite	17.32	13.32	-4.01	Fe2O3
Jarosite-K	-3.89	-13.1	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.65	21.69	25.34	MnOOH
Melanterit	-10.01	-12.22	-2.21	FeSO4:7H2O
NH3(g)	-7.3	-5.51	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.97	9.23	15.2	Mn(OH)2
Pyrolusite	-7.23	34.15	41.38	MnO2:H2O
Rhodochrc	-0.55	-11.68	-11.13	MnCO3
Siderite	-2.8	-13.69	-10.89	FeCO3
Smithsonit	-2	-12	-10	ZnCO3
Sylvite	-4.4	-3.5	0.9	KCl
Witherite	-1.1	-9.66	-8.56	BaCO3
Zn(OH)2(e	-2.59	8.91	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 18

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.80E-02	1.80E-02
Ba	1.34E-05	1.34E-05
Ca	6.59E-03	6.59E-03
Cl	2.42E-01	2.42E-01
Cu	2.20E-07	2.20E-07
F	6.80E-04	6.80E-04
Fe	1.74E-06	1.74E-06
K	3.31E-03	3.31E-03
Mg	5.33E-02	5.33E-02
Mn	2.90E-07	2.90E-07
N(-3)	3.60E-05	3.60E-05

```
        N(5)        3.00E-04  3.00E-04
        Na          2.33E-01  2.33E-01
        S(6)        2.74E-02  2.74E-02
        Zn          1.90E-06  1.90E-06

#NAME?  of          solution----------------------------

        pH          =                 8.46
        pe          =                    4
        Specific    Conductan (µS/cm,   25°C)      =              27796
        Density     (g/cm³)   =           1.01213
        Volume      (L)       =           1.00703
        Activity    of        water     =                 0.99
        Ionic       strength  (mol/kgw) =           3.68E-01
        Mass        of        water     (kg)        =          1.00E+00
        Total       carbon    (mol/kg)  =           1.58E-02
        Total       CO2       (mol/kg)  =           1.58E-02
        Temperatu   (°C)      =                   25
        Electrical  balance   (eq)      =           4.01E-02
        Percent     error,    100*(Cat-|=                 6.55
        Iterations  =                 10 (172       overall)
        Total       H         =           1.11E+02
        Total       O         =           5.57E+01

#NAME?  couples--------------------------------

        Redox       couple    pe        Eh        (volts)

        N(-3)/N(5)    4.4345    0.2623

#NAME?  of          species----------------------------

        Log         Log       Log       mole      V
        Species     Molality  Activity  Molality  Activity  Gamma   cm³/mol

        OH-         4.40E-06  2.89E-06    -5.357    -5.539  -0.182     -3.17
        H+          4.47E-09  3.47E-09    -8.349     -8.46  -0.111         0
        H2O         5.55E+01  9.90E-01     1.744    -0.004       0     18.07
Ba        1.34E-05
        Ba+2        9.68E-06  2.26E-06    -5.014    -5.646  -0.632    -11.41
        BaSO4       3.37E-06  3.67E-06    -5.472    -5.435   0.037         0
        BaHCO3+     2.29E-07  1.68E-07     -6.64    -6.776  -0.136         0
        BaCO3       1.12E-07  1.22E-07     -6.95    -6.913   0.037      -10.7
        BaOH+       3.12E-11  2.18E-11   -10.506   -10.661  -0.155         0
C(4)      1.58E-02
        HCO3-       1.09E-02  7.74E-03    -1.962    -2.111  -0.149     26.07
        MgHCO3+     1.69E-03  1.14E-03    -2.771    -2.944  -0.172      5.77
        MgCO3       1.15E-03  1.26E-03    -2.938    -2.901   0.037    -17.09
        NaHCO3      6.60E-04  7.18E-04    -3.181    -3.144   0.037       1.8
        NaCO3-      4.40E-04  3.22E-04    -3.357    -3.493  -0.136      1.24
```

	CO3-2	4.13E-04	1.05E-04	-3.384	-3.98	-0.596	-2.93
	CaCO3	2.39E-04	2.60E-04	-3.621	-3.584	0.037	-14.6
	CaHCO3+	2.02E-04	1.46E-04	-3.694	-3.835	-0.141	9.92
	CO2	5.60E-05	6.10E-05	-4.252	-4.215	0.037	34.43
	Zn(CO3)2-2	1.62E-06	4.60E-07	-5.792	-6.337	-0.545	0
	BaHCO3+	2.29E-07	1.68E-07	-6.64	-6.776	-0.136	0
	ZnCO3	1.89E-07	2.06E-07	-6.724	-6.687	0.037	0
	MnCO3	1.60E-07	1.75E-07	-6.795	-6.758	0.037	0
	BaCO3	1.12E-07	1.22E-07	-6.95	-6.913	0.037	-10.7
	CuCO3	3.27E-08	3.56E-08	-7.485	-7.449	0.037	0
	MnHCO3+	2.07E-08	1.45E-08	-7.684	-7.839	-0.155	0
	Cu(CO3)2-	1.65E-08	4.69E-09	-7.784	-8.329	-0.545	0
	ZnHCO3+	1.31E-08	9.59E-09	-7.882	-8.018	-0.136	0
	FeCO3	4.94E-10	5.38E-10	-9.306	-9.269	0.037	0
	CuHCO3+	3.36E-10	2.46E-10	-9.474	-9.61	-0.136	0
	FeHCO3+	2.27E-10	1.66E-10	-9.644	-9.78	-0.136	0
	(CO2)2	6.27E-11	6.82E-11	-10.203	-10.166	0.037	68.87
Ca	6.59E-03						
	Ca+2	5.36E-03	1.48E-03	-2.271	-2.83	-0.559	-16.98
	CaSO4	7.85E-04	8.54E-04	-3.105	-3.069	0.037	7.5
	CaCO3	2.39E-04	2.60E-04	-3.621	-3.584	0.037	-14.6
	CaHCO3+	2.02E-04	1.46E-04	-3.694	-3.835	-0.141	9.92
	CaOH+	9.60E-08	7.02E-08	-7.018	-7.154	-0.136	0
	CaHSO4+	2.66E-11	1.95E-11	-10.575	-10.711	-0.136	0
Cl	2.42E-01						
	Cl-	2.42E-01	1.62E-01	-0.616	-0.79	-0.173	18.6
	CuCl2-	4.11E-08	2.77E-08	-7.386	-7.558	-0.172	0
	CuCl3-2	2.97E-08	7.12E-09	-7.528	-8.148	-0.62	0
	MnCl+	1.98E-08	1.39E-08	-7.703	-7.858	-0.155	-2.83
	ZnOHCl	1.39E-08	1.51E-08	-7.858	-7.821	0.037	0
	ZnCl+	6.39E-09	4.30E-09	-8.195	-8.367	-0.172	-14.91
	MnCl2	9.03E-10	9.83E-10	-9.044	-9.008	0.037	85.89
	ZnCl2	6.71E-10	7.31E-10	-9.173	-9.136	0.037	102.03
	ZnCl3-	1.98E-10	1.33E-10	-9.704	-9.876	-0.172	14.67
	FeCl+	6.57E-11	4.80E-11	-10.183	-10.319	-0.136	0
	MnCl3-	6.28E-11	4.39E-11	-10.202	-10.357	-0.155	44.82
	ZnCl4-2	4.51E-11	1.08E-11	-10.346	-10.966	-0.62	148.52
	CuCl+	4.11E-11	2.77E-11	-10.386	-10.558	-0.172	1.42
	CuCl2	2.21E-12	2.41E-12	-11.655	-11.618	0.037	31.02
	CuCl3-	2.06E-15	1.39E-15	-14.685	-14.858	-0.172	0
	CuCl4-2	4.71E-18	1.13E-18	-17.327	-17.947	-0.62	0
	FeCl+2	4.18E-18	1.00E-18	-17.379	-17.999	-0.62	0
	FeCl2+	1.04E-18	7.27E-19	-17.984	-18.139	-0.155	0
	FeCl3	1.08E-20	1.18E-20	-19.965	-19.928	0.037	0
Cu(1)	7.08E-08						
	CuCl2-	4.11E-08	2.77E-08	-7.386	-7.558	-0.172	0
	CuCl3-2	2.97E-08	7.12E-09	-7.528	-8.148	-0.62	0
	Cu+	5.34E-12	3.32E-12	-11.272	-11.479	-0.206	0
Cu(2)	1.49E-07						
	Cu(OH)2	9.91E-08	1.08E-07	-7.004	-6.967	0.037	0

	CuCO3	3.27E-08	3.56E-08	-7.485	-7.449	0.037	0
	Cu(CO3)2-	1.65E-08	4.69E-09	-7.784	-8.329	-0.545	0
	CuHCO3+	3.36E-10	2.46E-10	-9.474	-9.61	-0.136	0
	CuOH+	2.69E-10	1.81E-10	-9.571	-9.743	-0.172	0
	Cu+2	2.32E-10	6.33E-11	-9.635	-10.199	-0.564	-25.55
	CuCl+	4.11E-11	2.77E-11	-10.386	-10.558	-0.172	1.42
	CuSO4	3.85E-11	4.19E-11	-10.414	-10.378	0.037	13.09
	Cu(OH)3-	2.54E-12	1.86E-12	-11.595	-11.731	-0.136	0
	CuCl2	2.21E-12	2.41E-12	-11.655	-11.618	0.037	31.02
	CuF+	3.80E-13	2.78E-13	-12.42	-12.556	-0.136	0
	Cu2(OH)2+	5.02E-14	1.43E-14	-13.3	-13.845	-0.545	0
	CuCl3-	2.06E-15	1.39E-15	-14.685	-14.858	-0.172	0
	Cu(OH)4-2	3.71E-16	1.06E-16	-15.43	-15.975	-0.545	0
	CuCl4-2	4.71E-18	1.13E-18	-17.327	-17.947	-0.62	0
F	6.80E-04						
	F-	3.67E-04	2.41E-04	-3.435	-3.617	-0.182	-0.77
	MgF+	2.92E-04	2.00E-04	-3.535	-3.698	-0.163	-10.3
	NaF	2.10E-05	2.29E-05	-4.677	-4.64	0.037	7.26
	HF	1.15E-09	1.26E-09	-8.938	-8.901	0.037	12.5
	MnF+	5.00E-11	3.50E-11	-10.301	-10.456	-0.155	0
	ZnF+	4.59E-11	3.35E-11	-10.338	-10.474	-0.136	0
	HF2-	1.59E-12	1.16E-12	-11.798	-11.935	-0.136	22.6
	FeF+	7.07E-13	5.17E-13	-12.15	-12.287	-0.136	0
	CuF+	3.80E-13	2.78E-13	-12.42	-12.556	-0.136	0
	FeF2+	1.07E-15	7.52E-16	-14.969	-15.124	-0.155	0
	FeF+2	3.26E-16	7.82E-17	-15.487	-16.107	-0.62	0
	FeF3	2.64E-16	2.88E-16	-15.578	-15.541	0.037	0
Fe(2)	1.71E-09						
	Fe+2	7.84E-10	2.14E-10	-9.106	-9.669	-0.564	-21.01
	FeCO3	4.94E-10	5.38E-10	-9.306	-9.269	0.037	0
	FeHCO3+	2.27E-10	1.66E-10	-9.644	-9.78	-0.136	0
	FeSO4	1.14E-10	1.24E-10	-9.945	-9.908	0.037	18.97
	FeCl+	6.57E-11	4.80E-11	-10.183	-10.319	-0.136	0
	FeOH+	2.76E-11	1.93E-11	-10.559	-10.713	-0.155	0
	FeF+	7.07E-13	5.17E-13	-12.15	-12.287	-0.136	0
	Fe(OH)2	4.32E-14	4.70E-14	-13.364	-13.328	0.037	0
	Fe(OH)3-	7.13E-16	4.99E-16	-15.147	-15.302	-0.155	0
	FeHSO4+	3.85E-18	2.82E-18	-17.414	-17.55	-0.136	0
Fe(3)	1.74E-06						
	Fe(OH)3	1.21E-06	1.31E-06	-5.919	-5.882	0.037	0
	Fe(OH)4-	4.82E-07	3.42E-07	-6.317	-6.466	-0.149	0
	Fe(OH)2+	5.03E-08	3.57E-08	-7.299	-7.448	-0.149	0
	FeOH+2	1.57E-12	3.77E-13	-11.804	-12.423	-0.62	0
	FeF2+	1.07E-15	7.52E-16	-14.969	-15.124	-0.155	0
	FeF+2	3.26E-16	7.82E-17	-15.487	-16.107	-0.62	0
	FeF3	2.64E-16	2.88E-16	-15.578	-15.541	0.037	0
	FeSO4+	1.04E-17	7.27E-18	-16.983	-17.138	-0.155	0
	FeCl+2	4.18E-18	1.00E-18	-17.379	-17.999	-0.62	0
	Fe+3	2.03E-18	2.05E-19	-17.693	-18.689	-0.997	0
	FeCl2+	1.04E-18	7.27E-19	-17.984	-18.139	-0.155	0

	Fe(SO4)2-	7.06E-19	5.16E-19	-18.151	-18.287	-0.136	0
	FeCl3	1.08E-20	1.18E-20	-19.965	-19.928	0.037	0
	Fe2(OH)2+	5.80E-22	3.83E-24	-21.237	-23.417	-2.18	0
	FeHSO4+2	2.37E-25	6.75E-26	-24.625	-25.17	-0.545	0
	Fe3(OH)4+	7.28E-26	2.85E-29	-25.138	-28.545	-3.407	0
H(0)	1.56E-28						
	H2	7.82E-29	8.51E-29	-28.107	-28.07	0.037	28.61
K	3.31E-03						
	K+	3.24E-03	2.16E-03	-2.489	-2.666	-0.177	9.47
	KSO4-	6.93E-05	4.92E-05	-4.159	-4.308	-0.149	34.65
Mg	5.33E-02						
	Mg+2	4.13E-02	1.26E-02	-1.384	-1.901	-0.517	-20.69
	MgSO4	8.78E-03	9.56E-03	-2.056	-2.02	0.037	5.84
	MgHCO3+	1.69E-03	1.14E-03	-2.771	-2.944	-0.172	5.77
	MgCO3	1.15E-03	1.26E-03	-2.938	-2.901	0.037	-17.09
	MgF+	2.92E-04	2.00E-04	-3.535	-3.698	-0.163	-10.3
	MgOH+	1.78E-05	1.30E-05	-4.75	-4.885	-0.135	0
Mn(2)	2.90E-07						
	MnCO3	1.60E-07	1.75E-07	-6.795	-6.758	0.037	0
	Mn+2	7.68E-08	2.10E-08	-7.115	-7.678	-0.564	-16.96
	MnHCO3+	2.07E-08	1.45E-08	-7.684	-7.839	-0.155	0
	MnCl+	1.98E-08	1.39E-08	-7.703	-7.858	-0.155	-2.83
	MnSO4	1.11E-08	1.21E-08	-7.954	-7.917	0.037	22.54
	MnCl2	9.03E-10	9.83E-10	-9.044	-9.008	0.037	85.89
	MnOH+	2.20E-10	1.54E-10	-9.657	-9.812	-0.155	0
	MnCl3-	6.28E-11	4.39E-11	-10.202	-10.357	-0.155	44.82
	MnF+	5.00E-11	3.50E-11	-10.301	-10.456	-0.155	0
	Mn(NO3)2	2.83E-15	3.08E-15	-14.548	-14.511	0.037	41.04
	Mn(OH)3-	1.11E-17	7.75E-18	-16.956	-17.111	-0.155	0
Mn(3)	6.43E-29						
	Mn+3	6.43E-29	6.48E-30	-28.192	-29.188	-0.997	0
N(-3)	3.60E-05						
	NH4+	3.19E-05	1.98E-05	-4.497	-4.703	-0.206	18.33
	NH3	2.99E-06	3.26E-06	-5.524	-5.487	0.037	24.42
	NH4SO4-	1.13E-06	8.28E-07	-5.946	-6.082	-0.136	39.04
N(5)	3.00E-04						
	NO3-	3.00E-04	1.92E-04	-3.523	-3.716	-0.194	30.06
	Mn(NO3)2	2.83E-15	3.08E-15	-14.548	-14.511	0.037	41.04
Na	2.33E-01						
	Na+	2.28E-01	1.65E-01	-0.642	-0.783	-0.14	-0.75
	NaSO4-	3.78E-03	2.68E-03	-2.423	-2.572	-0.149	19.09
	NaHCO3	6.60E-04	7.18E-04	-3.181	-3.144	0.037	1.8
	NaCO3-	4.40E-04	3.22E-04	-3.357	-3.493	-0.136	1.24
	NaF	2.10E-05	2.29E-05	-4.677	-4.64	0.037	7.26
	NaOH	4.38E-17	4.77E-17	-16.359	-16.322	0.037	0
O(0)	1.04E-36						
	O2	5.19E-37	5.65E-37	-36.285	-36.248	0.037	30.4
S(6)	2.74E-02						
	SO4-2	1.40E-02	3.24E-03	-1.854	-2.489	-0.635	16.68
	MgSO4	8.78E-03	9.56E-03	-2.056	-2.02	0.037	5.84

NaSO4-	3.78E-03	2.68E-03	-2.423	-2.572	-0.149	19.09
CaSO4	7.85E-04	8.54E-04	-3.105	-3.069	0.037	7.5
KSO4-	6.93E-05	4.92E-05	-4.159	-4.308	-0.149	34.65
BaSO4	3.37E-06	3.67E-06	-5.472	-5.435	0.037	0
NH4SO4-	1.13E-06	8.28E-07	-5.946	-6.082	-0.136	39.04
MnSO4	1.11E-08	1.21E-08	-7.954	-7.917	0.037	22.54
ZnSO4	6.87E-09	7.48E-09	-8.163	-8.126	0.037	21.71
HSO4-	1.50E-09	1.09E-09	-8.825	-8.961	-0.136	40.79
Zn(SO4)2-2	6.92E-10	1.97E-10	-9.16	-9.705	-0.545	-8.24
FeSO4	1.14E-10	1.24E-10	-9.945	-9.908	0.037	18.97
CuSO4	3.85E-11	4.19E-11	-10.414	-10.378	0.037	13.09
CaHSO4+	2.66E-11	1.95E-11	-10.575	-10.711	-0.136	0
FeSO4+	1.04E-17	7.27E-18	-16.983	-17.138	-0.155	0
FeHSO4+	3.85E-18	2.82E-18	-17.414	-17.55	-0.136	0
Fe(SO4)2-	7.06E-19	5.16E-19	-18.151	-18.287	-0.136	0
FeHSO4+2	2.37E-25	6.75E-26	-24.625	-25.17	-0.545	0
Zn 1.90E-06						
Zn(CO3)2-2	1.62E-06	4.60E-07	-5.792	-6.337	-0.545	0
ZnCO3	1.89E-07	2.06E-07	-6.724	-6.687	0.037	0
Zn+2	4.10E-08	9.84E-09	-7.387	-8.007	-0.62	-24.3
ZnOHCl	1.39E-08	1.51E-08	-7.858	-7.821	0.037	0
ZnHCO3+	1.31E-08	9.59E-09	-7.882	-8.018	-0.136	0
Zn(OH)2	9.29E-09	1.01E-08	-8.032	-7.995	0.037	0
ZnSO4	6.87E-09	7.48E-09	-8.163	-8.126	0.037	21.71
ZnCl+	6.39E-09	4.30E-09	-8.195	-8.367	-0.172	-14.91
ZnOH+	4.22E-09	3.08E-09	-8.375	-8.511	-0.136	0
Zn(SO4)2-2	6.92E-10	1.97E-10	-9.16	-9.705	-0.545	-8.24
ZnCl2	6.71E-10	7.31E-10	-9.173	-9.136	0.037	102.03
ZnCl3-	1.98E-10	1.33E-10	-9.704	-9.876	-0.172	14.67
ZnF+	4.59E-11	3.35E-11	-10.338	-10.474	-0.136	0
ZnCl4-2	4.51E-11	1.08E-11	-10.346	-10.966	-0.62	148.52
Zn(OH)3-	1.25E-11	9.13E-12	-10.903	-11.04	-0.136	0
Zn(OH)4-2	1.45E-15	4.13E-16	-14.839	-15.384	-0.545	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-1.04	-5.32	-4.28	CaSO4
Aragonite	1.53	-6.81	-8.34	CaCO3
Barite	1.71	-8.14	-9.84	BaSO4
Calcite	1.67	-6.81	-8.48	CaCO3
CO2(g)	-2.75	-4.22	-1.47	CO2
Dolomite	4.39	-12.69	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.79	6.68	4.89	Fe(OH)3
Fluorite	0.54	-10.06	-10.6	CaF2
Goethite	7.68	6.68	-1	FeOOH
Gypsum	-0.74	-5.33	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O

Halite	-3.14	-1.57	1.57	NaCl
Hausmann	-8.4	52.63	61.03	Mn3O4
Hematite	17.38	13.37	-4.01	Fe2O3
Jarosite-K	-3.77	-12.98	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.65	21.69	25.34	MnOOH
Melanterit	-9.98	-12.19	-2.21	FeSO4:7H2O
NH3(g)	-7.28	-5.49	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.97	9.23	15.2	Mn(OH)2
Pyrolusite	-7.23	34.15	41.38	MnO2:H2O
Rhodochrc	-0.53	-11.66	-11.13	MnCO3
Siderite	-2.76	-13.65	-10.89	FeCO3
Smithsonit	-1.99	-11.99	-10	ZnCO3
Sylvite	-4.36	-3.46	0.9	KCl
Witherite	-1.06	-9.63	-8.56	BaCO3
Zn(OH)2(e	-2.6	8.9	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 19

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.90E-02	1.90E-02
Ba	1.42E-05	1.42E-05
Ca	6.97E-03	6.97E-03
Cl	2.56E-01	2.56E-01
Cu	2.30E-07	2.30E-07
F	7.20E-04	7.20E-04
Fe	1.84E-06	1.84E-06
K	3.50E-03	3.50E-03
Mg	5.63E-02	5.63E-02
Mn	3.10E-07	3.10E-07
N(-3)	3.80E-05	3.80E-05
N(5)	3.20E-04	3.20E-04
Na	2.46E-01	2.46E-01
S(6)	2.89E-02	2.89E-02
Zn	2.00E-06	2.00E-06

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 29144
Density (g/cm³) = 1.01296
Volume (L) = 1.00727
Activity of water = 0.99

```
Ionic      strength   (mol/kgw) =          3.88E-01
Mass       of         water     (kg)     =          1.00E+00
Total      carbon     (mol/kg)  =          1.66E-02
Total      CO2        (mol/kg)  =          1.66E-02
Temperatu  (°C)       =                25
Electrical balance    (eq)      =          4.24E-02
Percent    error,     100*(Cat-|=               6.55
Iterations =                10 (182      overall)
Total      H          =         1.11E+02
Total      O          =         5.57E+01

#NAME?  couples--------------------------------

        Redox      couple     pe         Eh         (volts)

        N(-3)/N(5)    4.4352     0.2624

#NAME?  of         species---------------------------

        Log        Log        Log        mole       V
        Species    Molality   Activity   Molality   Activity   Gamma   cm³/mol

        OH-        4.43E-06   2.89E-06     -5.354     -5.539   -0.185     -3.13
        H+         4.49E-09   3.47E-09     -8.348     -8.46    -0.112         0
        H2O        5.55E+01   9.90E-01      1.744     -0.004        0     18.07
Ba        1.42E-05
        Ba+2       1.02E-05   2.34E-06     -4.991      -5.63   -0.639    -11.38
        BaSO4      3.57E-06   3.90E-06     -5.448     -5.409    0.039         0
        BaHCO3+    2.47E-07   1.80E-07     -6.608     -6.744   -0.136         0
        BaCO3      1.20E-07   1.31E-07      -6.92     -6.881    0.039     -10.7
        BaOH+      3.26E-11   2.27E-11    -10.487    -10.644   -0.157         0
C(4)      1.66E-02
        HCO3-      1.14E-02   8.02E-03     -1.945     -2.096   -0.151     26.13
        MgHCO3+    1.84E-03   1.23E-03     -2.735     -2.909   -0.175      5.77
        MgCO3      1.24E-03   1.36E-03     -2.905     -2.867    0.039    -17.09
        NaHCO3     7.17E-04   7.84E-04     -3.145     -3.106    0.039       1.8
        NaCO3-     4.81E-04   3.51E-04     -3.318     -3.455   -0.136      1.35
        CO3-2      4.36E-04   1.09E-04     -3.361     -3.964   -0.604     -2.86
        CaCO3      2.58E-04   2.82E-04     -3.589      -3.55    0.039     -14.6
        CaHCO3+    2.20E-04   1.58E-04     -3.658     -3.801   -0.143      9.92
        CO2        5.78E-05   6.32E-05     -4.238     -4.199    0.039     34.43
        Zn(CO3)2-: 1.71E-06   4.87E-07     -5.767     -6.312   -0.546         0
        BaHCO3+    2.47E-07   1.80E-07     -6.608     -6.744   -0.136         0
        ZnCO3      1.92E-07   2.10E-07     -6.717     -6.678    0.039         0
        MnCO3      1.72E-07   1.88E-07     -6.765     -6.726    0.039         0
        BaCO3      1.20E-07   1.31E-07      -6.92     -6.881    0.039     -10.7
        CuCO3      3.35E-08   3.66E-08     -7.475     -7.436    0.039         0
        MnHCO3+    2.24E-08   1.56E-08      -7.65     -7.807   -0.157         0
        Cu(CO3)2-  1.76E-08   5.01E-09     -7.755     -8.301   -0.546         0
        ZnHCO3+    1.34E-08   9.79E-09     -7.873     -8.009   -0.136         0
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	FeCO3	5.41E-10	5.92E-10	-9.267	-9.228	0.039	0
	CuHCO3+	3.46E-10	2.53E-10	-9.461	-9.597	-0.136	0
	FeHCO3+	2.50E-10	1.82E-10	-9.603	-9.739	-0.136	0
	(CO2)2	6.71E-11	7.33E-11	-10.174	-10.135	0.039	68.87
Ca	6.97E-03						
	Ca+2	5.66E-03	1.54E-03	-2.247	-2.811	-0.564	-16.95
	CaSO4	8.33E-04	9.11E-04	-3.079	-3.04	0.039	7.5
	CaCO3	2.58E-04	2.82E-04	-3.589	-3.55	0.039	-14.6
	CaHCO3+	2.20E-04	1.58E-04	-3.658	-3.801	-0.143	9.92
	CaOH+	1.00E-07	7.32E-08	-6.999	-7.136	-0.136	0
	CaHSO4+	2.84E-11	2.08E-11	-10.546	-10.683	-0.136	0
Cl	2.56E-01						
	Cl-	2.56E-01	1.71E-01	-0.593	-0.768	-0.176	18.62
	CuCl2-	4.53E-08	3.03E-08	-7.344	-7.518	-0.175	0
	CuCl3-2	3.48E-08	8.19E-09	-7.459	-8.087	-0.628	0
	MnCl+	2.17E-08	1.51E-08	-7.663	-7.82	-0.157	-2.83
	ZnOHCl	1.43E-08	1.56E-08	-7.845	-7.806	0.039	0
	ZnCl+	6.65E-09	4.45E-09	-8.177	-8.352	-0.175	-14.98
	MnCl2	1.03E-09	1.13E-09	-8.987	-8.948	0.039	85.89
	ZnCl2	7.26E-10	7.94E-10	-9.139	-9.1	0.039	102.03
	ZnCl3-	2.27E-10	1.52E-10	-9.644	-9.818	-0.175	14.53
	MnCl3-	7.59E-11	5.29E-11	-10.12	-10.277	-0.157	44.88
	FeCl+	7.32E-11	5.35E-11	-10.135	-10.272	-0.136	0
	ZnCl4-2	5.51E-11	1.30E-11	-10.259	-10.887	-0.628	148.65
	CuCl+	4.31E-11	2.88E-11	-10.365	-10.54	-0.175	1.45
	CuCl2	2.42E-12	2.64E-12	-11.617	-11.578	0.039	31.02
	CuCl3-	2.39E-15	1.60E-15	-14.622	-14.797	-0.175	0
	CuCl4-2	5.80E-18	1.37E-18	-17.237	-17.865	-0.628	0
	FeCl+2	4.75E-18	1.12E-18	-17.324	-17.952	-0.628	0
	FeCl2+	1.22E-18	8.51E-19	-17.913	-18.07	-0.157	0
	FeCl3	1.33E-20	1.45E-20	-19.877	-19.838	0.039	0
Cu(1)	8.01E-08						
	CuCl2-	4.53E-08	3.03E-08	-7.344	-7.518	-0.175	0
	CuCl3-2	3.48E-08	8.19E-09	-7.459	-8.087	-0.628	0
	Cu+	5.35E-12	3.30E-12	-11.272	-11.482	-0.21	0
Cu(2)	1.50E-07						
	Cu(OH)2	9.79E-08	1.07E-07	-7.009	-6.971	0.039	0
	CuCO3	3.35E-08	3.66E-08	-7.475	-7.436	0.039	0
	Cu(CO3)2-	1.76E-08	5.01E-09	-7.755	-8.301	-0.546	0
	CuHCO3+	3.46E-10	2.53E-10	-9.461	-9.597	-0.136	0
	CuOH+	2.68E-10	1.79E-10	-9.571	-9.746	-0.175	0
	Cu+2	2.34E-10	6.28E-11	-9.631	-10.202	-0.57	-25.54
	CuCl+	4.31E-11	2.88E-11	-10.365	-10.54	-0.175	1.45
	CuSO4	3.89E-11	4.26E-11	-10.41	-10.371	0.039	13.09
	Cu(OH)3-	2.52E-12	1.84E-12	-11.599	-11.735	-0.136	0
	CuCl2	2.42E-12	2.64E-12	-11.617	-11.578	0.039	31.02
	CuF+	3.90E-13	2.85E-13	-12.409	-12.546	-0.136	0
	Cu2(OH)2+	4.95E-14	1.41E-14	-13.306	-13.851	-0.546	0
	CuCl3-	2.39E-15	1.60E-15	-14.622	-14.797	-0.175	0
	Cu(OH)4-2	3.68E-16	1.05E-16	-15.434	-15.979	-0.546	0

	CuCl4-2	5.80E-18	1.37E-18	-17.237	-17.865	-0.628	0
F	7.20E-04						
	F-	3.81E-04	2.49E-04	-3.419	-3.604	-0.185	-0.76
	MgF+	3.16E-04	2.16E-04	-3.5	-3.666	-0.165	-10.3
	NaF	2.28E-05	2.49E-05	-4.643	-4.604	0.039	7.26
	HF	1.18E-09	1.30E-09	-8.927	-8.888	0.039	12.5
	MnF+	5.39E-11	3.75E-11	-10.269	-10.426	-0.157	0
	ZnF+	4.67E-11	3.41E-11	-10.331	-10.467	-0.136	0
	HF2-	1.69E-12	1.24E-12	-11.771	-11.908	-0.136	22.62
	FeF+	7.75E-13	5.66E-13	-12.111	-12.247	-0.136	0
	CuF+	3.90E-13	2.85E-13	-12.409	-12.546	-0.136	0
	FeF2+	1.22E-15	8.49E-16	-14.914	-15.071	-0.157	0
	FeF+2	3.64E-16	8.56E-17	-15.439	-16.067	-0.628	0
	FeF3	3.06E-16	3.35E-16	-15.514	-15.475	0.039	0
Fe(2)	1.86E-09						
	Fe+2	8.45E-10	2.27E-10	-9.073	-9.643	-0.57	-20.99
	FeCO3	5.41E-10	5.92E-10	-9.267	-9.228	0.039	0
	FeHCO3+	2.50E-10	1.82E-10	-9.603	-9.739	-0.136	0
	FeSO4	1.23E-10	1.34E-10	-9.911	-9.873	0.039	18.97
	FeCl+	7.32E-11	5.35E-11	-10.135	-10.272	-0.136	0
	FeOH+	2.95E-11	2.05E-11	-10.531	-10.688	-0.157	0
	FeF+	7.75E-13	5.66E-13	-12.111	-12.247	-0.136	0
	Fe(OH)2	4.56E-14	4.99E-14	-13.341	-13.302	0.039	0
	Fe(OH)3-	7.59E-16	5.29E-16	-15.12	-15.277	-0.157	0
	FeHSO4+	4.18E-18	3.06E-18	-17.378	-17.515	-0.136	0
Fe(3)	1.84E-06						
	Fe(OH)3	1.27E-06	1.39E-06	-5.895	-5.857	0.039	0
	Fe(OH)4-	5.13E-07	3.62E-07	-6.29	-6.441	-0.151	0
	Fe(OH)2+	5.35E-08	3.78E-08	-7.271	-7.422	-0.151	0
	FeOH+2	1.70E-12	4.00E-13	-11.77	-12.398	-0.628	0
	FeF2+	1.22E-15	8.49E-16	-14.914	-15.071	-0.157	0
	FeF+2	3.64E-16	8.56E-17	-15.439	-16.067	-0.628	0
	FeF3	3.06E-16	3.35E-16	-15.514	-15.475	0.039	0
	FeSO4+	1.13E-17	7.90E-18	-16.946	-17.103	-0.157	0
	FeCl+2	4.75E-18	1.12E-18	-17.324	-17.952	-0.628	0
	Fe+3	2.20E-18	2.17E-19	-17.657	-18.663	-1.006	0
	FeCl2+	1.22E-18	8.51E-19	-17.913	-18.07	-0.157	0
	Fe(SO4)2-	7.85E-19	5.73E-19	-18.105	-18.242	-0.136	0
	FeCl3	1.33E-20	1.45E-20	-19.877	-19.838	0.039	0
	Fe2(OH)2+	6.55E-22	4.31E-24	-21.184	-23.366	-2.182	0
	FeHSO4+2	2.58E-25	7.33E-26	-24.589	-25.135	-0.546	0
	Fe3(OH)4+	8.74E-26	3.40E-29	-25.058	-28.468	-3.41	0
H(0)	1.56E-28						
	H2	7.79E-29	8.51E-29	-28.109	-28.07	0.039	28.61
K	3.50E-03						
	K+	3.43E-03	2.27E-03	-2.465	-2.645	-0.179	9.49
	KSO4-	7.48E-05	5.29E-05	-4.126	-4.277	-0.151	34.66
Mg	5.63E-02						
	Mg+2	4.35E-02	1.31E-02	-1.362	-1.882	-0.52	-20.67
	MgSO4	9.34E-03	1.02E-02	-2.03	-1.991	0.039	5.84

	MgHCO3+	1.84E-03	1.23E-03	-2.735	-2.909	-0.175	5.77
	MgCO3	1.24E-03	1.36E-03	-2.905	-2.867	0.039	-17.09
	MgF+	3.16E-04	2.16E-04	-3.5	-3.666	-0.165	-10.3
	MgOH+	1.86E-05	1.36E-05	-4.73	-4.866	-0.136	0
Mn(2)	3.10E-07						
	MnCO3	1.72E-07	1.88E-07	-6.765	-6.726	0.039	0
	Mn+2	8.10E-08	2.18E-08	-7.092	-7.662	-0.57	-16.91
	MnHCO3+	2.24E-08	1.56E-08	-7.65	-7.807	-0.157	0
	MnCl+	2.17E-08	1.51E-08	-7.663	-7.82	-0.157	-2.83
	MnSO4	1.18E-08	1.29E-08	-7.93	-7.891	0.039	22.54
	MnCl2	1.03E-09	1.13E-09	-8.987	-8.948	0.039	85.89
	MnOH+	2.30E-10	1.60E-10	-9.639	-9.796	-0.157	0
	MnCl3-	7.59E-11	5.29E-11	-10.12	-10.277	-0.157	44.88
	MnF+	5.39E-11	3.75E-11	-10.269	-10.426	-0.157	0
	Mn(NO3)2	3.28E-15	3.59E-15	-14.484	-14.445	0.039	41.04
	Mn(OH)3-	1.15E-17	8.03E-18	-16.938	-17.095	-0.157	0
Mn(3)	6.83E-29						
	Mn+3	6.83E-29	6.73E-30	-28.166	-29.172	-1.006	0
N(-3)	3.80E-05						
	NH4+	3.37E-05	2.08E-05	-4.473	-4.683	-0.21	18.34
	NH3	3.12E-06	3.41E-06	-5.506	-5.467	0.039	24.42
	NH4SO4-	1.21E-06	8.87E-07	-5.916	-6.052	-0.136	39.1
N(5)	3.20E-04						
	NO3-	3.20E-04	2.03E-04	-3.495	-3.692	-0.197	30.08
	Mn(NO3)2	3.28E-15	3.59E-15	-14.484	-14.445	0.039	41.04
Na	2.46E-01						
	Na+	2.41E-01	1.74E-01	-0.619	-0.76	-0.141	-0.73
	NaSO4-	4.09E-03	2.89E-03	-2.388	-2.539	-0.151	19.25
	NaHCO3	7.17E-04	7.84E-04	-3.145	-3.106	0.039	1.8
	NaCO3-	4.81E-04	3.51E-04	-3.318	-3.455	-0.136	1.35
	NaF	2.28E-05	2.49E-05	-4.643	-4.604	0.039	7.26
	NaOH	4.59E-17	5.02E-17	-16.338	-16.299	0.039	0
O(0)	1.03E-36						
	O2	5.16E-37	5.64E-37	-36.288	-36.249	0.039	30.4
S(6)	2.89E-02						
	SO4-2	1.46E-02	3.32E-03	-1.836	-2.479	-0.644	16.74
	MgSO4	9.34E-03	1.02E-02	-2.03	-1.991	0.039	5.84
	NaSO4-	4.09E-03	2.89E-03	-2.388	-2.539	-0.151	19.25
	CaSO4	8.33E-04	9.11E-04	-3.079	-3.04	0.039	7.5
	KSO4-	7.48E-05	5.29E-05	-4.126	-4.277	-0.151	34.66
	BaSO4	3.57E-06	3.90E-06	-5.448	-5.409	0.039	0
	NH4SO4-	1.21E-06	8.87E-07	-5.916	-6.052	-0.136	39.1
	MnSO4	1.18E-08	1.29E-08	-7.93	-7.891	0.039	22.54
	ZnSO4	6.90E-09	7.54E-09	-8.161	-8.123	0.039	21.71
	HSO4-	1.53E-09	1.12E-09	-8.815	-8.951	-0.136	40.8
	Zn(SO4)2-2	7.14E-10	2.03E-10	-9.146	-9.692	-0.546	-8.03
	FeSO4	1.23E-10	1.34E-10	-9.911	-9.873	0.039	18.97
	CuSO4	3.89E-11	4.26E-11	-10.41	-10.371	0.039	13.09
	CaHSO4+	2.84E-11	2.08E-11	-10.546	-10.683	-0.136	0
	FeSO4+	1.13E-17	7.90E-18	-16.946	-17.103	-0.157	0

	FeHSO4+	4.18E-18	3.06E-18	-17.378	-17.515	-0.136	0
	Fe(SO4)2-	7.85E-19	5.73E-19	-18.105	-18.242	-0.136	0
	FeHSO4+2	2.58E-25	7.33E-26	-24.589	-25.135	-0.546	0
Zn	2.00E-06						
	Zn(CO3)2-2	1.71E-06	4.87E-07	-5.767	-6.312	-0.546	0
	ZnCO3	1.92E-07	2.10E-07	-6.717	-6.678	0.039	0
	Zn+2	4.12E-08	9.69E-09	-7.386	-8.014	-0.628	-24.28
	ZnOHCl	1.43E-08	1.56E-08	-7.845	-7.806	0.039	0
	ZnHCO3+	1.34E-08	9.79E-09	-7.873	-8.009	-0.136	0
	Zn(OH)2	9.10E-09	9.95E-09	-8.041	-8.002	0.039	0
	ZnSO4	6.90E-09	7.54E-09	-8.161	-8.123	0.039	21.71
	ZnCl+	6.65E-09	4.45E-09	-8.177	-8.352	-0.175	-14.98
	ZnOH+	4.15E-09	3.03E-09	-8.382	-8.518	-0.136	0
	ZnCl2	7.26E-10	7.94E-10	-9.139	-9.1	0.039	102.03
	Zn(SO4)2-2	7.14E-10	2.03E-10	-9.146	-9.692	-0.546	-8.03
	ZnCl3-	2.27E-10	1.52E-10	-9.644	-9.818	-0.175	14.53
	ZnCl4-2	5.51E-11	1.30E-11	-10.259	-10.887	-0.628	148.65
	ZnF+	4.67E-11	3.41E-11	-10.331	-10.467	-0.136	0
	Zn(OH)3-	1.23E-11	8.98E-12	-10.91	-11.047	-0.136	0
	Zn(OH)4-2	1.43E-15	4.06E-16	-14.846	-15.391	-0.546	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-1.01	-5.29	-4.28	CaSO4
Aragonite	1.56	-6.78	-8.34	CaCO3
Barite	1.73	-8.11	-9.84	BaSO4
Calcite	1.7	-6.78	-8.48	CaCO3
CO2(g)	-2.73	-4.2	-1.47	CO2
Dolomite	4.46	-12.62	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.81	6.7	4.89	Fe(OH)3
Fluorite	0.58	-10.02	-10.6	CaF2
Goethite	7.71	6.71	-1	FeOOH
Gypsum	-0.72	-5.3	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O
Halite	-3.1	-1.53	1.57	NaCl
Hausmann	-8.35	52.68	61.03	Mn3O4
Hematite	17.43	13.42	-4.01	Fe2O3
Jarosite-K	-3.65	-12.86	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.63	21.71	25.34	MnOOH
Melanterit	-9.94	-12.15	-2.21	FeSO4:7H2O
NH3(g)	-7.26	-5.47	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.95	9.25	15.2	Mn(OH)2
Pyrolusite	-7.22	34.16	41.38	MnO2:H2O
Rhodochro	-0.5	-11.63	-11.13	MnCO3
Siderite	-2.72	-13.61	-10.89	FeCO3
Smithsonit	-1.98	-11.98	-10	ZnCO3

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        Sylvite          -4.31      -3.41       0.9 KCl
        Witherite        -1.03      -9.59      -8.56 BaCO3
        Zn(OH)2(e         -2.6        8.9       11.5 Zn(OH)2

**For   a        gas,     SI       =        log10(fuga Fugacity   =        pressure   *
        For      ideal    gases,   phi      =                  1

Initial solution        20

 #NAME? composition-----------------------------

        Elements  Molality  Moles

        Alkalinity  2.00E-02  2.00E-02
        Ba          1.49E-05  1.49E-05
        Ca          7.34E-03  7.34E-03
        Cl          2.69E-01  2.69E-01
        Cu          2.50E-07  2.50E-07
        F           7.60E-04  7.60E-04
        Fe          1.93E-06  1.93E-06
        K           3.68E-03  3.68E-03
        Mg          5.93E-02  5.93E-02
        Mn          3.30E-07  3.30E-07
        N(-3)       4.00E-05  4.00E-05
        N(5)        3.40E-04  3.40E-04
        Na          2.59E-01  2.59E-01
        S(6)        3.05E-02  3.05E-02
        Zn          2.11E-06  2.11E-06

 #NAME? of       solution---------------------------

        pH       =            8.46
        pe       =               4
        Specific Conductan (µS/cm,  25°C)    =          30478
        Density  (g/cm³)  =        1.01379
        Volume   (L)      =         1.0075
        Activity of       water    =          0.989
        Ionic    strength (mol/kgw) =       4.08E-01
        Mass     of       water    (kg)     =       1.00E+00
        Total    carbon   (mol/kg) =        1.75E-02
        Total    CO2      (mol/kg) =        1.75E-02
        Temperatu (°C)    =              25
        Electrical balance (eq)    =        4.47E-02
        Percent  error,   100*(Cat-|=          6.56
        Iterations =          10 (192     overall)
        Total    H        =        1.11E+02
        Total    O        =        5.57E+01

 #NAME? couples---------------------------------
```

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4358	0.2624		

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.45E-06	2.89E-06	-5.352	-5.539	-0.188	-3.09
	H+	4.50E-09	3.47E-09	-8.347	-8.46	-0.113	0
	H2O	5.55E+01	9.89E-01	1.744	-0.005	0	18.07
Ba	1.49E-05						
	Ba+2	1.08E-05	2.43E-06	-4.969	-5.614	-0.646	-11.35
	BaSO4	3.76E-06	4.13E-06	-5.425	-5.384	0.041	0
	BaHCO3+	2.65E-07	1.93E-07	-6.578	-6.714	-0.136	0
	BaCO3	1.28E-07	1.41E-07	-6.892	-6.851	0.041	-10.7
	BaOH+	3.39E-11	2.35E-11	-10.47	-10.629	-0.159	0
C(4)	1.75E-02						
	HCO3-	1.18E-02	8.30E-03	-1.928	-2.081	-0.153	26.19
	MgHCO3+	2.00E-03	1.33E-03	-2.7	-2.877	-0.177	5.78
	MgCO3	1.33E-03	1.47E-03	-2.875	-2.834	0.041	-17.09
	NaHCO3	7.75E-04	8.52E-04	-3.11	-3.07	0.041	1.8
	NaCO3-	5.22E-04	3.82E-04	-3.282	-3.419	-0.136	1.45
	CO3-2	4.58E-04	1.12E-04	-3.339	-3.95	-0.611	-2.79
	CaCO3	2.76E-04	3.03E-04	-3.56	-3.519	0.041	-14.6
	CaHCO3+	2.37E-04	1.70E-04	-3.625	-3.77	-0.144	9.93
	CO2	5.95E-05	6.54E-05	-4.225	-4.185	0.041	34.43
	Zn(CO3)2-2	1.82E-06	5.17E-07	-5.741	-6.287	-0.545	0
	BaHCO3+	2.65E-07	1.93E-07	-6.578	-6.714	-0.136	0
	ZnCO3	1.96E-07	2.15E-07	-6.707	-6.667	0.041	0
	MnCO3	1.83E-07	2.01E-07	-6.737	-6.696	0.041	0
	BaCO3	1.28E-07	1.41E-07	-6.892	-6.851	0.041	-10.7
	CuCO3	3.56E-08	3.91E-08	-7.449	-7.408	0.041	0
	MnHCO3+	2.41E-08	1.67E-08	-7.619	-7.778	-0.159	0
	Cu(CO3)2-	1.94E-08	5.52E-09	-7.713	-8.258	-0.545	0
	ZnHCO3+	1.38E-08	1.01E-08	-7.861	-7.998	-0.136	0
	FeCO3	5.86E-10	6.44E-10	-9.232	-9.191	0.041	0
	CuHCO3+	3.69E-10	2.70E-10	-9.433	-9.569	-0.136	0
	FeHCO3+	2.72E-10	1.99E-10	-9.566	-9.702	-0.136	0
	(CO2)2	7.14E-11	7.85E-11	-10.146	-10.105	0.041	68.87
Ca	7.34E-03						
	Ca+2	5.95E-03	1.61E-03	-2.226	-2.794	-0.569	-16.93
	CaSO4	8.81E-04	9.68E-04	-3.055	-3.014	0.041	7.5
	CaCO3	2.76E-04	3.03E-04	-3.56	-3.519	0.041	-14.6
	CaHCO3+	2.37E-04	1.70E-04	-3.625	-3.77	-0.144	9.93
	CaOH+	1.04E-07	7.60E-08	-6.983	-7.119	-0.136	0
	CaHSO4+	3.02E-11	2.21E-11	-10.52	-10.656	-0.136	0
Cl	2.69E-01						
	Cl-	2.69E-01	1.79E-01	-0.57	-0.748	-0.178	18.63

	CuCl2-	5.16E-08	3.43E-08	-7.287	-7.464	-0.177	0
	CuCl3-2	4.20E-08	9.72E-09	-7.376	-8.012	-0.636	0
	MnCl+	2.37E-08	1.64E-08	-7.626	-7.785	-0.159	-2.83
	ZnOHCl	1.48E-08	1.62E-08	-7.83	-7.789	0.041	0
	ZnCl+	6.95E-09	4.63E-09	-8.158	-8.335	-0.177	-15.05
	MnCl2	1.17E-09	1.28E-09	-8.933	-8.893	0.041	85.89
	ZnCl2	7.88E-10	8.65E-10	-9.104	-9.063	0.041	102.03
	ZnCl3-	2.61E-10	1.73E-10	-9.584	-9.761	-0.177	14.39
	MnCl3-	9.09E-11	6.30E-11	-10.042	-10.201	-0.159	44.95
	FeCl+	8.08E-11	5.90E-11	-10.093	-10.229	-0.136	0
	ZnCl4-2	6.71E-11	1.55E-11	-10.173	-10.809	-0.636	148.77
	CuCl+	4.69E-11	3.12E-11	-10.329	-10.506	-0.177	1.48
	CuCl2	2.72E-12	2.99E-12	-11.565	-11.524	0.041	31.02
	CuCl3-	2.85E-15	1.90E-15	-14.545	-14.722	-0.177	0
	CuCl4-2	7.34E-18	1.70E-18	-17.135	-17.77	-0.636	0
	FeCl+2	5.33E-18	1.23E-18	-17.273	-17.909	-0.636	0
	FeCl2+	1.42E-18	9.84E-19	-17.848	-18.007	-0.159	0
	FeCl3	1.60E-20	1.76E-20	-19.796	-19.755	0.041	0
Cu(1)	9.37E-08						
	CuCl2-	5.16E-08	3.43E-08	-7.287	-7.464	-0.177	0
	CuCl3-2	4.20E-08	9.72E-09	-7.376	-8.012	-0.636	0
	Cu+	5.57E-12	3.40E-12	-11.255	-11.468	-0.214	0
Cu(2)	1.56E-07						
	Cu(OH)2	1.00E-07	1.10E-07	-6.998	-6.957	0.041	0
	CuCO3	3.56E-08	3.91E-08	-7.449	-7.408	0.041	0
	Cu(CO3)2-	1.94E-08	5.52E-09	-7.713	-8.258	-0.545	0
	CuHCO3+	3.69E-10	2.70E-10	-9.433	-9.569	-0.136	0
	CuOH+	2.78E-10	1.85E-10	-9.556	-9.733	-0.177	0
	Cu+2	2.45E-10	6.48E-11	-9.611	-10.188	-0.577	-25.52
	CuCl+	4.69E-11	3.12E-11	-10.329	-10.506	-0.177	1.48
	CuSO4	4.08E-11	4.49E-11	-10.389	-10.348	0.041	13.09
	CuCl2	2.72E-12	2.99E-12	-11.565	-11.524	0.041	31.02
	Cu(OH)3-	2.60E-12	1.90E-12	-11.586	-11.722	-0.136	0
	CuF+	4.14E-13	3.02E-13	-12.383	-12.52	-0.136	0
	Cu2(OH)2+	5.26E-14	1.50E-14	-13.279	-13.825	-0.545	0
	CuCl3-	2.85E-15	1.90E-15	-14.545	-14.722	-0.177	0
	Cu(OH)4-2	3.79E-16	1.08E-16	-15.421	-15.967	-0.545	0
	CuCl4-2	7.34E-18	1.70E-18	-17.135	-17.77	-0.636	0
F	7.60E-04						
	F-	3.95E-04	2.56E-04	-3.404	-3.591	-0.188	-0.74
	MgF+	3.41E-04	2.32E-04	-3.468	-3.635	-0.168	-10.29
	NaF	2.45E-05	2.69E-05	-4.611	-4.57	0.041	7.26
	HF	1.21E-09	1.33E-09	-8.916	-8.875	0.041	12.5
	MnF+	5.77E-11	4.00E-11	-10.239	-10.398	-0.159	0
	ZnF+	4.77E-11	3.48E-11	-10.322	-10.458	-0.136	0
	HF2-	1.79E-12	1.31E-12	-11.746	-11.883	-0.136	22.63
	FeF+	8.39E-13	6.13E-13	-12.076	-12.213	-0.136	0
	CuF+	4.14E-13	3.02E-13	-12.383	-12.52	-0.136	0
	FeF2+	1.37E-15	9.46E-16	-14.865	-15.024	-0.159	0
	FeF+2	4.01E-16	9.28E-17	-15.397	-16.033	-0.636	0

	FeF3	3.50E-16	3.84E-16	-15.456	-15.415	0.041	0
Fe(2)	2.01E-09						
	Fe+2	9.03E-10	2.39E-10	-9.044	-9.621	-0.577	-20.97
	FeCO3	5.86E-10	6.44E-10	-9.232	-9.191	0.041	0
	FeHCO3+	2.72E-10	1.99E-10	-9.566	-9.702	-0.136	0
	FeSO4	1.31E-10	1.44E-10	-9.882	-9.841	0.041	18.97
	FeCl+	8.08E-11	5.90E-11	-10.093	-10.229	-0.136	0
	FeOH+	3.11E-11	2.16E-11	-10.507	-10.666	-0.159	0
	FeF+	8.39E-13	6.13E-13	-12.076	-12.213	-0.136	0
	Fe(OH)2	4.77E-14	5.24E-14	-13.321	-13.28	0.041	0
	Fe(OH)3-	8.01E-16	5.56E-16	-15.096	-15.255	-0.159	0
	FeHSO4+	4.50E-18	3.29E-18	-17.347	-17.483	-0.136	0
Fe(3)	1.93E-06						
	Fe(OH)3	1.33E-06	1.46E-06	-5.876	-5.835	0.041	0
	Fe(OH)4-	5.41E-07	3.80E-07	-6.267	-6.42	-0.153	0
	Fe(OH)2+	5.65E-08	3.98E-08	-7.248	-7.4	-0.153	0
	FeOH+2	1.82E-12	4.21E-13	-11.74	-12.376	-0.636	0
	FeF2+	1.37E-15	9.46E-16	-14.865	-15.024	-0.159	0
	FeF+2	4.01E-16	9.28E-17	-15.397	-16.033	-0.636	0
	FeF3	3.50E-16	3.84E-16	-15.456	-15.415	0.041	0
	FeSO4+	1.22E-17	8.49E-18	-16.912	-17.071	-0.159	0
	FeCl+2	5.33E-18	1.23E-18	-17.273	-17.909	-0.636	0
	Fe+3	2.37E-18	2.29E-19	-17.626	-18.641	-1.015	0
	FeCl2+	1.42E-18	9.84E-19	-17.848	-18.007	-0.159	0
	Fe(SO4)2-	8.62E-19	6.29E-19	-18.065	-18.201	-0.136	0
	FeCl3	1.60E-20	1.76E-20	-19.796	-19.755	0.041	0
	Fe2(OH)2+	7.25E-22	4.77E-24	-21.14	-23.322	-2.182	0
	FeHSO4+2	2.77E-25	7.88E-26	-24.558	-25.103	-0.545	0
	Fe3(OH)4+	1.02E-25	3.96E-29	-24.993	-28.402	-3.409	0
H(0)	1.55E-28						
	H2	7.75E-29	8.51E-29	-28.111	-28.07	0.041	28.61
K	3.68E-03						
	K+	3.60E-03	2.37E-03	-2.444	-2.625	-0.182	9.5
	KSO4-	8.02E-05	5.64E-05	-4.096	-4.249	-0.153	34.68
Mg	5.93E-02						
	Mg+2	4.57E-02	1.37E-02	-1.34	-1.864	-0.523	-20.65
	MgSO4	9.90E-03	1.09E-02	-2.004	-1.964	0.041	5.84
	MgHCO3+	2.00E-03	1.33E-03	-2.7	-2.877	-0.177	5.78
	MgCO3	1.33E-03	1.47E-03	-2.875	-2.834	0.041	-17.09
	MgF+	3.41E-04	2.32E-04	-3.468	-3.635	-0.168	-10.29
	MgOH+	1.95E-05	1.42E-05	-4.711	-4.848	-0.138	0
Mn(2)	3.30E-07						
	MnCO3	1.83E-07	2.01E-07	-6.737	-6.696	0.041	0
	Mn+2	8.52E-08	2.26E-08	-7.07	-7.646	-0.577	-16.86
	MnHCO3+	2.41E-08	1.67E-08	-7.619	-7.778	-0.159	0
	MnCl+	2.37E-08	1.64E-08	-7.626	-7.785	-0.159	-2.83
	MnSO4	1.24E-08	1.36E-08	-7.907	-7.866	0.041	22.54
	MnCl2	1.17E-09	1.28E-09	-8.933	-8.893	0.041	85.89
	MnOH+	2.39E-10	1.66E-10	-9.622	-9.781	-0.159	0
	MnCl3-	9.09E-11	6.30E-11	-10.042	-10.201	-0.159	44.95

	MnF+	5.77E-11	4.00E-11	-10.239	-10.398	-0.159	0
	Mn(NO3)2	3.77E-15	4.14E-15	-14.424	-14.383	0.041	41.04
	Mn(OH)3-	1.20E-17	8.31E-18	-16.921	-17.08	-0.159	0
Mn(3)	7.22E-29						
	Mn+3	7.22E-29	6.97E-30	-28.142	-29.156	-1.015	0
N(-3)	4.00E-05						
	NH4+	3.55E-05	2.17E-05	-4.45	-4.664	-0.214	18.35
	NH3	3.24E-06	3.56E-06	-5.489	-5.448	0.041	24.42
	NH4SO4-	1.30E-06	9.47E-07	-5.887	-6.024	-0.136	39.17
N(5)	3.40E-04						
	NO3-	3.40E-04	2.15E-04	-3.469	-3.668	-0.2	30.1
	Mn(NO3)2	3.77E-15	4.14E-15	-14.424	-14.383	0.041	41.04
Na	2.59E-01						
	Na+	2.53E-01	1.83E-01	-0.597	-0.739	-0.142	-0.71
	NaSO4-	4.41E-03	3.10E-03	-2.356	-2.509	-0.153	19.41
	NaHCO3	7.75E-04	8.52E-04	-3.11	-3.07	0.041	1.8
	NaCO3-	5.22E-04	3.82E-04	-3.282	-3.419	-0.136	1.45
	NaF	2.45E-05	2.69E-05	-4.611	-4.57	0.041	7.26
	NaOH	4.80E-17	5.27E-17	-16.319	-16.278	0.041	0
O(0)	1.03E-36						
	O2	5.13E-37	5.63E-37	-36.29	-36.249	0.041	30.4
S(6)	3.05E-02						
	SO4-2	1.52E-02	3.39E-03	-1.818	-2.47	-0.652	16.8
	MgSO4	9.90E-03	1.09E-02	-2.004	-1.964	0.041	5.84
	NaSO4-	4.41E-03	3.10E-03	-2.356	-2.509	-0.153	19.41
	CaSO4	8.81E-04	9.68E-04	-3.055	-3.014	0.041	7.5
	KSO4-	8.02E-05	5.64E-05	-4.096	-4.249	-0.153	34.68
	BaSO4	3.76E-06	4.13E-06	-5.425	-5.384	0.041	0
	NH4SO4-	1.30E-06	9.47E-07	-5.887	-6.024	-0.136	39.17
	MnSO4	1.24E-08	1.36E-08	-7.907	-7.866	0.041	22.54
	ZnSO4	6.96E-09	7.64E-09	-8.158	-8.117	0.041	21.71
	HSO4-	1.56E-09	1.14E-09	-8.806	-8.942	-0.136	40.81
	Zn(SO4)2-2	7.39E-10	2.11E-10	-9.131	-9.677	-0.545	-7.82
	FeSO4	1.31E-10	1.44E-10	-9.882	-9.841	0.041	18.97
	CuSO4	4.08E-11	4.49E-11	-10.389	-10.348	0.041	13.09
	CaHSO4+	3.02E-11	2.21E-11	-10.52	-10.656	-0.136	0
	FeSO4+	1.22E-17	8.49E-18	-16.912	-17.071	-0.159	0
	FeHSO4+	4.50E-18	3.29E-18	-17.347	-17.483	-0.136	0
	Fe(SO4)2-	8.62E-19	6.29E-19	-18.065	-18.201	-0.136	0
	FeHSO4+2	2.77E-25	7.88E-26	-24.558	-25.103	-0.545	0
Zn	2.11E-06						
	Zn(CO3)2-2	1.82E-06	5.17E-07	-5.741	-6.287	-0.545	0
	ZnCO3	1.96E-07	2.15E-07	-6.707	-6.667	0.041	0
	Zn+2	4.16E-08	9.62E-09	-7.381	-8.017	-0.636	-24.27
	ZnOHCl	1.48E-08	1.62E-08	-7.83	-7.789	0.041	0
	ZnHCO3+	1.38E-08	1.01E-08	-7.861	-7.998	-0.136	0
	Zn(OH)2	8.98E-09	9.86E-09	-8.047	-8.006	0.041	0
	ZnSO4	6.96E-09	7.64E-09	-8.158	-8.117	0.041	21.71
	ZnCl+	6.95E-09	4.63E-09	-8.158	-8.335	-0.177	-15.05
	ZnOH+	4.12E-09	3.01E-09	-8.385	-8.521	-0.136	0

ZnCl2	7.88E-10	8.65E-10	-9.104	-9.063	0.041	102.03
Zn(SO4)2-2	7.39E-10	2.11E-10	-9.131	-9.677	-0.545	-7.82
ZnCl3-	2.61E-10	1.73E-10	-9.584	-9.761	-0.177	14.39
ZnCl4-2	6.71E-11	1.55E-11	-10.173	-10.809	-0.636	148.77
ZnF+	4.77E-11	3.48E-11	-10.322	-10.458	-0.136	0
Zn(OH)3-	1.22E-11	8.90E-12	-10.914	-11.051	-0.136	0
Zn(OH)4-2	1.41E-15	4.02E-16	-14.85	-15.395	-0.545	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-0.99	-5.26	-4.28	CaSO4
Aragonite	1.59	-6.74	-8.34	CaCO3
Barite	1.76	-8.08	-9.84	BaSO4
Calcite	1.74	-6.74	-8.48	CaCO3
CO2(g)	-2.72	-4.18	-1.47	CO2
Dolomite	4.53	-12.56	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.83	6.72	4.89	Fe(OH)3
Fluorite	0.62	-9.98	-10.6	CaF2
Goethite	7.73	6.73	-1	FeOOH
Gypsum	-0.69	-5.27	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O
Halite	-3.06	-1.49	1.57	NaCl
Hausmann	-8.31	52.72	61.03	Mn3O4
Hematite	17.47	13.46	-4.01	Fe2O3
Jarosite-K	-3.55	-12.76	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.62	21.72	25.34	MnOOH
Melanterit	-9.91	-12.12	-2.21	FeSO4:7H2O
NH3(g)	-7.24	-5.45	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.94	9.26	15.2	Mn(OH)2
Pyrolusite	-7.2	34.18	41.38	MnO2:H2O
Rhodochro	-0.47	-11.6	-11.13	MnCO3
Siderite	-2.68	-13.57	-10.89	FeCO3
Smithsonit	-1.97	-11.97	-10	ZnCO3
Sylvite	-4.27	-3.37	0.9	KCl
Witherite	-1	-9.56	-8.56	BaCO3
Zn(OH)2(e	-2.61	8.89	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 21

#NAME? composition----------

Elements	Molality	Moles

Alkalinity	2.10E-02	2.10E-02
Ba	1.57E-05	1.57E-05
Ca	7.71E-03	7.71E-03
Cl	2.83E-01	2.83E-01
Cu	2.60E-07	2.60E-07
F	8.00E-04	8.00E-04
Fe	2.03E-06	2.03E-06
K	3.87E-03	3.87E-03
Mg	6.23E-02	6.23E-02
Mn	3.40E-07	3.40E-07
N(-3)	4.20E-05	4.20E-05
N(5)	3.60E-04	3.60E-04
Na	2.72E-01	2.72E-01
S(6)	3.20E-02	3.20E-02
Zn	2.22E-06	2.22E-06

#NAME? of solution----------

pH	=	8.46		
pe	=	4		
Specific	Conductan	(µS/cm,	25°C)	= 31797
Density	(g/cm³)	=	1.01462	
Volume	(L)	=	1.00774	
Activity	of water	=	0.989	
Ionic	strength	(mol/kgw)	=	4.28E-01
Mass	of water	(kg)	=	1.00E+00
Total	carbon	(mol/kg)	=	1.83E-02
Total	CO2	(mol/kg)	=	1.83E-02
Temperatu	(°C)	=	25	
Electrical	balance	(eq)	=	4.69E-02
Percent	error,	100*(Cat-|	=	6.57
Iterations	=	11	(203	overall)
Total	H	=	1.11E+02	
Total	O	=	5.57E+01	

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4364	0.2624		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.47E-06	2.89E-06	-5.349	-5.54	-0.19	-3.06
H+	4.51E-09	3.47E-09	-8.346	-8.46	-0.114	0
H2O	5.55E+01	9.89E-01	1.744	-0.005	0	18.07

Ba 1.57E-05

	Ba+2	1.13E-05	2.52E-06	-4.947	-5.599	-0.652	-11.32
	BaSO4	3.95E-06	4.36E-06	-5.403	-5.361	0.043	0
	BaHCO3+	2.83E-07	2.07E-07	-6.549	-6.685	-0.136	0
	BaCO3	1.36E-07	1.51E-07	-6.865	-6.822	0.043	-10.7
	BaOH+	3.52E-11	2.43E-11	-10.453	-10.614	-0.161	0
C(4)	1.83E-02						
	HCO3-	1.22E-02	8.56E-03	-1.913	-2.067	-0.154	26.25
	MgHCO3+	2.16E-03	1.43E-03	-2.666	-2.846	-0.179	5.78
	MgCO3	1.43E-03	1.57E-03	-2.846	-2.803	0.043	-17.09
	NaHCO3	8.35E-04	9.22E-04	-3.078	-3.035	0.043	1.8
	NaCO3-	5.65E-04	4.13E-04	-3.248	-3.384	-0.136	1.56
	CO3-2	4.80E-04	1.16E-04	-3.319	-3.936	-0.618	-2.72
	CaCO3	2.94E-04	3.24E-04	-3.532	-3.489	0.043	-14.6
	CaHCO3+	2.55E-04	1.82E-04	-3.594	-3.74	-0.146	9.93
	CO2	6.12E-05	6.75E-05	-4.213	-4.171	0.043	34.43
	Zn(CO3)2-2	1.92E-06	5.47E-07	-5.717	-6.262	-0.545	0
	BaHCO3+	2.83E-07	2.07E-07	-6.549	-6.685	-0.136	0
	ZnCO3	2.00E-07	2.21E-07	-6.698	-6.656	0.043	0
	MnCO3	1.89E-07	2.09E-07	-6.724	-6.681	0.043	0
	BaCO3	1.36E-07	1.51E-07	-6.865	-6.822	0.043	-10.7
	CuCO3	3.61E-08	3.98E-08	-7.443	-7.4	0.043	0
	MnHCO3+	2.51E-08	1.73E-08	-7.601	-7.762	-0.161	0
	Cu(CO3)2-	2.03E-08	5.80E-09	-7.692	-8.237	-0.545	0
	ZnHCO3+	1.41E-08	1.03E-08	-7.85	-7.987	-0.136	0
	FeCO3	6.36E-10	7.02E-10	-9.197	-9.154	0.043	0
	CuHCO3+	3.76E-10	2.75E-10	-9.425	-9.561	-0.136	0
	FeHCO3+	2.96E-10	2.16E-10	-9.529	-9.665	-0.136	0
	(CO2)2	7.58E-11	8.36E-11	-10.12	-10.078	0.043	68.87
Ca	7.71E-03						
	Ca+2	6.23E-03	1.67E-03	-2.205	-2.778	-0.573	-16.91
	CaSO4	9.29E-04	1.03E-03	-3.032	-2.989	0.043	7.5
	CaCO3	2.94E-04	3.24E-04	-3.532	-3.489	0.043	-14.6
	CaHCO3+	2.55E-04	1.82E-04	-3.594	-3.74	-0.146	9.93
	CaOH+	1.08E-07	7.89E-08	-6.967	-7.103	-0.136	0
	CaHSO4+	3.20E-11	2.34E-11	-10.495	-10.632	-0.136	0
Cl	2.83E-01						
	Cl-	2.83E-01	1.87E-01	-0.549	-0.729	-0.18	18.64
	CuCl2-	5.60E-08	3.70E-08	-7.252	-7.432	-0.179	0
	CuCl3-2	4.82E-08	1.10E-08	-7.317	-7.96	-0.643	0
	MnCl+	2.50E-08	1.72E-08	-7.603	-7.763	-0.161	-2.82
	ZnOHCl	1.53E-08	1.69E-08	-7.816	-7.773	0.043	0
	ZnCl+	7.27E-09	4.81E-09	-8.139	-8.318	-0.179	-15.11
	MnCl2	1.27E-09	1.41E-09	-8.895	-8.852	0.043	85.89
	ZnCl2	8.52E-10	9.40E-10	-9.07	-9.027	0.043	102.03
	ZnCl3-	2.98E-10	1.97E-10	-9.526	-9.706	-0.179	14.25
	MnCl3-	1.05E-10	7.23E-11	-9.98	-10.141	-0.161	45.01
	FeCl+	8.91E-11	6.51E-11	-10.05	-10.186	-0.136	0
	ZnCl4-2	8.11E-11	1.84E-11	-10.091	-10.734	-0.643	148.89
	CuCl+	4.86E-11	3.22E-11	-10.313	-10.493	-0.179	1.51
	CuCl2	2.92E-12	3.22E-12	-11.534	-11.492	0.043	31.02

	CuCl3-	3.23E-15	2.14E-15	-14.491	-14.67	-0.179	0
	CuCl4-2	8.79E-18	2.00E-18	-17.056	-17.699	-0.643	0
	FeCl+2	5.98E-18	1.36E-18	-17.223	-17.866	-0.643	0
	FeCl2+	1.64E-18	1.14E-18	-17.784	-17.945	-0.161	0
	FeCl3	1.92E-20	2.12E-20	-19.717	-19.674	0.043	0
Cu(1)	1.04E-07						
	CuCl2-	5.60E-08	3.70E-08	-7.252	-7.432	-0.179	0
	CuCl3-2	4.82E-08	1.10E-08	-7.317	-7.96	-0.643	0
	Cu+	5.53E-12	3.36E-12	-11.257	-11.474	-0.217	0
Cu(2)	1.56E-07						
	Cu(OH)2	9.85E-08	1.09E-07	-7.007	-6.964	0.043	0
	CuCO3	3.61E-08	3.98E-08	-7.443	-7.4	0.043	0
	Cu(CO3)2-	2.03E-08	5.80E-09	-7.692	-8.237	-0.545	0
	CuHCO3+	3.76E-10	2.75E-10	-9.425	-9.561	-0.136	0
	CuOH+	2.76E-10	1.82E-10	-9.56	-9.739	-0.179	0
	Cu+2	2.45E-10	6.40E-11	-9.611	-10.194	-0.583	-25.5
	CuCl+	4.86E-11	3.22E-11	-10.313	-10.493	-0.179	1.51
	CuSO4	4.09E-11	4.51E-11	-10.388	-10.345	0.043	13.09
	CuCl2	2.92E-12	3.22E-12	-11.534	-11.492	0.043	31.02
	Cu(OH)3-	2.56E-12	1.87E-12	-11.592	-11.729	-0.136	0
	CuF+	4.19E-13	3.06E-13	-12.378	-12.514	-0.136	0
	Cu2(OH)2+	5.11E-14	1.46E-14	-13.292	-13.837	-0.545	0
	CuCl3-	3.23E-15	2.14E-15	-14.491	-14.67	-0.179	0
	Cu(OH)4-2	3.73E-16	1.06E-16	-15.429	-15.974	-0.545	0
	CuCl4-2	8.79E-18	2.00E-18	-17.056	-17.699	-0.643	0
F	8.00E-04						
	F-	4.08E-04	2.63E-04	-3.389	-3.58	-0.19	-0.73
	MgF+	3.66E-04	2.48E-04	-3.437	-3.606	-0.17	-10.29
	NaF	2.63E-05	2.90E-05	-4.581	-4.538	0.043	7.26
	HF	1.24E-09	1.37E-09	-8.907	-8.864	0.043	12.5
	MnF+	5.98E-11	4.13E-11	-10.224	-10.384	-0.161	0
	ZnF+	4.87E-11	3.56E-11	-10.313	-10.449	-0.136	0
	HF2-	1.89E-12	1.38E-12	-11.723	-11.86	-0.136	22.65
	FeF+	9.09E-13	6.65E-13	-12.041	-12.177	-0.136	0
	CuF+	4.19E-13	3.06E-13	-12.378	-12.514	-0.136	0
	FeF2+	1.53E-15	1.05E-15	-14.817	-14.977	-0.161	0
	FeF+2	4.42E-16	1.01E-16	-15.354	-15.997	-0.643	0
	FeF3	3.98E-16	4.39E-16	-15.4	-15.357	0.043	0
Fe(2)	2.16E-09						
	Fe+2	9.66E-10	2.53E-10	-9.015	-9.598	-0.583	-20.95
	FeCO3	6.36E-10	7.02E-10	-9.197	-9.154	0.043	0
	FeHCO3+	2.96E-10	2.16E-10	-9.529	-9.665	-0.136	0
	FeSO4	1.41E-10	1.55E-10	-9.852	-9.809	0.043	18.97
	FeCl+	8.91E-11	6.51E-11	-10.05	-10.186	-0.136	0
	FeOH+	3.30E-11	2.28E-11	-10.482	-10.643	-0.161	0
	FeF+	9.09E-13	6.65E-13	-12.041	-12.177	-0.136	0
	Fe(OH)2	5.01E-14	5.53E-14	-13.3	-13.257	0.043	0
	Fe(OH)3-	8.48E-16	5.86E-16	-15.072	-15.232	-0.161	0
	FeHSO4+	4.84E-18	3.54E-18	-17.315	-17.451	-0.136	0
Fe(3)	2.03E-06						

	Fe(OH)3	1.40E-06	1.54E-06	-5.855	-5.812	0.043	0
	Fe(OH)4-	5.72E-07	4.01E-07	-6.243	-6.397	-0.154	0
	Fe(OH)2+	5.98E-08	4.19E-08	-7.223	-7.377	-0.154	0
	FeOH+2	1.95E-12	4.44E-13	-11.709	-12.353	-0.643	0
	FeF2+	1.53E-15	1.05E-15	-14.817	-14.977	-0.161	0
	FeF+2	4.42E-16	1.01E-16	-15.354	-15.997	-0.643	0
	FeF3	3.98E-16	4.39E-16	-15.4	-15.357	0.043	0
	FeSO4+	1.32E-17	9.14E-18	-16.878	-17.039	-0.161	0
	FeCl+2	5.98E-18	1.36E-18	-17.223	-17.866	-0.643	0
	Fe+3	2.55E-18	2.41E-19	-17.594	-18.618	-1.023	0
	FeCl2+	1.64E-18	1.14E-18	-17.784	-17.945	-0.161	0
	Fe(SO4)2-	9.46E-19	6.91E-19	-18.024	-18.16	-0.136	0
	FeCl3	1.92E-20	2.12E-20	-19.717	-19.674	0.043	0
	Fe2(OH)2+	8.03E-22	5.31E-24	-21.095	-23.275	-2.18	0
	FeHSO4+2	2.98E-25	8.49E-26	-24.526	-25.071	-0.545	0
	Fe3(OH)4+	1.18E-25	4.65E-29	-24.927	-28.332	-3.406	0
H(0)	1.54E-28						
	H2	7.71E-29	8.51E-29	-28.113	-28.07	0.043	28.61
K	3.87E-03						
	K+	3.78E-03	2.48E-03	-2.422	-2.606	-0.184	9.51
	KSO4-	8.59E-05	6.02E-05	-4.066	-4.221	-0.154	34.69
Mg	6.23E-02						
	Mg+2	4.78E-02	1.42E-02	-1.32	-1.846	-0.526	-20.63
	MgSO4	1.05E-02	1.15E-02	-1.98	-1.938	0.043	5.84
	MgHCO3+	2.16E-03	1.43E-03	-2.666	-2.846	-0.179	5.78
	MgCO3	1.43E-03	1.57E-03	-2.846	-2.803	0.043	-17.09
	MgF+	3.66E-04	2.48E-04	-3.437	-3.606	-0.17	-10.29
	MgOH+	2.03E-05	1.48E-05	-4.692	-4.831	-0.139	0
Mn(2)	3.40E-07						
	MnCO3	1.89E-07	2.09E-07	-6.724	-6.681	0.043	0
	Mn+2	8.67E-08	2.27E-08	-7.062	-7.645	-0.583	-16.82
	MnHCO3+	2.51E-08	1.73E-08	-7.601	-7.762	-0.161	0
	MnCl+	2.50E-08	1.72E-08	-7.603	-7.763	-0.161	-2.82
	MnSO4	1.26E-08	1.39E-08	-7.899	-7.856	0.043	22.54
	MnCl2	1.27E-09	1.41E-09	-8.895	-8.852	0.043	85.89
	MnOH+	2.41E-10	1.66E-10	-9.619	-9.78	-0.161	0
	MnCl3-	1.05E-10	7.23E-11	-9.98	-10.141	-0.161	45.01
	MnF+	5.98E-11	4.13E-11	-10.224	-10.384	-0.161	0
	Mn(NO3)2	4.17E-15	4.60E-15	-14.38	-14.338	0.043	41.04
	Mn(OH)3-	1.21E-17	8.33E-18	-16.918	-17.079	-0.161	0
Mn(3)	7.39E-29						
	Mn+3	7.39E-29	7.01E-30	-28.131	-29.155	-1.023	0
N(-3)	4.20E-05						
	NH4+	3.73E-05	2.26E-05	-4.429	-4.646	-0.217	18.36
	NH3	3.37E-06	3.72E-06	-5.473	-5.43	0.043	24.42
	NH4SO4-	1.38E-06	1.01E-06	-5.861	-5.997	-0.136	39.23
N(5)	3.60E-04						
	NO3-	3.60E-04	2.26E-04	-3.444	-3.646	-0.203	30.11
	Mn(NO3)2	4.17E-15	4.60E-15	-14.38	-14.338	0.043	41.04
Na	2.72E-01						

	Na+	2.66E-01	1.91E-01	-0.575	-0.718	-0.143	-0.69
	NaSO4-	4.73E-03	3.32E-03	-2.325	-2.479	-0.154	19.56
	NaHCO3	8.35E-04	9.22E-04	-3.078	-3.035	0.043	1.8
	NaCO3-	5.65E-04	4.13E-04	-3.248	-3.384	-0.136	1.56
	NaF	2.63E-05	2.90E-05	-4.581	-4.538	0.043	7.26
	NaOH	5.01E-17	5.53E-17	-16.3	-16.258	0.043	0
O(0)	1.02E-36						
	O2	5.10E-37	5.63E-37	-36.293	-36.25	0.043	30.4
S(6)	3.20E-02						
	SO4-2	1.58E-02	3.46E-03	-1.801	-2.461	-0.66	16.86
	MgSO4	1.05E-02	1.15E-02	-1.98	-1.938	0.043	5.84
	NaSO4-	4.73E-03	3.32E-03	-2.325	-2.479	-0.154	19.56
	CaSO4	9.29E-04	1.03E-03	-3.032	-2.989	0.043	7.5
	KSO4-	8.59E-05	6.02E-05	-4.066	-4.221	-0.154	34.69
	BaSO4	3.95E-06	4.36E-06	-5.403	-5.361	0.043	0
	NH4SO4-	1.38E-06	1.01E-06	-5.861	-5.997	-0.136	39.23
	MnSO4	1.26E-08	1.39E-08	-7.899	-7.856	0.043	22.54
	ZnSO4	7.03E-09	7.75E-09	-8.153	-8.111	0.043	21.71
	HSO4-	1.60E-09	1.17E-09	-8.797	-8.934	-0.136	40.83
	Zn(SO4)2-2	7.64E-10	2.18E-10	-9.117	-9.662	-0.545	-7.61
	FeSO4	1.41E-10	1.55E-10	-9.852	-9.809	0.043	18.97
	CuSO4	4.09E-11	4.51E-11	-10.388	-10.345	0.043	13.09
	CaHSO4+	3.20E-11	2.34E-11	-10.495	-10.632	-0.136	0
	FeSO4+	1.32E-17	9.14E-18	-16.878	-17.039	-0.161	0
	FeHSO4+	4.84E-18	3.54E-18	-17.315	-17.451	-0.136	0
	Fe(SO4)2-	9.46E-19	6.91E-19	-18.024	-18.16	-0.136	0
	FeHSO4+2	2.98E-25	8.49E-26	-24.526	-25.071	-0.545	0
Zn	2.22E-06						
	Zn(CO3)2-2	1.92E-06	5.47E-07	-5.717	-6.262	-0.545	0
	ZnCO3	2.00E-07	2.21E-07	-6.698	-6.656	0.043	0
	Zn+2	4.21E-08	9.57E-09	-7.376	-8.019	-0.643	-24.25
	ZnOHCl	1.53E-08	1.69E-08	-7.816	-7.773	0.043	0
	ZnHCO3+	1.41E-08	1.03E-08	-7.85	-7.987	-0.136	0
	Zn(OH)2	8.88E-09	9.79E-09	-8.052	-8.009	0.043	0
	ZnCl+	7.27E-09	4.81E-09	-8.139	-8.318	-0.179	-15.11
	ZnSO4	7.03E-09	7.75E-09	-8.153	-8.111	0.043	21.71
	ZnOH+	4.09E-09	2.99E-09	-8.388	-8.524	-0.136	0
	ZnCl2	8.52E-10	9.40E-10	-9.07	-9.027	0.043	102.03
	Zn(SO4)2-2	7.64E-10	2.18E-10	-9.117	-9.662	-0.545	-7.61
	ZnCl3-	2.98E-10	1.97E-10	-9.526	-9.706	-0.179	14.25
	ZnCl4-2	8.11E-11	1.84E-11	-10.091	-10.734	-0.643	148.89
	ZnF+	4.87E-11	3.56E-11	-10.313	-10.449	-0.136	0
	Zn(OH)3-	1.21E-11	8.83E-12	-10.918	-11.054	-0.136	0
	Zn(OH)4-2	1.40E-15	3.99E-16	-14.854	-15.399	-0.545	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-0.96	-5.24	-4.28	CaSO4

Aragonite	1.62	-6.71	-8.34	CaCO3
Barite	1.78	-8.06	-9.84	BaSO4
Calcite	1.77	-6.71	-8.48	CaCO3
CO2(g)	-2.7	-4.17	-1.47	CO2
Dolomite	4.59	-12.5	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.86	6.75	4.89	Fe(OH)3
Fluorite	0.66	-9.94	-10.6	CaF2
Goethite	7.75	6.75	-1	FeOOH
Gypsum	-0.67	-5.25	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O
Halite	-3.02	-1.45	1.57	NaCl
Hausmann	-8.3	52.73	61.03	Mn3O4
Hematite	17.52	13.51	-4.01	Fe2O3
Jarosite-K	-3.44	-12.65	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.61	21.73	25.34	MnOOH
Melanterit	-9.88	-12.09	-2.21	FeSO4:7H2O
NH3(g)	-7.23	-5.43	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.93	9.27	15.2	Mn(OH)2
Pyrolusite	-7.2	34.18	41.38	MnO2:H2O
Rhodochro	-0.45	-11.58	-11.13	MnCO3
Siderite	-2.64	-13.53	-10.89	FeCO3
Smithsonit	-1.96	-11.96	-10	ZnCO3
Sylvite	-4.23	-3.33	0.9	KCl
Witherite	-0.97	-9.54	-8.56	BaCO3
Zn(OH)2(e	-2.61	8.89	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 22

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	2.21E-02	2.21E-02
Ba	1.64E-05	1.64E-05
Ca	8.08E-03	8.08E-03
Cl	2.96E-01	2.96E-01
Cu	2.70E-07	2.70E-07
F	8.30E-04	8.30E-04
Fe	2.13E-06	2.13E-06
K	4.06E-03	4.06E-03
Mg	6.52E-02	6.52E-02
Mn	3.60E-07	3.60E-07
N(-3)	4.40E-05	4.40E-05
N(5)	3.70E-04	3.70E-04
Na	2.85E-01	2.85E-01

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        S(6)        3.36E-02  3.36E-02
        Zn          2.32E-06  2.32E-06

#NAME?  of          solution----------------------------

        pH          =                 8.46
        pe          =                    4
        Specific    Conductan (µS/cm,     25°C)      =                33103
        Density     (g/cm³)   =             1.01545
        Volume      (L)       =             1.00799
        Activity    of        water       =                0.988
        Ionic       strength  (mol/kgw)   =             4.47E-01
        Mass        of        water       (kg)       =          1.00E+00
        Total       carbon    (mol/kg)    =             1.91E-02
        Total       CO2       (mol/kg)    =             1.91E-02
        Temperatu   (°C)      =                   25
        Electrical  balance   (eq)        =             4.92E-02
        Percent     error,    100*(Cat-|  =                6.58
        Iterations  =                 12  (215       overall)
        Total       H         =             1.11E+02
        Total       O         =             5.57E+01

#NAME?  couples--------------------------------

        Redox       couple    pe          Eh          (volts)

        N(-3)/N(5)    4.4354    0.2624

#NAME?  of          species----------------------------

        Log         Log       Log         mole        V
        Species     Molality  Activity    Molality    Activity    Gamma    cm³/mol

        OH-         4.50E-06  2.89E-06     -5.347      -5.54     -0.193      -3.02
        H+          4.51E-09  3.47E-09     -8.345      -8.46     -0.115          0
        H2O         5.55E+01  9.88E-01      1.744     -0.005          0      18.07
Ba        1.64E-05
        Ba+2        1.18E-05  2.60E-06     -4.927      -5.585    -0.658     -11.29
        BaSO4       4.14E-06  4.59E-06     -5.383      -5.338     0.045          0
        BaHCO3+     3.01E-07  2.20E-07     -6.522      -6.658    -0.136          0
        BaCO3       1.45E-07  1.60E-07      -6.84      -6.795     0.045       -10.7
        BaOH+       3.65E-11  2.51E-11    -10.437       -10.6    -0.163          0
C(4)      1.91E-02
        HCO3-       1.26E-02  8.82E-03     -1.899      -2.055    -0.156      26.31
        MgHCO3+     2.32E-03  1.53E-03     -2.635      -2.816    -0.182       5.78
        MgCO3       1.52E-03  1.69E-03     -2.818      -2.774     0.045     -17.09
        NaHCO3      8.96E-04  9.93E-04     -3.048      -3.003     0.045        1.8
        NaCO3-      6.08E-04  4.45E-04     -3.216      -3.352    -0.136       1.67
        CO3-2       5.02E-04  1.19E-04     -3.299      -3.923    -0.624      -2.65
        CaCO3       3.13E-04  3.46E-04     -3.505       -3.46     0.045      -14.6
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	CaHCO3+	2.73E-04	1.95E-04	-3.564	-3.711	-0.147	9.93
	CO2	6.28E-05	6.96E-05	-4.202	-4.158	0.045	34.43
	Zn(CO3)2-	2.01E-06	5.76E-07	-5.696	-6.24	-0.544	0
	BaHCO3+	3.01E-07	2.20E-07	-6.522	-6.658	-0.136	0
	ZnCO3	2.04E-07	2.26E-07	-6.691	-6.646	0.045	0
	MnCO3	2.00E-07	2.22E-07	-6.698	-6.654	0.045	0
	BaCO3	1.45E-07	1.60E-07	-6.84	-6.795	0.045	-10.7
	CuCO3	3.64E-08	4.03E-08	-7.439	-7.394	0.045	0
	MnHCO3+	2.68E-08	1.84E-08	-7.572	-7.735	-0.163	0
	Cu(CO3)2-	2.12E-08	6.06E-09	-7.674	-8.218	-0.544	0
	ZnHCO3+	1.44E-08	1.05E-08	-7.841	-7.977	-0.136	0
	FeCO3	6.87E-10	7.61E-10	-9.163	-9.119	0.045	0
	CuHCO3+	3.81E-10	2.78E-10	-9.419	-9.555	-0.136	0
	FeHCO3+	3.21E-10	2.35E-10	-9.494	-9.63	-0.136	0
	(CO2)2	8.01E-11	8.88E-11	-10.096	-10.051	0.045	68.87
Ca	8.08E-03						
	Ca+2	6.52E-03	1.73E-03	-2.186	-2.762	-0.576	-16.89
	CaSO4	9.77E-04	1.08E-03	-3.01	-2.965	0.045	7.5
	CaCO3	3.13E-04	3.46E-04	-3.505	-3.46	0.045	-14.6
	CaHCO3+	2.73E-04	1.95E-04	-3.564	-3.711	-0.147	9.93
	CaOH+	1.12E-07	8.18E-08	-6.951	-7.087	-0.136	0
	CaHSO4+	3.38E-11	2.47E-11	-10.472	-10.608	-0.136	0
Cl	2.96E-01						
	Cl-	2.96E-01	1.95E-01	-0.528	-0.71	-0.182	18.66
	CuCl2-	6.03E-08	3.97E-08	-7.22	-7.402	-0.182	0
	CuCl3-2	5.47E-08	1.23E-08	-7.262	-7.912	-0.65	0
	MnCl+	2.70E-08	1.86E-08	-7.568	-7.731	-0.163	-2.82
	ZnOHCl	1.57E-08	1.74E-08	-7.803	-7.758	0.045	0
	ZnCl+	7.56E-09	4.97E-09	-8.122	-8.303	-0.182	-15.18
	MnCl2	1.43E-09	1.58E-09	-8.846	-8.801	0.045	85.89
	ZnCl2	9.15E-10	1.02E-09	-9.038	-8.994	0.045	102.03
	ZnCl3-	3.37E-10	2.22E-10	-9.473	-9.654	-0.182	14.11
	MnCl3-	1.23E-10	8.48E-11	-9.909	-10.071	-0.163	45.08
	FeCl+	9.78E-11	7.15E-11	-10.01	-10.146	-0.136	0
	ZnCl4-2	9.68E-11	2.17E-11	-10.014	-10.664	-0.65	149.02
	CuCl+	5.02E-11	3.30E-11	-10.3	-10.481	-0.182	1.55
	CuCl2	3.12E-12	3.46E-12	-11.506	-11.462	0.045	31.02
	CuCl3-	3.63E-15	2.39E-15	-14.44	-14.622	-0.182	0
	CuCl4-2	1.04E-17	2.33E-18	-16.982	-17.632	-0.65	0
	FeCl+2	6.68E-18	1.49E-18	-17.175	-17.826	-0.65	0
	FeCl2+	1.89E-18	1.30E-18	-17.723	-17.886	-0.163	0
	FeCl3	2.29E-20	2.53E-20	-19.641	-19.596	0.045	0
Cu(1)	1.15E-07						
	CuCl2-	6.03E-08	3.97E-08	-7.22	-7.402	-0.182	0
	CuCl3-2	5.47E-08	1.23E-08	-7.262	-7.912	-0.65	0
	Cu+	5.49E-12	3.31E-12	-11.261	-11.481	-0.22	0
Cu(2)	1.55E-07						
	Cu(OH)2	9.64E-08	1.07E-07	-7.016	-6.971	0.045	0
	CuCO3	3.64E-08	4.03E-08	-7.439	-7.394	0.045	0
	Cu(CO3)2-	2.12E-08	6.06E-09	-7.674	-8.218	-0.544	0

	CuHCO3+	3.81E-10	2.78E-10	-9.419	-9.555	-0.136	0
	CuOH+	2.73E-10	1.80E-10	-9.564	-9.746	-0.182	0
	Cu+2	2.44E-10	6.30E-11	-9.612	-10.201	-0.589	-25.48
	CuCl+	5.02E-11	3.30E-11	-10.3	-10.481	-0.182	1.55
	CuSO4	4.09E-11	4.53E-11	-10.389	-10.344	0.045	13.09
	CuCl2	3.12E-12	3.46E-12	-11.506	-11.462	0.045	31.02
	Cu(OH)3-	2.51E-12	1.84E-12	-11.6	-11.736	-0.136	0
	CuF+	4.18E-13	3.05E-13	-12.379	-12.515	-0.136	0
	Cu2(OH)2+	4.93E-14	1.41E-14	-13.307	-13.851	-0.544	0
	CuCl3-	3.63E-15	2.39E-15	-14.44	-14.622	-0.182	0
	Cu(OH)4-2	3.65E-16	1.04E-16	-15.437	-15.981	-0.544	0
	CuCl4-2	1.04E-17	2.33E-18	-16.982	-17.632	-0.65	0
F	8.30E-04						
	F-	4.16E-04	2.67E-04	-3.381	-3.574	-0.193	-0.72
	MgF+	3.87E-04	2.61E-04	-3.412	-3.584	-0.172	-10.28
	NaF	2.77E-05	3.07E-05	-4.557	-4.513	0.045	7.26
	HF	1.25E-09	1.39E-09	-8.903	-8.858	0.045	12.5
	MnF+	6.28E-11	4.32E-11	-10.202	-10.365	-0.163	0
	ZnF+	4.88E-11	3.57E-11	-10.311	-10.447	-0.136	0
	HF2-	1.94E-12	1.42E-12	-11.713	-11.849	-0.136	22.66
	FeF+	9.69E-13	7.09E-13	-12.013	-12.149	-0.136	0
	CuF+	4.18E-13	3.05E-13	-12.379	-12.515	-0.136	0
	FeF2+	1.66E-15	1.14E-15	-14.781	-14.944	-0.163	0
	FeF+2	4.80E-16	1.07E-16	-15.319	-15.969	-0.65	0
	FeF3	4.34E-16	4.81E-16	-15.363	-15.318	0.045	0
Fe(2)	2.32E-09						
	Fe+2	1.03E-09	2.66E-10	-8.987	-9.575	-0.589	-20.93
	FeCO3	6.87E-10	7.61E-10	-9.163	-9.119	0.045	0
	FeHCO3+	3.21E-10	2.35E-10	-9.494	-9.63	-0.136	0
	FeSO4	1.50E-10	1.67E-10	-9.823	-9.778	0.045	18.97
	FeCl+	9.78E-11	7.15E-11	-10.01	-10.146	-0.136	0
	FeOH+	3.49E-11	2.40E-11	-10.458	-10.62	-0.163	0
	FeF+	9.69E-13	7.09E-13	-12.013	-12.149	-0.136	0
	Fe(OH)2	5.25E-14	5.82E-14	-13.28	-13.235	0.045	0
	Fe(OH)3-	8.96E-16	6.16E-16	-15.048	-15.211	-0.163	0
	FeHSO4+	5.19E-18	3.80E-18	-17.285	-17.42	-0.136	0
Fe(3)	2.13E-06						
	Fe(OH)3	1.46E-06	1.62E-06	-5.835	-5.791	0.045	0
	Fe(OH)4-	6.03E-07	4.21E-07	-6.22	-6.376	-0.156	0
	Fe(OH)2+	6.32E-08	4.41E-08	-7.199	-7.355	-0.156	0
	FeOH+2	2.09E-12	4.67E-13	-11.68	-12.33	-0.65	0
	FeF2+	1.66E-15	1.14E-15	-14.781	-14.944	-0.163	0
	FeF+2	4.80E-16	1.07E-16	-15.319	-15.969	-0.65	0
	FeF3	4.34E-16	4.81E-16	-15.363	-15.318	0.045	0
	FeSO4+	1.43E-17	9.81E-18	-16.846	-17.008	-0.163	0
	FeCl+2	6.68E-18	1.49E-18	-17.175	-17.826	-0.65	0
	Fe+3	2.73E-18	2.54E-19	-17.564	-18.595	-1.031	0
	FeCl2+	1.89E-18	1.30E-18	-17.723	-17.886	-0.163	0
	Fe(SO4)2-	1.03E-18	7.56E-19	-17.985	-18.121	-0.136	0
	FeCl3	2.29E-20	2.53E-20	-19.641	-19.596	0.045	0

	Fe2(OH)2+	8.81E-22	5.88E-24	-21.055	-23.231	-2.175	0
	FeHSO4+2	3.19E-25	9.11E-26	-24.497	-25.04	-0.544	0
	Fe3(OH)4+	1.36E-25	5.42E-29	-24.867	-28.266	-3.399	0
H(0)	1.54E-28						
	H2	7.68E-29	8.51E-29	-28.115	-28.07	0.045	28.61
K	4.06E-03						
	K+	3.97E-03	2.59E-03	-2.401	-2.588	-0.186	9.53
	KSO4-	9.17E-05	6.40E-05	-4.038	-4.194	-0.156	34.71
Mg	6.52E-02						
	Mg+2	5.00E-02	1.48E-02	-1.301	-1.83	-0.528	-20.61
	MgSO4	1.10E-02	1.22E-02	-1.958	-1.913	0.045	5.84
	MgHCO3+	2.32E-03	1.53E-03	-2.635	-2.816	-0.182	5.78
	MgCO3	1.52E-03	1.69E-03	-2.818	-2.774	0.045	-17.09
	MgF+	3.87E-04	2.61E-04	-3.412	-3.584	-0.172	-10.28
	MgOH+	2.12E-05	1.53E-05	-4.674	-4.815	-0.14	0
Mn(2)	3.60E-07						
	MnCO3	2.00E-07	2.22E-07	-6.698	-6.654	0.045	0
	Mn+2	9.09E-08	2.34E-08	-7.042	-7.63	-0.589	-16.77
	MnCl+	2.70E-08	1.86E-08	-7.568	-7.731	-0.163	-2.82
	MnHCO3+	2.68E-08	1.84E-08	-7.572	-7.735	-0.163	0
	MnSO4	1.32E-08	1.47E-08	-7.878	-7.833	0.045	22.54
	MnCl2	1.43E-09	1.58E-09	-8.846	-8.801	0.045	85.89
	MnOH+	2.50E-10	1.72E-10	-9.603	-9.765	-0.163	0
	MnCl3-	1.23E-10	8.48E-11	-9.909	-10.071	-0.163	45.08
	MnF+	6.28E-11	4.32E-11	-10.202	-10.365	-0.163	0
	Mn(NO3)2	4.47E-15	4.95E-15	-14.35	-14.305	0.045	41.04
	Mn(OH)3-	1.25E-17	8.60E-18	-16.903	-17.066	-0.163	0
Mn(3)	7.78E-29						
	Mn+3	7.78E-29	7.24E-30	-28.109	-29.14	-1.031	0
N(-3)	4.40E-05						
	NH4+	3.91E-05	2.35E-05	-4.408	-4.629	-0.22	18.37
	NH3	3.49E-06	3.87E-06	-5.457	-5.413	0.045	24.42
	NH4SO4-	1.46E-06	1.07E-06	-5.836	-5.972	-0.136	39.29
N(5)	3.70E-04						
	NO3-	3.70E-04	2.31E-04	-3.432	-3.637	-0.206	30.13
	Mn(NO3)2	4.47E-15	4.95E-15	-14.35	-14.305	0.045	41.04
Na	2.85E-01						
	Na+	2.79E-01	2.00E-01	-0.555	-0.698	-0.143	-0.67
	NaSO4-	5.06E-03	3.54E-03	-2.295	-2.451	-0.156	19.71
	NaHCO3	8.96E-04	9.93E-04	-3.048	-3.003	0.045	1.8
	NaCO3-	6.08E-04	4.45E-04	-3.216	-3.352	-0.136	1.67
	NaF	2.77E-05	3.07E-05	-4.557	-4.513	0.045	7.26
	NaOH	5.21E-17	5.78E-17	-16.283	-16.238	0.045	0
O(0)	1.01E-36						
	O2	5.07E-37	5.62E-37	-36.295	-36.25	0.045	30.4
S(6)	3.36E-02						
	SO4-2	1.64E-02	3.52E-03	-1.785	-2.453	-0.668	16.92
	MgSO4	1.10E-02	1.22E-02	-1.958	-1.913	0.045	5.84
	NaSO4-	5.06E-03	3.54E-03	-2.295	-2.451	-0.156	19.71
	CaSO4	9.77E-04	1.08E-03	-3.01	-2.965	0.045	7.5

	KSO4-	9.17E-05	6.40E-05	-4.038	-4.194	-0.156	34.71
	BaSO4	4.14E-06	4.59E-06	-5.383	-5.338	0.045	0
	NH4SO4-	1.46E-06	1.07E-06	-5.836	-5.972	-0.136	39.29
	MnSO4	1.32E-08	1.47E-08	-7.878	-7.833	0.045	22.54
	ZnSO4	7.07E-09	7.84E-09	-8.151	-8.106	0.045	21.71
	HSO4-	1.62E-09	1.19E-09	-8.789	-8.925	-0.136	40.84
	Zn(SO4)2-2	7.85E-10	2.24E-10	-9.105	-9.649	-0.544	-7.4
	FeSO4	1.50E-10	1.67E-10	-9.823	-9.778	0.045	18.97
	CuSO4	4.09E-11	4.53E-11	-10.389	-10.344	0.045	13.09
	CaHSO4+	3.38E-11	2.47E-11	-10.472	-10.608	-0.136	0
	FeSO4+	1.43E-17	9.81E-18	-16.846	-17.008	-0.163	0
	FeHSO4+	5.19E-18	3.80E-18	-17.285	-17.42	-0.136	0
	Fe(SO4)2-	1.03E-18	7.56E-19	-17.985	-18.121	-0.136	0
	FeHSO4+2	3.19E-25	9.11E-26	-24.497	-25.04	-0.544	0
Zn	2.32E-06						
	Zn(CO3)2-2	2.01E-06	5.76E-07	-5.696	-6.24	-0.544	0
	ZnCO3	2.04E-07	2.26E-07	-6.691	-6.646	0.045	0
	Zn+2	4.24E-08	9.49E-09	-7.373	-8.023	-0.65	-24.24
	ZnOHCl	1.57E-08	1.74E-08	-7.803	-7.758	0.045	0
	ZnHCO3+	1.44E-08	1.05E-08	-7.841	-7.977	-0.136	0
	Zn(OH)2	8.75E-09	9.70E-09	-8.058	-8.013	0.045	0
	ZnCl+	7.56E-09	4.97E-09	-8.122	-8.303	-0.182	-15.18
	ZnSO4	7.07E-09	7.84E-09	-8.151	-8.106	0.045	21.71
	ZnOH+	4.06E-09	2.97E-09	-8.392	-8.528	-0.136	0
	ZnCl2	9.15E-10	1.02E-09	-9.038	-8.994	0.045	102.03
	Zn(SO4)2-2	7.85E-10	2.24E-10	-9.105	-9.649	-0.544	-7.4
	ZnCl3-	3.37E-10	2.22E-10	-9.473	-9.654	-0.182	14.11
	ZnCl4-2	9.68E-11	2.17E-11	-10.014	-10.664	-0.65	149.02
	ZnF+	4.88E-11	3.57E-11	-10.311	-10.447	-0.136	0
	Zn(OH)3-	1.20E-11	8.75E-12	-10.922	-11.058	-0.136	0
	Zn(OH)4-2	1.38E-15	3.95E-16	-14.859	-15.403	-0.544	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-0.94	-5.22	-4.28	CaSO4			
Aragonite	1.65	-6.69	-8.34	CaCO3			
Barite	1.81	-8.04	-9.84	BaSO4			
Calcite	1.79	-6.69	-8.48	CaCO3			
CO2(g)	-2.69	-4.16	-1.47	CO2			
Dolomite	4.65	-12.44	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.88	6.77	4.89	Fe(OH)3			
Fluorite	0.69	-9.91	-10.6	CaF2			
Goethite	7.77	6.77	-1	FeOOH			
Gypsum	-0.64	-5.23	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	-0.01	1.5	H2O			
Halite	-2.98	-1.41	1.57	NaCl			
Hausmann	-8.26	52.77	61.03	Mn3O4			

Hematite	17.56	13.55	-4.01	Fe2O3
Jarosite-K	-3.34	-12.55	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.6	21.74	25.34	MnOOH
Melanterit	-9.85	-12.06	-2.21	FeSO4:7H2O
NH3(g)	-7.21	-5.41	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.92	9.28	15.2	Mn(OH)2
Pyrolusite	-7.19	34.19	41.38	MnO2:H2O
Rhodochrc	-0.42	-11.55	-11.13	MnCO3
Siderite	-2.61	-13.5	-10.89	FeCO3
Smithsonit	-1.95	-11.95	-10	ZnCO3
Sylvite	-4.2	-3.3	0.9	KCl
Witherite	-0.95	-9.51	-8.56	BaCO3
Zn(OH)2(e	-2.61	8.89	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 23

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	2.31E-02	2.31E-02
Ba	1.72E-05	1.72E-05
Ca	8.45E-03	8.45E-03
Cl	3.10E-01	3.10E-01
Cu	2.80E-07	2.80E-07
F	8.70E-04	8.70E-04
Fe	2.23E-06	2.23E-06
K	4.24E-03	4.24E-03
Mg	6.82E-02	6.82E-02
Mn	3.80E-07	3.80E-07
N(-3)	4.60E-05	4.60E-05
N(5)	3.90E-04	3.90E-04
Na	2.98E-01	2.98E-01
S(6)	3.51E-02	3.51E-02
Zn	2.43E-06	2.43E-06

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 34395
Density (g/cm³) = 1.01628
Volume (L) = 1.00823
Activity of water = 0.988
Ionic strength (mol/kgw) = 4.67E-01
Mass of water (kg) = 1.00E+00

```
Total carbon (mol/kg) = 2.00E-02
Total CO2 (mol/kg) = 2.00E-02
Temperatu (°C) = 25
Electrical balance (eq) = 5.14E-02
Percent error, 100*(Cat-| = 6.58
Iterations = 13 (228 overall)
Total H = 1.11E+02
Total O = 5.57E+01

#NAME? couples---------------------------------

Redox couple pe Eh (volts)

N(-3)/N(5) 4.436 0.2624

#NAME? of species----------------------------

Log Log Log mole V
Species Molality Activity Molality Activity Gamma cm³/mol

OH- 4.52E-06 2.88E-06 -5.345 -5.54 -0.195 -2.98
H+ 4.52E-09 3.47E-09 -8.345 -8.46 -0.115 0
H2O 5.55E+01 9.88E-01 1.744 -0.005 0 18.07
Ba 1.72E-05
Ba+2 1.24E-05 2.69E-06 -4.908 -5.571 -0.663 -11.26
BaSO4 4.33E-06 4.83E-06 -5.363 -5.316 0.047 0
BaHCO3+ 3.19E-07 2.33E-07 -6.496 -6.632 -0.136 0
BaCO3 1.53E-07 1.70E-07 -6.816 -6.769 0.047 -10.7
BaOH+ 3.78E-11 2.59E-11 -10.422 -10.586 -0.164 0
C(4) 2.00E-02
HCO3- 1.30E-02 9.07E-03 -1.885 -2.042 -0.158 26.37
MgHCO3+ 2.49E-03 1.63E-03 -2.604 -2.788 -0.184 5.79
MgCO3 1.62E-03 1.80E-03 -2.792 -2.745 0.047 -17.09
NaHCO3 9.58E-04 1.07E-03 -3.019 -2.972 0.047 1.8
NaCO3- 6.53E-04 4.78E-04 -3.185 -3.321 -0.136 1.78
CO3-2 5.24E-04 1.23E-04 -3.281 -3.911 -0.63 -2.59
CaCO3 3.31E-04 3.69E-04 -3.48 -3.433 0.047 -14.6
CaHCO3+ 2.92E-04 2.07E-04 -3.535 -3.684 -0.149 9.94
CO2 6.43E-05 7.16E-05 -4.192 -4.145 0.047 34.43
Zn(CO3)2-2 2.12E-06 6.08E-07 -5.674 -6.216 -0.542 0
BaHCO3+ 3.19E-07 2.33E-07 -6.496 -6.632 -0.136 0
MnCO3 2.12E-07 2.36E-07 -6.675 -6.628 0.047 0
ZnCO3 2.08E-07 2.32E-07 -6.682 -6.635 0.047 0
BaCO3 1.53E-07 1.70E-07 -6.816 -6.769 0.047 -10.7
CuCO3 3.66E-08 4.08E-08 -7.436 -7.39 0.047 0
MnHCO3+ 2.85E-08 1.95E-08 -7.545 -7.709 -0.164 0
Cu(CO3)2- 2.20E-08 6.30E-09 -7.659 -8.201 -0.542 0
ZnHCO3+ 1.48E-08 1.08E-08 -7.831 -7.966 -0.136 0
FeCO3 7.39E-10 8.22E-10 -9.132 -9.085 0.047 0
CuHCO3+ 3.84E-10 2.81E-10 -9.415 -9.551 -0.136 0
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	FeHCO3+	3.46E-10	2.54E-10	-9.46	-9.596	-0.136	0
	(CO2)2	8.44E-11	9.40E-11	-10.073	-10.027	0.047	68.87
Ca	8.45E-03						
	Ca+2	6.80E-03	1.79E-03	-2.167	-2.747	-0.58	-16.87
	CaSO4	1.03E-03	1.14E-03	-2.989	-2.943	0.047	7.5
	CaCO3	3.31E-04	3.69E-04	-3.48	-3.433	0.047	-14.6
	CaHCO3+	2.92E-04	2.07E-04	-3.535	-3.684	-0.149	9.94
	CaOH+	1.16E-07	8.46E-08	-6.937	-7.073	-0.136	0
	CaHSO4+	3.55E-11	2.60E-11	-10.449	-10.585	-0.136	0
Cl	3.10E-01						
	Cl-	3.10E-01	2.03E-01	-0.509	-0.693	-0.184	18.67
	CuCl2-	6.45E-08	4.23E-08	-7.19	-7.374	-0.184	0
	CuCl3-2	6.17E-08	1.36E-08	-7.21	-7.867	-0.657	0
	MnCl+	2.92E-08	2.00E-08	-7.535	-7.7	-0.164	-2.82
	ZnOHCl	1.63E-08	1.81E-08	-7.789	-7.742	0.047	0
	ZnCl+	7.89E-09	5.17E-09	-8.103	-8.287	-0.184	-15.25
	MnCl2	1.59E-09	1.77E-09	-8.799	-8.752	0.047	85.89
	ZnCl2	9.86E-10	1.10E-09	-9.006	-8.96	0.047	102.03
	ZnCl3-	3.81E-10	2.50E-10	-9.419	-9.602	-0.184	13.97
	MnCl3-	1.44E-10	9.88E-11	-9.841	-10.005	-0.164	45.14
	ZnCl4-2	1.15E-10	2.54E-11	-9.938	-10.595	-0.657	149.14
	FeCl+	1.07E-10	7.83E-11	-9.971	-10.106	-0.136	0
	CuCl+	5.16E-11	3.38E-11	-10.287	-10.471	-0.184	1.58
	CuCl2	3.31E-12	3.68E-12	-11.481	-11.434	0.047	31.02
	CuCl3-	4.04E-15	2.65E-15	-14.393	-14.577	-0.184	0
	CuCl4-2	1.22E-17	2.69E-18	-16.913	-17.57	-0.657	0
	FeCl+2	7.42E-18	1.64E-18	-17.13	-17.786	-0.657	0
	FeCl2+	2.16E-18	1.48E-18	-17.665	-17.829	-0.164	0
	FeCl3	2.70E-20	3.01E-20	-19.569	-19.522	0.047	0
Cu(1)	1.26E-07						
	CuCl2-	6.45E-08	4.23E-08	-7.19	-7.374	-0.184	0
	CuCl3-2	6.17E-08	1.36E-08	-7.21	-7.867	-0.657	0
	Cu+	5.43E-12	3.25E-12	-11.265	-11.488	-0.223	0
Cu(2)	1.54E-07						
	Cu(OH)2	9.43E-08	1.05E-07	-7.026	-6.979	0.047	0
	CuCO3	3.66E-08	4.08E-08	-7.436	-7.39	0.047	0
	Cu(CO3)2-	2.20E-08	6.30E-09	-7.659	-8.201	-0.542	0
	CuHCO3+	3.84E-10	2.81E-10	-9.415	-9.551	-0.136	0
	CuOH+	2.69E-10	1.76E-10	-9.57	-9.754	-0.184	0
	Cu+2	2.43E-10	6.19E-11	-9.614	-10.208	-0.594	-25.46
	CuCl+	5.16E-11	3.38E-11	-10.287	-10.471	-0.184	1.58
	CuSO4	4.07E-11	4.53E-11	-10.39	-10.344	0.047	13.09
	CuCl2	3.31E-12	3.68E-12	-11.481	-11.434	0.047	31.02
	Cu(OH)3-	2.46E-12	1.80E-12	-11.609	-11.744	-0.136	0
	CuF+	4.20E-13	3.07E-13	-12.377	-12.512	-0.136	0
	Cu2(OH)2+	4.74E-14	1.36E-14	-13.324	-13.866	-0.542	0
	CuCl3-	4.04E-15	2.65E-15	-14.393	-14.577	-0.184	0
	Cu(OH)4-2	3.57E-16	1.02E-16	-15.447	-15.99	-0.542	0
	CuCl4-2	1.22E-17	2.69E-18	-16.913	-17.57	-0.657	0
F	8.70E-04						

	F-	4.28E-04	2.73E-04	-3.369	-3.564	-0.195	-0.7
	MgF+	4.13E-04	2.77E-04	-3.384	-3.558	-0.173	-10.28
	NaF	2.95E-05	3.28E-05	-4.53	-4.484	0.047	7.26
	HF	1.27E-09	1.42E-09	-8.895	-8.848	0.047	12.5
	MnF+	6.66E-11	4.56E-11	-10.176	-10.341	-0.164	0
	ZnF+	4.99E-11	3.65E-11	-10.302	-10.438	-0.136	0
	HF2-	2.03E-12	1.49E-12	-11.693	-11.828	-0.136	22.68
	FeF+	1.04E-12	7.63E-13	-11.982	-12.118	-0.136	0
	CuF+	4.20E-13	3.07E-13	-12.377	-12.512	-0.136	0
	FeF2+	1.83E-15	1.25E-15	-14.738	-14.902	-0.164	0
	FeF+2	5.24E-16	1.15E-16	-15.281	-15.938	-0.657	0
	FeF3	4.87E-16	5.42E-16	-15.313	-15.266	0.047	0
Fe(2)	2.49E-09						
	Fe+2	1.10E-09	2.80E-10	-8.96	-9.554	-0.594	-20.9
	FeCO3	7.39E-10	8.22E-10	-9.132	-9.085	0.047	0
	FeHCO3+	3.46E-10	2.54E-10	-9.46	-9.596	-0.136	0
	FeSO4	1.60E-10	1.78E-10	-9.796	-9.749	0.047	18.97
	FeCl+	1.07E-10	7.83E-11	-9.971	-10.106	-0.136	0
	FeOH+	3.68E-11	2.52E-11	-10.435	-10.599	-0.164	0
	FeF+	1.04E-12	7.63E-13	-11.982	-12.118	-0.136	0
	Fe(OH)2	5.48E-14	6.11E-14	-13.261	-13.214	0.047	0
	Fe(OH)3-	9.43E-16	6.46E-16	-15.025	-15.19	-0.164	0
	FeHSO4+	5.55E-18	4.06E-18	-17.256	-17.391	-0.136	0
Fe(3)	2.23E-06						
	Fe(OH)3	1.53E-06	1.70E-06	-5.816	-5.77	0.047	0
	Fe(OH)4-	6.35E-07	4.42E-07	-6.197	-6.355	-0.158	0
	Fe(OH)2+	6.66E-08	4.63E-08	-7.177	-7.334	-0.158	0
	FeOH+2	2.23E-12	4.91E-13	-11.652	-12.309	-0.657	0
	FeF2+	1.83E-15	1.25E-15	-14.738	-14.902	-0.164	0
	FeF+2	5.24E-16	1.15E-16	-15.281	-15.938	-0.657	0
	FeF3	4.87E-16	5.42E-16	-15.313	-15.266	0.047	0
	FeSO4+	1.53E-17	1.05E-17	-16.815	-16.979	-0.164	0
	FeCl+2	7.42E-18	1.64E-18	-17.13	-17.786	-0.657	0
	Fe+3	2.92E-18	2.67E-19	-17.535	-18.574	-1.039	0
	FeCl2+	2.16E-18	1.48E-18	-17.665	-17.829	-0.164	0
	Fe(SO4)2-	1.13E-18	8.23E-19	-17.949	-18.085	-0.136	0
	FeCl3	2.70E-20	3.01E-20	-19.569	-19.522	0.047	0
	Fe2(OH)2+	9.58E-22	6.49E-24	-21.018	-23.188	-2.169	0
	FeHSO4+2	3.40E-25	9.74E-26	-24.469	-25.011	-0.542	0
	Fe3(OH)4+	1.54E-25	6.28E-29	-24.812	-28.202	-3.39	0
H(0)	1.53E-28						
	H2	7.64E-29	8.51E-29	-28.117	-28.07	0.047	28.61
K	4.24E-03						
	K+	4.14E-03	2.69E-03	-2.383	-2.571	-0.188	9.54
	KSO4-	9.73E-05	6.77E-05	-4.012	-4.17	-0.158	34.72
Mg	6.82E-02						
	Mg+2	5.21E-02	1.54E-02	-1.283	-1.814	-0.53	-20.59
	MgSO4	1.16E-02	1.29E-02	-1.936	-1.889	0.047	5.84
	MgHCO3+	2.49E-03	1.63E-03	-2.604	-2.788	-0.184	5.79
	MgCO3	1.62E-03	1.80E-03	-2.792	-2.745	0.047	-17.09

	MgF+	4.13E-04	2.77E-04	-3.384	-3.558	-0.173	-10.28
	MgOH+	2.20E-05	1.59E-05	-4.657	-4.799	-0.142	0
Mn(2)	3.80E-07						
	MnCO3	2.12E-07	2.36E-07	-6.675	-6.628	0.047	0
	Mn+2	9.49E-08	2.42E-08	-7.023	-7.617	-0.594	-16.73
	MnCl+	2.92E-08	2.00E-08	-7.535	-7.7	-0.164	-2.82
	MnHCO3+	2.85E-08	1.95E-08	-7.545	-7.709	-0.164	0
	MnSO4	1.38E-08	1.54E-08	-7.859	-7.812	0.047	22.54
	MnCl2	1.59E-09	1.77E-09	-8.799	-8.752	0.047	85.89
	MnOH+	2.58E-10	1.77E-10	-9.588	-9.752	-0.164	0
	MnCl3-	1.44E-10	9.88E-11	-9.841	-10.005	-0.164	45.14
	MnF+	6.66E-11	4.56E-11	-10.176	-10.341	-0.164	0
	Mn(NO3)2	5.04E-15	5.61E-15	-14.298	-14.251	0.047	41.04
	Mn(OH)3-	1.29E-17	8.86E-18	-16.888	-17.053	-0.164	0
Mn(3)	8.17E-29						
	Mn+3	8.17E-29	7.47E-30	-28.088	-29.127	-1.039	0
N(-3)	4.60E-05						
	NH4+	4.09E-05	2.44E-05	-4.389	-4.612	-0.223	18.37
	NH3	3.61E-06	4.02E-06	-5.443	-5.396	0.047	24.42
	NH4SO4-	1.54E-06	1.13E-06	-5.812	-5.948	-0.136	39.35
N(5)	3.90E-04						
	NO3-	3.90E-04	2.41E-04	-3.409	-3.617	-0.208	30.15
	Mn(NO3)2	5.04E-15	5.61E-15	-14.298	-14.251	0.047	41.04
Na	2.98E-01						
	Na+	2.91E-01	2.09E-01	-0.536	-0.68	-0.144	-0.66
	NaSO4-	5.40E-03	3.76E-03	-2.267	-2.425	-0.158	19.85
	NaHCO3	9.58E-04	1.07E-03	-3.019	-2.972	0.047	1.8
	NaCO3-	6.53E-04	4.78E-04	-3.185	-3.321	-0.136	1.78
	NaF	2.95E-05	3.28E-05	-4.53	-4.484	0.047	7.26
	NaOH	5.42E-17	6.03E-17	-16.266	-16.22	0.047	0
O(0)	1.01E-36						
	O2	5.04E-37	5.61E-37	-36.297	-36.251	0.047	30.4
S(6)	3.51E-02						
	SO4-2	1.70E-02	3.59E-03	-1.77	-2.445	-0.676	16.97
	MgSO4	1.16E-02	1.29E-02	-1.936	-1.889	0.047	5.84
	NaSO4-	5.40E-03	3.76E-03	-2.267	-2.425	-0.158	19.85
	CaSO4	1.03E-03	1.14E-03	-2.989	-2.943	0.047	7.5
	KSO4-	9.73E-05	6.77E-05	-4.012	-4.17	-0.158	34.72
	BaSO4	4.33E-06	4.83E-06	-5.363	-5.316	0.047	0
	NH4SO4-	1.54E-06	1.13E-06	-5.812	-5.948	-0.136	39.35
	MnSO4	1.38E-08	1.54E-08	-7.859	-7.812	0.047	22.54
	ZnSO4	7.15E-09	7.96E-09	-8.146	-8.099	0.047	21.71
	HSO4-	1.65E-09	1.21E-09	-8.782	-8.918	-0.136	40.85
	Zn(SO4)2-2	8.08E-10	2.32E-10	-9.092	-9.635	-0.542	-7.2
	FeSO4	1.60E-10	1.78E-10	-9.796	-9.749	0.047	18.97
	CuSO4	4.07E-11	4.53E-11	-10.39	-10.344	0.047	13.09
	CaHSO4+	3.55E-11	2.60E-11	-10.449	-10.585	-0.136	0
	FeSO4+	1.53E-17	1.05E-17	-16.815	-16.979	-0.164	0
	FeHSO4+	5.55E-18	4.06E-18	-17.256	-17.391	-0.136	0
	Fe(SO4)2-	1.13E-18	8.23E-19	-17.949	-18.085	-0.136	0

	FeHSO4+2	3.40E-25	9.74E-26	-24.469	-25.011	-0.542	0
Zn	2.43E-06						
	Zn(CO3)2-2	2.12E-06	6.08E-07	-5.674	-6.216	-0.542	0
	ZnCO3	2.08E-07	2.32E-07	-6.682	-6.635	0.047	0
	Zn+2	4.30E-08	9.47E-09	-7.367	-8.024	-0.657	-24.22
	ZnOHCl	1.63E-08	1.81E-08	-7.789	-7.742	0.047	0
	ZnHCO3+	1.48E-08	1.08E-08	-7.831	-7.966	-0.136	0
	Zn(OH)2	8.69E-09	9.67E-09	-8.061	-8.015	0.047	0
	ZnCl+	7.89E-09	5.17E-09	-8.103	-8.287	-0.184	-15.25
	ZnSO4	7.15E-09	7.96E-09	-8.146	-8.099	0.047	21.71
	ZnOH+	4.04E-09	2.96E-09	-8.394	-8.529	-0.136	0
	ZnCl2	9.86E-10	1.10E-09	-9.006	-8.96	0.047	102.03
	Zn(SO4)2-2	8.08E-10	2.32E-10	-9.092	-9.635	-0.542	-7.2
	ZnCl3-	3.81E-10	2.50E-10	-9.419	-9.602	-0.184	13.97
	ZnCl4-2	1.15E-10	2.54E-11	-9.938	-10.595	-0.657	149.14
	ZnF+	4.99E-11	3.65E-11	-10.302	-10.438	-0.136	0
	Zn(OH)3-	1.19E-11	8.71E-12	-10.924	-11.06	-0.136	0
	Zn(OH)4-2	1.37E-15	3.93E-16	-14.863	-15.405	-0.542	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-0.92	-5.19	-4.28	CaSO4			
Aragonite	1.68	-6.66	-8.34	CaCO3			
Barite	1.83	-8.02	-9.84	BaSO4			
Calcite	1.82	-6.66	-8.48	CaCO3			
CO2(g)	-2.68	-4.15	-1.47	CO2			
Dolomite	4.7	-12.38	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.9	6.79	4.89	Fe(OH)3			
Fluorite	0.72	-9.88	-10.6	CaF2			
Goethite	7.8	6.8	-1	FeOOH			
Gypsum	-0.62	-5.2	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	-0.01	1.5	H2O			
Halite	-2.94	-1.37	1.57	NaCl			
Hausmann	-8.22	52.81	61.03	Mn3O4			
Hematite	17.6	13.6	-4.01	Fe2O3			
Jarosite-K	-3.24	-12.45	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.59	21.75	25.34	MnOOH			
Melanterit	-9.83	-12.04	-2.21	FeSO4:7H2O			
NH3(g)	-7.19	-5.4	1.8	NH3			
O2(g)	-33.36	-36.25	-2.89	O2			
Pyrochroit	-5.91	9.29	15.2	Mn(OH)2			
Pyrolusite	-7.17	34.21	41.38	MnO2:H2O			
Rhodochro	-0.4	-11.53	-11.13	MnCO3			
Siderite	-2.57	-13.46	-10.89	FeCO3			
Smithsonit	-1.94	-11.94	-10	ZnCO3			
Sylvite	-4.16	-3.26	0.9	KCl			
Witherite	-0.92	-9.48	-8.56	BaCO3			

```
            Zn(OH)2(e       -2.61        8.89        11.5  Zn(OH)2

**For       a           gas,        SI          =           log10(fuga Fugacity    =           pressure    *
            For         ideal       gases,      phi         =                      1

Initial     solution            24

 #NAME?     composition-----------------------------

            Elements    Molality    Moles

            Alkalinity   2.41E-02   2.41E-02
            Ba           1.79E-05   1.79E-05
            Ca           8.82E-03   8.82E-03
            Cl           3.24E-01   3.24E-01
            Cu           3.00E-07   3.00E-07
            F            9.10E-04   9.10E-04
            Fe           2.33E-06   2.33E-06
            K            4.43E-03   4.43E-03
            Mg           7.12E-02   7.12E-02
            Mn           3.90E-07   3.90E-07
            N(-3)        4.80E-05   4.80E-05
            N(5)         4.10E-04   4.10E-04
            Na           3.11E-01   3.11E-01
            S(6)         3.67E-02   3.67E-02
            Zn           2.54E-06   2.54E-06

 #NAME?     of          solution---------------------------

            pH          =                   8.46
            pe          =                      4
            Specific    Conductan (µS/cm,       25°C)       =                 35676
            Density     (g/cm³)   =               1.0171
            Volume      (L)       =              1.00847
            Activity    of        water         =                 0.987
            Ionic       strength  (mol/kgw)     =             4.87E-01
            Mass        of        water         (kg)        =             1.00E+00
            Total       carbon    (mol/kg)      =             2.08E-02
            Total       CO2       (mol/kg)      =             2.08E-02
            Temperatu   (°C)      =                     25
            Electrical  balance   (eq)          =             5.37E-02
            Percent     error,    100*(Cat-|=                     6.59
            Iterations  =                   13  (241        overall)
            Total       H         =             1.11E+02
            Total       O         =             5.57E+01

 #NAME?     couples--------------------------------

            Redox       couple    pe            Eh          (volts)
```

N(-3)/N(5) 4.4365 0.2624

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.54E-06	2.88E-06	-5.343	-5.54	-0.197	-2.95
	H+	4.53E-09	3.47E-09	-8.344	-8.46	-0.116	0
	H2O	5.55E+01	9.87E-01	1.744	-0.006	0	18.07
Ba	1.79E-05						
	Ba+2	1.29E-05	2.77E-06	-4.889	-5.557	-0.668	-11.23
	BaSO4	4.53E-06	5.06E-06	-5.344	-5.296	0.049	0
	BaHCO3+	3.38E-07	2.47E-07	-6.472	-6.607	-0.135	0
	BaCO3	1.61E-07	1.80E-07	-6.793	-6.744	0.049	-10.7
	BaOH+	3.92E-11	2.67E-11	-10.407	-10.573	-0.166	0
C(4)	2.08E-02						
	HCO3-	1.34E-02	9.31E-03	-1.872	-2.031	-0.159	26.43
	MgHCO3+	2.66E-03	1.74E-03	-2.575	-2.761	-0.186	5.79
	MgCO3	1.71E-03	1.91E-03	-2.767	-2.718	0.049	-17.09
	NaHCO3	1.02E-03	1.14E-03	-2.991	-2.942	0.049	1.8
	NaCO3-	6.98E-04	5.11E-04	-3.156	-3.291	-0.135	1.88
	CO3-2	5.45E-04	1.26E-04	-3.264	-3.9	-0.636	-2.53
	CaCO3	3.50E-04	3.92E-04	-3.456	-3.407	0.049	-14.6
	CaHCO3+	3.11E-04	2.20E-04	-3.508	-3.658	-0.15	9.94
	CO2	6.57E-05	7.35E-05	-4.182	-4.134	0.049	34.43
	Zn(CO3)2-2	2.22E-06	6.40E-07	-5.653	-6.194	-0.54	0
	BaHCO3+	3.38E-07	2.47E-07	-6.472	-6.607	-0.135	0
	MnCO3	2.17E-07	2.43E-07	-6.663	-6.615	0.049	0
	ZnCO3	2.13E-07	2.38E-07	-6.673	-6.624	0.049	0
	BaCO3	1.61E-07	1.80E-07	-6.793	-6.744	0.049	-10.7
	CuCO3	3.80E-08	4.25E-08	-7.42	-7.372	0.049	0
	MnHCO3+	2.95E-08	2.02E-08	-7.53	-7.696	-0.166	0
	Cu(CO3)2-	2.34E-08	6.74E-09	-7.631	-8.171	-0.54	0
	ZnHCO3+	1.51E-08	1.11E-08	-7.82	-7.955	-0.135	0
	FeCO3	7.92E-10	8.86E-10	-9.101	-9.053	0.049	0
	CuHCO3+	4.00E-10	2.93E-10	-9.398	-9.533	-0.135	0
	FeHCO3+	3.73E-10	2.73E-10	-9.429	-9.564	-0.135	0
	(CO2)2	8.87E-11	9.92E-11	-10.052	-10.003	0.049	68.87
Ca	8.82E-03						
	Ca+2	7.09E-03	1.85E-03	-2.15	-2.733	-0.583	-16.85
	CaSO4	1.07E-03	1.20E-03	-2.97	-2.921	0.049	7.5
	CaCO3	3.50E-04	3.92E-04	-3.456	-3.407	0.049	-14.6
	CaHCO3+	3.11E-04	2.20E-04	-3.508	-3.658	-0.15	9.94
	CaOH+	1.19E-07	8.75E-08	-6.923	-7.058	-0.135	0
	CaHSO4+	3.73E-11	2.74E-11	-10.428	-10.563	-0.135	0
Cl	3.24E-01						
	Cl-	3.24E-01	2.11E-01	-0.49	-0.676	-0.186	18.68
	CuCl3-2	7.14E-08	1.55E-08	-7.147	-7.81	-0.663	0
	CuCl2-	7.11E-08	4.64E-08	-7.148	-7.334	-0.186	0

	MnCl+	3.06E-08	2.09E-08	-7.515	-7.681	-0.166	-2.81
	ZnOHCl	1.68E-08	1.88E-08	-7.774	-7.726	0.049	0
	ZnCl+	8.23E-09	5.37E-09	-8.085	-8.27	-0.186	-15.31
	MnCl2	1.72E-09	1.92E-09	-8.766	-8.717	0.049	85.89
	ZnCl2	1.06E-09	1.19E-09	-8.975	-8.926	0.049	102.03
	ZnCl3-	4.30E-10	2.80E-10	-9.367	-9.552	-0.186	13.83
	MnCl3-	1.63E-10	1.12E-10	-9.787	-9.953	-0.166	45.2
	ZnCl4-2	1.37E-10	2.96E-11	-9.865	-10.528	-0.663	149.25
	FeCl+	1.17E-10	8.53E-11	-9.934	-10.069	-0.135	0
	CuCl+	5.47E-11	3.57E-11	-10.262	-10.448	-0.186	1.61
	CuCl2	3.61E-12	4.04E-12	-11.443	-11.394	0.049	31.02
	CuCl3-	4.63E-15	3.02E-15	-14.334	-14.52	-0.186	0
	CuCl4-2	1.47E-17	3.19E-18	-16.833	-17.496	-0.663	0
	FeCl+2	8.21E-18	1.78E-18	-17.086	-17.749	-0.663	0
	FeCl2+	2.46E-18	1.68E-18	-17.609	-17.775	-0.166	0
	FeCl3	3.16E-20	3.54E-20	-19.5	-19.451	0.049	0
Cu(1)	1.42E-07						
	CuCl3-2	7.14E-08	1.55E-08	-7.147	-7.81	-0.663	0
	CuCl2-	7.11E-08	4.64E-08	-7.148	-7.334	-0.186	0
	Cu+	5.55E-12	3.30E-12	-11.256	-11.482	-0.226	0
Cu(2)	1.58E-07						
	Cu(OH)2	9.51E-08	1.06E-07	-7.022	-6.973	0.049	0
	CuCO3	3.80E-08	4.25E-08	-7.42	-7.372	0.049	0
	Cu(CO3)2-	2.34E-08	6.74E-09	-7.631	-8.171	-0.54	0
	CuHCO3+	4.00E-10	2.93E-10	-9.398	-9.533	-0.135	0
	CuOH+	2.74E-10	1.79E-10	-9.562	-9.747	-0.186	0
	Cu+2	2.50E-10	6.28E-11	-9.602	-10.202	-0.599	-25.45
	CuCl+	5.47E-11	3.57E-11	-10.262	-10.448	-0.186	1.61
	CuSO4	4.18E-11	4.68E-11	-10.379	-10.33	0.049	13.09
	CuCl2	3.61E-12	4.04E-12	-11.443	-11.394	0.049	31.02
	Cu(OH)3-	2.49E-12	1.83E-12	-11.603	-11.739	-0.135	0
	CuF+	4.35E-13	3.19E-13	-12.361	-12.496	-0.135	0
	Cu2(OH)2+	4.86E-14	1.40E-14	-13.313	-13.854	-0.54	0
	CuCl3-	4.63E-15	3.02E-15	-14.334	-14.52	-0.186	0
	Cu(OH)4-2	3.60E-16	1.04E-16	-15.444	-15.984	-0.54	0
	CuCl4-2	1.47E-17	3.19E-18	-16.833	-17.496	-0.663	0
F	9.10E-04						
	F-	4.40E-04	2.79E-04	-3.357	-3.555	-0.197	-0.69
	MgF+	4.39E-04	2.93E-04	-3.357	-3.532	-0.175	-10.28
	NaF	3.13E-05	3.50E-05	-4.505	-4.456	0.049	7.26
	HF	1.30E-09	1.45E-09	-8.887	-8.839	0.049	12.5
	MnF+	6.86E-11	4.69E-11	-10.163	-10.329	-0.166	0
	ZnF+	5.09E-11	3.73E-11	-10.294	-10.429	-0.135	0
	HF2-	2.12E-12	1.55E-12	-11.674	-11.809	-0.135	22.69
	FeF+	1.12E-12	8.18E-13	-11.952	-12.087	-0.135	0
	CuF+	4.35E-13	3.19E-13	-12.361	-12.496	-0.135	0
	FeF2+	2.01E-15	1.37E-15	-14.696	-14.862	-0.166	0
	FeF+2	5.70E-16	1.24E-16	-15.244	-15.907	-0.663	0
	FeF3	5.43E-16	6.07E-16	-15.265	-15.216	0.049	0
Fe(2)	2.66E-09						

	Fe+2	1.17E-09	2.93E-10	-8.934	-9.533	-0.599	-20.89
	FeCO3	7.92E-10	8.86E-10	-9.101	-9.053	0.049	0
	FeHCO3+	3.73E-10	2.73E-10	-9.429	-9.564	-0.135	0
	FeSO4	1.70E-10	1.90E-10	-9.77	-9.721	0.049	18.97
	FeCl+	1.17E-10	8.53E-11	-9.934	-10.069	-0.135	0
	FeOH+	3.87E-11	2.64E-11	-10.413	-10.578	-0.166	0
	FeF+	1.12E-12	8.18E-13	-11.952	-12.087	-0.135	0
	Fe(OH)2	5.72E-14	6.40E-14	-13.243	-13.194	0.049	0
	Fe(OH)3-	9.91E-16	6.77E-16	-15.004	-15.17	-0.166	0
	FeHSO4+	5.91E-18	4.33E-18	-17.228	-17.363	-0.135	0
Fe(3)	2.33E-06						
	Fe(OH)3	1.59E-06	1.78E-06	-5.798	-5.75	0.049	0
	Fe(OH)4-	6.67E-07	4.62E-07	-6.176	-6.335	-0.159	0
	Fe(OH)2+	7.00E-08	4.85E-08	-7.155	-7.314	-0.159	0
	FeOH+2	2.37E-12	5.15E-13	-11.625	-12.288	-0.663	0
	FeF2+	2.01E-15	1.37E-15	-14.696	-14.862	-0.166	0
	FeF+2	5.70E-16	1.24E-16	-15.244	-15.907	-0.663	0
	FeF3	5.43E-16	6.07E-16	-15.265	-15.216	0.049	0
	FeSO4+	1.64E-17	1.12E-17	-16.785	-16.951	-0.166	0
	FeCl+2	8.21E-18	1.78E-18	-17.086	-17.749	-0.663	0
	Fe+3	3.11E-18	2.80E-19	-17.507	-18.553	-1.046	0
	FeCl2+	2.46E-18	1.68E-18	-17.609	-17.775	-0.166	0
	Fe(SO4)2-	1.22E-18	8.92E-19	-17.914	-18.05	-0.135	0
	FeCl3	3.16E-20	3.54E-20	-19.5	-19.451	0.049	0
	Fe2(OH)2+	1.04E-21	7.13E-24	-20.985	-23.147	-2.162	0
	FeHSO4+2	3.61E-25	1.04E-25	-24.443	-24.983	-0.54	0
	Fe3(OH)4+	1.73E-25	7.23E-29	-24.763	-28.141	-3.378	0
H(0)	1.52E-28						
	H2	7.61E-29	8.51E-29	-28.119	-28.07	0.049	28.61
K	4.43E-03						
	K+	4.33E-03	2.79E-03	-2.364	-2.554	-0.19	9.55
	KSO4-	1.03E-04	7.15E-05	-3.987	-4.146	-0.159	34.73
Mg	7.12E-02						
	Mg+2	5.42E-02	1.59E-02	-1.266	-1.798	-0.532	-20.57
	MgSO4	1.22E-02	1.36E-02	-1.915	-1.866	0.049	5.84
	MgHCO3+	2.66E-03	1.74E-03	-2.575	-2.761	-0.186	5.79
	MgCO3	1.71E-03	1.91E-03	-2.767	-2.718	0.049	-17.09
	MgF+	4.39E-04	2.93E-04	-3.357	-3.532	-0.175	-10.28
	MgOH+	2.29E-05	1.65E-05	-4.641	-4.784	-0.143	0
Mn(2)	3.90E-07						
	MnCO3	2.17E-07	2.43E-07	-6.663	-6.615	0.049	0
	Mn+2	9.65E-08	2.43E-08	-7.015	-7.615	-0.599	-16.69
	MnCl+	3.06E-08	2.09E-08	-7.515	-7.681	-0.166	-2.81
	MnHCO3+	2.95E-08	2.02E-08	-7.53	-7.696	-0.166	0
	MnSO4	1.41E-08	1.57E-08	-7.852	-7.803	0.049	22.54
	MnCl2	1.72E-09	1.92E-09	-8.766	-8.717	0.049	85.89
	MnOH+	2.60E-10	1.78E-10	-9.584	-9.75	-0.166	0
	MnCl3-	1.63E-10	1.12E-10	-9.787	-9.953	-0.166	45.2
	MnF+	6.86E-11	4.69E-11	-10.163	-10.329	-0.166	0
	Mn(NO3)2	5.50E-15	6.15E-15	-14.26	-14.211	0.049	41.04

	Mn(OH)3-	1.30E-17	8.88E-18	-16.886	-17.051	-0.166	0
Mn(3)	8.34E-29						
	Mn+3	8.34E-29	7.50E-30	-28.079	-29.125	-1.046	0
N(-3)	4.80E-05						
	NH4+	4.27E-05	2.53E-05	-4.37	-4.596	-0.226	18.38
	NH3	3.72E-06	4.16E-06	-5.429	-5.381	0.049	24.42
	NH4SO4-	1.62E-06	1.19E-06	-5.789	-5.925	-0.135	39.41
N(5)	4.10E-04						
	NO3-	4.10E-04	2.52E-04	-3.387	-3.598	-0.211	30.16
	Mn(NO3)2	5.50E-15	6.15E-15	-14.26	-14.211	0.049	41.04
Na	3.11E-01						
	Na+	3.04E-01	2.18E-01	-0.517	-0.661	-0.144	-0.64
	NaSO4-	5.75E-03	3.98E-03	-2.241	-2.4	-0.159	19.99
	NaHCO3	1.02E-03	1.14E-03	-2.991	-2.942	0.049	1.8
	NaCO3-	6.98E-04	5.11E-04	-3.156	-3.291	-0.135	1.88
	NaF	3.13E-05	3.50E-05	-4.505	-4.456	0.049	7.26
	NaOH	5.62E-17	6.28E-17	-16.25	-16.202	0.049	0
O(0)	1.00E-36						
	O2	5.01E-37	5.61E-37	-36.3	-36.251	0.049	30.4
S(6)	3.67E-02						
	SO4-2	1.76E-02	3.65E-03	-1.756	-2.438	-0.683	17.03
	MgSO4	1.22E-02	1.36E-02	-1.915	-1.866	0.049	5.84
	NaSO4-	5.75E-03	3.98E-03	-2.241	-2.4	-0.159	19.99
	CaSO4	1.07E-03	1.20E-03	-2.97	-2.921	0.049	7.5
	KSO4-	1.03E-04	7.15E-05	-3.987	-4.146	-0.159	34.73
	BaSO4	4.53E-06	5.06E-06	-5.344	-5.296	0.049	0
	NH4SO4-	1.62E-06	1.19E-06	-5.789	-5.925	-0.135	39.41
	MnSO4	1.41E-08	1.57E-08	-7.852	-7.803	0.049	22.54
	ZnSO4	7.23E-09	8.08E-09	-8.141	-8.092	0.049	21.71
	HSO4-	1.68E-09	1.23E-09	-8.775	-8.911	-0.135	40.86
	Zn(SO4)2-2	8.31E-10	2.40E-10	-9.08	-9.621	-0.54	-7
	FeSO4	1.70E-10	1.90E-10	-9.77	-9.721	0.049	18.97
	CuSO4	4.18E-11	4.68E-11	-10.379	-10.33	0.049	13.09
	CaHSO4+	3.73E-11	2.74E-11	-10.428	-10.563	-0.135	0
	FeSO4+	1.64E-17	1.12E-17	-16.785	-16.951	-0.166	0
	FeHSO4+	5.91E-18	4.33E-18	-17.228	-17.363	-0.135	0
	Fe(SO4)2-	1.22E-18	8.92E-19	-17.914	-18.05	-0.135	0
	FeHSO4+2	3.61E-25	1.04E-25	-24.443	-24.983	-0.54	0
Zn	2.54E-06						
	Zn(CO3)2-2	2.22E-06	6.40E-07	-5.653	-6.194	-0.54	0
	ZnCO3	2.13E-07	2.38E-07	-6.673	-6.624	0.049	0
	Zn+2	4.36E-08	9.46E-09	-7.361	-8.024	-0.663	-24.21
	ZnOHCl	1.68E-08	1.88E-08	-7.774	-7.726	0.049	0
	ZnHCO3+	1.51E-08	1.11E-08	-7.82	-7.955	-0.135	0
	Zn(OH)2	8.63E-09	9.65E-09	-8.064	-8.015	0.049	0
	ZnCl+	8.23E-09	5.37E-09	-8.085	-8.27	-0.186	-15.31
	ZnSO4	7.23E-09	8.08E-09	-8.141	-8.092	0.049	21.71
	ZnOH+	4.03E-09	2.95E-09	-8.395	-8.53	-0.135	0
	ZnCl2	1.06E-09	1.19E-09	-8.975	-8.926	0.049	102.03
	Zn(SO4)2-2	8.31E-10	2.40E-10	-9.08	-9.621	-0.54	-7

ZnCl3-	4.30E-10	2.80E-10	-9.367	-9.552	-0.186	13.83
ZnCl4-2	1.37E-10	2.96E-11	-9.865	-10.528	-0.663	149.25
ZnF+	5.09E-11	3.73E-11	-10.294	-10.429	-0.135	0
Zn(OH)3-	1.19E-11	8.69E-12	-10.926	-11.061	-0.135	0
Zn(OH)4-2	1.36E-15	3.92E-16	-14.866	-15.406	-0.54	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-0.89	-5.17	-4.28	CaSO4
Aragonite	1.7	-6.63	-8.34	CaCO3
Barite	1.85	-8	-9.84	BaSO4
Calcite	1.85	-6.63	-8.48	CaCO3
CO2(g)	-2.67	-4.13	-1.47	CO2
Dolomite	4.75	-12.33	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.92	6.81	4.89	Fe(OH)3
Fluorite	0.76	-9.84	-10.6	CaF2
Goethite	7.82	6.82	-1	FeOOH
Gypsum	-0.6	-5.18	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	-0.01	1.5	H2O
Halite	-2.91	-1.34	1.57	NaCl
Hausmann	-8.22	52.81	61.03	Mn3O4
Hematite	17.65	13.64	-4.01	Fe2O3
Jarosite-K	-3.15	-12.36	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.59	21.75	25.34	MnOOH
Melanterit	-9.8	-12.01	-2.21	FeSO4:7H2O
NH3(g)	-7.18	-5.38	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.91	9.29	15.2	Mn(OH)2
Pyrolusite	-7.17	34.21	41.38	MnO2:H2O
Rhodochro	-0.38	-11.51	-11.13	MnCO3
Siderite	-2.54	-13.43	-10.89	FeCO3
Smithsonit	-1.92	-11.92	-10	ZnCO3
Sylvite	-4.13	-3.23	0.9	KCl
Witherite	-0.9	-9.46	-8.56	BaCO3
Zn(OH)2(e	-2.62	8.88	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 25

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	2.51E-02	2.51E-02
Ba	1.87E-05	1.87E-05

Ca	9.19E-03	9.19E-03
Cl	3.37E-01	3.37E-01
Cu	3.10E-07	3.10E-07
F	9.50E-04	9.50E-04
Fe	2.42E-06	2.42E-06
K	4.61E-03	4.61E-03
Mg	7.42E-02	7.42E-02
Mn	4.10E-07	4.10E-07
N(-3)	5.00E-05	5.00E-05
N(5)	4.20E-04	4.20E-04
Na	3.24E-01	3.24E-01
S(6)	3.82E-02	3.82E-02
Zn	2.64E-06	2.64E-06

#NAME? of solution----------

pH	=	8.46			
pe	=	4			
Specific	Conductan	(µS/cm,	25°C)	=	36943
Density	(g/cm³)	=	1.01793		
Volume	(L)	=	1.00871		
Activity	of	water	=	0.987	
Ionic	strength	(mol/kgw)	=	5.07E-01	
Mass	of	water	(kg)	=	1.00E+00
Total	carbon	(mol/kg)	=	2.16E-02	
Total	CO2	(mol/kg)	=	2.16E-02	
Temperatu	(°C)	=	25		
Electrical	balance	(eq)	=	5.59E-02	
Percent	error,	100*(Cat-|	=	6.59	
Iterations	=	14	(255	overall)	
Total	H	=	1.11E+02		
Total	O	=	5.57E+01		

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4357	0.2624		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.56E-06	2.88E-06	-5.341	-5.541	-0.2	-2.91
H+	4.54E-09	3.47E-09	-8.343	-8.46	-0.117	0
H2O	5.55E+01	9.87E-01	1.744	-0.006	0	18.07
Ba	1.87E-05					
Ba+2	1.35E-05	2.86E-06	-4.871	-5.544	-0.673	-11.21
BaSO4	4.72E-06	5.30E-06	-5.326	-5.276	0.051	0

	BaHCO3+	3.56E-07	2.61E-07	-6.448	-6.583	-0.135	0
	BaCO3	1.70E-07	1.91E-07	-6.771	-6.72	0.051	-10.7
	BaOH+	4.05E-11	2.75E-11	-10.393	-10.56	-0.167	0
C(4)	2.16E-02						
	HCO3-	1.38E-02	9.55E-03	-1.86	-2.02	-0.16	26.49
	MgHCO3+	2.84E-03	1.84E-03	-2.547	-2.735	-0.188	5.79
	MgCO3	1.81E-03	2.03E-03	-2.743	-2.692	0.051	-17.09
	NaHCO3	1.08E-03	1.22E-03	-2.965	-2.914	0.051	1.8
	NaCO3-	7.44E-04	5.46E-04	-3.128	-3.263	-0.135	1.99
	CO3-2	5.66E-04	1.29E-04	-3.247	-3.889	-0.642	-2.46
	CaCO3	3.69E-04	4.15E-04	-3.433	-3.382	0.051	-14.6
	CaHCO3+	3.30E-04	2.33E-04	-3.482	-3.633	-0.151	9.94
	CO2	6.71E-05	7.54E-05	-4.173	-4.122	0.051	34.43
	Zn(CO3)2-2	2.32E-06	6.71E-07	-5.635	-6.174	-0.538	0
	BaHCO3+	3.56E-07	2.61E-07	-6.448	-6.583	-0.135	0
	MnCO3	2.28E-07	2.57E-07	-6.642	-6.591	0.051	0
	ZnCO3	2.16E-07	2.43E-07	-6.665	-6.615	0.051	0
	BaCO3	1.70E-07	1.91E-07	-6.771	-6.72	0.051	-10.7
	CuCO3	3.80E-08	4.27E-08	-7.421	-7.37	0.051	0
	MnHCO3+	3.13E-08	2.13E-08	-7.505	-7.672	-0.167	0
	Cu(CO3)2-	2.39E-08	6.93E-09	-7.621	-8.159	-0.538	0
	ZnHCO3+	1.55E-08	1.13E-08	-7.811	-7.946	-0.135	0
	FeCO3	8.42E-10	9.47E-10	-9.074	-9.024	0.051	0
	CuHCO3+	4.01E-10	2.94E-10	-9.397	-9.531	-0.135	0
	FeHCO3+	3.98E-10	2.92E-10	-9.4	-9.535	-0.135	0
	(CO2)2	9.29E-11	1.04E-10	-10.032	-9.981	0.051	68.87
Ca	9.19E-03						
	Ca+2	7.37E-03	1.91E-03	-2.133	-2.718	-0.586	-16.84
	CaSO4	1.12E-03	1.26E-03	-2.95	-2.9	0.051	7.5
	CaCO3	3.69E-04	4.15E-04	-3.433	-3.382	0.051	-14.6
	CaHCO3+	3.30E-04	2.33E-04	-3.482	-3.633	-0.151	9.94
	CaOH+	1.23E-07	9.03E-08	-6.91	-7.044	-0.135	0
	CaHSO4+	3.91E-11	2.87E-11	-10.408	-10.542	-0.135	0
Cl	3.37E-01						
	Cl-	3.37E-01	2.19E-01	-0.472	-0.66	-0.188	18.69
	CuCl3-2	7.92E-08	1.70E-08	-7.101	-7.771	-0.669	0
	CuCl2-	7.53E-08	4.89E-08	-7.123	-7.311	-0.188	0
	MnCl+	3.28E-08	2.23E-08	-7.484	-7.652	-0.167	-2.81
	ZnOHCl	1.73E-08	1.94E-08	-7.762	-7.711	0.051	0
	ZnCl+	8.55E-09	5.55E-09	-8.068	-8.255	-0.188	-15.38
	MnCl2	1.90E-09	2.13E-09	-8.722	-8.672	0.051	85.89
	ZnCl2	1.13E-09	1.27E-09	-8.946	-8.895	0.051	102.03
	ZnCl3-	4.81E-10	3.12E-10	-9.318	-9.505	-0.188	13.69
	MnCl3-	1.89E-10	1.28E-10	-9.724	-9.892	-0.167	45.27
	ZnCl4-2	1.60E-10	3.43E-11	-9.796	-10.465	-0.669	149.37
	FeCl+	1.26E-10	9.23E-11	-9.9	-10.035	-0.135	0
	CuCl+	5.58E-11	3.62E-11	-10.253	-10.441	-0.188	1.64
	CuCl2	3.79E-12	4.26E-12	-11.422	-11.371	0.051	31.02
	CuCl3-	5.09E-15	3.31E-15	-14.293	-14.481	-0.188	0
	CuCl4-2	1.69E-17	3.63E-18	-16.771	-17.441	-0.669	0

	FeCl+2	9.01E-18	1.93E-18	-17.045	-17.715	-0.669	0
	FeCl2+	2.77E-18	1.89E-18	-17.557	-17.725	-0.167	0
	FeCl3	3.67E-20	4.13E-20	-19.435	-19.385	0.051	0
Cu(1)	1.55E-07						
	CuCl3-2	7.92E-08	1.70E-08	-7.101	-7.771	-0.669	0
	CuCl2-	7.53E-08	4.89E-08	-7.123	-7.311	-0.188	0
	Cu+	5.47E-12	3.23E-12	-11.262	-11.491	-0.229	0
Cu(2)	1.56E-07						
	Cu(OH)2	9.26E-08	1.04E-07	-7.033	-6.983	0.051	0
	CuCO3	3.80E-08	4.27E-08	-7.421	-7.37	0.051	0
	Cu(CO3)2-	2.39E-08	6.93E-09	-7.621	-8.159	-0.538	0
	CuHCO3+	4.01E-10	2.94E-10	-9.397	-9.531	-0.135	0
	CuOH+	2.70E-10	1.75E-10	-9.569	-9.757	-0.188	0
	Cu+2	2.47E-10	6.15E-11	-9.607	-10.211	-0.604	-25.43
	CuCl+	5.58E-11	3.62E-11	-10.253	-10.441	-0.188	1.64
	CuSO4	4.14E-11	4.65E-11	-10.383	-10.333	0.051	13.09
	CuCl2	3.79E-12	4.26E-12	-11.422	-11.371	0.051	31.02
	Cu(OH)3-	2.43E-12	1.78E-12	-11.614	-11.749	-0.135	0
	CuF+	4.34E-13	3.19E-13	-12.362	-12.497	-0.135	0
	Cu2(OH)2+	4.63E-14	1.34E-14	-13.334	-13.873	-0.538	0
	CuCl3-	5.09E-15	3.31E-15	-14.293	-14.481	-0.188	0
	Cu(OH)4-2	3.50E-16	1.01E-16	-15.456	-15.994	-0.538	0
	CuCl4-2	1.69E-17	3.63E-18	-16.771	-17.441	-0.669	0
F	9.50E-04						
	MgF+	4.66E-04	3.10E-04	-3.332	-3.508	-0.177	-10.27
	F-	4.51E-04	2.85E-04	-3.346	-3.546	-0.2	-0.68
	NaF	3.31E-05	3.72E-05	-4.48	-4.43	0.051	7.26
	HF	1.32E-09	1.48E-09	-8.88	-8.83	0.051	12.5
	MnF+	7.24E-11	4.93E-11	-10.14	-10.307	-0.167	0
	ZnF+	5.17E-11	3.79E-11	-10.287	-10.421	-0.135	0
	HF2-	2.21E-12	1.62E-12	-11.657	-11.791	-0.135	22.7
	FeF+	1.19E-12	8.70E-13	-11.926	-12.06	-0.135	0
	CuF+	4.34E-13	3.19E-13	-12.362	-12.497	-0.135	0
	FeF2+	2.20E-15	1.49E-15	-14.659	-14.826	-0.167	0
	FeF+2	6.15E-16	1.32E-16	-15.211	-15.88	-0.669	0
	FeF3	6.00E-16	6.74E-16	-15.222	-15.172	0.051	0
Fe(2)	2.82E-09						
	Fe+2	1.23E-09	3.06E-10	-8.91	-9.515	-0.604	-20.87
	FeCO3	8.42E-10	9.47E-10	-9.074	-9.024	0.051	0
	FeHCO3+	3.98E-10	2.92E-10	-9.4	-9.535	-0.135	0
	FeSO4	1.79E-10	2.01E-10	-9.747	-9.696	0.051	18.97
	FeCl+	1.26E-10	9.23E-11	-9.9	-10.035	-0.135	0
	FeOH+	4.04E-11	2.75E-11	-10.393	-10.561	-0.167	0
	FeF+	1.19E-12	8.70E-13	-11.926	-12.06	-0.135	0
	Fe(OH)2	5.93E-14	6.66E-14	-13.227	-13.176	0.051	0
	Fe(OH)3-	1.04E-15	7.04E-16	-14.985	-15.152	-0.167	0
	FeHSO4+	6.25E-18	4.59E-18	-17.204	-17.338	-0.135	0
Fe(3)	2.42E-06						
	Fe(OH)3	1.65E-06	1.85E-06	-5.783	-5.732	0.051	0
	Fe(OH)4-	6.96E-07	4.81E-07	-6.158	-6.318	-0.16	0

	Fe(OH)2+	7.31E-08	5.05E-08	-7.136	-7.296	-0.16	0
	FeOH+2	2.51E-12	5.36E-13	-11.601	-12.271	-0.669	0
	FeF2+	2.20E-15	1.49E-15	-14.659	-14.826	-0.167	0
	FeF+2	6.15E-16	1.32E-16	-15.211	-15.88	-0.669	0
	FeF3	6.00E-16	6.74E-16	-15.222	-15.172	0.051	0
	FeSO4+	1.74E-17	1.19E-17	-16.759	-16.926	-0.167	0
	FeCl+2	9.01E-18	1.93E-18	-17.045	-17.715	-0.669	0
	Fe+3	3.29E-18	2.92E-19	-17.482	-18.535	-1.052	0
	FeCl2+	2.77E-18	1.89E-18	-17.557	-17.725	-0.167	0
	Fe(SO4)2-	1.31E-18	9.60E-19	-17.883	-18.018	-0.135	0
	FeCl3	3.67E-20	4.13E-20	-19.435	-19.385	0.051	0
	Fe2(OH)2+	1.10E-21	7.74E-24	-20.958	-23.111	-2.153	0
	FeHSO4+2	3.80E-25	1.10E-25	-24.42	-24.958	-0.538	0
	Fe3(OH)4+	1.89E-25	8.17E-29	-24.724	-28.088	-3.364	0
H(0)	1.52E-28						
	H2	7.57E-29	8.51E-29	-28.121	-28.07	0.051	28.61
K	4.61E-03						
	K+	4.50E-03	2.89E-03	-2.347	-2.539	-0.192	9.56
	KSO4-	1.09E-04	7.53E-05	-3.963	-4.123	-0.16	34.75
Mg	7.42E-02						
	Mg+2	5.64E-02	1.65E-02	-1.249	-1.783	-0.534	-20.55
	MgSO4	1.27E-02	1.43E-02	-1.895	-1.844	0.051	5.84
	MgHCO3+	2.84E-03	1.84E-03	-2.547	-2.735	-0.188	5.79
	MgCO3	1.81E-03	2.03E-03	-2.743	-2.692	0.051	-17.09
	MgF+	4.66E-04	3.10E-04	-3.332	-3.508	-0.177	-10.27
	MgOH+	2.37E-05	1.70E-05	-4.625	-4.769	-0.144	0
Mn(2)	4.10E-07						
	MnCO3	2.28E-07	2.57E-07	-6.642	-6.591	0.051	0
	Mn+2	1.01E-07	2.50E-08	-6.998	-7.602	-0.604	-16.65
	MnCl+	3.28E-08	2.23E-08	-7.484	-7.652	-0.167	-2.81
	MnHCO3+	3.13E-08	2.13E-08	-7.505	-7.672	-0.167	0
	MnSO4	1.47E-08	1.65E-08	-7.834	-7.783	0.051	22.54
	MnCl2	1.90E-09	2.13E-09	-8.722	-8.672	0.051	85.89
	MnOH+	2.69E-10	1.83E-10	-9.57	-9.738	-0.167	0
	MnCl3-	1.89E-10	1.28E-10	-9.724	-9.892	-0.167	45.27
	MnF+	7.24E-11	4.93E-11	-10.14	-10.307	-0.167	0
	Mn(NO3)2	5.85E-15	6.58E-15	-14.233	-14.182	0.051	41.04
	Mn(OH)3-	1.34E-17	9.13E-18	-16.872	-17.039	-0.167	0
Mn(3)	8.72E-29						
	Mn+3	8.72E-29	7.73E-30	-28.059	-29.112	-1.052	0
N(-3)	5.00E-05						
	NH4+	4.45E-05	2.62E-05	-4.352	-4.581	-0.229	18.39
	NH3	3.84E-06	4.31E-06	-5.416	-5.365	0.051	24.42
	NH4SO4-	1.71E-06	1.25E-06	-5.768	-5.903	-0.135	39.47
N(5)	4.20E-04						
	NO3-	4.20E-04	2.57E-04	-3.377	-3.59	-0.213	30.18
	Mn(NO3)2	5.85E-15	6.58E-15	-14.233	-14.182	0.051	41.04
Na	3.24E-01						
	Na+	3.16E-01	2.27E-01	-0.5	-0.644	-0.144	-0.63
	NaSO4-	6.10E-03	4.21E-03	-2.215	-2.375	-0.16	20.13

	NaHCO3	1.08E-03	1.22E-03	-2.965	-2.914	0.051	1.8
	NaCO3-	7.44E-04	5.46E-04	-3.128	-3.263	-0.135	1.99
	NaF	3.31E-05	3.72E-05	-4.48	-4.43	0.051	7.26
	NaOH	5.82E-17	6.54E-17	-16.235	-16.185	0.051	0
O(0)	9.97E-37						
	O2	4.99E-37	5.60E-37	-36.302	-36.252	0.051	30.4
S(6)	3.82E-02						
	SO4-2	1.81E-02	3.70E-03	-1.742	-2.431	-0.69	17.08
	MgSO4	1.27E-02	1.43E-02	-1.895	-1.844	0.051	5.84
	NaSO4-	6.10E-03	4.21E-03	-2.215	-2.375	-0.16	20.13
	CaSO4	1.12E-03	1.26E-03	-2.95	-2.9	0.051	7.5
	KSO4-	1.09E-04	7.53E-05	-3.963	-4.123	-0.16	34.75
	BaSO4	4.72E-06	5.30E-06	-5.326	-5.276	0.051	0
	NH4SO4-	1.71E-06	1.25E-06	-5.768	-5.903	-0.135	39.47
	MnSO4	1.47E-08	1.65E-08	-7.834	-7.783	0.051	22.54
	ZnSO4	7.28E-09	8.19E-09	-8.138	-8.087	0.051	21.71
	HSO4-	1.70E-09	1.25E-09	-8.769	-8.904	-0.135	40.88
	Zn(SO4)2-2	8.51E-10	2.46E-10	-9.07	-9.608	-0.538	-6.8
	FeSO4	1.79E-10	2.01E-10	-9.747	-9.696	0.051	18.97
	CuSO4	4.14E-11	4.65E-11	-10.383	-10.333	0.051	13.09
	CaHSO4+	3.91E-11	2.87E-11	-10.408	-10.542	-0.135	0
	FeSO4+	1.74E-17	1.19E-17	-16.759	-16.926	-0.167	0
	FeHSO4+	6.25E-18	4.59E-18	-17.204	-17.338	-0.135	0
	Fe(SO4)2-	1.31E-18	9.60E-19	-17.883	-18.018	-0.135	0
	FeHSO4+2	3.80E-25	1.10E-25	-24.42	-24.958	-0.538	0
Zn	2.64E-06						
	Zn(CO3)2-2	2.32E-06	6.71E-07	-5.635	-6.174	-0.538	0
	ZnCO3	2.16E-07	2.43E-07	-6.665	-6.615	0.051	0
	Zn+2	4.41E-08	9.43E-09	-7.356	-8.026	-0.669	-24.2
	ZnOHCl	1.73E-08	1.94E-08	-7.762	-7.711	0.051	0
	ZnHCO3+	1.55E-08	1.13E-08	-7.811	-7.946	-0.135	0
	Zn(OH)2	8.55E-09	9.61E-09	-8.068	-8.017	0.051	0
	ZnCl+	8.55E-09	5.55E-09	-8.068	-8.255	-0.188	-15.38
	ZnSO4	7.28E-09	8.19E-09	-8.138	-8.087	0.051	21.71
	ZnOH+	4.01E-09	2.94E-09	-8.397	-8.531	-0.135	0
	ZnCl2	1.13E-09	1.27E-09	-8.946	-8.895	0.051	102.03
	Zn(SO4)2-2	8.51E-10	2.46E-10	-9.07	-9.608	-0.538	-6.8
	ZnCl3-	4.81E-10	3.12E-10	-9.318	-9.505	-0.188	13.69
	ZnCl4-2	1.60E-10	3.43E-11	-9.796	-10.465	-0.669	149.37
	ZnF+	5.17E-11	3.79E-11	-10.287	-10.421	-0.135	0
	Zn(OH)3-	1.18E-11	8.65E-12	-10.928	-11.063	-0.135	0
	Zn(OH)4-2	1.35E-15	3.90E-16	-14.871	-15.409	-0.538	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-0.87	-5.15	-4.28	CaSO4			
Aragonite	1.73	-6.61	-8.34	CaCO3			
Barite	1.87	-7.98	-9.84	BaSO4			

Calcite	1.87	-6.61	-8.48	CaCO3
CO2(g)	-2.65	-4.12	-1.47	CO2
Dolomite	4.8	-12.28	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.94	6.83	4.89	Fe(OH)3
Fluorite	0.79	-9.81	-10.6	CaF2
Goethite	7.83	6.83	-1	FeOOH
Gypsum	-0.58	-5.16	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	-0.01	1.5	H2O
Halite	-2.87	-1.3	1.57	NaCl
Hausmann	-8.18	52.85	61.03	Mn3O4
Hematite	17.68	13.67	-4.01	Fe2O3
Jarosite-K	-3.07	-12.28	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.57	21.77	25.34	MnOOH
Melanterit	-9.78	-11.99	-2.21	FeSO4:7H2O
NH3(g)	-7.16	-5.37	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.89	9.31	15.2	Mn(OH)2
Pyrolusite	-7.16	34.22	41.38	MnO2:H2O
Rhodochrc	-0.36	-11.49	-11.13	MnCO3
Siderite	-2.51	-13.4	-10.89	FeCO3
Smithsonit	-1.91	-11.91	-10	ZnCO3
Sylvite	-4.1	-3.2	0.9	KCl
Witherite	-0.87	-9.43	-8.56	BaCO3
Zn(OH)2(e	-2.62	8.88	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 26

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	2.61E-02	2.61E-02
Ba	1.94E-05	1.94E-05
Ca	9.56E-03	9.56E-03
Cl	3.51E-01	3.51E-01
Cu	3.20E-07	3.20E-07
F	9.90E-04	9.90E-04
Fe	2.52E-06	2.52E-06
K	4.80E-03	4.80E-03
Mg	7.72E-02	7.72E-02
Mn	4.30E-07	4.30E-07
N(-3)	5.20E-05	5.20E-05
N(5)	4.40E-04	4.40E-04
Na	3.38E-01	3.38E-01
S(6)	3.97E-02	3.97E-02
Zn	2.75E-06	2.75E-06

#NAME? of solution----------

pH	=	8.46		
pe	=	4		
Specific	Conductan	(µS/cm,	25°C)	= 38199
Density	(g/cm³)	=	1.01875	
Volume	(L)	=	1.00896	
Activity	of	water	=	0.986
Ionic	strength	(mol/kgw)	=	5.26E-01
Mass	of	water	(kg)	= 1.00E+00
Total	carbon	(mol/kg)	=	2.25E-02
Total	CO2	(mol/kg)	=	2.25E-02
Temperatu	(°C)	=	25	
Electrical	balance	(eq)	=	5.82E-02
Percent	error,	100*(Cat-|	=	6.6
Iterations	=	14	(269	overall)
Total	H	=	1.11E+02	
Total	O	=	5.57E+01	

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4362	0.2624		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.58E-06	2.88E-06	-5.339	-5.541	-0.202	-2.88
H+	4.55E-09	3.47E-09	-8.342	-8.46	-0.118	0
H2O	5.55E+01	9.86E-01	1.744	-0.006	0	18.07
Ba	1.94E-05					
Ba+2	1.40E-05	2.94E-06	-4.854	-5.532	-0.677	-11.18
BaSO4	4.91E-06	5.54E-06	-5.309	-5.257	0.053	0
BaHCO3+	3.75E-07	2.76E-07	-6.426	-6.56	-0.134	0
BaCO3	1.78E-07	2.01E-07	-6.75	-6.697	0.053	-10.7
BaOH+	4.18E-11	2.83E-11	-10.379	-10.548	-0.169	0
C(4)	2.25E-02					
HCO3-	1.42E-02	9.78E-03	-1.848	-2.01	-0.162	26.55
MgHCO3+	3.02E-03	1.95E-03	-2.52	-2.71	-0.189	5.8
MgCO3	1.91E-03	2.15E-03	-2.72	-2.667	0.053	-17.09
NaHCO3	1.15E-03	1.30E-03	-2.94	-2.887	0.053	1.8
NaCO3-	7.91E-04	5.81E-04	-3.102	-3.236	-0.134	2.1
CO3-2	5.87E-04	1.32E-04	-3.232	-3.879	-0.647	-2.4
CaCO3	3.88E-04	4.39E-04	-3.411	-3.358	0.053	-14.6
CaHCO3+	3.50E-04	2.46E-04	-3.456	-3.609	-0.152	9.94
CO2	6.85E-05	7.73E-05	-4.165	-4.112	0.053	34.43

	Zn(CO3)2-2	2.42E-06	7.05E-07	-5.616	-6.152	-0.536	0
	BaHCO3+	3.75E-07	2.76E-07	-6.426	-6.56	-0.134	0
	MnCO3	2.39E-07	2.70E-07	-6.621	-6.568	0.053	0
	ZnCO3	2.21E-07	2.49E-07	-6.656	-6.603	0.053	0
	BaCO3	1.78E-07	2.01E-07	-6.75	-6.697	0.053	-10.7
	CuCO3	3.78E-08	4.27E-08	-7.422	-7.37	0.053	0
	MnHCO3+	3.31E-08	2.24E-08	-7.481	-7.649	-0.169	0
	Cu(CO3)2-	2.44E-08	7.11E-09	-7.613	-8.148	-0.536	0
	ZnHCO3+	1.58E-08	1.16E-08	-7.801	-7.934	-0.134	0
	FeCO3	8.98E-10	1.01E-09	-9.047	-8.994	0.053	0
	FeHCO3+	4.25E-10	3.12E-10	-9.371	-9.505	-0.134	0
	CuHCO3+	4.01E-10	2.95E-10	-9.397	-9.531	-0.134	0
	(CO2)2	9.71E-11	1.10E-10	-10.013	-9.96	0.053	68.87
Ca	9.56E-03						
	Ca+2	7.65E-03	1.97E-03	-2.116	-2.705	-0.588	-16.82
	CaSO4	1.17E-03	1.32E-03	-2.932	-2.88	0.053	7.5
	CaCO3	3.88E-04	4.39E-04	-3.411	-3.358	0.053	-14.6
	CaHCO3+	3.50E-04	2.46E-04	-3.456	-3.609	-0.152	9.94
	CaOH+	1.27E-07	9.32E-08	-6.897	-7.031	-0.134	0
	CaHSO4+	4.09E-11	3.01E-11	-10.388	-10.522	-0.134	0
Cl	3.51E-01						
	Cl-	3.51E-01	2.27E-01	-0.455	-0.644	-0.189	18.71
	CuCl3-2	8.73E-08	1.84E-08	-7.059	-7.734	-0.675	0
	CuCl2-	7.94E-08	5.13E-08	-7.1	-7.29	-0.189	0
	MnCl+	3.51E-08	2.38E-08	-7.455	-7.624	-0.169	-2.81
	ZnOHCl	1.79E-08	2.02E-08	-7.748	-7.695	0.053	0
	ZnCl+	8.92E-09	5.77E-09	-8.05	-8.239	-0.189	-15.44
	MnCl2	2.08E-09	2.35E-09	-8.681	-8.628	0.053	85.89
	ZnCl2	1.21E-09	1.37E-09	-8.916	-8.863	0.053	102.03
	ZnCl3-	5.39E-10	3.48E-10	-9.268	-9.458	-0.189	13.55
	MnCl3-	2.17E-10	1.47E-10	-9.664	-9.833	-0.169	45.33
	ZnCl4-2	1.88E-10	3.96E-11	-9.727	-10.402	-0.675	149.49
	FeCl+	1.36E-10	1.00E-10	-9.866	-10	-0.134	0
	CuCl+	5.68E-11	3.67E-11	-10.246	-10.435	-0.189	1.67
	CuCl2	3.96E-12	4.47E-12	-11.402	-11.35	0.053	31.02
	CuCl3-	5.56E-15	3.60E-15	-14.255	-14.444	-0.189	0
	CuCl4-2	1.94E-17	4.09E-18	-16.713	-17.389	-0.675	0
	FeCl+2	9.89E-18	2.09E-18	-17.005	-17.68	-0.675	0
	FeCl2+	3.12E-18	2.12E-18	-17.506	-17.674	-0.169	0
	FeCl3	4.25E-20	4.80E-20	-19.371	-19.319	0.053	0
Cu(1)	1.67E-07						
	CuCl3-2	8.73E-08	1.84E-08	-7.059	-7.734	-0.675	0
	CuCl2-	7.94E-08	5.13E-08	-7.1	-7.29	-0.189	0
	Cu+	5.38E-12	3.16E-12	-11.269	-11.501	-0.232	0
Cu(2)	1.53E-07						
	Cu(OH)2	9.00E-08	1.02E-07	-7.046	-6.993	0.053	0
	CuCO3	3.78E-08	4.27E-08	-7.422	-7.37	0.053	0
	Cu(CO3)2-	2.44E-08	7.11E-09	-7.613	-8.148	-0.536	0
	CuHCO3+	4.01E-10	2.95E-10	-9.397	-9.531	-0.134	0
	CuOH+	2.65E-10	1.71E-10	-9.577	-9.767	-0.189	0

	Cu+2	2.45E-10	6.01E-11	-9.612	-10.221	-0.609	-25.42
	CuCl+	5.68E-11	3.67E-11	-10.246	-10.435	-0.189	1.67
	CuSO4	4.09E-11	4.62E-11	-10.388	-10.336	0.053	13.09
	CuCl2	3.96E-12	4.47E-12	-11.402	-11.35	0.053	31.02
	Cu(OH)3-	2.37E-12	1.74E-12	-11.625	-11.759	-0.134	0
	CuF+	4.32E-13	3.18E-13	-12.364	-12.498	-0.134	0
	Cu2(OH)2+	4.39E-14	1.28E-14	-13.357	-13.893	-0.536	0
	CuCl3-	5.56E-15	3.60E-15	-14.255	-14.444	-0.189	0
	Cu(OH)4-2	3.39E-16	9.88E-17	-15.469	-16.005	-0.536	0
	CuCl4-2	1.94E-17	4.09E-18	-16.713	-17.389	-0.675	0
F	9.90E-04						
	MgF+	4.93E-04	3.27E-04	-3.307	-3.485	-0.179	-10.27
	F-	4.62E-04	2.90E-04	-3.336	-3.537	-0.202	-0.66
	NaF	3.49E-05	3.94E-05	-4.457	-4.404	0.053	7.26
	HF	1.34E-09	1.51E-09	-8.874	-8.821	0.053	12.5
	MnF+	7.62E-11	5.17E-11	-10.118	-10.287	-0.169	0
	ZnF+	5.27E-11	3.87E-11	-10.278	-10.412	-0.134	0
	HF2-	2.29E-12	1.68E-12	-11.641	-11.774	-0.134	22.72
	FeF+	1.26E-12	9.27E-13	-11.899	-12.033	-0.134	0
	CuF+	4.32E-13	3.18E-13	-12.364	-12.498	-0.134	0
	FeF2+	2.39E-15	1.62E-15	-14.621	-14.79	-0.169	0
	FeF+2	6.65E-16	1.40E-16	-15.177	-15.853	-0.675	0
	FeF3	6.61E-16	7.46E-16	-15.18	-15.127	0.053	0
Fe(2)	2.99E-09						
	Fe+2	1.30E-09	3.20E-10	-8.886	-9.496	-0.609	-20.85
	FeCO3	8.98E-10	1.01E-09	-9.047	-8.994	0.053	0
	FeHCO3+	4.25E-10	3.12E-10	-9.371	-9.505	-0.134	0
	FeSO4	1.89E-10	2.14E-10	-9.723	-9.671	0.053	18.97
	FeCl+	1.36E-10	1.00E-10	-9.866	-10	-0.134	0
	FeOH+	4.24E-11	2.87E-11	-10.373	-10.542	-0.169	0
	FeF+	1.26E-12	9.27E-13	-11.899	-12.033	-0.134	0
	Fe(OH)2	6.16E-14	6.96E-14	-13.21	-13.158	0.053	0
	Fe(OH)3-	1.08E-15	7.35E-16	-14.965	-15.134	-0.169	0
	FeHSO4+	6.62E-18	4.87E-18	-17.179	-17.313	-0.134	0
Fe(3)	2.52E-06						
	Fe(OH)3	1.71E-06	1.93E-06	-5.766	-5.714	0.053	0
	Fe(OH)4-	7.28E-07	5.02E-07	-6.138	-6.3	-0.162	0
	Fe(OH)2+	7.66E-08	5.28E-08	-7.116	-7.278	-0.162	0
	FeOH+2	2.65E-12	5.60E-13	-11.576	-12.252	-0.675	0
	FeF2+	2.39E-15	1.62E-15	-14.621	-14.79	-0.169	0
	FeF+2	6.65E-16	1.40E-16	-15.177	-15.853	-0.675	0
	FeF3	6.61E-16	7.46E-16	-15.18	-15.127	0.053	0
	FeSO4+	1.86E-17	1.26E-17	-16.732	-16.901	-0.169	0
	FeCl+2	9.89E-18	2.09E-18	-17.005	-17.68	-0.675	0
	Fe+3	3.49E-18	3.05E-19	-17.457	-18.516	-1.059	0
	FeCl2+	3.12E-18	2.12E-18	-17.506	-17.674	-0.169	0
	Fe(SO4)2-	1.41E-18	1.03E-18	-17.852	-17.986	-0.134	0
	FeCl3	4.25E-20	4.80E-20	-19.371	-19.319	0.053	0
	Fe2(OH)2+	1.17E-21	8.45E-24	-20.931	-23.073	-2.143	0
	FeHSO4+2	4.01E-25	1.17E-25	-24.397	-24.933	-0.536	0

	Fe3(OH)4+	2.07E-25	9.31E-29	-24.683	-28.031	-3.348	0
H(0)	1.51E-28						
	H2	7.54E-29	8.51E-29	-28.123	-28.07	0.053	28.61
K	4.80E-03						
	K+	4.69E-03	3.00E-03	-2.329	-2.523	-0.194	9.58
	KSO4-	1.15E-04	7.92E-05	-3.94	-4.101	-0.162	34.76
Mg	7.72E-02						
	Mg+2	5.85E-02	1.71E-02	-1.233	-1.768	-0.535	-20.54
	MgSO4	1.33E-02	1.50E-02	-1.876	-1.823	0.053	5.84
	MgHCO3+	3.02E-03	1.95E-03	-2.52	-2.71	-0.189	5.8
	MgCO3	1.91E-03	2.15E-03	-2.72	-2.667	0.053	-17.09
	MgF+	4.93E-04	3.27E-04	-3.307	-3.485	-0.179	-10.27
	MgOH+	2.46E-05	1.76E-05	-4.609	-4.754	-0.145	0
Mn(2)	4.30E-07						
	MnCO3	2.39E-07	2.70E-07	-6.621	-6.568	0.053	0
	Mn+2	1.05E-07	2.57E-08	-6.98	-7.59	-0.609	-16.61
	MnCl+	3.51E-08	2.38E-08	-7.455	-7.624	-0.169	-2.81
	MnHCO3+	3.31E-08	2.24E-08	-7.481	-7.649	-0.169	0
	MnSO4	1.52E-08	1.72E-08	-7.817	-7.765	0.053	22.54
	MnCl2	2.08E-09	2.35E-09	-8.681	-8.628	0.053	85.89
	MnOH+	2.78E-10	1.88E-10	-9.557	-9.726	-0.169	0
	MnCl3-	2.17E-10	1.47E-10	-9.664	-9.833	-0.169	45.33
	MnF+	7.62E-11	5.17E-11	-10.118	-10.287	-0.169	0
	Mn(NO3)2	6.50E-15	7.34E-15	-14.187	-14.134	0.053	41.04
	Mn(OH)3-	1.38E-17	9.38E-18	-16.859	-17.028	-0.169	0
Mn(3)	9.11E-29						
	Mn+3	9.11E-29	7.95E-30	-28.041	-29.1	-1.059	0
N(-3)	5.20E-05						
	NH4+	4.63E-05	2.71E-05	-4.335	-4.567	-0.232	18.39
	NH3	3.95E-06	4.46E-06	-5.403	-5.351	0.053	24.42
	NH4SO4-	1.79E-06	1.31E-06	-5.748	-5.882	-0.134	39.53
N(5)	4.40E-04						
	NO3-	4.40E-04	2.68E-04	-3.357	-3.572	-0.216	30.19
	Mn(NO3)2	6.50E-15	7.34E-15	-14.187	-14.134	0.053	41.04
Na	3.38E-01						
	Na+	3.29E-01	2.36E-01	-0.483	-0.627	-0.144	-0.61
	NaSO4-	6.45E-03	4.45E-03	-2.19	-2.352	-0.162	20.26
	NaHCO3	1.15E-03	1.30E-03	-2.94	-2.887	0.053	1.8
	NaCO3-	7.91E-04	5.81E-04	-3.102	-3.236	-0.134	2.1
	NaF	3.49E-05	3.94E-05	-4.457	-4.404	0.053	7.26
	NaOH	6.02E-17	6.79E-17	-16.221	-16.168	0.053	0
O(0)	9.92E-37						
	O2	4.96E-37	5.60E-37	-36.305	-36.252	0.053	30.4
S(6)	3.97E-02						
	SO4-2	1.87E-02	3.76E-03	-1.729	-2.425	-0.696	17.13
	MgSO4	1.33E-02	1.50E-02	-1.876	-1.823	0.053	5.84
	NaSO4-	6.45E-03	4.45E-03	-2.19	-2.352	-0.162	20.26
	CaSO4	1.17E-03	1.32E-03	-2.932	-2.88	0.053	7.5
	KSO4-	1.15E-04	7.92E-05	-3.94	-4.101	-0.162	34.76
	BaSO4	4.91E-06	5.54E-06	-5.309	-5.257	0.053	0

NH4SO4-	1.79E-06	1.31E-06	-5.748	-5.882	-0.134	39.53
MnSO4	1.52E-08	1.72E-08	-7.817	-7.765	0.053	22.54
ZnSO4	7.38E-09	8.33E-09	-8.132	-8.08	0.053	21.71
HSO4-	1.73E-09	1.27E-09	-8.763	-8.897	-0.134	40.89
Zn(SO4)2-2	8.73E-10	2.54E-10	-9.059	-9.595	-0.536	-6.6
FeSO4	1.89E-10	2.14E-10	-9.723	-9.671	0.053	18.97
CaHSO4+	4.09E-11	3.01E-11	-10.388	-10.522	-0.134	0
CuSO4	4.09E-11	4.62E-11	-10.388	-10.336	0.053	13.09
FeSO4+	1.86E-17	1.26E-17	-16.732	-16.901	-0.169	0
FeHSO4+	6.62E-18	4.87E-18	-17.179	-17.313	-0.134	0
Fe(SO4)2-	1.41E-18	1.03E-18	-17.852	-17.986	-0.134	0
FeHSO4+2	4.01E-25	1.17E-25	-24.397	-24.933	-0.536	0
Zn	2.75E-06					
Zn(CO3)2-2	2.42E-06	7.05E-07	-5.616	-6.152	-0.536	0
ZnCO3	2.21E-07	2.49E-07	-6.656	-6.603	0.053	0
Zn+2	4.47E-08	9.45E-09	-7.349	-8.025	-0.675	-24.18
ZnOHCl	1.79E-08	2.02E-08	-7.748	-7.695	0.053	0
ZnHCO3+	1.58E-08	1.16E-08	-7.801	-7.934	-0.134	0
ZnCl+	8.92E-09	5.77E-09	-8.05	-8.239	-0.189	-15.44
Zn(OH)2	8.52E-09	9.62E-09	-8.069	-8.017	0.053	0
ZnSO4	7.38E-09	8.33E-09	-8.132	-8.08	0.053	21.71
ZnOH+	4.01E-09	2.95E-09	-8.397	-8.531	-0.134	0
ZnCl2	1.21E-09	1.37E-09	-8.916	-8.863	0.053	102.03
Zn(SO4)2-2	8.73E-10	2.54E-10	-9.059	-9.595	-0.536	-6.6
ZnCl3-	5.39E-10	3.48E-10	-9.268	-9.458	-0.189	13.55
ZnCl4-2	1.88E-10	3.96E-11	-9.727	-10.402	-0.675	149.49
ZnF+	5.27E-11	3.87E-11	-10.278	-10.412	-0.134	0
Zn(OH)3-	1.18E-11	8.65E-12	-10.929	-11.063	-0.134	0
Zn(OH)4-2	1.34E-15	3.90E-16	-14.873	-15.409	-0.536	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-0.85	-5.13	-4.28	CaSO4			
Aragonite	1.75	-6.58	-8.34	CaCO3			
Barite	1.89	-7.96	-9.84	BaSO4			
Calcite	1.9	-6.58	-8.48	CaCO3			
CO2(g)	-2.64	-4.11	-1.47	CO2			
Dolomite	4.85	-12.23	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.96	6.85	4.89	Fe(OH)3			
Fluorite	0.82	-9.78	-10.6	CaF2			
Goethite	7.85	6.85	-1	FeOOH			
Gypsum	-0.56	-5.14	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	-0.01	1.5	H2O			
Halite	-2.84	-1.27	1.57	NaCl			
Hausmann	-8.14	52.89	61.03	Mn3O4			
Hematite	17.72	13.71	-4.01	Fe2O3			
Jarosite-K	-2.99	-12.2	-9.21	KFe3(SO4)2(OH)6			

Manganite	-3.56	21.78	25.34	MnOOH
Melanterit	-9.75	-11.96	-2.21	FeSO4:7H2O
NH3(g)	-7.15	-5.35	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.88	9.32	15.2	Mn(OH)2
Pyrolusite	-7.15	34.23	41.38	MnO2:H2O
Rhodochrc	-0.34	-11.47	-11.13	MnCO3
Siderite	-2.48	-13.37	-10.89	FeCO3
Smithsonit	-1.9	-11.9	-10	ZnCO3
Sylvite	-4.07	-3.17	0.9	KCl
Witherite	-0.85	-9.41	-8.56	BaCO3
Zn(OH)2(e	-2.62	8.88	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 27

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	2.71E-02	2.71E-02
Ba	2.02E-05	2.02E-05
Ca	9.93E-03	9.93E-03
Cl	3.64E-01	3.64E-01
Cu	3.30E-07	3.30E-07
F	1.03E-03	1.03E-03
Fe	2.62E-06	2.62E-06
K	4.99E-03	4.99E-03
Mg	8.02E-02	8.02E-02
Mn	4.40E-07	4.40E-07
N(-3)	5.40E-05	5.40E-05
N(5)	4.60E-04	4.60E-04
Na	3.51E-01	3.51E-01
S(6)	4.13E-02	4.13E-02
Zn	2.86E-06	2.86E-06

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 39444
Density (g/cm³) = 1.01957
Volume (L) = 1.0092
Activity of water = 0.986
Ionic strength (mol/kgw) = 5.46E-01
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 2.33E-02
Total CO2 (mol/kg) = 2.33E-02

```
Temperatu (°C)          =                    25
Electrical  balance     (eq)        =            6.05E-02
Percent     error,      100*(Cat-|=                  6.61
Iterations  =                   13  (282        overall)
Total       H           =           1.11E+02
Total       O           =           5.57E+01

#NAME?  couples--------------------------------

        Redox       couple      pe          Eh          (volts)

        N(-3)/N(5)     4.4367      0.2625

#NAME?  of          species----------------------------

        Log         Log         Log         mole        V
        Species     Molality    Activity    Molality    Activity    Gamma     cm³/mol

        OH-          4.60E-06   2.88E-06     -5.337      -5.541     -0.204      -2.85
        H+           4.55E-09   3.47E-09     -8.342      -8.46      -0.118          0
        H2O          5.55E+01   9.86E-01      1.744      -0.006          0      18.07
Ba        2.02E-05
        Ba+2         1.45E-05   3.03E-06     -4.838      -5.519     -0.681     -11.15
        BaSO4        5.10E-06   5.78E-06     -5.293      -5.238      0.055          0
        BaHCO3+      3.94E-07   2.90E-07     -6.405      -6.538     -0.133          0
        BaCO3        1.86E-07   2.11E-07      -6.73      -6.675      0.055       -10.7
        BaOH+        4.31E-11   2.91E-11    -10.365     -10.536      -0.17          0
C(4)      2.33E-02
        HCO3-        1.46E-02   1.00E-02     -1.837          -2     -0.163      26.61
        MgHCO3+      3.20E-03   2.06E-03     -2.495      -2.686     -0.191        5.8
        MgCO3        2.01E-03   2.27E-03     -2.698      -2.643      0.055     -17.09
        NaHCO3       1.21E-03   1.38E-03     -2.916      -2.861      0.055        1.8
        NaCO3-       8.38E-04   6.17E-04     -3.077       -3.21     -0.133        2.2
        CO3-2        6.07E-04   1.35E-04     -3.217      -3.869     -0.652      -2.34
        CaCO3        4.08E-04   4.63E-04      -3.39      -3.335      0.055      -14.6
        CaHCO3+      3.70E-04   2.60E-04     -3.432      -3.586     -0.153       9.95
        CO2          6.98E-05   7.91E-05     -4.156      -4.102      0.055      34.43
        Zn(CO3)2-:   2.52E-06   7.40E-07     -5.598      -6.131     -0.533          0
        BaHCO3+      3.94E-07   2.90E-07     -6.405      -6.538     -0.133          0
        MnCO3        2.45E-07   2.78E-07     -6.611      -6.556      0.055          0
        ZnCO3        2.26E-07   2.56E-07     -6.647      -6.592      0.055          0
        BaCO3        1.86E-07   2.11E-07      -6.73      -6.675      0.055       -10.7
        CuCO3        3.76E-08   4.27E-08     -7.425       -7.37      0.055          0
        MnHCO3+      3.41E-08   2.30E-08     -7.467      -7.638      -0.17          0
        Cu(CO3)2-    2.48E-08   7.26E-09     -7.606      -8.139     -0.533          0
        ZnHCO3+      1.62E-08   1.19E-08      -7.79      -7.923     -0.133          0
        FeCO3        9.54E-10   1.08E-09      -9.02      -8.966      0.055          0
        FeHCO3+      4.53E-10   3.33E-10     -9.344      -9.477     -0.133          0
        CuHCO3+      4.00E-10   2.94E-10     -9.398      -9.531     -0.133          0
        (CO2)2       1.01E-10   1.15E-10     -9.995       -9.94      0.055      68.87
```

Ca	9.93E-03						
	Ca+2	7.94E-03	2.04E-03	-2.1	-2.691	-0.591	-16.8
	CaSO4	1.22E-03	1.38E-03	-2.915	-2.86	0.055	7.5
	CaCO3	4.08E-04	4.63E-04	-3.39	-3.335	0.055	-14.6
	CaHCO3+	3.70E-04	2.60E-04	-3.432	-3.586	-0.153	9.95
	CaOH+	1.31E-07	9.60E-08	-6.884	-7.018	-0.133	0
	CaHSO4+	4.27E-11	3.15E-11	-10.369	-10.502	-0.133	0
Cl	3.64E-01						
	Cl-	3.64E-01	2.35E-01	-0.438	-0.63	-0.191	18.72
	CuCl3-2	9.58E-08	2.00E-08	-7.019	-7.7	-0.681	0
	CuCl2-	8.34E-08	5.37E-08	-7.079	-7.27	-0.191	0
	MnCl+	3.66E-08	2.47E-08	-7.437	-7.607	-0.17	-2.8
	ZnOHCl	1.85E-08	2.09E-08	-7.734	-7.679	0.055	0
	ZnCl+	9.30E-09	5.99E-09	-8.032	-8.223	-0.191	-15.51
	MnCl2	2.23E-09	2.53E-09	-8.651	-8.597	0.055	85.89
	ZnCl2	1.30E-09	1.47E-09	-8.887	-8.832	0.055	102.03
	ZnCl3-	6.02E-10	3.88E-10	-9.221	-9.412	-0.191	13.41
	MnCl3-	2.42E-10	1.64E-10	-9.616	-9.786	-0.17	45.39
	ZnCl4-2	2.19E-10	4.56E-11	-9.66	-10.341	-0.681	149.6
	FeCl+	1.47E-10	1.08E-10	-9.833	-9.966	-0.133	0
	CuCl+	5.76E-11	3.71E-11	-10.239	-10.431	-0.191	1.7
	CuCl2	4.12E-12	4.68E-12	-11.385	-11.33	0.055	31.02
	CuCl3-	6.05E-15	3.89E-15	-14.218	-14.41	-0.191	0
	CuCl4-2	2.20E-17	4.58E-18	-16.658	-17.339	-0.681	0
	FeCl+2	1.08E-17	2.26E-18	-16.966	-17.646	-0.681	0
	FeCl2+	3.50E-18	2.37E-18	-17.456	-17.626	-0.17	0
	FeCl3	4.90E-20	5.55E-20	-19.31	-19.256	0.055	0
Cu(1)	1.79E-07						
	CuCl3-2	9.58E-08	2.00E-08	-7.019	-7.7	-0.681	0
	CuCl2-	8.34E-08	5.37E-08	-7.079	-7.27	-0.191	0
	Cu+	5.29E-12	3.08E-12	-11.277	-11.511	-0.235	0
Cu(2)	1.51E-07						
	Cu(OH)2	8.74E-08	9.92E-08	-7.058	-7.004	0.055	0
	CuCO3	3.76E-08	4.27E-08	-7.425	-7.37	0.055	0
	Cu(CO3)2-	2.48E-08	7.26E-09	-7.606	-8.139	-0.533	0
	CuHCO3+	4.00E-10	2.94E-10	-9.398	-9.531	-0.133	0
	CuOH+	2.59E-10	1.67E-10	-9.586	-9.777	-0.191	0
	Cu+2	2.41E-10	5.87E-11	-9.617	-10.231	-0.614	-25.4
	CuCl+	5.76E-11	3.71E-11	-10.239	-10.431	-0.191	1.7
	CuSO4	4.03E-11	4.57E-11	-10.395	-10.34	0.055	13.09
	CuCl2	4.12E-12	4.68E-12	-11.385	-11.33	0.055	31.02
	Cu(OH)3-	2.31E-12	1.70E-12	-11.637	-11.77	-0.133	0
	CuF+	4.29E-13	3.16E-13	-12.367	-12.501	-0.133	0
	Cu2(OH)2+	4.16E-14	1.22E-14	-13.381	-13.914	-0.533	0
	CuCl3-	6.05E-15	3.89E-15	-14.218	-14.41	-0.191	0
	Cu(OH)4-2	3.29E-16	9.63E-17	-15.484	-16.016	-0.533	0
	CuCl4-2	2.20E-17	4.58E-18	-16.658	-17.339	-0.681	0
F	1.03E-03						
	MgF+	5.21E-04	3.44E-04	-3.283	-3.463	-0.18	-10.27
	F-	4.72E-04	2.96E-04	-3.326	-3.529	-0.204	-0.65

	NaF	3.67E-05	4.17E-05	-4.435	-4.38	0.055	7.26
	HF	1.36E-09	1.54E-09	-8.868	-8.813	0.055	12.5
	MnF+	7.82E-11	5.28E-11	-10.107	-10.277	-0.17	0
	ZnF+	5.38E-11	3.96E-11	-10.269	-10.403	-0.133	0
	HF2-	2.37E-12	1.74E-12	-11.626	-11.759	-0.133	22.73
	FeF+	1.34E-12	9.85E-13	-11.873	-12.006	-0.133	0
	CuF+	4.29E-13	3.16E-13	-12.367	-12.501	-0.133	0
	FeF2+	2.60E-15	1.76E-15	-14.586	-14.756	-0.17	0
	FeF3	7.25E-16	8.22E-16	-15.14	-15.085	0.055	0
	FeF+2	7.15E-16	1.49E-16	-15.145	-15.826	-0.681	0
Fe(2)	3.17E-09						
	Fe+2	1.37E-09	3.33E-10	-8.863	-9.477	-0.614	-20.83
	FeCO3	9.54E-10	1.08E-09	-9.02	-8.966	0.055	0
	FeHCO3+	4.53E-10	3.33E-10	-9.344	-9.477	-0.133	0
	FeSO4	1.99E-10	2.26E-10	-9.7	-9.646	0.055	18.97
	FeCl+	1.47E-10	1.08E-10	-9.833	-9.966	-0.133	0
	FeOH+	4.44E-11	3.00E-11	-10.353	-10.523	-0.17	0
	FeF+	1.34E-12	9.85E-13	-11.873	-12.006	-0.133	0
	Fe(OH)2	6.40E-14	7.25E-14	-13.194	-13.14	0.055	0
	Fe(OH)3-	1.13E-15	7.66E-16	-14.946	-15.116	-0.17	0
	FeHSO4+	7.00E-18	5.15E-18	-17.155	-17.288	-0.133	0
Fe(3)	2.62E-06						
	Fe(OH)3	1.78E-06	2.01E-06	-5.75	-5.696	0.055	0
	Fe(OH)4-	7.60E-07	5.22E-07	-6.119	-6.282	-0.163	0
	Fe(OH)2+	8.01E-08	5.50E-08	-7.096	-7.26	-0.163	0
	FeOH+2	2.80E-12	5.84E-13	-11.552	-12.233	-0.681	0
	FeF2+	2.60E-15	1.76E-15	-14.586	-14.756	-0.17	0
	FeF3	7.25E-16	8.22E-16	-15.14	-15.085	0.055	0
	FeF+2	7.15E-16	1.49E-16	-15.145	-15.826	-0.681	0
	FeSO4+	1.97E-17	1.33E-17	-16.706	-16.876	-0.17	0
	FeCl+2	1.08E-17	2.26E-18	-16.966	-17.646	-0.681	0
	Fe+3	3.70E-18	3.18E-19	-17.432	-18.497	-1.065	0
	FeCl2+	3.50E-18	2.37E-18	-17.456	-17.626	-0.17	0
	Fe(SO4)2-	1.51E-18	1.11E-18	-17.822	-17.955	-0.133	0
	FeCl3	4.90E-20	5.55E-20	-19.31	-19.256	0.055	0
	Fe2(OH)2+	1.24E-21	9.19E-24	-20.906	-23.037	-2.131	0
	FeHSO4+2	4.21E-25	1.24E-25	-24.375	-24.908	-0.533	0
	Fe3(OH)4+	2.26E-25	1.06E-28	-24.646	-27.976	-3.33	0
H(0)	1.50E-28						
	H2	7.51E-29	8.51E-29	-28.125	-28.07	0.055	28.61
K	4.99E-03						
	K+	4.87E-03	3.10E-03	-2.313	-2.508	-0.196	9.59
	KSO4-	1.21E-04	8.31E-05	-3.917	-4.08	-0.163	34.77
Mg	8.02E-02						
	Mg+2	6.06E-02	1.76E-02	-1.218	-1.754	-0.536	-20.52
	MgSO4	1.39E-02	1.58E-02	-1.857	-1.803	0.055	5.84
	MgHCO3+	3.20E-03	2.06E-03	-2.495	-2.686	-0.191	5.8
	MgCO3	2.01E-03	2.27E-03	-2.698	-2.643	0.055	-17.09
	MgF+	5.21E-04	3.44E-04	-3.283	-3.463	-0.18	-10.27
	MgOH+	2.55E-05	1.82E-05	-4.594	-4.74	-0.146	0

Mn(2)	4.40E-07						
	MnCO3	2.45E-07	2.78E-07	-6.611	-6.556	0.055	0
	Mn+2	1.06E-07	2.59E-08	-6.974	-7.588	-0.614	-16.57
	MnCl+	3.66E-08	2.47E-08	-7.437	-7.607	-0.17	-2.8
	MnHCO3+	3.41E-08	2.30E-08	-7.467	-7.638	-0.17	0
	MnSO4	1.55E-08	1.75E-08	-7.811	-7.756	0.055	22.54
	MnCl2	2.23E-09	2.53E-09	-8.651	-8.597	0.055	85.89
	MnOH+	2.80E-10	1.89E-10	-9.554	-9.724	-0.17	0
	MnCl3-	2.42E-10	1.64E-10	-9.616	-9.786	-0.17	45.39
	MnF+	7.82E-11	5.28E-11	-10.107	-10.277	-0.17	0
	Mn(NO3)2	7.03E-15	7.98E-15	-14.153	-14.098	0.055	41.04
	Mn(OH)3-	1.39E-17	9.41E-18	-16.856	-17.026	-0.17	0
Mn(3)	9.28E-29						
	Mn+3	9.28E-29	7.99E-30	-28.033	-29.098	-1.065	0
N(-3)	5.40E-05						
	NH4+	4.81E-05	2.80E-05	-4.318	-4.553	-0.235	18.4
	NH3	4.06E-06	4.60E-06	-5.391	-5.337	0.055	24.42
	NH4SO4-	1.87E-06	1.38E-06	-5.728	-5.862	-0.133	39.59
N(5)	4.60E-04						
	NO3-	4.60E-04	2.78E-04	-3.337	-3.555	-0.218	30.2
	Mn(NO3)2	7.03E-15	7.98E-15	-14.153	-14.098	0.055	41.04
Na	3.51E-01						
	Na+	3.42E-01	2.45E-01	-0.466	-0.611	-0.145	-0.6
	NaSO4-	6.81E-03	4.68E-03	-2.167	-2.33	-0.163	20.39
	NaHCO3	1.21E-03	1.38E-03	-2.916	-2.861	0.055	1.8
	NaCO3-	8.38E-04	6.17E-04	-3.077	-3.21	-0.133	2.2
	NaF	3.67E-05	4.17E-05	-4.435	-4.38	0.055	7.26
	NaOH	6.21E-17	7.05E-17	-16.207	-16.152	0.055	0
O(0)	9.86E-37						
	O2	4.93E-37	5.59E-37	-36.307	-36.253	0.055	30.4
S(6)	4.13E-02						
	SO4-2	1.92E-02	3.81E-03	-1.716	-2.419	-0.703	17.18
	MgSO4	1.39E-02	1.58E-02	-1.857	-1.803	0.055	5.84
	NaSO4-	6.81E-03	4.68E-03	-2.167	-2.33	-0.163	20.39
	CaSO4	1.22E-03	1.38E-03	-2.915	-2.86	0.055	7.5
	KSO4-	1.21E-04	8.31E-05	-3.917	-4.08	-0.163	34.77
	BaSO4	5.10E-06	5.78E-06	-5.293	-5.238	0.055	0
	NH4SO4-	1.87E-06	1.38E-06	-5.728	-5.862	-0.133	39.59
	MnSO4	1.55E-08	1.75E-08	-7.811	-7.756	0.055	22.54
	ZnSO4	7.47E-09	8.47E-09	-8.127	-8.072	0.055	21.71
	HSO4-	1.75E-09	1.29E-09	-8.758	-8.891	-0.133	40.9
	Zn(SO4)2-2	8.95E-10	2.63E-10	-9.048	-9.581	-0.533	-6.41
	FeSO4	1.99E-10	2.26E-10	-9.7	-9.646	0.055	18.97
	CaHSO4+	4.27E-11	3.15E-11	-10.369	-10.502	-0.133	0
	CuSO4	4.03E-11	4.57E-11	-10.395	-10.34	0.055	13.09
	FeSO4+	1.97E-17	1.33E-17	-16.706	-16.876	-0.17	0
	FeHSO4+	7.00E-18	5.15E-18	-17.155	-17.288	-0.133	0
	Fe(SO4)2-	1.51E-18	1.11E-18	-17.822	-17.955	-0.133	0
	FeHSO4+2	4.21E-25	1.24E-25	-24.375	-24.908	-0.533	0
Zn	2.86E-06						

Zn(CO3)2-2	2.52E-06	7.40E-07	-5.598	-6.131	-0.533	0
ZnCO3	2.26E-07	2.56E-07	-6.647	-6.592	0.055	0
Zn+2	4.55E-08	9.48E-09	-7.342	-8.023	-0.681	-24.17
ZnOHCl	1.85E-08	2.09E-08	-7.734	-7.679	0.055	0
ZnHCO3+	1.62E-08	1.19E-08	-7.79	-7.923	-0.133	0
ZnCl+	9.30E-09	5.99E-09	-8.032	-8.223	-0.191	-15.51
Zn(OH)2	8.50E-09	9.64E-09	-8.07	-8.016	0.055	0
ZnSO4	7.47E-09	8.47E-09	-8.127	-8.072	0.055	21.71
ZnOH+	4.02E-09	2.96E-09	-8.396	-8.53	-0.133	0
ZnCl2	1.30E-09	1.47E-09	-8.887	-8.832	0.055	102.03
Zn(SO4)2-2	8.95E-10	2.63E-10	-9.048	-9.581	-0.533	-6.41
ZnCl3-	6.02E-10	3.88E-10	-9.221	-9.412	-0.191	13.41
ZnCl4-2	2.19E-10	4.56E-11	-9.66	-10.341	-0.681	149.6
ZnF+	5.38E-11	3.96E-11	-10.269	-10.403	-0.133	0
Zn(OH)3-	1.18E-11	8.67E-12	-10.929	-11.062	-0.133	0
Zn(OH)4-2	1.33E-15	3.91E-16	-14.876	-15.408	-0.533	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-0.83	-5.11	-4.28	CaSO4			
Aragonite	1.78	-6.56	-8.34	CaCO3			
Barite	1.91	-7.94	-9.84	BaSO4			
Calcite	1.92	-6.56	-8.48	CaCO3			
CO2(g)	-2.63	-4.1	-1.47	CO2			
Dolomite	4.9	-12.18	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.97	6.86	4.89	Fe(OH)3			
Fluorite	0.85	-9.75	-10.6	CaF2			
Goethite	7.87	6.87	-1	FeOOH			
Gypsum	-0.54	-5.12	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	-0.01	1.5	H2O			
Halite	-2.81	-1.24	1.57	NaCl			
Hausmann	-8.14	52.89	61.03	Mn3O4			
Hematite	17.76	13.75	-4.01	Fe2O3			
Jarosite-K	-2.9	-12.11	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.56	21.78	25.34	MnOOH			
Melanterit	-9.73	-11.94	-2.21	FeSO4:7H2O			
NH3(g)	-7.13	-5.34	1.8	NH3			
O2(g)	-33.36	-36.25	-2.89	O2			
Pyrochroit	-5.88	9.32	15.2	Mn(OH)2			
Pyrolusite	-7.15	34.23	41.38	MnO2:H2O			
Rhodochro	-0.33	-11.46	-11.13	MnCO3			
Siderite	-2.46	-13.35	-10.89	FeCO3			
Smithsonit	-1.89	-11.89	-10	ZnCO3			
Sylvite	-4.04	-3.14	0.9	KCl			
Witherite	-0.83	-9.39	-8.56	BaCO3			
Zn(OH)2(e	-2.62	8.88	11.5	Zn(OH)2			

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**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 28

#NAME? composition-----------------------------

Elements Molality Moles

Alkalinity 2.81E-02 2.81E-02
Ba 2.10E-05 2.10E-05
Ca 1.03E-02 1.03E-02
Cl 3.78E-01 3.78E-01
Cu 3.40E-07 3.40E-07
F 1.06E-03 1.06E-03
Fe 2.72E-06 2.72E-06
K 5.17E-03 5.17E-03
Mg 8.32E-02 8.32E-02
Mn 4.60E-07 4.60E-07
N(-3) 5.60E-05 5.60E-05
N(5) 4.80E-04 4.80E-04
Na 3.64E-01 3.64E-01
S(6) 4.28E-02 4.28E-02
Zn 2.96E-06 2.96E-06

#NAME? of solution---------------------------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 40677
Density (g/cm³) = 1.02039
Volume (L) = 1.00945
Activity of water = 0.985
Ionic strength (mol/kgw) = 5.66E-01
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 2.41E-02
Total CO2 (mol/kg) = 2.41E-02
Temperatu (°C) = 25
Electrical balance (eq) = 6.27E-02
Percent error, 100*(Cat-| = 6.61
Iterations = 13 (295 overall)
Total H = 1.11E+02
Total O = 5.58E+01

#NAME? couples--------------------------------

Redox couple pe Eh (volts)

N(-3)/N(5) 4.4371 0.2625
```

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.62E-06	2.88E-06	-5.336	-5.541	-0.206	-2.81
	H+	4.56E-09	3.47E-09	-8.341	-8.46	-0.119	0
	H2O	5.55E+01	9.85E-01	1.744	-0.007	0	18.07
Ba	2.10E-05						
	Ba+2	1.51E-05	3.11E-06	-4.822	-5.507	-0.685	-11.13
	BaSO4	5.29E-06	6.02E-06	-5.277	-5.22	0.057	0
	BaHCO3+	4.13E-07	3.04E-07	-6.384	-6.517	-0.132	0
	BaCO3	1.95E-07	2.22E-07	-6.71	-6.654	0.057	-10.7
	BaOH+	4.44E-11	2.99E-11	-10.352	-10.524	-0.172	0
C(4)	2.41E-02						
	HCO3-	1.49E-02	1.02E-02	-1.826	-1.991	-0.164	26.66
	MgHCO3+	3.39E-03	2.17E-03	-2.47	-2.663	-0.193	5.8
	MgCO3	2.11E-03	2.40E-03	-2.677	-2.62	0.057	-17.09
	NaHCO3	1.28E-03	1.46E-03	-2.893	-2.836	0.057	1.8
	NaCO3-	8.86E-04	6.53E-04	-3.052	-3.185	-0.132	2.3
	CO3-2	6.28E-04	1.38E-04	-3.202	-3.86	-0.657	-2.28
	CaCO3	4.27E-04	4.87E-04	-3.369	-3.313	0.057	-14.6
	CaHCO3+	3.90E-04	2.73E-04	-3.409	-3.563	-0.155	9.95
	CO2	7.10E-05	8.09E-05	-4.149	-4.092	0.057	34.43
	Zn(CO3)2-2	2.62E-06	7.73E-07	-5.582	-6.112	-0.53	0
	BaHCO3+	4.13E-07	3.04E-07	-6.384	-6.517	-0.132	0
	MnCO3	2.56E-07	2.91E-07	-6.592	-6.535	0.057	0
	ZnCO3	2.30E-07	2.62E-07	-6.639	-6.582	0.057	0
	BaCO3	1.95E-07	2.22E-07	-6.71	-6.654	0.057	-10.7
	CuCO3	3.73E-08	4.25E-08	-7.428	-7.371	0.057	0
	MnHCO3+	3.59E-08	2.42E-08	-7.445	-7.617	-0.172	0
	Cu(CO3)2-	2.50E-08	7.40E-09	-7.601	-8.131	-0.53	0
	ZnHCO3+	1.66E-08	1.22E-08	-7.781	-7.914	-0.132	0
	FeCO3	1.01E-09	1.15E-09	-8.995	-8.939	0.057	0
	FeHCO3+	4.82E-10	3.55E-10	-9.317	-9.45	-0.132	0
	CuHCO3+	3.98E-10	2.93E-10	-9.4	-9.533	-0.132	0
	(CO2)2	1.05E-10	1.20E-10	-9.977	-9.921	0.057	68.87
Ca	1.03E-02						
	Ca+2	8.22E-03	2.10E-03	-2.085	-2.678	-0.593	-16.78
	CaSO4	1.27E-03	1.44E-03	-2.898	-2.841	0.057	7.5
	CaCO3	4.27E-04	4.87E-04	-3.369	-3.313	0.057	-14.6
	CaHCO3+	3.90E-04	2.73E-04	-3.409	-3.563	-0.155	9.95
	CaOH+	1.34E-07	9.89E-08	-6.872	-7.005	-0.132	0
	CaHSO4+	4.46E-11	3.29E-11	-10.351	-10.484	-0.132	0
Cl	3.78E-01						
	Cl-	3.78E-01	2.43E-01	-0.423	-0.615	-0.193	18.73
	CuCl3-2	1.05E-07	2.15E-08	-6.981	-7.667	-0.686	0
	CuCl2-	8.73E-08	5.60E-08	-7.059	-7.252	-0.193	0
	MnCl+	3.90E-08	2.62E-08	-7.409	-7.581	-0.172	-2.8
	ZnOHCl	1.90E-08	2.17E-08	-7.721	-7.664	0.057	0

	ZnCl+	9.66E-09	6.20E-09	-8.015	-8.208	-0.193	-15.58
	MnCl2	2.44E-09	2.78E-09	-8.613	-8.556	0.057	85.89
	ZnCl2	1.38E-09	1.57E-09	-8.86	-8.803	0.057	102.03
	ZnCl3-	6.68E-10	4.28E-10	-9.175	-9.368	-0.193	13.27
	MnCl3-	2.76E-10	1.86E-10	-9.56	-9.731	-0.172	45.45
	ZnCl4-2	2.53E-10	5.21E-11	-9.597	-10.283	-0.686	149.71
	FeCl+	1.58E-10	1.16E-10	-9.802	-9.934	-0.132	0
	CuCl+	5.83E-11	3.74E-11	-10.234	-10.427	-0.193	1.73
	CuCl2	4.28E-12	4.88E-12	-11.369	-11.312	0.057	31.02
	CuCl3-	6.54E-15	4.20E-15	-14.184	-14.377	-0.193	0
	CuCl4-2	2.48E-17	5.10E-18	-16.606	-17.292	-0.686	0
	FeCl+2	1.18E-17	2.43E-18	-16.928	-17.614	-0.686	0
	FeCl2+	3.91E-18	2.64E-18	-17.408	-17.579	-0.172	0
	FeCl3	5.61E-20	6.39E-20	-19.251	-19.194	0.057	0
Cu(1)	1.92E-07						
	CuCl3-2	1.05E-07	2.15E-08	-6.981	-7.667	-0.686	0
	CuCl2-	8.73E-08	5.60E-08	-7.059	-7.252	-0.193	0
	Cu+	5.19E-12	3.01E-12	-11.285	-11.522	-0.237	0
Cu(2)	1.48E-07						
	Cu(OH)2	8.48E-08	9.66E-08	-7.071	-7.015	0.057	0
	CuCO3	3.73E-08	4.25E-08	-7.428	-7.371	0.057	0
	Cu(CO3)2-	2.50E-08	7.40E-09	-7.601	-8.131	-0.53	0
	CuHCO3+	3.98E-10	2.93E-10	-9.4	-9.533	-0.132	0
	CuOH+	2.54E-10	1.63E-10	-9.595	-9.788	-0.193	0
	Cu+2	2.38E-10	5.73E-11	-9.624	-10.242	-0.618	-25.39
	CuCl+	5.83E-11	3.74E-11	-10.234	-10.427	-0.193	1.73
	CuSO4	3.97E-11	4.52E-11	-10.401	-10.345	0.057	13.09
	CuCl2	4.28E-12	4.88E-12	-11.369	-11.312	0.057	31.02
	Cu(OH)3-	2.24E-12	1.65E-12	-11.649	-11.781	-0.132	0
	CuF+	4.21E-13	3.11E-13	-12.376	-12.508	-0.132	0
	Cu2(OH)2+	3.93E-14	1.16E-14	-13.406	-13.936	-0.53	0
	CuCl3-	6.54E-15	4.20E-15	-14.184	-14.377	-0.193	0
	Cu(OH)4-2	3.17E-16	9.38E-17	-15.498	-16.028	-0.53	0
	CuCl4-2	2.48E-17	5.10E-18	-16.606	-17.292	-0.686	0
F	1.06E-03						
	MgF+	5.44E-04	3.58E-04	-3.265	-3.446	-0.182	-10.27
	F-	4.78E-04	2.98E-04	-3.32	-3.526	-0.206	-0.64
	NaF	3.82E-05	4.35E-05	-4.418	-4.361	0.057	7.26
	HF	1.36E-09	1.55E-09	-8.867	-8.81	0.057	12.5
	MnF+	8.12E-11	5.47E-11	-10.09	-10.262	-0.172	0
	ZnF+	5.41E-11	3.99E-11	-10.267	-10.399	-0.132	0
	HF2-	2.40E-12	1.77E-12	-11.62	-11.752	-0.132	22.74
	FeF+	1.40E-12	1.04E-12	-11.853	-11.985	-0.132	0
	CuF+	4.21E-13	3.11E-13	-12.376	-12.508	-0.132	0
	FeF2+	2.76E-15	1.86E-15	-14.56	-14.731	-0.172	0
	FeF3	7.69E-16	8.76E-16	-15.114	-15.057	0.057	0
	FeF+2	7.61E-16	1.57E-16	-15.119	-15.805	-0.686	0
Fe(2)	3.35E-09						
	Fe+2	1.44E-09	3.48E-10	-8.841	-9.459	-0.618	-20.81
	FeCO3	1.01E-09	1.15E-09	-8.995	-8.939	0.057	0

	FeHCO3+	4.82E-10	3.55E-10	-9.317	-9.45	-0.132	0
	FeSO4	2.10E-10	2.39E-10	-9.679	-9.622	0.057	18.97
	FeCl+	1.58E-10	1.16E-10	-9.802	-9.934	-0.132	0
	FeOH+	4.64E-11	3.12E-11	-10.334	-10.506	-0.172	0
	FeF+	1.40E-12	1.04E-12	-11.853	-11.985	-0.132	0
	Fe(OH)2	6.63E-14	7.55E-14	-13.179	-13.122	0.057	0
	Fe(OH)3-	1.18E-15	7.97E-16	-14.927	-15.099	-0.172	0
	FeHSO4+	7.38E-18	5.44E-18	-17.132	-17.264	-0.132	0
Fe(3)	2.72E-06						
	Fe(OH)3	1.84E-06	2.10E-06	-5.735	-5.679	0.057	0
	Fe(OH)4-	7.93E-07	5.43E-07	-6.101	-6.265	-0.164	0
	Fe(OH)2+	8.36E-08	5.73E-08	-7.078	-7.242	-0.164	0
	FeOH+2	2.96E-12	6.09E-13	-11.529	-12.216	-0.686	0
	FeF2+	2.76E-15	1.86E-15	-14.56	-14.731	-0.172	0
	FeF3	7.69E-16	8.76E-16	-15.114	-15.057	0.057	0
	FeF+2	7.61E-16	1.57E-16	-15.119	-15.805	-0.686	0
	FeSO4+	2.09E-17	1.41E-17	-16.68	-16.852	-0.172	0
	FeCl+2	1.18E-17	2.43E-18	-16.928	-17.614	-0.686	0
	FeCl2+	3.91E-18	2.64E-18	-17.408	-17.579	-0.172	0
	Fe+3	3.91E-18	3.32E-19	-17.408	-18.479	-1.071	0
	Fe(SO4)2-	1.61E-18	1.19E-18	-17.792	-17.925	-0.132	0
	FeCl3	5.61E-20	6.39E-20	-19.251	-19.194	0.057	0
	Fe2(OH)2+	1.31E-21	9.98E-24	-20.883	-23.001	-2.118	0
	FeHSO4+2	4.42E-25	1.31E-25	-24.355	-24.884	-0.53	0
	Fe3(OH)4+	2.44E-25	1.19E-28	-24.614	-27.923	-3.31	0
H(0)	1.49E-28						
	H2	7.47E-29	8.51E-29	-28.127	-28.07	0.057	28.61
K	5.17E-03						
	K+	5.04E-03	3.20E-03	-2.297	-2.495	-0.197	9.6
	KSO4-	1.27E-04	8.70E-05	-3.896	-4.061	-0.164	34.78
Mg	8.32E-02						
	Mg+2	6.27E-02	1.82E-02	-1.203	-1.74	-0.537	-20.5
	MgSO4	1.45E-02	1.65E-02	-1.84	-1.783	0.057	5.84
	MgHCO3+	3.39E-03	2.17E-03	-2.47	-2.663	-0.193	5.8
	MgCO3	2.11E-03	2.40E-03	-2.677	-2.62	0.057	-17.09
	MgF+	5.44E-04	3.58E-04	-3.265	-3.446	-0.182	-10.27
	MgOH+	2.63E-05	1.88E-05	-4.579	-4.727	-0.147	0
Mn(2)	4.60E-07						
	MnCO3	2.56E-07	2.91E-07	-6.592	-6.535	0.057	0
	Mn+2	1.10E-07	2.66E-08	-6.958	-7.576	-0.618	-16.54
	MnCl+	3.90E-08	2.62E-08	-7.409	-7.581	-0.172	-2.8
	MnHCO3+	3.59E-08	2.42E-08	-7.445	-7.617	-0.172	0
	MnSO4	1.60E-08	1.83E-08	-7.795	-7.739	0.057	22.54
	MnCl2	2.44E-09	2.78E-09	-8.613	-8.556	0.057	85.89
	MnOH+	2.88E-10	1.94E-10	-9.541	-9.712	-0.172	0
	MnCl3-	2.76E-10	1.86E-10	-9.56	-9.731	-0.172	45.45
	MnF+	8.12E-11	5.47E-11	-10.09	-10.262	-0.172	0
	Mn(NO3)2	7.75E-15	8.83E-15	-14.111	-14.054	0.057	41.04
	Mn(OH)3-	1.43E-17	9.65E-18	-16.844	-17.015	-0.172	0
Mn(3)	9.66E-29						

	Mn+3	9.66E-29	8.21E-30	-28.015	-29.086	-1.071	0
N(-3)	5.60E-05						
	NH4+	4.99E-05	2.89E-05	-4.302	-4.539	-0.237	18.41
	NH3	4.17E-06	4.75E-06	-5.38	-5.323	0.057	24.42
	NH4SO4-	1.95E-06	1.44E-06	-5.71	-5.842	-0.132	39.65
N(5)	4.80E-04						
	NO3-	4.80E-04	2.89E-04	-3.319	-3.539	-0.22	30.22
	Mn(NO3)2	7.75E-15	8.83E-15	-14.111	-14.054	0.057	41.04
Na	3.64E-01						
	Na+	3.54E-01	2.54E-01	-0.451	-0.595	-0.145	-0.58
	NaSO4-	7.18E-03	4.92E-03	-2.144	-2.308	-0.164	20.52
	NaHCO3	1.28E-03	1.46E-03	-2.893	-2.836	0.057	1.8
	NaCO3-	8.86E-04	6.53E-04	-3.052	-3.185	-0.132	2.3
	NaF	3.82E-05	4.35E-05	-4.418	-4.361	0.057	7.26
	NaOH	6.41E-17	7.30E-17	-16.193	-16.137	0.057	0
O(0)	9.81E-37						
	O2	4.90E-37	5.58E-37	-36.31	-36.253	0.057	30.4
S(6)	4.28E-02						
	SO4-2	1.98E-02	3.86E-03	-1.704	-2.413	-0.709	17.23
	MgSO4	1.45E-02	1.65E-02	-1.84	-1.783	0.057	5.84
	NaSO4-	7.18E-03	4.92E-03	-2.144	-2.308	-0.164	20.52
	CaSO4	1.27E-03	1.44E-03	-2.898	-2.841	0.057	7.5
	KSO4-	1.27E-04	8.70E-05	-3.896	-4.061	-0.164	34.78
	BaSO4	5.29E-06	6.02E-06	-5.277	-5.22	0.057	0
	NH4SO4-	1.95E-06	1.44E-06	-5.71	-5.842	-0.132	39.65
	MnSO4	1.60E-08	1.83E-08	-7.795	-7.739	0.057	22.54
	ZnSO4	7.55E-09	8.60E-09	-8.122	-8.066	0.057	21.71
	HSO4-	1.77E-09	1.30E-09	-8.753	-8.885	-0.132	40.91
	Zn(SO4)2-2	9.14E-10	2.70E-10	-9.039	-9.569	-0.53	-6.21
	FeSO4	2.10E-10	2.39E-10	-9.679	-9.622	0.057	18.97
	CaHSO4+	4.46E-11	3.29E-11	-10.351	-10.484	-0.132	0
	CuSO4	3.97E-11	4.52E-11	-10.401	-10.345	0.057	13.09
	FeSO4+	2.09E-17	1.41E-17	-16.68	-16.852	-0.172	0
	FeHSO4+	7.38E-18	5.44E-18	-17.132	-17.264	-0.132	0
	Fe(SO4)2-	1.61E-18	1.19E-18	-17.792	-17.925	-0.132	0
	FeHSO4+2	4.42E-25	1.31E-25	-24.355	-24.884	-0.53	0
Zn	2.96E-06						
	Zn(CO3)2-2	2.62E-06	7.73E-07	-5.582	-6.112	-0.53	0
	ZnCO3	2.30E-07	2.62E-07	-6.639	-6.582	0.057	0
	Zn+2	4.61E-08	9.49E-09	-7.336	-8.023	-0.686	-24.16
	ZnOHCl	1.90E-08	2.17E-08	-7.721	-7.664	0.057	0
	ZnHCO3+	1.66E-08	1.22E-08	-7.781	-7.914	-0.132	0
	ZnCl+	9.66E-09	6.20E-09	-8.015	-8.208	-0.193	-15.58
	Zn(OH)2	8.46E-09	9.64E-09	-8.072	-8.016	0.057	0
	ZnSO4	7.55E-09	8.60E-09	-8.122	-8.066	0.057	21.71
	ZnOH+	4.01E-09	2.96E-09	-8.397	-8.529	-0.132	0
	ZnCl2	1.38E-09	1.57E-09	-8.86	-8.803	0.057	102.03
	Zn(SO4)2-2	9.14E-10	2.70E-10	-9.039	-9.569	-0.53	-6.21
	ZnCl3-	6.68E-10	4.28E-10	-9.175	-9.368	-0.193	13.27
	ZnCl4-2	2.53E-10	5.21E-11	-9.597	-10.283	-0.686	149.71

ZnF+	5.41E-11	3.99E-11	-10.267	-10.399	-0.132	0
Zn(OH)3-	1.18E-11	8.66E-12	-10.93	-11.062	-0.132	0
Zn(OH)4-2	1.32E-15	3.90E-16	-14.879	-15.409	-0.53	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-0.81	-5.09	-4.28	CaSO4
Aragonite	1.8	-6.54	-8.34	CaCO3
Barite	1.92	-7.92	-9.84	BaSO4
Calcite	1.94	-6.54	-8.48	CaCO3
CO2(g)	-2.62	-4.09	-1.47	CO2
Dolomite	4.95	-12.14	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.99	6.88	4.89	Fe(OH)3
Fluorite	0.87	-9.73	-10.6	CaF2
Goethite	7.89	6.89	-1	FeOOH
Gypsum	-0.52	-5.1	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	-0.01	1.5	H2O
Halite	-2.78	-1.21	1.57	NaCl
Hausmann	-8.1	52.93	61.03	Mn3O4
Hematite	17.79	13.78	-4.01	Fe2O3
Jarosite-K	-2.83	-12.04	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.55	21.79	25.34	MnOOH
Melanterit	-9.71	-11.92	-2.21	FeSO4:7H2O
NH3(g)	-7.12	-5.32	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.87	9.33	15.2	Mn(OH)2
Pyrolusite	-7.14	34.24	41.38	MnO2:H2O
Rhodochro	-0.31	-11.44	-11.13	MnCO3
Siderite	-2.43	-13.32	-10.89	FeCO3
Smithsonit	-1.88	-11.88	-10	ZnCO3
Sylvite	-4.01	-3.11	0.9	KCl
Witherite	-0.81	-9.37	-8.56	BaCO3
Zn(OH)2(e	-2.62	8.88	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 29

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	2.91E-02	2.91E-02
Ba	2.17E-05	2.17E-05
Ca	1.07E-02	1.07E-02
Cl	3.92E-01	3.92E-01

Cu	3.60E-07	3.60E-07
F	1.10E-03	1.10E-03
Fe	2.81E-06	2.81E-06
K	5.36E-03	5.36E-03
Mg	8.62E-02	8.62E-02
Mn	4.80E-07	4.80E-07
N(-3)	5.80E-05	5.80E-05
N(5)	4.90E-04	4.90E-04
Na	3.77E-01	3.77E-01
S(6)	4.44E-02	4.44E-02
Zn	3.07E-06	3.07E-06

#NAME? of solution----------

pH	=	8.46			
pe	=	4			
Specific	Conductan	(µS/cm,	25°C)	=	41899
Density	(g/cm³)	=	1.02122		
Volume	(L)	=	1.00969		
Activity	of	water	=	0.985	
Ionic	strength	(mol/kgw)	=	5.85E-01	
Mass	of	water	(kg)	=	1.00E+00
Total	carbon	(mol/kg)	=	2.49E-02	
Total	CO2	(mol/kg)	=	2.49E-02	
Temperatu	(°C)	=	25		
Electrical	balance	(eq)	=	6.50E-02	
Percent	error,	100*(Cat-|	=	6.62	
Iterations	=	13	(308	overall)	
Total	H	=	1.11E+02		
Total	O	=	5.58E+01		

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4364	0.2624		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.64E-06	2.87E-06	-5.334	-5.542	-0.208	-2.78
H+	4.57E-09	3.47E-09	-8.34	-8.46	-0.12	0
H2O	5.55E+01	9.85E-01	1.744	-0.007	0	18.07
Ba	2.17E-05					
Ba+2	1.56E-05	3.19E-06	-4.807	-5.496	-0.689	-11.1
BaSO4	5.48E-06	6.27E-06	-5.262	-5.203	0.059	0
BaHCO3+	4.32E-07	3.19E-07	-6.364	-6.496	-0.132	0
BaCO3	2.03E-07	2.33E-07	-6.692	-6.633	0.059	-10.7

	BaOH+	4.58E-11	3.07E-11	-10.34	-10.512	-0.173	0
C(4)	2.49E-02						
	HCO3-	1.53E-02	1.04E-02	-1.816	-1.982	-0.166	26.72
	MgHCO3+	3.58E-03	2.29E-03	-2.446	-2.64	-0.195	5.81
	MgCO3	2.21E-03	2.53E-03	-2.656	-2.598	0.059	-17.09
	NaHCO3	1.35E-03	1.54E-03	-2.87	-2.812	0.059	1.8
	NaCO3-	9.35E-04	6.91E-04	-3.029	-3.161	-0.132	2.41
	CO3-2	6.48E-04	1.41E-04	-3.189	-3.851	-0.662	-2.23
	CaCO3	4.48E-04	5.12E-04	-3.349	-3.291	0.059	-14.6
	CaHCO3+	4.11E-04	2.88E-04	-3.386	-3.541	-0.156	9.95
	CO2	7.22E-05	8.26E-05	-4.142	-4.083	0.059	34.43
	Zn(CO3)2-2	2.72E-06	8.10E-07	-5.566	-6.092	-0.526	0
	BaHCO3+	4.32E-07	3.19E-07	-6.364	-6.496	-0.132	0
	MnCO3	2.67E-07	3.05E-07	-6.574	-6.515	0.059	0
	ZnCO3	2.35E-07	2.69E-07	-6.63	-6.571	0.059	0
	BaCO3	2.03E-07	2.33E-07	-6.692	-6.633	0.059	-10.7
	CuCO3	3.80E-08	4.35E-08	-7.42	-7.361	0.059	0
	MnHCO3+	3.77E-08	2.53E-08	-7.424	-7.596	-0.173	0
	Cu(CO3)2-	2.60E-08	7.73E-09	-7.586	-8.112	-0.526	0
	ZnHCO3+	1.70E-08	1.25E-08	-7.771	-7.902	-0.132	0
	FeCO3	1.07E-09	1.22E-09	-8.972	-8.914	0.059	0
	FeHCO3+	5.09E-10	3.76E-10	-9.294	-9.425	-0.132	0
	CuHCO3+	4.07E-10	3.00E-10	-9.391	-9.522	-0.132	0
	(CO2)2	1.09E-10	1.25E-10	-9.961	-9.903	0.059	68.87
Ca	1.07E-02						
	Ca+2	8.51E-03	2.16E-03	-2.07	-2.665	-0.595	-16.77
	CaSO4	1.32E-03	1.50E-03	-2.881	-2.823	0.059	7.5
	CaCO3	4.48E-04	5.12E-04	-3.349	-3.291	0.059	-14.6
	CaHCO3+	4.11E-04	2.88E-04	-3.386	-3.541	-0.156	9.95
	CaOH+	1.38E-07	1.02E-07	-6.861	-6.992	-0.132	0
	CaHSO4+	4.64E-11	3.43E-11	-10.333	-10.465	-0.132	0
Cl	3.92E-01						
	Cl-	3.92E-01	2.51E-01	-0.407	-0.601	-0.194	18.74
	CuCl3-2	1.17E-07	2.38E-08	-6.933	-7.624	-0.692	0
	CuCl2-	9.36E-08	5.98E-08	-7.029	-7.223	-0.195	0
	MnCl+	4.14E-08	2.78E-08	-7.383	-7.556	-0.173	-2.8
	ZnOHCl	1.96E-08	2.25E-08	-7.707	-7.648	0.059	0
	ZnCl+	1.01E-08	6.43E-09	-7.997	-8.192	-0.195	-15.64
	MnCl2	2.66E-09	3.04E-09	-8.576	-8.517	0.059	85.89
	ZnCl2	1.47E-09	1.69E-09	-8.831	-8.773	0.059	102.03
	ZnCl3-	7.42E-10	4.74E-10	-9.13	-9.324	-0.195	13.13
	MnCl3-	3.12E-10	2.10E-10	-9.506	-9.678	-0.173	45.51
	ZnCl4-2	2.93E-10	5.95E-11	-9.534	-10.225	-0.692	149.82
	FeCl+	1.69E-10	1.25E-10	-9.773	-9.904	-0.132	0
	CuCl+	6.06E-11	3.87E-11	-10.217	-10.412	-0.195	1.76
	CuCl2	4.55E-12	5.21E-12	-11.342	-11.283	0.059	31.02
	CuCl3-	7.25E-15	4.63E-15	-14.14	-14.334	-0.195	0
	CuCl4-2	2.86E-17	5.81E-18	-16.544	-17.236	-0.692	0
	FeCl+2	1.28E-17	2.60E-18	-16.893	-17.584	-0.692	0
	FeCl2+	4.34E-18	2.91E-18	-17.363	-17.536	-0.173	0

	FeCl3	6.38E-20	7.30E-20	-19.195	-19.137	0.059	0
Cu(1)	2.10E-07						
	CuCl3-2	1.17E-07	2.38E-08	-6.933	-7.624	-0.692	0
	CuCl2-	9.36E-08	5.98E-08	-7.029	-7.223	-0.195	0
	Cu+	5.24E-12	3.02E-12	-11.281	-11.521	-0.24	0
Cu(2)	1.50E-07						
	Cu(OH)2	8.46E-08	9.68E-08	-7.073	-7.014	0.059	0
	CuCO3	3.80E-08	4.35E-08	-7.42	-7.361	0.059	0
	Cu(CO3)2-	2.60E-08	7.73E-09	-7.586	-8.112	-0.526	0
	CuHCO3+	4.07E-10	3.00E-10	-9.391	-9.522	-0.132	0
	CuOH+	2.55E-10	1.63E-10	-9.593	-9.787	-0.195	0
	Cu+2	2.41E-10	5.75E-11	-9.618	-10.241	-0.622	-25.37
	CuCl+	6.06E-11	3.87E-11	-10.217	-10.412	-0.195	1.76
	CuSO4	4.01E-11	4.59E-11	-10.396	-10.338	0.059	13.09
	CuCl2	4.55E-12	5.21E-12	-11.342	-11.283	0.059	31.02
	Cu(OH)3-	2.24E-12	1.66E-12	-11.649	-11.781	-0.132	0
	CuF+	4.28E-13	3.16E-13	-12.368	-12.5	-0.132	0
	Cu2(OH)2+	3.91E-14	1.17E-14	-13.408	-13.934	-0.526	0
	CuCl3-	7.25E-15	4.63E-15	-14.14	-14.334	-0.195	0
	Cu(OH)4-2	3.15E-16	9.38E-17	-15.502	-16.028	-0.526	0
	CuCl4-2	2.86E-17	5.81E-18	-16.544	-17.236	-0.692	0
F	1.10E-03						
	MgF+	5.72E-04	3.75E-04	-3.243	-3.426	-0.183	-10.26
	F-	4.88E-04	3.03E-04	-3.312	-3.519	-0.208	-0.63
	NaF	4.00E-05	4.58E-05	-4.398	-4.339	0.059	7.26
	HF	1.38E-09	1.57E-09	-8.862	-8.803	0.059	12.5
	MnF+	8.49E-11	5.71E-11	-10.071	-10.244	-0.173	0
	ZnF+	5.52E-11	4.08E-11	-10.258	-10.39	-0.132	0
	HF2-	2.47E-12	1.83E-12	-11.607	-11.738	-0.132	22.75
	FeF+	1.48E-12	1.09E-12	-11.831	-11.962	-0.132	0
	CuF+	4.28E-13	3.16E-13	-12.368	-12.5	-0.132	0
	FeF2+	2.96E-15	1.99E-15	-14.529	-14.701	-0.173	0
	FeF3	8.34E-16	9.54E-16	-15.079	-15.021	0.059	0
	FeF+2	8.12E-16	1.65E-16	-15.091	-15.782	-0.692	0
Fe(2)	3.52E-09						
	Fe+2	1.51E-09	3.60E-10	-8.821	-9.443	-0.622	-20.79
	FeCO3	1.07E-09	1.22E-09	-8.972	-8.914	0.059	0
	FeHCO3+	5.09E-10	3.76E-10	-9.294	-9.425	-0.132	0
	FeSO4	2.19E-10	2.51E-10	-9.659	-9.601	0.059	18.97
	FeCl+	1.69E-10	1.25E-10	-9.773	-9.904	-0.132	0
	FeOH+	4.82E-11	3.24E-11	-10.317	-10.49	-0.173	0
	FeF+	1.48E-12	1.09E-12	-11.831	-11.962	-0.132	0
	Fe(OH)2	6.84E-14	7.82E-14	-13.165	-13.107	0.059	0
	Fe(OH)3-	1.23E-15	8.25E-16	-14.911	-15.083	-0.173	0
	FeHSO4+	7.74E-18	5.72E-18	-17.111	-17.243	-0.132	0
Fe(3)	2.81E-06						
	Fe(OH)3	1.90E-06	2.17E-06	-5.722	-5.663	0.059	0
	Fe(OH)4-	8.23E-07	5.62E-07	-6.085	-6.25	-0.166	0
	Fe(OH)2+	8.69E-08	5.93E-08	-7.061	-7.227	-0.166	0
	FeOH+2	3.10E-12	6.31E-13	-11.508	-12.2	-0.692	0

	FeF2+	2.96E-15	1.99E-15	-14.529	-14.701	-0.173	0
	FeF3	8.34E-16	9.54E-16	-15.079	-15.021	0.059	0
	FeF+2	8.12E-16	1.65E-16	-15.091	-15.782	-0.692	0
	FeSO4+	2.20E-17	1.48E-17	-16.658	-16.831	-0.173	0
	FeCl+2	1.28E-17	2.60E-18	-16.893	-17.584	-0.692	0
	FeCl2+	4.34E-18	2.91E-18	-17.363	-17.536	-0.173	0
	Fe+3	4.11E-18	3.44E-19	-17.387	-18.463	-1.077	0
	Fe(SO4)2-	1.71E-18	1.27E-18	-17.766	-17.898	-0.132	0
	FeCl3	6.38E-20	7.30E-20	-19.195	-19.137	0.059	0
	Fe2(OH)2+	1.36E-21	1.07E-23	-20.866	-22.97	-2.104	0
	FeHSO4+2	4.61E-25	1.37E-25	-24.337	-24.863	-0.526	0
	Fe3(OH)4+	2.58E-25	1.33E-28	-24.589	-27.877	-3.288	0
H(0)	1.49E-28						
	H2	7.44E-29	8.51E-29	-28.129	-28.07	0.059	28.61
K	5.36E-03						
	K+	5.23E-03	3.31E-03	-2.282	-2.481	-0.199	9.61
	KSO4-	1.33E-04	9.10E-05	-3.876	-4.041	-0.166	34.8
Mg	8.62E-02						
	Mg+2	6.48E-02	1.88E-02	-1.189	-1.727	-0.538	-20.48
	MgSO4	1.51E-02	1.72E-02	-1.823	-1.764	0.059	5.84
	MgHCO3+	3.58E-03	2.29E-03	-2.446	-2.64	-0.195	5.81
	MgCO3	2.21E-03	2.53E-03	-2.656	-2.598	0.059	-17.09
	MgF+	5.72E-04	3.75E-04	-3.243	-3.426	-0.183	-10.26
	MgOH+	2.72E-05	1.94E-05	-4.565	-4.713	-0.148	0
Mn(2)	4.80E-07						
	MnCO3	2.67E-07	3.05E-07	-6.574	-6.515	0.059	0
	Mn+2	1.14E-07	2.73E-08	-6.942	-7.565	-0.622	-16.5
	MnCl+	4.14E-08	2.78E-08	-7.383	-7.556	-0.173	-2.8
	MnHCO3+	3.77E-08	2.53E-08	-7.424	-7.596	-0.173	0
	MnSO4	1.66E-08	1.90E-08	-7.781	-7.722	0.059	22.54
	MnCl2	2.66E-09	3.04E-09	-8.576	-8.517	0.059	85.89
	MnCl3-	3.12E-10	2.10E-10	-9.506	-9.678	-0.173	45.51
	MnOH+	2.96E-10	1.99E-10	-9.529	-9.701	-0.173	0
	MnF+	8.49E-11	5.71E-11	-10.071	-10.244	-0.173	0
	Mn(NO3)2	8.17E-15	9.35E-15	-14.088	-14.029	0.059	41.04
	Mn(OH)3-	1.47E-17	9.89E-18	-16.832	-17.005	-0.173	0
Mn(3)	1.00E-28						
	Mn+3	1.00E-28	8.42E-30	-27.998	-29.075	-1.077	0
N(-3)	5.80E-05						
	NH4+	5.17E-05	2.98E-05	-4.287	-4.526	-0.24	18.41
	NH3	4.28E-06	4.89E-06	-5.369	-5.31	0.059	24.42
	NH4SO4-	2.03E-06	1.50E-06	-5.692	-5.824	-0.132	39.71
N(5)	4.90E-04						
	NO3-	4.90E-04	2.94E-04	-3.31	-3.532	-0.222	30.23
	Mn(NO3)2	8.17E-15	9.35E-15	-14.088	-14.029	0.059	41.04
Na	3.77E-01						
	Na+	3.67E-01	2.63E-01	-0.435	-0.58	-0.145	-0.57
	NaSO4-	7.55E-03	5.16E-03	-2.122	-2.288	-0.166	20.65
	NaHCO3	1.35E-03	1.54E-03	-2.87	-2.812	0.059	1.8
	NaCO3-	9.35E-04	6.91E-04	-3.029	-3.161	-0.132	2.41

	NaF	4.00E-05	4.58E-05	-4.398	-4.339	0.059	7.26
	NaOH	6.61E-17	7.56E-17	-16.18	-16.122	0.059	0
O(0)	9.75E-37						
	O2	4.88E-37	5.58E-37	-36.312	-36.254	0.059	30.4
S(6)	4.44E-02						
	SO4-2	2.03E-02	3.91E-03	-1.692	-2.407	-0.715	17.28
	MgSO4	1.51E-02	1.72E-02	-1.823	-1.764	0.059	5.84
	NaSO4-	7.55E-03	5.16E-03	-2.122	-2.288	-0.166	20.65
	CaSO4	1.32E-03	1.50E-03	-2.881	-2.823	0.059	7.5
	KSO4-	1.33E-04	9.10E-05	-3.876	-4.041	-0.166	34.8
	BaSO4	5.48E-06	6.27E-06	-5.262	-5.203	0.059	0
	NH4SO4-	2.03E-06	1.50E-06	-5.692	-5.824	-0.132	39.71
	MnSO4	1.66E-08	1.90E-08	-7.781	-7.722	0.059	22.54
	ZnSO4	7.65E-09	8.75E-09	-8.116	-8.058	0.059	21.71
	HSO4-	1.79E-09	1.32E-09	-8.748	-8.88	-0.132	40.92
	Zn(SO4)2-2	9.35E-10	2.79E-10	-9.029	-9.555	-0.526	-6.02
	FeSO4	2.19E-10	2.51E-10	-9.659	-9.601	0.059	18.97
	CaHSO4+	4.64E-11	3.43E-11	-10.333	-10.465	-0.132	0
	CuSO4	4.01E-11	4.59E-11	-10.396	-10.338	0.059	13.09
	FeSO4+	2.20E-17	1.48E-17	-16.658	-16.831	-0.173	0
	FeHSO4+	7.74E-18	5.72E-18	-17.111	-17.243	-0.132	0
	Fe(SO4)2-	1.71E-18	1.27E-18	-17.766	-17.898	-0.132	0
	FeHSO4+2	4.61E-25	1.37E-25	-24.337	-24.863	-0.526	0
Zn	3.07E-06						
	Zn(CO3)2-2	2.72E-06	8.10E-07	-5.566	-6.092	-0.526	0
	ZnCO3	2.35E-07	2.69E-07	-6.63	-6.571	0.059	0
	Zn+2	4.69E-08	9.54E-09	-7.329	-8.02	-0.692	-24.15
	ZnOHCl	1.96E-08	2.25E-08	-7.707	-7.648	0.059	0
	ZnHCO3+	1.70E-08	1.25E-08	-7.771	-7.902	-0.132	0
	ZnCl+	1.01E-08	6.43E-09	-7.997	-8.192	-0.195	-15.64
	Zn(OH)2	8.46E-09	9.68E-09	-8.072	-8.014	0.059	0
	ZnSO4	7.65E-09	8.75E-09	-8.116	-8.058	0.059	21.71
	ZnOH+	4.02E-09	2.97E-09	-8.396	-8.527	-0.132	0
	ZnCl2	1.47E-09	1.69E-09	-8.831	-8.773	0.059	102.03
	Zn(SO4)2-2	9.35E-10	2.79E-10	-9.029	-9.555	-0.526	-6.02
	ZnCl3-	7.42E-10	4.74E-10	-9.13	-9.324	-0.195	13.13
	ZnCl4-2	2.93E-10	5.95E-11	-9.534	-10.225	-0.692	149.82
	ZnF+	5.52E-11	4.08E-11	-10.258	-10.39	-0.132	0
	Zn(OH)3-	1.18E-11	8.70E-12	-10.929	-11.061	-0.132	0
	Zn(OH)4-2	1.31E-15	3.91E-16	-14.881	-15.407	-0.526	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1 atm)	
Anhydrite	-0.8	-5.07	-4.28	CaSO4
Aragonite	1.82	-6.52	-8.34	CaCO3
Barite	1.94	-7.9	-9.84	BaSO4
Calcite	1.96	-6.52	-8.48	CaCO3
CO2(g)	-2.62	-4.08	-1.47	CO2

Dolomite	4.99	-12.09	-17.08	CaMg(CO3)2
Fe(OH)3(a)	2.01	6.9	4.89	Fe(OH)3
Fluorite	0.9	-9.7	-10.6	CaF2
Goethite	7.9	6.9	-1	FeOOH
Gypsum	-0.5	-5.09	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	-0.01	1.5	H2O
Halite	-2.75	-1.18	1.57	NaCl
Hausmann	-8.07	52.96	61.03	Mn3O4
Hematite	17.82	13.81	-4.01	Fe2O3
Jarosite-K	-2.76	-11.97	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.54	21.8	25.34	MnOOH
Melanterit	-9.69	-11.9	-2.21	FeSO4:7H2O
NH3(g)	-7.11	-5.31	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.86	9.34	15.2	Mn(OH)2
Pyrolusite	-7.12	34.26	41.38	MnO2:H2O
Rhodochro	-0.29	-11.42	-11.13	MnCO3
Siderite	-2.4	-13.29	-10.89	FeCO3
Smithsonit	-1.87	-11.87	-10	ZnCO3
Sylvite	-3.98	-3.08	0.9	KCl
Witherite	-0.78	-9.35	-8.56	BaCO3
Zn(OH)2(e	-2.61	8.89	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 30

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	3.02E-02	3.02E-02
Ba	2.25E-05	2.25E-05
Ca	1.11E-02	1.11E-02
Cl	4.05E-01	4.05E-01
Cu	3.70E-07	3.70E-07
F	1.14E-03	1.14E-03
Fe	2.91E-06	2.91E-06
K	5.55E-03	5.55E-03
Mg	8.92E-02	8.92E-02
Mn	4.90E-07	4.90E-07
N(-3)	6.00E-05	6.00E-05
N(5)	5.10E-04	5.10E-04
Na	3.90E-01	3.90E-01
S(6)	4.59E-02	4.59E-02
Zn	3.18E-06	3.18E-06

#NAME? of solution----------

```
pH          =          8.46
pe          =             4
Specific    Conductan (µS/cm,    25°C)     =          43111
Density     (g/cm³)   =          1.02203
Volume      (L)       =          1.00994
Activity    of        water    =          0.984
Ionic       strength  (mol/kgw) =        6.05E-01
Mass        of        water    (kg)      =        1.00E+00
Total       carbon    (mol/kg) =        2.57E-02
Total       CO2       (mol/kg) =        2.57E-02
Temperatu   (°C)      =              25
Electrical  balance   (eq)     =        6.73E-02
Percent     error,    100*(Cat-|=            6.63
Iterations  =              13 (321     overall)
Total       H         =        1.11E+02
Total       O         =        5.58E+01

#NAME?  couples--------------------------------

        Redox     couple    pe        Eh        (volts)

        N(-3)/N(5)   4.4368    0.2625

#NAME?  of        species----------------------------

        Log       Log       Log       mole      V
        Species   Molality  Activity  Molality  Activity  Gamma   cm³/mol

        OH-       4.65E-06  2.87E-06  -5.332    -5.542    -0.209  -2.75
        H+        4.57E-09  3.47E-09  -8.34     -8.46     -0.12   0
        H2O       5.55E+01  9.84E-01  1.744     -0.007    0       18.07
Ba        2.25E-05
        Ba+2      1.61E-05  3.28E-06  -4.792    -5.484    -0.692  -11.08
        BaSO4     5.67E-06  6.51E-06  -5.247    -5.186    0.06    0
        BaHCO3+   4.52E-07  3.34E-07  -6.345    -6.476    -0.131  0
        BaCO3     2.12E-07  2.44E-07  -6.674    -6.613    0.06    -10.7
        BaOH+     4.71E-11  3.15E-11  -10.327   -10.501   -0.174  0
C(4)      2.57E-02
        HCO3-     1.56E-02  1.06E-02  -1.807    -1.973    -0.167  26.78
        MgHCO3+   3.78E-03  2.41E-03  -2.422    -2.619    -0.196  5.81
        MgCO3     2.31E-03  2.65E-03  -2.636    -2.576    0.06    -17.09
        NaHCO3    1.42E-03  1.63E-03  -2.849    -2.789    0.06    1.8
        NaCO3-    9.84E-04  7.28E-04  -3.007    -3.138    -0.131  2.51
        CO3-2     6.68E-04  1.44E-04  -3.175    -3.842    -0.667  -2.17
        CaCO3     4.67E-04  5.37E-04  -3.33     -3.27     0.06    -14.6
        CaHCO3+   4.33E-04  3.02E-04  -3.364    -3.521    -0.157  9.95
        CO2       7.33E-05  8.42E-05  -4.135    -4.074    0.06    34.43
        Zn(CO3)2-2 2.82E-06 8.47E-07  -5.55     -6.072    -0.522  0
        BaHCO3+   4.52E-07  3.34E-07  -6.345    -6.476    -0.131  0
```

	MnCO3	2.72E-07	3.13E-07	-6.565	-6.505	0.06	0
	ZnCO3	2.40E-07	2.76E-07	-6.62	-6.56	0.06	0
	BaCO3	2.12E-07	2.44E-07	-6.674	-6.613	0.06	-10.7
	MnHCO3+	3.87E-08	2.59E-08	-7.412	-7.586	-0.174	0
	CuCO3	3.76E-08	4.32E-08	-7.425	-7.364	0.06	0
	Cu(CO3)2-	2.60E-08	7.82E-09	-7.584	-8.107	-0.522	0
	ZnHCO3+	1.74E-08	1.29E-08	-7.76	-7.891	-0.131	0
	FeCO3	1.13E-09	1.29E-09	-8.949	-8.889	0.06	0
	FeHCO3+	5.38E-10	3.98E-10	-9.269	-9.4	-0.131	0
	CuHCO3+	4.03E-10	2.98E-10	-9.395	-9.526	-0.131	0
	(CO2)2	1.13E-10	1.30E-10	-9.946	-9.885	0.06	68.87
Ca	1.11E-02						
	Ca+2	8.79E-03	2.22E-03	-2.056	-2.653	-0.597	-16.75
	CaSO4	1.36E-03	1.57E-03	-2.866	-2.805	0.06	7.5
	CaCO3	4.67E-04	5.37E-04	-3.33	-3.27	0.06	-14.6
	CaHCO3+	4.33E-04	3.02E-04	-3.364	-3.521	-0.157	9.95
	CaOH+	1.41E-07	1.05E-07	-6.849	-6.98	-0.131	0
	CaHSO4+	4.82E-11	3.57E-11	-10.317	-10.447	-0.131	0
Cl	4.05E-01						
	Cl-	4.05E-01	2.58E-01	-0.392	-0.588	-0.196	18.75
	CuCl3-2	1.26E-07	2.54E-08	-6.899	-7.596	-0.697	0
	CuCl2-	9.73E-08	6.20E-08	-7.012	-7.208	-0.196	0
	MnCl+	4.30E-08	2.88E-08	-7.366	-7.54	-0.174	-2.8
	ZnOHCl	2.03E-08	2.33E-08	-7.693	-7.632	0.06	0
	ZnCl+	1.05E-08	6.68E-09	-7.979	-8.175	-0.196	-15.71
	MnCl2	2.83E-09	3.25E-09	-8.549	-8.488	0.06	85.89
	ZnCl2	1.57E-09	1.81E-09	-8.804	-8.743	0.06	102.03
	ZnCl3-	8.22E-10	5.23E-10	-9.085	-9.281	-0.196	12.99
	MnCl3-	3.45E-10	2.31E-10	-9.462	-9.636	-0.174	45.58
	ZnCl4-2	3.37E-10	6.78E-11	-9.472	-10.169	-0.697	149.94
	FeCl+	1.81E-10	1.34E-10	-9.744	-9.874	-0.131	0
	CuCl+	6.11E-11	3.89E-11	-10.214	-10.41	-0.196	1.79
	CuCl2	4.69E-12	5.40E-12	-11.328	-11.268	0.06	31.02
	CuCl3-	7.77E-15	4.95E-15	-14.11	-14.306	-0.196	0
	CuCl4-2	3.18E-17	6.40E-18	-16.497	-17.194	-0.697	0
	FeCl+2	1.39E-17	2.79E-18	-16.858	-17.554	-0.697	0
	FeCl2+	4.81E-18	3.22E-18	-17.318	-17.492	-0.174	0
	FeCl3	7.24E-20	8.32E-20	-19.14	-19.08	0.06	0
Cu(1)	2.24E-07						
	CuCl3-2	1.26E-07	2.54E-08	-6.899	-7.596	-0.697	0
	CuCl2-	9.73E-08	6.20E-08	-7.012	-7.208	-0.196	0
	Cu+	5.13E-12	2.94E-12	-11.29	-11.532	-0.242	0
Cu(2)	1.47E-07						
	Cu(OH)2	8.19E-08	9.41E-08	-7.087	-7.026	0.06	0
	CuCO3	3.76E-08	4.32E-08	-7.425	-7.364	0.06	0
	Cu(CO3)2-	2.60E-08	7.82E-09	-7.584	-8.107	-0.522	0
	CuHCO3+	4.03E-10	2.98E-10	-9.395	-9.526	-0.131	0
	CuOH+	2.49E-10	1.59E-10	-9.603	-9.799	-0.196	0
	Cu+2	2.37E-10	5.59E-11	-9.626	-10.252	-0.626	-25.36
	CuCl+	6.11E-11	3.89E-11	-10.214	-10.41	-0.196	1.79

	CuSO4	3.94E-11	4.53E-11	-10.405	-10.344	0.06	13.09
	CuCl2	4.69E-12	5.40E-12	-11.328	-11.268	0.06	31.02
	Cu(OH)3-	2.17E-12	1.61E-12	-11.663	-11.793	-0.131	0
	CuF+	4.23E-13	3.13E-13	-12.374	-12.505	-0.131	0
	Cu2(OH)2+	3.67E-14	1.10E-14	-13.435	-13.957	-0.522	0
	CuCl3-	7.77E-15	4.95E-15	-14.11	-14.306	-0.196	0
	Cu(OH)4-2	3.04E-16	9.12E-17	-15.518	-16.04	-0.522	0
	CuCl4-2	3.18E-17	6.40E-18	-16.497	-17.194	-0.697	0
F	1.14E-03						
	MgF+	6.01E-04	3.93E-04	-3.221	-3.406	-0.185	-10.26
	F-	4.98E-04	3.07E-04	-3.303	-3.512	-0.209	-0.61
	NaF	4.18E-05	4.81E-05	-4.378	-4.318	0.06	7.26
	HF	1.39E-09	1.60E-09	-8.857	-8.796	0.06	12.5
	MnF+	8.69E-11	5.82E-11	-10.061	-10.235	-0.174	0
	ZnF+	5.63E-11	4.17E-11	-10.25	-10.38	-0.131	0
	HF2-	2.54E-12	1.88E-12	-11.594	-11.725	-0.131	22.76
	FeF+	1.56E-12	1.15E-12	-11.808	-11.939	-0.131	0
	CuF+	4.23E-13	3.13E-13	-12.374	-12.505	-0.131	0
	FeF2+	3.18E-15	2.13E-15	-14.497	-14.671	-0.174	0
	FeF3	9.03E-16	1.04E-15	-15.044	-14.984	0.06	0
	FeF+2	8.67E-16	1.74E-16	-15.062	-15.759	-0.697	0
Fe(2)	3.71E-09						
	Fe+2	1.59E-09	3.75E-10	-8.8	-9.426	-0.626	-20.77
	FeCO3	1.13E-09	1.29E-09	-8.949	-8.889	0.06	0
	FeHCO3+	5.38E-10	3.98E-10	-9.269	-9.4	-0.131	0
	FeSO4	2.30E-10	2.64E-10	-9.639	-9.578	0.06	18.97
	FeCl+	1.81E-10	1.34E-10	-9.744	-9.874	-0.131	0
	FeOH+	5.02E-11	3.36E-11	-10.299	-10.473	-0.174	0
	FeF+	1.56E-12	1.15E-12	-11.808	-11.939	-0.131	0
	Fe(OH)2	7.07E-14	8.12E-14	-13.151	-13.09	0.06	0
	Fe(OH)3-	1.28E-15	8.57E-16	-14.893	-15.067	-0.174	0
	FeHSO4+	8.13E-18	6.02E-18	-17.09	-17.221	-0.131	0
Fe(3)	2.91E-06						
	Fe(OH)3	1.96E-06	2.25E-06	-5.708	-5.647	0.06	0
	Fe(OH)4-	8.56E-07	5.83E-07	-6.068	-6.234	-0.167	0
	Fe(OH)2+	9.05E-08	6.16E-08	-7.044	-7.21	-0.167	0
	FeOH+2	3.26E-12	6.56E-13	-11.487	-12.183	-0.697	0
	FeF2+	3.18E-15	2.13E-15	-14.497	-14.671	-0.174	0
	FeF3	9.03E-16	1.04E-15	-15.044	-14.984	0.06	0
	FeF+2	8.67E-16	1.74E-16	-15.062	-15.759	-0.697	0
	FeSO4+	2.32E-17	1.55E-17	-16.634	-16.808	-0.174	0
	FeCl+2	1.39E-17	2.79E-18	-16.858	-17.554	-0.697	0
	FeCl2+	4.81E-18	3.22E-18	-17.318	-17.492	-0.174	0
	Fe+3	4.32E-18	3.58E-19	-17.364	-18.446	-1.082	0
	Fe(SO4)2-	1.82E-18	1.35E-18	-17.74	-17.871	-0.131	0
	FeCl3	7.24E-20	8.32E-20	-19.14	-19.08	0.06	0
	Fe2(OH)2+	1.42E-21	1.16E-23	-20.847	-22.937	-2.089	0
	FeHSO4+2	4.81E-25	1.44E-25	-24.318	-24.841	-0.522	0
	Fe3(OH)4+	2.74E-25	1.49E-28	-24.562	-27.827	-3.265	0
H(0)	1.48E-28						

	H2	7.41E-29	8.51E-29	-28.13	-28.07	0.06	28.61
K	5.55E-03						
	K+	5.41E-03	3.41E-03	-2.267	-2.467	-0.2	9.62
	KSO4-	1.39E-04	9.50E-05	-3.856	-4.022	-0.167	34.81
Mg	8.92E-02						
	Mg+2	6.69E-02	1.93E-02	-1.175	-1.713	-0.539	-20.47
	MgSO4	1.56E-02	1.80E-02	-1.806	-1.746	0.06	5.84
	MgHCO3+	3.78E-03	2.41E-03	-2.422	-2.619	-0.196	5.81
	MgCO3	2.31E-03	2.65E-03	-2.636	-2.576	0.06	-17.09
	MgF+	6.01E-04	3.93E-04	-3.221	-3.406	-0.185	-10.26
	MgOH+	2.81E-05	1.99E-05	-4.551	-4.7	-0.149	0
Mn(2)	4.90E-07						
	MnCO3	2.72E-07	3.13E-07	-6.565	-6.505	0.06	0
	Mn+2	1.16E-07	2.74E-08	-6.936	-7.563	-0.626	-16.47
	MnCl+	4.30E-08	2.88E-08	-7.366	-7.54	-0.174	-2.8
	MnHCO3+	3.87E-08	2.59E-08	-7.412	-7.586	-0.174	0
	MnSO4	1.68E-08	1.93E-08	-7.775	-7.715	0.06	22.54
	MnCl2	2.83E-09	3.25E-09	-8.549	-8.488	0.06	85.89
	MnCl3-	3.45E-10	2.31E-10	-9.462	-9.636	-0.174	45.58
	MnOH+	2.98E-10	2.00E-10	-9.525	-9.7	-0.174	0
	MnF+	8.69E-11	5.82E-11	-10.061	-10.235	-0.174	0
	Mn(NO3)2	8.77E-15	1.01E-14	-14.057	-13.997	0.06	41.04
	Mn(OH)3-	1.48E-17	9.92E-18	-16.829	-17.004	-0.174	0
Mn(3)	1.02E-28						
	Mn+3	1.02E-28	8.46E-30	-27.991	-29.073	-1.082	0
N(-3)	6.00E-05						
	NH4+	5.35E-05	3.06E-05	-4.272	-4.514	-0.242	18.42
	NH3	4.38E-06	5.04E-06	-5.358	-5.298	0.06	24.42
	NH4SO4-	2.11E-06	1.56E-06	-5.675	-5.806	-0.131	39.77
N(5)	5.10E-04						
	NO3-	5.10E-04	3.04E-04	-3.292	-3.517	-0.225	30.25
	Mn(NO3)2	8.77E-15	1.01E-14	-14.057	-13.997	0.06	41.04
Na	3.90E-01						
	Na+	3.80E-01	2.72E-01	-0.421	-0.565	-0.145	-0.55
	NaSO4-	7.93E-03	5.40E-03	-2.101	-2.268	-0.167	20.78
	NaHCO3	1.42E-03	1.63E-03	-2.849	-2.789	0.06	1.8
	NaCO3-	9.84E-04	7.28E-04	-3.007	-3.138	-0.131	2.51
	NaF	4.18E-05	4.81E-05	-4.378	-4.318	0.06	7.26
	NaOH	6.80E-17	7.81E-17	-16.168	-16.107	0.06	0
O(0)	9.70E-37						
	O2	4.85E-37	5.57E-37	-36.314	-36.254	0.06	30.4
S(6)	4.59E-02						
	SO4-2	2.08E-02	3.96E-03	-1.681	-2.402	-0.721	17.33
	MgSO4	1.56E-02	1.80E-02	-1.806	-1.746	0.06	5.84
	NaSO4-	7.93E-03	5.40E-03	-2.101	-2.268	-0.167	20.78
	CaSO4	1.36E-03	1.57E-03	-2.866	-2.805	0.06	7.5
	KSO4-	1.39E-04	9.50E-05	-3.856	-4.022	-0.167	34.81
	BaSO4	5.67E-06	6.51E-06	-5.247	-5.186	0.06	0
	NH4SO4-	2.11E-06	1.56E-06	-5.675	-5.806	-0.131	39.77
	MnSO4	1.68E-08	1.93E-08	-7.775	-7.715	0.06	22.54

	ZnSO4	7.76E-09	8.92E-09	-8.11	-8.05	0.06	21.71
	HSO4-	1.80E-09	1.34E-09	-8.744	-8.874	-0.131	40.93
	Zn(SO4)2-2	9.56E-10	2.87E-10	-9.019	-9.542	-0.522	-5.83
	FeSO4	2.30E-10	2.64E-10	-9.639	-9.578	0.06	18.97
	CaHSO4+	4.82E-11	3.57E-11	-10.317	-10.447	-0.131	0
	CuSO4	3.94E-11	4.53E-11	-10.405	-10.344	0.06	13.09
	FeSO4+	2.32E-17	1.55E-17	-16.634	-16.808	-0.174	0
	FeHSO4+	8.13E-18	6.02E-18	-17.09	-17.221	-0.131	0
	Fe(SO4)2-	1.82E-18	1.35E-18	-17.74	-17.871	-0.131	0
	FeHSO4+2	4.81E-25	1.44E-25	-24.318	-24.841	-0.522	0
Zn	3.18E-06						
	Zn(CO3)2-2	2.82E-06	8.47E-07	-5.55	-6.072	-0.522	0
	ZnCO3	2.40E-07	2.76E-07	-6.62	-6.56	0.06	0
	Zn+2	4.78E-08	9.60E-09	-7.321	-8.018	-0.697	-24.14
	ZnOHCl	2.03E-08	2.33E-08	-7.693	-7.632	0.06	0
	ZnHCO3+	1.74E-08	1.29E-08	-7.76	-7.891	-0.131	0
	ZnCl+	1.05E-08	6.68E-09	-7.979	-8.175	-0.196	-15.71
	Zn(OH)2	8.47E-09	9.74E-09	-8.072	-8.012	0.06	0
	ZnSO4	7.76E-09	8.92E-09	-8.11	-8.05	0.06	21.71
	ZnOH+	4.04E-09	2.99E-09	-8.394	-8.525	-0.131	0
	ZnCl2	1.57E-09	1.81E-09	-8.804	-8.743	0.06	102.03
	Zn(SO4)2-2	9.56E-10	2.87E-10	-9.019	-9.542	-0.522	-5.83
	ZnCl3-	8.22E-10	5.23E-10	-9.085	-9.281	-0.196	12.99
	ZnCl4-2	3.37E-10	6.78E-11	-9.472	-10.169	-0.697	149.94
	ZnF+	5.63E-11	4.17E-11	-10.25	-10.38	-0.131	0
	Zn(OH)3-	1.18E-11	8.74E-12	-10.928	-11.059	-0.131	0
	Zn(OH)4-2	1.31E-15	3.93E-16	-14.883	-15.406	-0.522	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-0.78	-5.06	-4.28	CaSO4			
Aragonite	1.84	-6.5	-8.34	CaCO3			
Barite	1.96	-7.89	-9.84	BaSO4			
Calcite	1.98	-6.5	-8.48	CaCO3			
CO2(g)	-2.61	-4.07	-1.47	CO2			
Dolomite	5.03	-12.05	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	2.02	6.91	4.89	Fe(OH)3			
Fluorite	0.92	-9.68	-10.6	CaF2			
Goethite	7.92	6.92	-1	FeOOH			
Gypsum	-0.49	-5.07	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	-0.01	1.5	H2O			
Halite	-2.72	-1.15	1.57	NaCl			
Hausmann	-8.07	52.96	61.03	Mn3O4			
Hematite	17.85	13.85	-4.01	Fe2O3			
Jarosite-K	-2.68	-11.89	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.54	21.8	25.34	MnOOH			
Melanterit	-9.67	-11.88	-2.21	FeSO4:7H2O			

NH3(g)	-7.09	-5.3	1.8	NH3
O2(g)	-33.36	-36.25	-2.89	O2
Pyrochroit	-5.86	9.34	15.2	Mn(OH)2
Pyrolusite	-7.12	34.26	41.38	MnO2:H2O
Rhodochrc	-0.27	-11.4	-11.13	MnCO3
Siderite	-2.38	-13.27	-10.89	FeCO3
Smithsonit	-1.86	-11.86	-10	ZnCO3
Sylvite	-3.95	-3.05	0.9	KCl
Witherite	-0.76	-9.33	-8.56	BaCO3
Zn(OH)2(e	-2.61	8.89	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

Initial solution 31

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	3.12E-02	3.12E-02
Ba	2.32E-05	2.32E-05
Ca	1.14E-02	1.14E-02
Cl	4.19E-01	4.19E-01
Cu	3.80E-07	3.80E-07
F	1.18E-03	1.18E-03
Fe	3.01E-06	3.01E-06
K	5.73E-03	5.73E-03
Mg	9.22E-02	9.22E-02
Mn	5.10E-07	5.10E-07
N(-3)	6.20E-05	6.20E-05
N(5)	5.30E-04	5.30E-04
Na	4.03E-01	4.03E-01
S(6)	4.74E-02	4.74E-02
Zn	3.28E-06	3.28E-06

#NAME? of solution----------

pH	=	8.46		
pe	=	4		
Specific	Conductan	(µS/cm,	25°C)	= 44312
Density	(g/cm³)	=	1.02285	
Volume	(L)	=	1.01018	
Activity	of	water	=	0.984
Ionic	strength	(mol/kgw)	=	6.24E-01
Mass	of	water	(kg)	= 1.00E+00
Total	carbon	(mol/kg)	=	2.66E-02
Total	CO2	(mol/kg)	=	2.66E-02
Temperatu	(°C)	=	25	
Electrical	balance	(eq)	=	6.95E-02

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Percent    error,     100*(Cat-|=              6.63
Iterations =                13 (334      overall)
Total      H          =        1.11E+02
Total      O          =        5.58E+01

#NAME?  couples--------------------------------

Redox      couple     pe         Eh         (volts)

N(-3)/N(5)    4.4372     0.2625

#NAME?  of         species----------------------------

Log        Log        Log        mole       V
Species    Molality   Activity   Molality   Activity   Gamma    cm³/mol

OH-         4.67E-06  2.87E-06    -5.331     -5.542    -0.211     -2.71
H+          4.58E-09  3.47E-09    -8.339      -8.46    -0.121         0
H2O         5.55E+01  9.84E-01     1.744     -0.007         0     18.07
Ba          2.32E-05
Ba+2        1.67E-05  3.36E-06    -4.778     -5.473    -0.695    -11.05
BaSO4       5.85E-06  6.76E-06    -5.233      -5.17     0.062         0
BaHCO3+     4.71E-07  3.49E-07    -6.327     -6.457     -0.13         0
BaCO3       2.21E-07  2.55E-07    -6.657     -6.594     0.062      -10.7
BaOH+       4.84E-11  3.23E-11   -10.315     -10.49    -0.175         0
C(4)        2.66E-02
HCO3-       1.59E-02  1.08E-02    -1.797     -1.965    -0.168     26.83
MgHCO3+     3.98E-03  2.53E-03      -2.4     -2.598    -0.198      5.81
MgCO3       2.41E-03  2.79E-03    -2.618     -2.555     0.062    -17.09
NaHCO3      1.48E-03  1.71E-03    -2.829     -2.766     0.062       1.8
NaCO3-      1.03E-03  7.67E-04    -2.986     -3.115     -0.13      2.62
CO3-2       6.87E-04  1.47E-04    -3.163     -3.834    -0.671     -2.11
CaCO3       4.87E-04  5.63E-04    -3.312      -3.25     0.062     -14.6
CaHCO3+     4.54E-04  3.16E-04    -3.343       -3.5    -0.158      9.95
CO2         7.44E-05  8.59E-05    -4.129     -4.066     0.062     34.43
Zn(CO3)2-2  2.91E-06  8.83E-07    -5.536     -6.054    -0.518         0
BaHCO3+     4.71E-07  3.49E-07    -6.327     -6.457     -0.13         0
MnCO3       2.83E-07  3.27E-07    -6.548     -6.486     0.062         0
ZnCO3       2.44E-07  2.82E-07    -6.612      -6.55     0.062         0
BaCO3       2.21E-07  2.55E-07    -6.657     -6.594     0.062      -10.7
MnHCO3+     4.06E-08  2.71E-08    -7.392     -7.567    -0.175         0
CuCO3       3.71E-08  4.28E-08    -7.431     -7.368     0.062         0
Cu(CO3)2-   2.61E-08  7.90E-09    -7.584     -8.102    -0.518         0
ZnHCO3+     1.77E-08  1.32E-08    -7.751     -7.881     -0.13         0
FeCO3       1.19E-09  1.37E-09    -8.926     -8.864     0.062         0
FeHCO3+     5.68E-10  4.22E-10    -9.246     -9.375     -0.13         0
CuHCO3+     3.98E-10  2.96E-10      -9.4     -9.529     -0.13         0
(CO2)2      1.17E-10  1.35E-10    -9.931     -9.869     0.062     68.87
Ca          1.14E-02
Ca+2        9.07E-03  2.29E-03    -2.043     -2.641    -0.599    -16.73
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	CaSO4	1.41E-03	1.63E-03	-2.85	-2.788	0.062	7.5
	CaCO3	4.87E-04	5.63E-04	-3.312	-3.25	0.062	-14.6
	CaHCO3+	4.54E-04	3.16E-04	-3.343	-3.5	-0.158	9.95
	CaOH+	1.45E-07	1.08E-07	-6.839	-6.968	-0.13	0
	CaHSO4+	5.00E-11	3.71E-11	-10.301	-10.43	-0.13	0
Cl	4.19E-01						
	Cl-	4.19E-01	2.66E-01	-0.378	-0.575	-0.197	18.76
	CuCl3-2	1.36E-07	2.70E-08	-6.867	-7.569	-0.702	0
	CuCl2-	1.01E-07	6.40E-08	-6.996	-7.194	-0.198	0
	MnCl+	4.56E-08	3.04E-08	-7.341	-7.517	-0.175	-2.8
	ZnOHCl	2.09E-08	2.41E-08	-7.68	-7.618	0.062	0
	ZnCl+	1.09E-08	6.91E-09	-7.963	-8.161	-0.198	-15.78
	MnCl2	3.06E-09	3.54E-09	-8.514	-8.452	0.062	85.89
	ZnCl2	1.67E-09	1.93E-09	-8.778	-8.716	0.062	102.03
	ZnCl3-	9.07E-10	5.75E-10	-9.043	-9.24	-0.198	12.85
	MnCl3-	3.88E-10	2.59E-10	-9.411	-9.586	-0.175	45.64
	ZnCl4-2	3.86E-10	7.67E-11	-9.414	-10.115	-0.702	150.05
	FeCl+	1.93E-10	1.43E-10	-9.715	-9.845	-0.13	0
	CuCl+	6.15E-11	3.90E-11	-10.211	-10.409	-0.198	1.82
	CuCl2	4.83E-12	5.57E-12	-11.316	-11.254	0.062	31.02
	CuCl3-	8.30E-15	5.26E-15	-14.081	-14.279	-0.198	0
	CuCl4-2	3.53E-17	7.02E-18	-16.452	-17.154	-0.702	0
	FeCl+2	1.50E-17	2.99E-18	-16.823	-17.525	-0.702	0
	FeCl2+	5.32E-18	3.55E-18	-17.274	-17.45	-0.175	0
	FeCl3	8.19E-20	9.45E-20	-19.087	-19.024	0.062	0
Cu(1)	2.37E-07						
	CuCl3-2	1.36E-07	2.70E-08	-6.867	-7.569	-0.702	0
	CuCl2-	1.01E-07	6.40E-08	-6.996	-7.194	-0.198	0
	Cu+	5.01E-12	2.86E-12	-11.3	-11.544	-0.244	0
Cu(2)	1.43E-07						
	Cu(OH)2	7.92E-08	9.15E-08	-7.101	-7.039	0.062	0
	CuCO3	3.71E-08	4.28E-08	-7.431	-7.368	0.062	0
	Cu(CO3)2-	2.61E-08	7.90E-09	-7.584	-8.102	-0.518	0
	CuHCO3+	3.98E-10	2.96E-10	-9.4	-9.529	-0.13	0
	CuOH+	2.43E-10	1.54E-10	-9.614	-9.811	-0.198	0
	Cu+2	2.32E-10	5.44E-11	-9.634	-10.264	-0.63	-25.34
	CuCl+	6.15E-11	3.90E-11	-10.211	-10.409	-0.198	1.82
	CuSO4	3.86E-11	4.45E-11	-10.414	-10.351	0.062	13.09
	CuCl2	4.83E-12	5.57E-12	-11.316	-11.254	0.062	31.02
	Cu(OH)3-	2.11E-12	1.56E-12	-11.676	-11.806	-0.13	0
	CuF+	4.16E-13	3.09E-13	-12.381	-12.51	-0.13	0
	Cu2(OH)2+	3.44E-14	1.04E-14	-13.463	-13.982	-0.518	0
	CuCl3-	8.30E-15	5.26E-15	-14.081	-14.279	-0.198	0
	Cu(OH)4-2	2.92E-16	8.85E-17	-15.535	-16.053	-0.518	0
	CuCl4-2	3.53E-17	7.02E-18	-16.452	-17.154	-0.702	0
F	1.18E-03						
	MgF+	6.29E-04	4.10E-04	-3.201	-3.387	-0.186	-10.26
	F-	5.07E-04	3.12E-04	-3.295	-3.506	-0.211	-0.6
	NaF	4.37E-05	5.04E-05	-4.36	-4.297	0.062	7.26
	HF	1.40E-09	1.62E-09	-8.853	-8.79	0.062	12.5

	MnF+	9.06E-11	6.05E-11	-10.043	-10.218	-0.175	0
	ZnF+	5.72E-11	4.25E-11	-10.242	-10.372	-0.13	0
	HF2-	2.61E-12	1.94E-12	-11.583	-11.712	-0.13	22.78
	FeF+	1.64E-12	1.21E-12	-11.787	-11.916	-0.13	0
	CuF+	4.16E-13	3.09E-13	-12.381	-12.51	-0.13	0
	FeF2+	3.41E-15	2.28E-15	-14.467	-14.642	-0.175	0
	FeF3	9.75E-16	1.13E-15	-15.011	-14.949	0.062	0
	FeF+2	9.23E-16	1.84E-16	-15.035	-15.736	-0.702	0
Fe(2)	3.90E-09						
	Fe+2	1.66E-09	3.89E-10	-8.78	-9.41	-0.63	-20.76
	FeCO3	1.19E-09	1.37E-09	-8.926	-8.864	0.062	0
	FeHCO3+	5.68E-10	4.22E-10	-9.246	-9.375	-0.13	0
	FeSO4	2.40E-10	2.77E-10	-9.619	-9.557	0.062	18.97
	FeCl+	1.93E-10	1.43E-10	-9.715	-9.845	-0.13	0
	FeOH+	5.23E-11	3.49E-11	-10.282	-10.457	-0.175	0
	FeF+	1.64E-12	1.21E-12	-11.787	-11.916	-0.13	0
	Fe(OH)2	7.30E-14	8.43E-14	-13.137	-13.074	0.062	0
	Fe(OH)3-	1.33E-15	8.88E-16	-14.876	-15.052	-0.175	0
	FeHSO4+	8.52E-18	6.32E-18	-17.07	-17.199	-0.13	0
Fe(3)	3.01E-06						
	Fe(OH)3	2.02E-06	2.34E-06	-5.694	-5.632	0.062	0
	Fe(OH)4-	8.89E-07	6.04E-07	-6.051	-6.219	-0.168	0
	Fe(OH)2+	9.41E-08	6.39E-08	-7.027	-7.194	-0.168	0
	FeOH+2	3.42E-12	6.81E-13	-11.466	-12.167	-0.702	0
	FeF2+	3.41E-15	2.28E-15	-14.467	-14.642	-0.175	0
	FeF3	9.75E-16	1.13E-15	-15.011	-14.949	0.062	0
	FeF+2	9.23E-16	1.84E-16	-15.035	-15.736	-0.702	0
	FeSO4+	2.45E-17	1.63E-17	-16.612	-16.787	-0.175	0
	FeCl+2	1.50E-17	2.99E-18	-16.823	-17.525	-0.702	0
	FeCl2+	5.32E-18	3.55E-18	-17.274	-17.45	-0.175	0
	Fe+3	4.54E-18	3.72E-19	-17.343	-18.43	-1.087	0
	Fe(SO4)2-	1.93E-18	1.43E-18	-17.714	-17.844	-0.13	0
	FeCl3	8.19E-20	9.45E-20	-19.087	-19.024	0.062	0
	Fe2(OH)2+	1.48E-21	1.25E-23	-20.831	-22.904	-2.074	0
	FeHSO4+2	5.00E-25	1.52E-25	-24.301	-24.819	-0.518	0
	Fe3(OH)4+	2.89E-25	1.67E-28	-24.539	-27.779	-3.24	0
H(0)	1.47E-28						
	H2	7.37E-29	8.51E-29	-28.132	-28.07	0.062	28.61
K	5.73E-03						
	K+	5.59E-03	3.51E-03	-2.253	-2.455	-0.202	9.63
	KSO4-	1.45E-04	9.88E-05	-3.837	-4.005	-0.168	34.82
Mg	9.22E-02						
	Mg+2	6.89E-02	1.99E-02	-1.162	-1.701	-0.539	-20.45
	MgSO4	1.62E-02	1.87E-02	-1.79	-1.728	0.062	5.84
	MgHCO3+	3.98E-03	2.53E-03	-2.4	-2.598	-0.198	5.81
	MgCO3	2.41E-03	2.79E-03	-2.618	-2.555	0.062	-17.09
	MgF+	6.29E-04	4.10E-04	-3.201	-3.387	-0.186	-10.26
	MgOH+	2.90E-05	2.05E-05	-4.538	-4.688	-0.15	0
Mn(2)	5.10E-07						
	MnCO3	2.83E-07	3.27E-07	-6.548	-6.486	0.062	0

	Mn+2	1.20E-07	2.81E-08	-6.922	-7.552	-0.63	-16.44
	MnCl+	4.56E-08	3.04E-08	-7.341	-7.517	-0.175	-2.8
	MnHCO3+	4.06E-08	2.71E-08	-7.392	-7.567	-0.175	0
	MnSO4	1.73E-08	2.00E-08	-7.761	-7.699	0.062	22.54
	MnCl2	3.06E-09	3.54E-09	-8.514	-8.452	0.062	85.89
	MnCl3-	3.88E-10	2.59E-10	-9.411	-9.586	-0.175	45.64
	MnOH+	3.06E-10	2.05E-10	-9.514	-9.689	-0.175	0
	MnF+	9.06E-11	6.05E-11	-10.043	-10.218	-0.175	0
	Mn(NO3)2	9.58E-15	1.11E-14	-14.019	-13.956	0.062	41.04
	Mn(OH)3-	1.52E-17	1.02E-17	-16.818	-16.994	-0.175	0
Mn(3)	1.06E-28						
	Mn+3	1.06E-28	8.67E-30	-27.975	-29.062	-1.087	0
N(-3)	6.20E-05						
	NH4+	5.53E-05	3.15E-05	-4.257	-4.501	-0.244	18.43
	NH3	4.49E-06	5.18E-06	-5.348	-5.286	0.062	24.42
	NH4SO4-	2.19E-06	1.63E-06	-5.659	-5.789	-0.13	39.83
N(5)	5.30E-04						
	NO3-	5.30E-04	3.15E-04	-3.276	-3.502	-0.227	30.26
	Mn(NO3)2	9.58E-15	1.11E-14	-14.019	-13.956	0.062	41.04
Na	4.03E-01						
	Na+	3.92E-01	2.81E-01	-0.407	-0.551	-0.145	-0.54
	NaSO4-	8.31E-03	5.65E-03	-2.08	-2.248	-0.168	20.9
	NaHCO3	1.48E-03	1.71E-03	-2.829	-2.766	0.062	1.8
	NaCO3-	1.03E-03	7.67E-04	-2.986	-3.115	-0.13	2.62
	NaF	4.37E-05	5.04E-05	-4.36	-4.297	0.062	7.26
	NaOH	6.99E-17	8.07E-17	-16.156	-16.093	0.062	0
O(0)	9.64E-37						
	O2	4.82E-37	5.57E-37	-36.317	-36.254	0.062	30.4
S(6)	4.74E-02						
	SO4-2	2.14E-02	4.01E-03	-1.671	-2.397	-0.726	17.38
	MgSO4	1.62E-02	1.87E-02	-1.79	-1.728	0.062	5.84
	NaSO4-	8.31E-03	5.65E-03	-2.08	-2.248	-0.168	20.9
	CaSO4	1.41E-03	1.63E-03	-2.85	-2.788	0.062	7.5
	KSO4-	1.45E-04	9.88E-05	-3.837	-4.005	-0.168	34.82
	BaSO4	5.85E-06	6.76E-06	-5.233	-5.17	0.062	0
	NH4SO4-	2.19E-06	1.63E-06	-5.659	-5.789	-0.13	39.83
	MnSO4	1.73E-08	2.00E-08	-7.761	-7.699	0.062	22.54
	ZnSO4	7.85E-09	9.06E-09	-8.105	-8.043	0.062	21.71
	HSO4-	1.82E-09	1.35E-09	-8.74	-8.869	-0.13	40.94
	Zn(SO4)2-2	9.74E-10	2.95E-10	-9.012	-9.53	-0.518	-5.63
	FeSO4	2.40E-10	2.77E-10	-9.619	-9.557	0.062	18.97
	CaHSO4+	5.00E-11	3.71E-11	-10.301	-10.43	-0.13	0
	CuSO4	3.86E-11	4.45E-11	-10.414	-10.351	0.062	13.09
	FeSO4+	2.45E-17	1.63E-17	-16.612	-16.787	-0.175	0
	FeHSO4+	8.52E-18	6.32E-18	-17.07	-17.199	-0.13	0
	Fe(SO4)2-	1.93E-18	1.43E-18	-17.714	-17.844	-0.13	0
	FeHSO4+2	5.00E-25	1.52E-25	-24.301	-24.819	-0.518	0
Zn	3.28E-06						
	Zn(CO3)2-2	2.91E-06	8.83E-07	-5.536	-6.054	-0.518	0
	ZnCO3	2.44E-07	2.82E-07	-6.612	-6.55	0.062	0

Zn+2	4.85E-08	9.64E-09	-7.314	-8.016	-0.702	-24.13
ZnOHCl	2.09E-08	2.41E-08	-7.68	-7.618	0.062	0
ZnHCO3+	1.77E-08	1.32E-08	-7.751	-7.881	-0.13	0
ZnCl+	1.09E-08	6.91E-09	-7.963	-8.161	-0.198	-15.78
Zn(OH)2	8.46E-09	9.77E-09	-8.073	-8.01	0.062	0
ZnSO4	7.85E-09	9.06E-09	-8.105	-8.043	0.062	21.71
ZnOH+	4.04E-09	3.00E-09	-8.393	-8.523	-0.13	0
ZnCl2	1.67E-09	1.93E-09	-8.778	-8.716	0.062	102.03
Zn(SO4)2-2	9.74E-10	2.95E-10	-9.012	-9.53	-0.518	-5.63
ZnCl3-	9.07E-10	5.75E-10	-9.043	-9.24	-0.198	12.85
ZnCl4-2	3.86E-10	7.67E-11	-9.414	-10.115	-0.702	150.05
ZnF+	5.72E-11	4.25E-11	-10.242	-10.372	-0.13	0
Zn(OH)3-	1.18E-11	8.76E-12	-10.928	-11.057	-0.13	0
Zn(OH)4-2	1.30E-15	3.94E-16	-14.886	-15.405	-0.518	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1 atm)
Anhydrite	-0.76	-5.04	-4.28	CaSO4			
Aragonite	1.86	-6.48	-8.34	CaCO3			
Barite	1.97	-7.87	-9.84	BaSO4			
Calcite	2	-6.48	-8.48	CaCO3			
CO2(g)	-2.6	-4.07	-1.47	CO2			
Dolomite	5.07	-12.01	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	2.04	6.93	4.89	Fe(OH)3			
Fluorite	0.95	-9.65	-10.6	CaF2			
Goethite	7.94	6.94	-1	FeOOH			
Gypsum	-0.47	-5.05	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	-0.01	1.5	H2O			
Halite	-2.7	-1.13	1.57	NaCl			
Hausmann	-8.03	53	61.03	Mn3O4			
Hematite	17.89	13.88	-4.01	Fe2O3			
Jarosite-K	-2.61	-11.82	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.53	21.81	25.34	MnOOH			
Melanterit	-9.65	-11.86	-2.21	FeSO4:7H2O			
NH3(g)	-7.08	-5.29	1.8	NH3			
O2(g)	-33.36	-36.25	-2.89	O2			
Pyrochroit	-5.85	9.35	15.2	Mn(OH)2			
Pyrolusite	-7.11	34.27	41.38	MnO2:H2O			
Rhodochro	-0.26	-11.39	-11.13	MnCO3			
Siderite	-2.35	-13.24	-10.89	FeCO3			
Smithsonit	-1.85	-11.85	-10	ZnCO3			
Sylvite	-3.93	-3.03	0.9	KCl			
Witherite	-0.75	-9.31	-8.56	BaCO3			
Zn(OH)2(e	-2.61	8.89	11.5	Zn(OH)2			

**For a gas, SI = log10(fuga Fugacity = pressure *
For ideal gases, phi = 1

```
Initial     solution          32

 #NAME?  composition-----------------------------

         Elements  Molality   Moles

         Alkalinity   3.22E-02  3.22E-02
         Ba           2.40E-05  2.40E-05
         Ca           1.18E-02  1.18E-02
         Cl           4.32E-01  4.32E-01
         Cu           3.90E-07  3.90E-07
         F            1.22E-03  1.22E-03
         Fe           3.11E-06  3.11E-06
         K            5.92E-03  5.92E-03
         Mg           9.52E-02  9.52E-02
         Mn           5.30E-07  5.30E-07
         N(-3)        6.40E-05  6.40E-05
         N(5)         5.40E-04  5.40E-04
         Na           4.16E-01  4.16E-01
         S(6)         4.90E-02  4.90E-02
         Zn           3.39E-06  3.39E-06

 #NAME?  of        solution----------------------------

         pH        =                8.46
         pe        =                   4
         Specific  Conductan (µS/cm,   25°C)     =              45503
         Density   (g/cm³)   =           1.02367
         Volume    (L)       =           1.01043
         Activity  of        water     =              0.983
         Ionic     strength  (mol/kgw) =           6.44E-01
         Mass      of        water     (kg)      =          1.00E+00
         Total     carbon    (mol/kg)  =           2.74E-02
         Total     CO2       (mol/kg)  =           2.74E-02
         Temperatu (°C)      =                25
         Electrical balance  (eq)      =           7.18E-02
         Percent   error,    100*(Cat-|=               6.64
         Iterations =                13 (347      overall)
         Total     H         =          1.11E+02
         Total     O         =          5.58E+01

 #NAME?  couples--------------------------------

         Redox     couple    pe        Eh        (volts)

         N(-3)/N(5)   4.4366    0.2625

 #NAME?  of        species----------------------------
```

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.68E-06	2.87E-06	-5.329	-5.542	-0.213	-2.68
	H+	4.59E-09	3.47E-09	-8.339	-8.46	-0.121	0
	H2O	5.55E+01	9.83E-01	1.744	-0.007	0	18.07
Ba	2.40E-05						
	Ba+2	1.72E-05	3.45E-06	-4.764	-5.462	-0.698	-11.03
	BaSO4	6.04E-06	7.01E-06	-5.219	-5.155	0.064	0
	BaHCO3+	4.90E-07	3.65E-07	-6.31	-6.438	-0.129	0
	BaCO3	2.29E-07	2.66E-07	-6.64	-6.575	0.064	-10.7
	BaOH+	4.98E-11	3.31E-11	-10.303	-10.48	-0.177	0
C(4)	2.74E-02						
	HCO3-	1.63E-02	1.10E-02	-1.789	-1.957	-0.169	26.89
	MgHCO3+	4.19E-03	2.65E-03	-2.378	-2.577	-0.199	5.82
	MgCO3	2.52E-03	2.92E-03	-2.599	-2.535	0.064	-17.09
	NaHCO3	1.55E-03	1.80E-03	-2.809	-2.745	0.064	1.8
	NaCO3-	1.08E-03	8.06E-04	-2.965	-3.094	-0.129	2.72
	CO3-2	7.07E-04	1.49E-04	-3.151	-3.826	-0.675	-2.06
	CaCO3	5.07E-04	5.88E-04	-3.295	-3.23	0.064	-14.6
	CaHCO3+	4.76E-04	3.30E-04	-3.322	-3.481	-0.159	9.96
	CO2	7.54E-05	8.75E-05	-4.123	-4.058	0.064	34.43
	Zn(CO3)2-2	3.02E-06	9.23E-07	-5.521	-6.035	-0.514	0
	BaHCO3+	4.90E-07	3.65E-07	-6.31	-6.438	-0.129	0
	MnCO3	2.94E-07	3.41E-07	-6.532	-6.468	0.064	0
	ZnCO3	2.50E-07	2.89E-07	-6.603	-6.539	0.064	0
	BaCO3	2.29E-07	2.66E-07	-6.64	-6.575	0.064	-10.7
	MnHCO3+	4.24E-08	2.83E-08	-7.372	-7.549	-0.177	0
	CuCO3	3.66E-08	4.24E-08	-7.437	-7.373	0.064	0
	Cu(CO3)2-	2.60E-08	7.96E-09	-7.585	-8.099	-0.514	0
	ZnHCO3+	1.82E-08	1.35E-08	-7.741	-7.87	-0.129	0
	FeCO3	1.25E-09	1.44E-09	-8.905	-8.84	0.064	0
	FeHCO3+	5.99E-10	4.45E-10	-9.223	-9.351	-0.129	0
	CuHCO3+	3.93E-10	2.93E-10	-9.405	-9.534	-0.129	0
	(CO2)2	1.21E-10	1.40E-10	-9.917	-9.853	0.064	68.87
Ca	1.18E-02						
	Ca+2	9.35E-03	2.35E-03	-2.029	-2.629	-0.6	-16.72
	CaSO4	1.46E-03	1.69E-03	-2.836	-2.772	0.064	7.5
	CaCO3	5.07E-04	5.88E-04	-3.295	-3.23	0.064	-14.6
	CaHCO3+	4.76E-04	3.30E-04	-3.322	-3.481	-0.159	9.96
	CaOH+	1.49E-07	1.11E-07	-6.828	-6.957	-0.129	0
	CaHSO4+	5.19E-11	3.86E-11	-10.285	-10.414	-0.129	0
Cl	4.32E-01						
	Cl-	4.32E-01	2.74E-01	-0.364	-0.562	-0.198	18.77
	CuCl3-2	1.46E-07	2.86E-08	-6.837	-7.543	-0.706	0
	CuCl2-	1.04E-07	6.59E-08	-6.982	-7.181	-0.199	0
	MnCl+	4.82E-08	3.21E-08	-7.317	-7.494	-0.177	-2.79
	ZnOHCl	2.16E-08	2.50E-08	-7.666	-7.602	0.064	0
	ZnCl+	1.13E-08	7.17E-09	-7.945	-8.145	-0.199	-15.84
	MnCl2	3.31E-09	3.84E-09	-8.48	-8.416	0.064	85.89

	ZnCl2	1.77E-09	2.06E-09	-8.751	-8.687	0.064	102.03
	ZnCl3-	1.00E-09	6.32E-10	-9	-9.199	-0.199	12.71
	ZnCl4-2	4.41E-10	8.68E-11	-9.355	-10.061	-0.706	150.16
	MnCl3-	4.35E-10	2.90E-10	-9.362	-9.538	-0.177	45.7
	FeCl+	2.05E-10	1.53E-10	-9.688	-9.816	-0.129	0
	CuCl+	6.17E-11	3.90E-11	-10.209	-10.409	-0.199	1.85
	CuCl2	4.95E-12	5.74E-12	-11.305	-11.241	0.064	31.02
	CuCl3-	8.83E-15	5.58E-15	-14.054	-14.253	-0.199	0
	CuCl4-2	3.90E-17	7.67E-18	-16.409	-17.115	-0.706	0
	FeCl+2	1.62E-17	3.19E-18	-16.79	-17.496	-0.706	0
	FeCl2+	5.86E-18	3.90E-18	-17.232	-17.409	-0.177	0
	FeCl3	9.22E-20	1.07E-19	-19.035	-18.971	0.064	0
Cu(1)	2.50E-07						
	CuCl3-2	1.46E-07	2.86E-08	-6.837	-7.543	-0.706	0
	CuCl2-	1.04E-07	6.59E-08	-6.982	-7.181	-0.199	0
	Cu+	4.90E-12	2.78E-12	-11.31	-11.556	-0.247	0
Cu(2)	1.40E-07						
	Cu(OH)2	7.66E-08	8.89E-08	-7.116	-7.051	0.064	0
	CuCO3	3.66E-08	4.24E-08	-7.437	-7.373	0.064	0
	Cu(CO3)2-	2.60E-08	7.96E-09	-7.585	-8.099	-0.514	0
	CuHCO3+	3.93E-10	2.93E-10	-9.405	-9.534	-0.129	0
	CuOH+	2.37E-10	1.50E-10	-9.625	-9.824	-0.199	0
	Cu+2	2.28E-10	5.29E-11	-9.642	-10.276	-0.634	-25.33
	CuCl+	6.17E-11	3.90E-11	-10.209	-10.409	-0.199	1.85
	CuSO4	3.78E-11	4.38E-11	-10.423	-10.359	0.064	13.09
	CuCl2	4.95E-12	5.74E-12	-11.305	-11.241	0.064	31.02
	Cu(OH)3-	2.04E-12	1.52E-12	-11.69	-11.819	-0.129	0
	CuF+	4.09E-13	3.04E-13	-12.388	-12.517	-0.129	0
	Cu2(OH)2+	3.22E-14	9.85E-15	-13.492	-14.007	-0.514	0
	CuCl3-	8.83E-15	5.58E-15	-14.054	-14.253	-0.199	0
	Cu(OH)4-2	2.81E-16	8.59E-17	-15.552	-16.066	-0.514	0
	CuCl4-2	3.90E-17	7.67E-18	-16.409	-17.115	-0.706	0
F	1.22E-03						
	MgF+	6.59E-04	4.28E-04	-3.181	-3.368	-0.187	-10.26
	F-	5.16E-04	3.16E-04	-3.288	-3.5	-0.213	-0.59
	NaF	4.55E-05	5.28E-05	-4.342	-4.278	0.064	7.26
	HF	1.42E-09	1.64E-09	-8.849	-8.784	0.064	12.5
	MnF+	9.43E-11	6.28E-11	-10.025	-10.202	-0.177	0
	ZnF+	5.83E-11	4.34E-11	-10.234	-10.363	-0.129	0
	HF2-	2.68E-12	1.99E-12	-11.572	-11.701	-0.129	22.79
	FeF+	1.71E-12	1.28E-12	-11.766	-11.894	-0.129	0
	CuF+	4.09E-13	3.04E-13	-12.388	-12.517	-0.129	0
	FeF2+	3.65E-15	2.43E-15	-14.438	-14.615	-0.177	0
	FeF3	1.05E-15	1.22E-15	-14.98	-14.915	0.064	0
	FeF+2	9.81E-16	1.93E-16	-15.008	-15.714	-0.706	0
Fe(2)	4.09E-09						
	Fe+2	1.74E-09	4.04E-10	-8.76	-9.394	-0.634	-20.74
	FeCO3	1.25E-09	1.44E-09	-8.905	-8.84	0.064	0
	FeHCO3+	5.99E-10	4.45E-10	-9.223	-9.351	-0.129	0
	FeSO4	2.51E-10	2.91E-10	-9.601	-9.536	0.064	18.97

	FeCl+	2.05E-10	1.53E-10	-9.688	-9.816	-0.129	0
	FeOH+	5.43E-11	3.62E-11	-10.265	-10.441	-0.177	0
	FeF+	1.71E-12	1.28E-12	-11.766	-11.894	-0.129	0
	Fe(OH)2	7.53E-14	8.73E-14	-13.123	-13.059	0.064	0
	Fe(OH)3-	1.38E-15	9.20E-16	-14.86	-15.036	-0.177	0
	FeHSO4+	8.91E-18	6.63E-18	-17.05	-17.178	-0.129	0
Fe(3)	3.11E-06						
	Fe(OH)3	2.09E-06	2.42E-06	-5.681	-5.616	0.064	0
	Fe(OH)4-	9.23E-07	6.25E-07	-6.035	-6.204	-0.169	0
	Fe(OH)2+	9.77E-08	6.62E-08	-7.01	-7.179	-0.169	0
	FeOH+2	3.59E-12	7.06E-13	-11.445	-12.151	-0.706	0
	FeF2+	3.65E-15	2.43E-15	-14.438	-14.615	-0.177	0
	FeF3	1.05E-15	1.22E-15	-14.98	-14.915	0.064	0
	FeF+2	9.81E-16	1.93E-16	-15.008	-15.714	-0.706	0
	FeSO4+	2.57E-17	1.71E-17	-16.59	-16.766	-0.177	0
	FeCl+2	1.62E-17	3.19E-18	-16.79	-17.496	-0.706	0
	FeCl2+	5.86E-18	3.90E-18	-17.232	-17.409	-0.177	0
	Fe+3	4.77E-18	3.86E-19	-17.322	-18.414	-1.092	0
	Fe(SO4)2-	2.04E-18	1.52E-18	-17.69	-17.818	-0.129	0
	FeCl3	9.22E-20	1.07E-19	-19.035	-18.971	0.064	0
	Fe2(OH)2+	1.53E-21	1.34E-23	-20.816	-22.873	-2.057	0
	FeHSO4+2	5.20E-25	1.59E-25	-24.284	-24.798	-0.514	0
	Fe3(OH)4+	3.03E-25	1.85E-28	-24.518	-27.732	-3.214	0
H(0)	1.47E-28						
	H2	7.34E-29	8.51E-29	-28.134	-28.07	0.064	28.61
K	5.92E-03						
	K+	5.77E-03	3.61E-03	-2.239	-2.442	-0.203	9.65
	KSO4-	1.52E-04	1.03E-04	-3.819	-3.988	-0.169	34.83
Mg	9.52E-02						
	Mg+2	7.10E-02	2.05E-02	-1.149	-1.688	-0.539	-20.44
	MgSO4	1.68E-02	1.95E-02	-1.775	-1.71	0.064	5.84
	MgHCO3+	4.19E-03	2.65E-03	-2.378	-2.577	-0.199	5.82
	MgCO3	2.52E-03	2.92E-03	-2.599	-2.535	0.064	-17.09
	MgF+	6.59E-04	4.28E-04	-3.181	-3.368	-0.187	-10.26
	MgOH+	2.99E-05	2.11E-05	-4.525	-4.676	-0.151	0
Mn(2)	5.30E-07						
	MnCO3	2.94E-07	3.41E-07	-6.532	-6.468	0.064	0
	Mn+2	1.24E-07	2.87E-08	-6.907	-7.542	-0.634	-16.41
	MnCl+	4.82E-08	3.21E-08	-7.317	-7.494	-0.177	-2.79
	MnHCO3+	4.24E-08	2.83E-08	-7.372	-7.549	-0.177	0
	MnSO4	1.79E-08	2.07E-08	-7.748	-7.684	0.064	22.54
	MnCl2	3.31E-09	3.84E-09	-8.48	-8.416	0.064	85.89
	MnCl3-	4.35E-10	2.90E-10	-9.362	-9.538	-0.177	45.7
	MnOH+	3.15E-10	2.09E-10	-9.502	-9.679	-0.177	0
	MnF+	9.43E-11	6.28E-11	-10.025	-10.202	-0.177	0
	Mn(NO3)2	1.00E-14	1.17E-14	-13.998	-13.934	0.064	41.04
	Mn(OH)3-	1.56E-17	1.04E-17	-16.807	-16.984	-0.177	0
Mn(3)	1.10E-28						
	Mn+3	1.10E-28	8.88E-30	-27.959	-29.052	-1.092	0
N(-3)	6.40E-05						

	NH4+	5.71E-05	3.24E-05	-4.243	-4.49	-0.247	18.43
	NH3	4.59E-06	5.32E-06	-5.338	-5.274	0.064	24.42
	NH4SO4-	2.27E-06	1.69E-06	-5.643	-5.772	-0.129	39.89
N(5)	5.40E-04						
	NO3-	5.40E-04	3.19E-04	-3.268	-3.496	-0.229	30.27
	Mn(NO3)2	1.00E-14	1.17E-14	-13.998	-13.934	0.064	41.04
Na	4.16E-01						
	Na+	4.05E-01	2.90E-01	-0.393	-0.537	-0.144	-0.52
	NaSO4-	8.70E-03	5.90E-03	-2.061	-2.23	-0.169	21.02
	NaHCO3	1.55E-03	1.80E-03	-2.809	-2.745	0.064	1.8
	NaCO3-	1.08E-03	8.06E-04	-2.965	-3.094	-0.129	2.72
	NaF	4.55E-05	5.28E-05	-4.342	-4.278	0.064	7.26
	NaOH	7.18E-17	8.33E-17	-16.144	-16.08	0.064	0
O(0)	9.59E-37						
	O2	4.79E-37	5.56E-37	-36.319	-36.255	0.064	30.4
S(6)	4.90E-02						
	SO4-2	2.19E-02	4.05E-03	-1.66	-2.392	-0.732	17.42
	MgSO4	1.68E-02	1.95E-02	-1.775	-1.71	0.064	5.84
	NaSO4-	8.70E-03	5.90E-03	-2.061	-2.23	-0.169	21.02
	CaSO4	1.46E-03	1.69E-03	-2.836	-2.772	0.064	7.5
	KSO4-	1.52E-04	1.03E-04	-3.819	-3.988	-0.169	34.83
	BaSO4	6.04E-06	7.01E-06	-5.219	-5.155	0.064	0
	NH4SO4-	2.27E-06	1.69E-06	-5.643	-5.772	-0.129	39.89
	MnSO4	1.79E-08	2.07E-08	-7.748	-7.684	0.064	22.54
	ZnSO4	7.97E-09	9.24E-09	-8.099	-8.034	0.064	21.71
	HSO4-	1.84E-09	1.37E-09	-8.736	-8.864	-0.129	40.95
	Zn(SO4)2-2	9.94E-10	3.04E-10	-9.002	-9.517	-0.514	-5.44
	FeSO4	2.51E-10	2.91E-10	-9.601	-9.536	0.064	18.97
	CaHSO4+	5.19E-11	3.86E-11	-10.285	-10.414	-0.129	0
	CuSO4	3.78E-11	4.38E-11	-10.423	-10.359	0.064	13.09
	FeSO4+	2.57E-17	1.71E-17	-16.59	-16.766	-0.177	0
	FeHSO4+	8.91E-18	6.63E-18	-17.05	-17.178	-0.129	0
	Fe(SO4)2-	2.04E-18	1.52E-18	-17.69	-17.818	-0.129	0
	FeHSO4+2	5.20E-25	1.59E-25	-24.284	-24.798	-0.514	0
Zn	3.39E-06						
	Zn(CO3)2-2	3.02E-06	9.23E-07	-5.521	-6.035	-0.514	0
	ZnCO3	2.50E-07	2.89E-07	-6.603	-6.539	0.064	0
	Zn+2	4.94E-08	9.72E-09	-7.306	-8.012	-0.706	-24.12
	ZnOHCl	2.16E-08	2.50E-08	-7.666	-7.602	0.064	0
	ZnHCO3+	1.82E-08	1.35E-08	-7.741	-7.87	-0.129	0
	ZnCl+	1.13E-08	7.17E-09	-7.945	-8.145	-0.199	-15.84
	Zn(OH)2	8.48E-09	9.84E-09	-8.072	-8.007	0.064	0
	ZnSO4	7.97E-09	9.24E-09	-8.099	-8.034	0.064	21.71
	ZnOH+	4.06E-09	3.02E-09	-8.391	-8.52	-0.129	0
	ZnCl2	1.77E-09	2.06E-09	-8.751	-8.687	0.064	102.03
	ZnCl3-	1.00E-09	6.32E-10	-9	-9.199	-0.199	12.71
	Zn(SO4)2-2	9.94E-10	3.04E-10	-9.002	-9.517	-0.514	-5.44
	ZnCl4-2	4.41E-10	8.68E-11	-9.355	-10.061	-0.706	150.16
	ZnF+	5.83E-11	4.34E-11	-10.234	-10.363	-0.129	0
	Zn(OH)3-	1.19E-11	8.82E-12	-10.926	-11.055	-0.129	0

```
Zn(OH)4-2   1.30E-15   3.96E-16    -14.888    -15.402    -0.514          0

#NAME?  indices------------------------------

        Phase       SI**        log         IAP         log         K(298       K,                  1  atm)

        Anhydrite     -0.74      -5.02      -4.28  CaSO4
        Aragonite      1.88      -6.46      -8.34  CaCO3
        Barite         1.99      -7.85      -9.84  BaSO4
        Calcite        2.02      -6.46      -8.48  CaCO3
        CO2(g)        -2.59      -4.06      -1.47  CO2
        Dolomite       5.11     -11.97     -17.08  CaMg(CO3)2
        Fe(OH)3(a)     2.05       6.94       4.89  Fe(OH)3
        Fluorite       0.97      -9.63      -10.6  CaF2
        Goethite       7.95       6.95         -1  FeOOH
        Gypsum        -0.45      -5.04      -4.58  CaSO4:2H2O
        H2(g)        -24.97     -28.07       -3.1  H2
        H2O(g)        -1.51      -0.01        1.5  H2O
        Halite        -2.67       -1.1       1.57  NaCl
        Hausmann         -8      53.03      61.03  Mn3O4
        Hematite      17.92      13.91      -4.01  Fe2O3
        Jarosite-K    -2.54     -11.75      -9.21  KFe3(SO4)2(OH)6
        Manganite     -3.52      21.82      25.34  MnOOH
        Melanterit    -9.63     -11.84      -2.21  FeSO4:7H2O
        NH3(g)        -7.07      -5.27        1.8  NH3
        O2(g)        -33.36     -36.25      -2.89  O2
        Pyrochroit    -5.84       9.36       15.2  Mn(OH)2
        Pyrolusite     -7.1      34.28      41.38  MnO2:H2O
        Rhodochrc     -0.24     -11.37     -11.13  MnCO3
        Siderite      -2.33     -13.22     -10.89  FeCO3
        Smithsonit    -1.84     -11.84        -10  ZnCO3
        Sylvite        -3.9         -3        0.9  KCl
        Witherite     -0.73      -9.29      -8.56  BaCO3
        Zn(OH)2(e     -2.61       8.89       11.5  Zn(OH)2

**For   a       gas,    SI      =       log10(fuga Fugacity     =       pressure    *
        For     ideal   gases,  phi     =                   1

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End     of      simulation.
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Reading input   data    for     simulation      2
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End     of      Run     after           0.349 Seconds.
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```

```
        Input   file:   C:\Users\a Group   Pty   Ltd\EESI   Group   -   2024 -   QLD\7240! Tick   hill   model   update\4.  Laboratory ConcLI.pqi
        Output  file:   C:\Users\a Group   Pty   Ltd\EESI   Group   -   2024 -   QLD\7240! Tick   hill   model   update\4.  Laboratory ConcLI.pqo
Database file:  C:\Prograr Files   (x86)\USG: Interactive 3.7.3-15968\database\phreeqc.dat

------------------
Reading data   base.
------------------

        SOLUTION_MASTER_SPECIES
        SOLUTION_SPECIES
        PHASES
        EXCHANGE_MASTER_SPECIES
        EXCHANGE_SPECIES
        SURFACE_MASTER_SPECIES
        SURFACE_SPECIES
        RATES
        END
-------------------------------------
Reading input data   for   simulation   1
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        DATABASE C:\Prograr Files   (x86)\USG: Interactive 3.7.3-15968\database\phreeqc.dat
        SOLUTION_SPREAD
```

Na	K	Ca	Mg	Cl	S(6)	F	N(-3)	Alkalinity	N(5)	Ba	Cu	Fe	Mn	Zn	pH
10.79	0.15	0.31	2.47	11.21	1.27	0.03	0.002	0.834166	0.01	0.00015	0.00001	0.00008	0.00001	0.00009	8.46
16.08	0.23	0.46	3.68	16.71	1.89	0.05	0.002	1.243423	0.02	0.00129	0.00002	0.00012	0.00002	0.00013	8.46
21.96	0.31	0.62	5.03	22.82	2.59	0.06	0.003	1.698152	0.03	0.00051	0.00002	0.00016	0.00003	0.00018	8.46
27.84	0.4	0.79	6.37	28.94	3.28	0.08	0.004	2.152882	0.04	0.0006	0.00003	0.00021	0.00004	0.00023	8.46
33.13	0.47	0.94	7.58	34.44	3.9	0.1	0.005	2.562139	0.04	0.00355	0.00003	0.00025	0.00004	0.00027	8.46
39.01	0.56	1.11	8.93	40.55	4.59	0.11	0.006	3.016869	0.05	0.00431	0.00004	0.00029	0.00005	0.00032	8.46
44.72	0.64	1.27	10.23	46.48	5.26	0.13	0.007	3.457957	0.06	0.00507	0.00004	0.00033	0.00006	0.00036	8.46
50.42	0.72	1.43	11.54	52.41	5.94	0.15	0.008	3.899045	0.07	0.00582	0.00005	0.00038	0.00006	0.00041	8.46
56.13	0.8	1.59	12.84	58.34	6.61	0.16	0.009	4.340132	0.07	0.00658	0.00005	0.00042	0.00007	0.00046	8.46
61.83	0.88	1.75	14.15	64.26	7.28	0.18	0.01	4.78122	0.08	0.00734	0.00006	0.00046	0.00008	0.0005	8.46
67.53	0.96	1.91	15.45	70.19	7.95	0.2	0.01	5.222308	0.09	0.00809	0.00006	0.0005	0.00009	0.00055	8.46
73.24	1.04	2.08	16.76	76.12	8.62	0.21	0.011	5.663396	0.1	0.00885	0.00007	0.00055	0.00009	0.0006	8.46
78.94	1.12	2.24	18.07	82.05	9.29	0.23	0.012	6.104484	0.1	0.00961	0.00007	0.00059	0.0001	0.00064	8.46
84.65	1.2	2.4	19.37	87.98	9.97	0.25	0.013	6.545572	0.11	0.01036	0.00008	0.00063	0.00011	0.00069	8.46
90.35	1.29	2.56	20.68	93.91	10.64	0.26	0.014	6.98666	0.12	0.01112	0.00009	0.00067	0.00011	0.00074	8.46
96.05	1.37	2.72	21.98	99.84	11.31	0.28	0.015	7.427748	0.13	0.01188	0.00009	0.00072	0.00012	0.00078	8.46
101.76	1.45	2.88	23.29	105.77	11.98	0.3	0.016	7.868835	0.13	0.01263	0.0001	0.00076	0.00013	0.00083	8.46
107.46	1.53	3.04	24.59	111.69	12.65	0.31	0.017	8.309923	0.14	0.01339	0.0001	0.0008	0.00014	0.00088	8.46
113.17	1.61	3.21	25.9	117.62	13.32	0.33	0.017	8.751011	0.15	0.01415	0.00011	0.00085	0.00014	0.00092	8.46
118.87	1.69	3.37	27.2	123.55	14	0.35	0.018	9.192099	0.16	0.0149	0.00011	0.00089	0.00015	0.00097	8.46
124.57	1.77	3.53	28.51	129.48	14.67	0.36	0.019	9.633187	0.16	0.01566	0.00012	0.00093	0.00016	0.00102	8.46
130.28	1.85	3.69	29.81	135.41	15.34	0.38	0.02	10.07427	0.17	0.01642	0.00012	0.00097	0.00016	0.00106	8.46
135.98	1.93	3.85	31.12	141.34	16.01	0.4	0.021	10.51536	0.18	0.01717	0.00013	0.00102	0.00017	0.00111	8.46
141.69	2.02	4.01	32.42	147.27	16.68	0.41	0.022	10.95645	0.19	0.01793	0.00013	0.00106	0.00018	0.00115	8.46
147.39	2.1	4.18	33.73	153.19	17.35	0.43	0.023	11.39754	0.19	0.01869	0.00014	0.0011	0.00019	0.0012	8.46
153.1	2.18	4.34	35.04	159.12	18.02	0.45	0.024	11.83863	0.2	0.01944	0.00015	0.00114	0.00019	0.00125	8.46
158.8	2.26	4.5	36.34	165.05	18.7	0.46	0.025	12.27971	0.21	0.0202	0.00015	0.00119	0.0002	0.00129	8.46
164.5	2.34	4.66	37.65	170.98	19.37	0.48	0.025	12.7208	0.22	0.02095	0.00016	0.00123	0.00021	0.00134	8.46
170.21	2.42	4.82	38.95	176.91	20.04	0.5	0.026	13.16189	0.22	0.02171	0.00016	0.00127	0.00022	0.00139	8.46
175.91	2.5	4.98	40.26	182.84	20.71	0.51	0.027	13.60298	0.23	0.02247	0.00017	0.00131	0.00022	0.00143	8.46
181.62	2.58	5.15	41.56	188.77	21.38	0.53	0.028	14.04407	0.24	0.02322	0.00017	0.00136	0.00023	0.00148	8.46
187.32	2.66	5.31	42.87	194.7	22.05	0.55	0.029	14.48515	0.25	0.02398	0.00018	0.0014	0.00024	0.00153	8.46

```
------------------------------------------
Beginning of initial solution calculations.
------------------------------------------

Initial solution 1

 #NAME? composition-----------------------------

        Elements   Molality   Moles

        Alkalinity  8.34E-04  8.34E-04
        Ba          1.50E-07  1.50E-07
        Ca          3.10E-04  3.10E-04
        Cl          1.12E-02  1.12E-02
        Cu          1.00E-08  1.00E-08
        F           3.00E-05  3.00E-05
        Fe          8.00E-08  8.00E-08
        K           1.50E-04  1.50E-04
        Mg          2.47E-03  2.47E-03
        Mn          1.00E-08  1.00E-08
        N(-3)       2.00E-06  2.00E-06
        N(5)        1.00E-05  1.00E-05
        Na          1.08E-02  1.08E-02
        S(6)        1.27E-03  1.27E-03
        Zn          9.00E-08  9.00E-08

 #NAME? of solution----------------------------

        pH          =          8.46
        pe          =             4
        Specific    Conductan (µS/cm,  25°C)    =          1678
        Density     (g/cm³)   =        0.99776
        Volume      (L)       =        1.00314
        Activity    of        water    =             1
        Ionic       strength  (mol/kgw) =       1.86E-02
        Mass        of        water    (kg)     =       1.00E+00
        Total       carbon    (mol/kg) =       8.03E-04
        Total       CO2       (mol/kg) =       8.03E-04
        Temperatu   (°C)      =             25
        Electrical  balance   (eq)     =       1.88E-03
        Percent     error,    100*(Cat-|=          6.24
        Iterations  =                7
        Total       H         =        1.11E+02
        Total       O         =        5.55E+01

 #NAME? couples--------------------------------

        Redox       couple    pe       Eh       (volts)

        N(-3)/N(5)   4.4048   0.2606
```

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	3.35E-06	2.92E-06	-5.475	-5.535	-0.06	-3.99
	H+	3.89E-09	3.47E-09	-8.41	-8.46	-0.05	0
	H2O	5.55E+01	1.00E+00	1.744	0	0	18.07
Ba	1.50E-07						
	Ba+2	1.27E-07	7.41E-08	-6.897	-7.13	-0.233	-12.43
	BaSO4	2.24E-08	2.25E-08	-7.649	-7.648	0.002	0
	BaHCO3+	5.35E-10	4.68E-10	-9.271	-9.33	-0.058	0
	BaCO3	3.40E-10	3.41E-10	-9.469	-9.467	0.002	-10.7
	BaOH+	8.25E-13	7.23E-13	-12.084	-12.141	-0.057	0
C(4)	8.03E-04						
	HCO3-	7.50E-04	6.59E-04	-3.125	-3.181	-0.056	24.82
	CO3-2	1.49E-05	8.92E-06	-4.826	-5.05	-0.224	-4.87
	MgHCO3+	1.20E-05	1.05E-05	-4.921	-4.98	-0.059	5.56
	MgCO3	1.15E-05	1.16E-05	-4.939	-4.938	0.002	-17.09
	CO2	5.12E-06	5.14E-06	-5.291	-5.289	0.002	34.43
	NaHCO3	3.48E-06	3.49E-06	-5.459	-5.457	0.002	1.8
	CaCO3	2.56E-06	2.57E-06	-5.592	-5.591	0.002	-14.6
	NaCO3-	1.79E-06	1.56E-06	-5.747	-5.806	-0.058	-0.85
	CaHCO3+	1.64E-06	1.44E-06	-5.786	-5.841	-0.055	9.75
	ZnCO3	2.75E-08	2.76E-08	-7.561	-7.559	0.002	0
	Zn(CO3)2-2	9.00E-09	5.26E-09	-8.046	-8.279	-0.234	0
	MnCO3	2.72E-09	2.73E-09	-8.565	-8.563	0.002	0
	ZnHCO3+	1.47E-09	1.29E-09	-8.832	-8.891	-0.058	0
	BaHCO3+	5.35E-10	4.68E-10	-9.271	-9.33	-0.058	0
	BaCO3	3.40E-10	3.41E-10	-9.469	-9.467	0.002	-10.7
	CuCO3	2.67E-10	2.68E-10	-9.573	-9.571	0.002	0
	MnHCO3+	2.59E-10	2.27E-10	-9.588	-9.644	-0.057	0
	Cu(CO3)2-	5.16E-12	3.01E-12	-11.288	-11.521	-0.234	0
	CuHCO3+	2.12E-12	1.85E-12	-11.674	-11.733	-0.058	0
	FeCO3	2.04E-12	2.05E-12	-11.69	-11.689	0.002	0
	FeHCO3+	7.22E-13	6.31E-13	-12.141	-12.2	-0.058	0
	(CO2)2	4.83E-13	4.85E-13	-12.316	-12.314	0.002	68.87
Ca	3.10E-04						
	Ca+2	2.87E-04	1.71E-04	-3.542	-3.766	-0.224	-17.83
	CaSO4	1.84E-05	1.85E-05	-4.735	-4.733	0.002	7.5
	CaCO3	2.56E-06	2.57E-06	-5.592	-5.591	0.002	-14.6
	CaHCO3+	1.64E-06	1.44E-06	-5.786	-5.841	-0.055	9.75
	CaOH+	9.38E-09	8.20E-09	-8.028	-8.086	-0.058	0
	CaHSO4+	4.82E-13	4.22E-13	-12.317	-12.375	-0.058	0
Cl	1.12E-02						
	Cl-	1.12E-02	9.77E-03	-1.95	-2.01	-0.06	18.17
	ZnOHCl	1.44E-09	1.45E-09	-8.842	-8.84	0.002	0
	ZnCl+	4.67E-10	4.08E-10	-9.331	-9.39	-0.059	-13.89
	MnCl+	1.75E-10	1.54E-10	-9.757	-9.813	-0.057	-3.01

	CuCl2-	1.02E-11	8.88E-12	-10.992	-11.052	-0.059	0
	ZnCl2	4.16E-12	4.17E-12	-11.381	-11.38	0.002	102.03
	MnCl2	6.53E-13	6.56E-13	-12.185	-12.183	0.002	85.89
	CuCl3-2	2.32E-13	1.38E-13	-12.634	-12.861	-0.227	0
	CuCl+	1.69E-13	1.47E-13	-12.773	-12.832	-0.059	0.74
	FeCl+	1.48E-13	1.29E-13	-12.83	-12.889	-0.058	0
	ZnCl3-	5.24E-14	4.58E-14	-13.28	-13.34	-0.059	16.94
	MnCl3-	2.01E-15	1.76E-15	-14.697	-14.753	-0.057	43.49
	CuCl2	7.70E-16	7.74E-16	-15.113	-15.112	0.002	31.02
	ZnCl4-2	3.78E-16	2.24E-16	-15.422	-15.649	-0.227	145.62
	CuCl3-	3.07E-20	2.68E-20	-19.512	-19.571	-0.059	0
	FeCl+2	4.56E-21	2.70E-21	-20.341	-20.569	-0.227	0
	FeCl2+	1.34E-22	1.18E-22	-21.872	-21.929	-0.057	0
	CuCl4-2	2.22E-24	1.31E-24	-23.654	-23.881	-0.227	0
	FeCl3	1.15E-25	1.15E-25	-24.941	-24.939	0.002	0
Cu(1)	1.08E-11						
	CuCl2-	1.02E-11	8.88E-12	-10.992	-11.052	-0.059	0
	Cu+	3.40E-13	2.94E-13	-12.469	-12.532	-0.063	0
	CuCl3-2	2.32E-13	1.38E-13	-12.634	-12.861	-0.227	0
Cu(2)	9.99E-09						
	Cu(OH)2	9.69E-09	9.73E-09	-8.014	-8.012	0.002	0
	CuCO3	2.67E-10	2.68E-10	-9.573	-9.571	0.002	0
	CuOH+	1.85E-11	1.62E-11	-10.733	-10.792	-0.059	0
	Cu+2	9.29E-12	5.60E-12	-11.032	-11.252	-0.219	-26.31
	Cu(CO3)2-	5.16E-12	3.01E-12	-11.288	-11.521	-0.234	0
	CuHCO3+	2.12E-12	1.85E-12	-11.674	-11.733	-0.058	0
	CuSO4	6.91E-13	6.94E-13	-12.16	-12.159	0.002	13.09
	Cu(OH)3-	1.93E-13	1.69E-13	-12.714	-12.772	-0.058	0
	CuCl+	1.69E-13	1.47E-13	-12.773	-12.832	-0.059	0.74
	CuF+	2.79E-15	2.43E-15	-14.555	-14.614	-0.058	0
	CuCl2	7.70E-16	7.74E-16	-15.113	-15.112	0.002	31.02
	Cu2(OH)2+	1.96E-16	1.14E-16	-15.709	-15.943	-0.234	0
	Cu(OH)4-2	1.66E-17	9.72E-18	-16.779	-17.012	-0.234	0
	CuCl3-	3.07E-20	2.68E-20	-19.512	-19.571	-0.059	0
	CuCl4-2	2.22E-24	1.31E-24	-23.654	-23.881	-0.227	0
F	3.00E-05						
	F-	2.74E-05	2.39E-05	-4.562	-4.622	-0.06	-1.22
	MgF+	2.45E-06	2.14E-06	-5.612	-5.669	-0.058	-10.49
	NaF	1.29E-07	1.30E-07	-6.89	-6.888	0.002	7.26
	HF	1.24E-10	1.24E-10	-9.908	-9.906	0.002	12.5
	ZnF+	5.98E-12	5.23E-12	-11.223	-11.282	-0.058	0
	MnF+	7.27E-13	6.38E-13	-12.139	-12.196	-0.057	0
	HF2-	1.30E-14	1.14E-14	-13.886	-13.944	-0.058	22.16
	CuF+	2.79E-15	2.43E-15	-14.555	-14.614	-0.058	0
	FeF+	2.62E-15	2.29E-15	-14.582	-14.641	-0.058	0
	FeF+2	5.84E-19	3.46E-19	-18.233	-18.461	-0.227	0
	FeF2+	3.75E-19	3.29E-19	-18.426	-18.483	-0.057	0
	FeF3	1.24E-20	1.25E-20	-19.907	-19.905	0.002	0
Fe(2)	2.08E-11						
	Fe+2	1.59E-11	9.58E-12	-10.799	-11.019	-0.219	-21.83

	FeCO3	2.04E-12	2.05E-12	-11.69	-11.689	0.002	0
	FeSO4	1.03E-12	1.03E-12	-11.988	-11.986	0.002	18.97
	FeOH+	9.95E-13	8.73E-13	-12.002	-12.059	-0.057	0
	FeHCO3+	7.22E-13	6.31E-13	-12.141	-12.2	-0.058	0
	FeCl+	1.48E-13	1.29E-13	-12.83	-12.889	-0.058	0
	FeF+	2.62E-15	2.29E-15	-14.582	-14.641	-0.058	0
	Fe(OH)2	2.13E-15	2.14E-15	-14.671	-14.669	0.002	0
	Fe(OH)3-	2.62E-17	2.29E-17	-16.583	-16.639	-0.057	0
	FeHSO4+	2.69E-20	2.36E-20	-19.57	-19.628	-0.058	0
Fe(3)	8.00E-08						
	Fe(OH)3	6.01E-08	6.03E-08	-7.221	-7.219	0.002	0
	Fe(OH)4-	1.81E-08	1.59E-08	-7.744	-7.8	-0.056	0
	Fe(OH)2+	1.85E-09	1.63E-09	-8.733	-8.789	-0.056	0
	FeOH+2	2.87E-14	1.70E-14	-13.542	-13.769	-0.227	0
	FeF+2	5.84E-19	3.46E-19	-18.233	-18.461	-0.227	0
	FeF2+	3.75E-19	3.29E-19	-18.426	-18.483	-0.057	0
	FeSO4+	6.94E-20	6.08E-20	-19.159	-19.216	-0.057	0
	Fe+3	2.56E-20	9.15E-21	-19.592	-20.039	-0.446	0
	FeF3	1.24E-20	1.25E-20	-19.907	-19.905	0.002	0
	FeCl+2	4.56E-21	2.70E-21	-20.341	-20.569	-0.227	0
	Fe(SO4)2-	9.24E-22	8.08E-22	-21.034	-21.093	-0.058	0
	FeCl2+	1.34E-22	1.18E-22	-21.872	-21.929	-0.057	0
	FeCl3	1.15E-25	1.15E-25	-24.941	-24.939	0.002	0
	Fe2(OH)2+	6.71E-26	7.80E-27	-25.173	-26.108	-0.935	0
	FeHSO4+2	9.67E-28	5.65E-28	-27.014	-27.248	-0.234	0
	Fe3(OH)4+	7.64E-32	2.65E-33	-31.117	-32.577	-1.46	0
H(0)	1.70E-28						
	H2	8.48E-29	8.51E-29	-28.072	-28.07	0.002	28.61
K	1.50E-04						
	K+	1.49E-04	1.30E-04	-3.826	-3.886	-0.06	9.1
	KSO4-	6.31E-07	5.55E-07	-6.2	-6.256	-0.056	34.2
Mg	2.47E-03						
	Mg+2	2.25E-03	1.36E-03	-2.648	-2.867	-0.22	-21.52
	MgSO4	1.92E-04	1.93E-04	-3.716	-3.714	0.002	5.84
	MgHCO3+	1.20E-05	1.05E-05	-4.921	-4.98	-0.059	5.56
	MgCO3	1.15E-05	1.16E-05	-4.939	-4.938	0.002	-17.09
	MgF+	2.45E-06	2.14E-06	-5.612	-5.669	-0.058	-10.49
	MgOH+	1.61E-06	1.42E-06	-5.794	-5.848	-0.054	0
Mn(2)	1.00E-08						
	Mn+2	6.40E-09	3.86E-09	-8.194	-8.414	-0.219	-19.45
	MnCO3	2.72E-09	2.73E-09	-8.565	-8.563	0.002	0
	MnSO4	4.15E-10	4.16E-10	-9.382	-9.381	0.002	22.54
	MnHCO3+	2.59E-10	2.27E-10	-9.588	-9.644	-0.057	0
	MnCl+	1.75E-10	1.54E-10	-9.757	-9.813	-0.057	-3.01
	MnOH+	3.26E-11	2.86E-11	-10.487	-10.544	-0.057	0
	MnF+	7.27E-13	6.38E-13	-12.139	-12.196	-0.057	0
	MnCl2	6.53E-13	6.56E-13	-12.185	-12.183	0.002	85.89
	MnCl3-	2.01E-15	1.76E-15	-14.697	-14.753	-0.057	43.49
	Mn(OH)3-	1.67E-18	1.47E-18	-17.777	-17.834	-0.057	0
	Mn(NO3)2	1.15E-18	1.16E-18	-17.938	-17.936	0.002	41.04

Mn(3)	3.33E-30						
	Mn+3	3.33E-30	1.19E-30	-29.477	-29.924	-0.446	0
N(-3)	2.00E-06						
	NH4+	1.74E-06	1.51E-06	-5.759	-5.822	-0.063	18.05
	NH3	2.47E-07	2.48E-07	-6.608	-6.606	0.002	24.42
	NH4SO4-	1.35E-08	1.18E-08	-7.871	-7.929	-0.058	37.76
N(5)	1.00E-05						
	NO3-	1.00E-05	8.68E-06	-5	-5.061	-0.061	29.59
	Mn(NO3)2	1.15E-18	1.16E-18	-17.938	-17.936	0.002	41.04
Na	1.08E-02						
	Na+	1.08E-02	9.42E-03	-1.969	-2.026	-0.057	-1.33
	NaSO4-	3.26E-05	2.87E-05	-4.487	-4.543	-0.056	14.65
	NaHCO3	3.48E-06	3.49E-06	-5.459	-5.457	0.002	1.8
	NaCO3-	1.79E-06	1.56E-06	-5.747	-5.806	-0.058	-0.85
	NaF	1.29E-07	1.30E-07	-6.89	-6.888	0.002	7.26
	NaOH	2.74E-18	2.75E-18	-17.563	-17.561	0.002	0
O(0)	1.15E-36						
	O2	5.73E-37	5.75E-37	-36.242	-36.24	0.002	30.4
S(6)	1.27E-03						
	SO4-2	1.03E-03	6.07E-04	-2.989	-3.217	-0.228	14.91
	MgSO4	1.92E-04	1.93E-04	-3.716	-3.714	0.002	5.84
	NaSO4-	3.26E-05	2.87E-05	-4.487	-4.543	-0.056	14.65
	CaSO4	1.84E-05	1.85E-05	-4.735	-4.733	0.002	7.5
	KSO4-	6.31E-07	5.55E-07	-6.2	-6.256	-0.056	34.2
	BaSO4	2.24E-08	2.25E-08	-7.649	-7.648	0.002	0
	NH4SO4-	1.35E-08	1.18E-08	-7.871	-7.929	-0.058	37.76
	ZnSO4	2.20E-09	2.20E-09	-8.659	-8.657	0.002	21.71
	MnSO4	4.15E-10	4.16E-10	-9.382	-9.381	0.002	22.54
	HSO4-	2.34E-10	2.05E-10	-9.631	-9.689	-0.058	40.37
	Zn(SO4)2-2	1.86E-11	1.09E-11	-10.73	-10.964	-0.234	-12.61
	FeSO4	1.03E-12	1.03E-12	-11.988	-11.986	0.002	18.97
	CuSO4	6.91E-13	6.94E-13	-12.16	-12.159	0.002	13.09
	CaHSO4+	4.82E-13	4.22E-13	-12.317	-12.375	-0.058	0
	FeSO4+	6.94E-20	6.08E-20	-19.159	-19.216	-0.057	0
	FeHSO4+	2.69E-20	2.36E-20	-19.57	-19.628	-0.058	0
	Fe(SO4)2-	9.24E-22	8.08E-22	-21.034	-21.093	-0.058	0
	FeHSO4+2	9.67E-28	5.65E-28	-27.014	-27.248	-0.234	0
Zn	9.00E-08						
	ZnCO3	2.75E-08	2.76E-08	-7.561	-7.559	0.002	0
	Zn+2	2.62E-08	1.55E-08	-7.582	-7.81	-0.227	-25.05
	Zn(OH)2	1.62E-08	1.62E-08	-7.792	-7.79	0.002	0
	Zn(CO3)2-2	9.00E-09	5.26E-09	-8.046	-8.279	-0.234	0
	ZnOH+	5.61E-09	4.90E-09	-8.251	-8.31	-0.058	0
	ZnSO4	2.20E-09	2.20E-09	-8.659	-8.657	0.002	21.71
	ZnHCO3+	1.47E-09	1.29E-09	-8.832	-8.891	-0.058	0
	ZnOHCl	1.44E-09	1.45E-09	-8.842	-8.84	0.002	0
	ZnCl+	4.67E-10	4.08E-10	-9.331	-9.39	-0.059	-13.89
	Zn(SO4)2-2	1.86E-11	1.09E-11	-10.73	-10.964	-0.234	-12.61
	Zn(OH)3-	1.69E-11	1.48E-11	-10.772	-10.83	-0.058	0
	ZnF+	5.98E-12	5.23E-12	-11.223	-11.282	-0.058	0

ZnCl2	4.16E-12	4.17E-12	-11.381	-11.38	0.002	102.03
ZnCl3-	5.24E-14	4.58E-14	-13.28	-13.34	-0.059	16.94
Zn(OH)4-2	1.16E-15	6.75E-16	-14.937	-15.17	-0.234	0
ZnCl4-2	3.78E-16	2.24E-16	-15.422	-15.649	-0.227	145.62

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1	
Anhydrite	-2.71	-6.98	-4.28	CaSO4
Aragonite	-0.48	-8.82	-8.34	CaCO3
Barite	-0.5	-10.35	-9.84	BaSO4
Calcite	-0.34	-8.82	-8.48	CaCO3
CO2(g)	-3.82	-5.29	-1.47	CO2
Dolomite	0.35	-16.73	-17.08	CaMg(CO3)2
Fe(OH)3(a)	0.45	5.34	4.89	Fe(OH)3
Fluorite	-2.41	-13.01	-10.6	CaF2
Goethite	6.34	5.34	-1	FeOOH
Gypsum	-2.4	-6.98	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-5.61	-4.04	1.57	NaCl
Hausmann	-10.59	50.44	61.03	Mn3O4
Hematite	14.69	10.68	-4.01	Fe2O3
Jarosite-K	-10.47	-19.68	-9.21	KFe3(SO4)2(OH)6
Manganite	-4.37	20.97	25.34	MnOOH
Melanterit	-12.03	-14.24	-2.21	FeSO4:7H2O
NH3(g)	-8.4	-6.61	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.69	8.51	15.2	Mn(OH)2
Pyrolusite	-7.95	33.43	41.38	MnO2:H2O
Rhodochro	-2.33	-13.46	-11.13	MnCO3
Siderite	-5.18	-16.07	-10.89	FeCO3
Smithsonit	-2.86	-12.86	-10	ZnCO3
Sylvite	-6.8	-5.9	0.9	KCl
Witherite	-3.62	-12.18	-8.56	BaCO3
Zn(OH)2(e	-2.39	9.11	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 2

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.24E-03	1.24E-03
Ba	1.29E-06	1.29E-06
Ca	4.60E-04	4.60E-04

Cl	1.67E-02	1.67E-02
Cu	2.00E-08	2.00E-08
F	5.00E-05	5.00E-05
Fe	1.20E-07	1.20E-07
K	2.30E-04	2.30E-04
Mg	3.68E-03	3.68E-03
Mn	2.00E-08	2.00E-08
N(-3)	2.00E-06	2.00E-06
N(5)	2.00E-05	2.00E-05
Na	1.61E-02	1.61E-02
S(6)	1.89E-03	1.89E-03
Zn	1.30E-07	1.30E-07

#NAME? of solution----------

```
pH          =                8.46
pe          =                   4
Specific    Conductan (µS/cm,   25°C)      =                2442
Density     (g/cm³)   =          0.99812
Volume      (L)       =          1.00323
Activity    of        water     =              0.999
Ionic       strength  (mol/kgw) =           2.75E-02
Mass        of        water     (kg)         =          1.00E+00
Total       carbon    (mol/kg)  =           1.19E-03
Total       CO2       (mol/kg)  =           1.19E-03
Temperatu   (°C)      =                  25
Electrical  balance   (eq)      =           2.79E-03
Percent     error,    100*(Cat-|=                6.26
Iterations  =                 7 (14        overall)
Total       H         =          1.11E+02
Total       O         =          5.55E+01
```

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4424	0.2628		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	3.44E-06	2.92E-06	-5.464	-5.535	-0.071	-3.95
H+	3.95E-09	3.47E-09	-8.403	-8.46	-0.057	0
H2O	5.55E+01	9.99E-01	1.744	0	0	18.07
Ba	1.29E-06					
Ba+2	1.06E-06	5.64E-07	-5.975	-6.249	-0.274	-12.35
BaSO4	2.21E-07	2.23E-07	-6.655	-6.652	0.003	0
BaHCO3+	5.96E-09	5.09E-09	-8.225	-8.293	-0.068	0

	BaCO3	3.69E-09	3.71E-09	-8.433	-8.43	0.003	-10.7
	BaOH+	6.42E-12	5.51E-12	-11.193	-11.259	-0.066	0
C(4)	1.19E-03						
	HCO3-	1.10E-03	9.42E-04	-2.961	-3.026	-0.065	24.87
	MgHCO3+	2.37E-05	2.02E-05	-4.626	-4.695	-0.069	5.58
	CO3-2	2.33E-05	1.27E-05	-4.633	-4.895	-0.261	-4.75
	MgCO3	2.21E-05	2.23E-05	-4.655	-4.653	0.003	-17.09
	CO2	7.30E-06	7.35E-06	-5.137	-5.134	0.003	34.43
	NaHCO3	7.22E-06	7.27E-06	-5.141	-5.139	0.003	1.8
	CaCO3	4.89E-06	4.92E-06	-5.311	-5.308	0.003	-14.6
	NaCO3-	3.81E-06	3.26E-06	-5.419	-5.487	-0.068	-0.78
	CaHCO3+	3.20E-06	2.76E-06	-5.495	-5.558	-0.064	9.76
	ZnCO3	4.33E-08	4.36E-08	-7.364	-7.361	0.003	0
	Zn(CO3)2-2	2.23E-08	1.19E-08	-7.652	-7.926	-0.273	0
	MnCO3	6.45E-09	6.49E-09	-8.19	-8.188	0.003	0
	BaHCO3+	5.96E-09	5.09E-09	-8.225	-8.293	-0.068	0
	BaCO3	3.69E-09	3.71E-09	-8.433	-8.43	0.003	-10.7
	ZnHCO3+	2.38E-09	2.03E-09	-8.624	-8.692	-0.068	0
	CuCO3	7.53E-10	7.58E-10	-9.123	-9.12	0.003	0
	MnHCO3+	6.28E-10	5.39E-10	-9.202	-9.269	-0.066	0
	Cu(CO3)2-	2.28E-11	1.22E-11	-10.642	-10.915	-0.273	0
	CuHCO3+	6.12E-12	5.23E-12	-11.213	-11.281	-0.068	0
	FeCO3	4.35E-12	4.38E-12	-11.362	-11.359	0.003	0
	FeHCO3+	1.58E-12	1.35E-12	-11.802	-11.87	-0.068	0
	(CO2)2	9.85E-13	9.91E-13	-12.007	-12.004	0.003	68.87
Ca	4.60E-04						
	Ca+2	4.20E-04	2.30E-04	-3.377	-3.638	-0.261	-17.75
	CaSO4	3.20E-05	3.22E-05	-4.494	-4.492	0.003	7.5
	CaCO3	4.89E-06	4.92E-06	-5.311	-5.308	0.003	-14.6
	CaHCO3+	3.20E-06	2.76E-06	-5.495	-5.558	-0.064	9.76
	CaOH+	1.29E-08	1.10E-08	-7.89	-7.959	-0.068	0
	CaHSO4+	8.60E-13	7.35E-13	-12.065	-12.134	-0.068	0
Cl	1.67E-02						
	Cl-	1.67E-02	1.42E-02	-1.777	-1.847	-0.07	18.2
	ZnOHCl	2.31E-09	2.33E-09	-8.636	-8.633	0.003	0
	ZnCl+	7.70E-10	6.56E-10	-9.114	-9.183	-0.069	-13.9
	MnCl+	4.33E-10	3.72E-10	-9.364	-9.43	-0.066	-3
	CuCl2-	4.36E-11	3.72E-11	-10.36	-10.43	-0.069	0
	ZnCl2	9.70E-12	9.77E-12	-11.013	-11.01	0.003	102.03
	MnCl2	2.29E-12	2.31E-12	-11.64	-11.637	0.003	85.89
	CuCl3-2	1.55E-12	8.38E-13	-11.811	-12.077	-0.266	0
	CuCl+	4.98E-13	4.24E-13	-12.303	-12.373	-0.069	0.77
	FeCl+	3.29E-13	2.81E-13	-12.483	-12.551	-0.068	0
	ZnCl3-	1.83E-13	1.56E-13	-12.738	-12.807	-0.069	16.9
	MnCl3-	1.05E-14	9.03E-15	-13.978	-14.044	-0.066	43.54
	CuCl2	3.22E-15	3.24E-15	-14.492	-14.49	0.003	31.02
	ZnCl4-2	2.05E-15	1.11E-15	-14.689	-14.955	-0.266	145.76
	CuCl3-	1.92E-19	1.63E-19	-18.717	-18.787	-0.069	0
	FeCl+2	1.08E-20	5.87E-21	-19.965	-20.231	-0.266	0
	FeCl2+	4.35E-22	3.73E-22	-21.362	-21.428	-0.066	0

	CuCl4-2	2.15E-23	1.16E-23	-22.668	-22.934	-0.266	0
	FeCl3	5.27E-25	5.30E-25	-24.278	-24.276	0.003	0
Cu(1)	4.59E-11						
	CuCl2-	4.36E-11	3.72E-11	-10.36	-10.43	-0.069	0
	CuCl3-2	1.55E-12	8.38E-13	-11.811	-12.077	-0.266	0
	Cu+	6.90E-13	5.82E-13	-12.161	-12.235	-0.074	0
Cu(2)	2.00E-08						
	Cu(OH)2	1.91E-08	1.92E-08	-7.719	-7.716	0.003	0
	CuCO3	7.53E-10	7.58E-10	-9.123	-9.12	0.003	0
	CuOH+	3.75E-11	3.19E-11	-10.426	-10.496	-0.069	0
	Cu(CO3)2-	2.28E-11	1.22E-11	-10.642	-10.915	-0.273	0
	Cu+2	1.99E-11	1.11E-11	-10.7	-10.955	-0.255	-26.24
	CuHCO3+	6.12E-12	5.23E-12	-11.213	-11.281	-0.068	0
	CuSO4	1.77E-12	1.78E-12	-11.751	-11.749	0.003	13.09
	CuCl+	4.98E-13	4.24E-13	-12.303	-12.373	-0.069	0.77
	Cu(OH)3-	3.91E-13	3.34E-13	-12.408	-12.476	-0.068	0
	CuF+	8.89E-15	7.60E-15	-14.051	-14.119	-0.068	0
	CuCl2	3.22E-15	3.24E-15	-14.492	-14.49	0.003	31.02
	Cu2(OH)2+	8.38E-16	4.46E-16	-15.077	-15.35	-0.273	0
	Cu(OH)4-2	3.60E-17	1.92E-17	-16.443	-16.717	-0.273	0
	CuCl3-	1.92E-19	1.63E-19	-18.717	-18.787	-0.069	0
	CuCl4-2	2.15E-23	1.16E-23	-22.668	-22.934	-0.266	0
F	5.00E-05						
	F-	4.44E-05	3.77E-05	-4.353	-4.424	-0.071	-1.19
	MgF+	5.33E-06	4.56E-06	-5.273	-5.341	-0.068	-10.48
	NaF	2.96E-07	2.98E-07	-6.529	-6.527	0.003	7.26
	HF	1.95E-10	1.96E-10	-9.711	-9.708	0.003	12.5
	ZnF+	1.07E-11	9.12E-12	-10.972	-11.04	-0.068	0
	MnF+	1.95E-12	1.67E-12	-11.71	-11.777	-0.066	0
	HF2-	3.32E-14	2.83E-14	-13.479	-13.548	-0.068	22.19
	CuF+	8.89E-15	7.60E-15	-14.051	-14.119	-0.068	0
	FeF+	6.32E-15	5.40E-15	-14.2	-14.268	-0.068	0
	FeF+2	1.51E-18	8.17E-19	-17.822	-18.088	-0.266	0
	FeF2+	1.43E-18	1.23E-18	-17.845	-17.912	-0.066	0
	FeF3	7.27E-20	7.32E-20	-19.138	-19.136	0.003	0
Fe(2)	3.55E-11						
	Fe+2	2.58E-11	1.43E-11	-10.589	-10.844	-0.255	-21.76
	FeCO3	4.35E-12	4.38E-12	-11.362	-11.359	0.003	0
	FeSO4	1.99E-12	2.01E-12	-11.7	-11.697	0.003	18.97
	FeHCO3+	1.58E-12	1.35E-12	-11.802	-11.87	-0.068	0
	FeOH+	1.52E-12	1.31E-12	-11.818	-11.884	-0.066	0
	FeCl+	3.29E-13	2.81E-13	-12.483	-12.551	-0.068	0
	FeF+	6.32E-15	5.40E-15	-14.2	-14.268	-0.068	0
	Fe(OH)2	3.18E-15	3.20E-15	-14.497	-14.495	0.003	0
	Fe(OH)3-	4.00E-17	3.43E-17	-16.399	-16.465	-0.066	0
	FeHSO4+	5.35E-20	4.57E-20	-19.271	-19.34	-0.068	0
Fe(3)	1.20E-07						
	Fe(OH)3	8.96E-08	9.02E-08	-7.048	-7.045	0.003	0
	Fe(OH)4-	2.76E-08	2.37E-08	-7.56	-7.625	-0.065	0
	Fe(OH)2+	2.82E-09	2.43E-09	-8.549	-8.615	-0.065	0

	FeOH+2	4.69E-14	2.55E-14	-13.329	-13.594	-0.266	0
	FeF+2	1.51E-18	8.17E-19	-17.822	-18.088	-0.266	0
	FeF2+	1.43E-18	1.23E-18	-17.845	-17.912	-0.066	0
	FeSO4+	1.38E-19	1.18E-19	-18.861	-18.927	-0.066	0
	FeF3	7.27E-20	7.32E-20	-19.138	-19.136	0.003	0
	Fe+3	4.43E-20	1.37E-20	-19.353	-19.864	-0.511	0
	FeCl+2	1.08E-20	5.87E-21	-19.965	-20.231	-0.266	0
	Fe(SO4)2-	2.39E-21	2.04E-21	-20.622	-20.691	-0.068	0
	FeCl2+	4.35E-22	3.73E-22	-21.362	-21.428	-0.066	0
	FeCl3	5.27E-25	5.30E-25	-24.278	-24.276	0.003	0
	Fe2(OH)2+	2.16E-25	1.74E-26	-24.665	-25.759	-1.093	0
	FeHSO4+2	2.06E-27	1.10E-27	-26.686	-26.96	-0.273	0
	Fe3(OH)4+	4.52E-31	8.84E-33	-30.345	-32.053	-1.708	0
H(0)	1.69E-28						
	H2	8.46E-29	8.51E-29	-28.073	-28.07	0.003	28.61
K	2.30E-04						
	K+	2.29E-04	1.94E-04	-3.641	-3.711	-0.071	9.12
	KSO4-	1.25E-06	1.08E-06	-5.903	-5.968	-0.065	34.23
Mg	3.68E-03						
	Mg+2	3.29E-03	1.83E-03	-2.483	-2.738	-0.255	-21.44
	MgSO4	3.36E-04	3.38E-04	-3.474	-3.471	0.003	5.84
	MgHCO3+	2.37E-05	2.02E-05	-4.626	-4.695	-0.069	5.58
	MgCO3	2.21E-05	2.23E-05	-4.655	-4.653	0.003	-17.09
	MgF+	5.33E-06	4.56E-06	-5.273	-5.341	-0.068	-10.48
	MgOH+	2.21E-06	1.92E-06	-5.655	-5.718	-0.062	0
Mn(2)	2.00E-08						
	Mn+2	1.15E-08	6.41E-09	-7.938	-8.193	-0.255	-19.18
	MnCO3	6.45E-09	6.49E-09	-8.19	-8.188	0.003	0
	MnSO4	8.93E-10	8.99E-10	-9.049	-9.046	0.003	22.54
	MnHCO3+	6.28E-10	5.39E-10	-9.202	-9.269	-0.066	0
	MnCl+	4.33E-10	3.72E-10	-9.364	-9.43	-0.066	-3
	MnOH+	5.54E-11	4.75E-11	-10.257	-10.323	-0.066	0
	MnCl2	2.29E-12	2.31E-12	-11.64	-11.637	0.003	85.89
	MnF+	1.95E-12	1.67E-12	-11.71	-11.777	-0.066	0
	MnCl3-	1.05E-14	9.03E-15	-13.978	-14.044	-0.066	43.54
	Mn(NO3)2	7.26E-18	7.31E-18	-17.139	-17.136	0.003	41.04
	Mn(OH)3-	2.84E-18	2.43E-18	-17.547	-17.614	-0.066	0
Mn(3)	6.43E-30						
	Mn+3	6.43E-30	1.98E-30	-29.192	-29.703	-0.511	0
N(-3)	2.00E-06						
	NH4+	1.74E-06	1.47E-06	-5.759	-5.833	-0.074	18.07
	NH3	2.40E-07	2.41E-07	-6.62	-6.617	0.003	24.42
	NH4SO4-	1.75E-08	1.49E-08	-7.758	-7.827	-0.068	37.8
N(5)	2.00E-05						
	NO3-	2.00E-05	1.69E-05	-4.699	-4.772	-0.073	29.62
	Mn(NO3)2	7.26E-18	7.31E-18	-17.139	-17.136	0.003	41.04
Na	1.61E-02						
	Na+	1.60E-02	1.37E-02	-1.796	-1.863	-0.067	-1.29
	NaSO4-	6.30E-05	5.42E-05	-4.201	-4.266	-0.065	14.92
	NaHCO3	7.22E-06	7.27E-06	-5.141	-5.139	0.003	1.8

	NaCO3-	3.81E-06	3.26E-06	-5.419	-5.487	-0.068	-0.78
	NaF	2.96E-07	2.98E-07	-6.529	-6.527	0.003	7.26
	NaOH	3.98E-18	4.00E-18	-17.4	-17.398	0.003	0
O(0)	1.14E-36						
	O2	5.71E-37	5.75E-37	-36.243	-36.241	0.003	30.4
S(6)	1.89E-03						
	SO4-2	1.46E-03	7.88E-04	-2.836	-3.103	-0.267	15.02
	MgSO4	3.36E-04	3.38E-04	-3.474	-3.471	0.003	5.84
	NaSO4-	6.30E-05	5.42E-05	-4.201	-4.266	-0.065	14.92
	CaSO4	3.20E-05	3.22E-05	-4.494	-4.492	0.003	7.5
	KSO4-	1.25E-06	1.08E-06	-5.903	-5.968	-0.065	34.23
	BaSO4	2.21E-07	2.23E-07	-6.655	-6.652	0.003	0
	NH4SO4-	1.75E-08	1.49E-08	-7.758	-7.827	-0.068	37.8
	ZnSO4	3.15E-09	3.17E-09	-8.502	-8.499	0.003	21.71
	MnSO4	8.93E-10	8.99E-10	-9.049	-9.046	0.003	22.54
	HSO4-	3.11E-10	2.66E-10	-9.507	-9.576	-0.068	40.4
	Zn(SO4)2-2	3.81E-11	2.03E-11	-10.419	-10.693	-0.273	-12.43
	FeSO4	1.99E-12	2.01E-12	-11.7	-11.697	0.003	18.97
	CuSO4	1.77E-12	1.78E-12	-11.751	-11.749	0.003	13.09
	CaHSO4+	8.60E-13	7.35E-13	-12.065	-12.134	-0.068	0
	FeSO4+	1.38E-19	1.18E-19	-18.861	-18.927	-0.066	0
	FeHSO4+	5.35E-20	4.57E-20	-19.271	-19.34	-0.068	0
	Fe(SO4)2-	2.39E-21	2.04E-21	-20.622	-20.691	-0.068	0
	FeHSO4+2	2.06E-27	1.10E-27	-26.686	-26.96	-0.273	0
Zn	1.30E-07						
	ZnCO3	4.33E-08	4.36E-08	-7.364	-7.361	0.003	0
	Zn+2	3.16E-08	1.71E-08	-7.5	-7.766	-0.266	-24.98
	Zn(CO3)2-2	2.23E-08	1.19E-08	-7.652	-7.926	-0.273	0
	Zn(OH)2	1.78E-08	1.79E-08	-7.749	-7.747	0.003	0
	ZnOH+	6.34E-09	5.42E-09	-8.198	-8.266	-0.068	0
	ZnSO4	3.15E-09	3.17E-09	-8.502	-8.499	0.003	21.71
	ZnHCO3+	2.38E-09	2.03E-09	-8.624	-8.692	-0.068	0
	ZnOHCl	2.31E-09	2.33E-09	-8.636	-8.633	0.003	0
	ZnCl+	7.70E-10	6.56E-10	-9.114	-9.183	-0.069	-13.9
	Zn(SO4)2-2	3.81E-11	2.03E-11	-10.419	-10.693	-0.273	-12.43
	Zn(OH)3-	1.91E-11	1.63E-11	-10.719	-10.787	-0.068	0
	ZnF+	1.07E-11	9.12E-12	-10.972	-11.04	-0.068	0
	ZnCl2	9.70E-12	9.77E-12	-11.013	-11.01	0.003	102.03
	ZnCl3-	1.83E-13	1.56E-13	-12.738	-12.807	-0.069	16.9
	ZnCl4-2	2.05E-15	1.11E-15	-14.689	-14.955	-0.266	145.76
	Zn(OH)4-2	1.40E-15	7.46E-16	-14.854	-15.127	-0.273	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-2.46	-6.74	-4.28	CaSO4			
Aragonite	-0.2	-8.53	-8.34	CaCO3			
Barite	0.49	-9.35	-9.84	BaSO4			
Calcite	-0.05	-8.53	-8.48	CaCO3			

CO2(g)	-3.67	-5.13	-1.47	CO2
Dolomite	0.92	-16.17	-17.08	CaMg(CO3)2
Fe(OH)3(a)	0.62	5.52	4.89	Fe(OH)3
Fluorite	-1.89	-12.49	-10.6	CaF2
Goethite	6.52	5.52	-1	FeOOH
Gypsum	-2.16	-6.74	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-5.28	-3.71	1.57	NaCl
Hausmann	-9.93	51.1	61.03	Mn3O4
Hematite	15.04	11.03	-4.01	Fe2O3
Jarosite-K	-9.54	-18.75	-9.21	KFe3(SO4)2(OH)6
Manganite	-4.15	21.19	25.34	MnOOH
Melanterit	-11.74	-13.95	-2.21	FeSO4:7H2O
NH3(g)	-8.41	-6.62	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.47	8.73	15.2	Mn(OH)2
Pyrolusite	-7.73	33.65	41.38	MnO2:H2O
Rhodochrc	-1.96	-13.09	-11.13	MnCO3
Siderite	-4.85	-15.74	-10.89	FeCO3
Smithsonit	-2.66	-12.66	-10	ZnCO3
Sylvite	-6.46	-5.56	0.9	KCl
Witherite	-2.58	-11.14	-8.56	BaCO3
Zn(OH)2(e	-2.35	9.15	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 3

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.70E-03	1.70E-03
Ba	5.10E-07	5.10E-07
Ca	6.20E-04	6.20E-04
Cl	2.28E-02	2.28E-02
Cu	2.00E-08	2.00E-08
F	6.00E-05	6.00E-05
Fe	1.60E-07	1.60E-07
K	3.10E-04	3.10E-04
Mg	5.03E-03	5.03E-03
Mn	3.00E-08	3.00E-08
N(-3)	3.00E-06	3.00E-06
N(5)	3.00E-05	3.00E-05
Na	2.20E-02	2.20E-02
S(6)	2.59E-03	2.59E-03
Zn	1.80E-07	1.80E-07

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 3268
Density (g/cm³) = 0.9985
Volume (L) = 1.00332
Activity of water = 0.999
Ionic strength (mol/kgw) = 3.72E-02
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 1.62E-03
Total CO2 (mol/kg) = 1.62E-03
Temperatu (°C) = 25
Electrical balance (eq) = 3.79E-03
Percent error, 100*(Cat-|= 6.25
Iterations = 7 (21 overall)
Total H = 1.11E+02
Total O = 5.55E+01

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4425	0.2628		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	3.51E-06	2.92E-06	-5.455	-5.535	-0.081	-3.92
H+	4.01E-09	3.47E-09	-8.397	-8.46	-0.063	0
H2O	5.55E+01	9.99E-01	1.744	0	0	18.07
Ba	5.10E-07					
Ba+2	4.09E-07	2.01E-07	-6.388	-6.696	-0.308	-12.28
BaSO4	9.62E-08	9.70E-08	-7.017	-7.013	0.004	0
BaHCO3+	2.85E-09	2.39E-09	-8.545	-8.622	-0.077	0
BaCO3	1.73E-09	1.74E-09	-8.763	-8.76	0.004	-10.7
BaOH+	2.33E-12	1.97E-12	-11.632	-11.707	-0.075	0
C(4)	1.62E-03					
HCO3-	1.47E-03	1.24E-03	-2.834	-2.908	-0.073	24.92
MgHCO3+	3.99E-05	3.33E-05	-4.399	-4.477	-0.079	5.59
MgCO3	3.64E-05	3.67E-05	-4.439	-4.435	0.004	-17.09
CO3-2	3.29E-05	1.67E-05	-4.483	-4.776	-0.293	-4.65
NaHCO3	1.27E-05	1.28E-05	-4.897	-4.893	0.004	1.8
CO2	9.57E-06	9.66E-06	-5.019	-5.015	0.004	34.43
CaCO3	7.93E-06	8.00E-06	-5.101	-5.097	0.004	-14.6
NaCO3-	6.83E-06	5.72E-06	-5.166	-5.242	-0.077	-0.71
CaHCO3+	5.30E-06	4.49E-06	-5.276	-5.347	-0.071	9.78
ZnCO3	6.08E-08	6.14E-08	-7.216	-7.212	0.004	0

	Zn(CO3)2-2	4.45E-08	2.20E-08	-7.351	-7.658	-0.307	0
	MnCO3	1.08E-08	1.09E-08	-7.965	-7.961	0.004	0
	ZnHCO3+	3.42E-09	2.86E-09	-8.466	-8.543	-0.077	0
	BaHCO3+	2.85E-09	2.39E-09	-8.545	-8.622	-0.077	0
	BaCO3	1.73E-09	1.74E-09	-8.763	-8.76	0.004	-10.7
	MnHCO3+	1.08E-09	9.07E-10	-8.968	-9.043	-0.075	0
	CuCO3	9.76E-10	9.84E-10	-9.011	-9.007	0.004	0
	Cu(CO3)2-	4.21E-11	2.07E-11	-10.376	-10.683	-0.307	0
	CuHCO3+	8.10E-12	6.79E-12	-11.091	-11.168	-0.077	0
	FeCO3	7.58E-12	7.65E-12	-11.12	-11.117	0.004	0
	FeHCO3+	2.81E-12	2.36E-12	-11.551	-11.628	-0.077	0
	(CO2)2	1.70E-12	1.71E-12	-11.77	-11.767	0.004	68.87
Ca	6.20E-04						
	Ca+2	5.59E-04	2.85E-04	-3.253	-3.546	-0.293	-17.69
	CaSO4	4.83E-05	4.87E-05	-4.316	-4.313	0.004	7.5
	CaCO3	7.93E-06	8.00E-06	-5.101	-5.097	0.004	-14.6
	CaHCO3+	5.30E-06	4.49E-06	-5.276	-5.347	-0.071	9.78
	CaOH+	1.62E-08	1.36E-08	-7.789	-7.866	-0.077	0
	CaHSO4+	1.32E-12	1.11E-12	-11.878	-11.955	-0.077	0
Cl	2.28E-02						
	Cl-	2.28E-02	1.90E-02	-1.642	-1.721	-0.079	18.23
	ZnOHCl	3.31E-09	3.33E-09	-8.481	-8.477	0.004	0
	ZnCl+	1.13E-09	9.40E-10	-8.948	-9.027	-0.079	-13.92
	MnCl+	7.56E-10	6.37E-10	-9.121	-9.196	-0.075	-2.98
	CuCl2-	7.87E-11	6.57E-11	-10.104	-10.183	-0.079	0
	ZnCl2	1.86E-11	1.87E-11	-10.732	-10.728	0.004	102.03
	MnCl2	5.24E-12	5.28E-12	-11.281	-11.277	0.004	85.89
	CuCl3-2	3.94E-12	1.98E-12	-11.405	-11.704	-0.299	0
	CuCl+	6.71E-13	5.60E-13	-12.173	-12.252	-0.079	0.8
	FeCl+	5.97E-13	5.00E-13	-12.224	-12.301	-0.077	0
	ZnCl3-	4.78E-13	3.99E-13	-12.32	-12.399	-0.079	16.85
	MnCl3-	3.29E-14	2.77E-14	-13.483	-13.558	-0.075	43.59
	ZnCl4-2	7.57E-15	3.80E-15	-14.121	-14.42	-0.299	145.89
	CuCl2	5.67E-15	5.72E-15	-14.246	-14.243	0.004	31.02
	CuCl3-	4.62E-19	3.86E-19	-18.335	-18.414	-0.079	0
	FeCl+2	2.08E-20	1.04E-20	-19.682	-19.981	-0.299	0
	FeCl2+	1.05E-21	8.87E-22	-20.978	-21.052	-0.075	0
	CuCl4-2	7.31E-23	3.67E-23	-22.136	-22.435	-0.299	0
	FeCl3	1.67E-24	1.69E-24	-23.777	-23.773	0.004	0
Cu(1)	8.33E-11						
	CuCl2-	7.87E-11	6.57E-11	-10.104	-10.183	-0.079	0
	CuCl3-2	3.94E-12	1.98E-12	-11.405	-11.704	-0.299	0
	Cu+	6.99E-13	5.75E-13	-12.156	-12.241	-0.085	0
Cu(2)	1.99E-08						
	Cu(OH)2	1.88E-08	1.90E-08	-7.725	-7.721	0.004	0
	CuCO3	9.76E-10	9.84E-10	-9.011	-9.007	0.004	0
	Cu(CO3)2-	4.21E-11	2.07E-11	-10.376	-10.683	-0.307	0
	CuOH+	3.78E-11	3.16E-11	-10.423	-10.501	-0.079	0
	Cu+2	2.11E-11	1.10E-11	-10.675	-10.961	-0.285	-26.18
	CuHCO3+	8.10E-12	6.79E-12	-11.091	-11.168	-0.077	0

	CuSO4	2.13E-12	2.15E-12	-11.671	-11.668	0.004	13.09
	CuCl+	6.71E-13	5.60E-13	-12.173	-12.252	-0.079	0.8
	Cu(OH)3-	3.94E-13	3.30E-13	-12.405	-12.482	-0.077	0
	CuF+	1.02E-14	8.57E-15	-13.99	-14.067	-0.077	0
	CuCl2	5.67E-15	5.72E-15	-14.246	-14.243	0.004	31.02
	Cu2(OH)2+	8.83E-16	4.36E-16	-15.054	-15.361	-0.307	0
	Cu(OH)4-2	3.85E-17	1.90E-17	-16.415	-16.722	-0.307	0
	CuCl3-	4.62E-19	3.86E-19	-18.335	-18.414	-0.079	0
	CuCl4-2	7.31E-23	3.67E-23	-22.136	-22.435	-0.299	0
F	6.00E-05						
	F-	5.18E-05	4.30E-05	-4.286	-4.367	-0.081	-1.16
	MgF+	7.80E-06	6.54E-06	-5.108	-5.185	-0.077	-10.46
	NaF	4.51E-07	4.54E-07	-6.346	-6.343	0.004	7.26
	HF	2.22E-10	2.24E-10	-9.654	-9.651	0.004	12.5
	ZnF+	1.33E-11	1.12E-11	-10.876	-10.952	-0.077	0
	MnF+	2.91E-12	2.45E-12	-11.537	-11.612	-0.075	0
	HF2-	4.40E-14	3.69E-14	-13.356	-13.433	-0.077	22.21
	CuF+	1.02E-14	8.57E-15	-13.99	-14.067	-0.077	0
	FeF+	9.77E-15	8.19E-15	-14.01	-14.087	-0.077	0
	FeF2+	2.52E-18	2.12E-18	-17.599	-17.673	-0.075	0
	FeF+2	2.47E-18	1.24E-18	-17.608	-17.907	-0.299	0
	FeF3	1.43E-19	1.45E-19	-18.844	-18.84	0.004	0
Fe(2)	5.30E-11						
	Fe+2	3.67E-11	1.91E-11	-10.435	-10.72	-0.285	-21.7
	FeCO3	7.58E-12	7.65E-12	-11.12	-11.117	0.004	0
	FeSO4	3.23E-12	3.26E-12	-11.491	-11.487	0.004	18.97
	FeHCO3+	2.81E-12	2.36E-12	-11.551	-11.628	-0.077	0
	FeOH+	2.06E-12	1.74E-12	-11.686	-11.761	-0.075	0
	FeCl+	5.97E-13	5.00E-13	-12.224	-12.301	-0.077	0
	FeF+	9.77E-15	8.19E-15	-14.01	-14.087	-0.077	0
	Fe(OH)2	4.22E-15	4.26E-15	-14.375	-14.371	0.004	0
	Fe(OH)3-	5.41E-17	4.56E-17	-16.267	-16.341	-0.075	0
	FeHSO4+	8.86E-20	7.43E-20	-19.053	-19.129	-0.077	0
Fe(3)	1.60E-07						
	Fe(OH)3	1.19E-07	1.20E-07	-6.925	-6.921	0.004	0
	Fe(OH)4-	3.73E-08	3.15E-08	-7.428	-7.502	-0.073	0
	Fe(OH)2+	3.82E-09	3.23E-09	-8.418	-8.491	-0.073	0
	FeOH+2	6.74E-14	3.38E-14	-13.172	-13.471	-0.299	0
	FeF2+	2.52E-18	2.12E-18	-17.599	-17.673	-0.075	0
	FeF+2	2.47E-18	1.24E-18	-17.608	-17.907	-0.299	0
	FeSO4+	2.28E-19	1.92E-19	-18.642	-18.717	-0.075	0
	FeF3	1.43E-19	1.45E-19	-18.844	-18.84	0.004	0
	Fe+3	6.67E-20	1.82E-20	-19.176	-19.74	-0.564	0
	FeCl+2	2.08E-20	1.04E-20	-19.682	-19.981	-0.299	0
	Fe(SO4)2-	4.82E-21	4.04E-21	-20.317	-20.394	-0.077	0
	FeCl2+	1.05E-21	8.87E-22	-20.978	-21.052	-0.075	0
	FeCl3	1.67E-24	1.69E-24	-23.777	-23.773	0.004	0
	Fe2(OH)2+	5.22E-25	3.08E-26	-24.282	-25.511	-1.229	0
	FeHSO4+2	3.61E-27	1.78E-27	-26.442	-26.749	-0.307	0
	Fe3(OH)4+	1.73E-30	2.08E-32	-29.762	-31.682	-1.92	0

H(0)	1.69E-28						
	H2	8.44E-29	8.51E-29	-28.074	-28.07	0.004	28.61
K	3.10E-04						
	K+	3.08E-04	2.56E-04	-3.512	-3.591	-0.08	9.14
	KSO4-	2.05E-06	1.73E-06	-5.688	-5.762	-0.073	34.26
Mg	5.03E-03						
	Mg+2	4.43E-03	2.30E-03	-2.354	-2.638	-0.284	-21.38
	MgSO4	5.14E-04	5.19E-04	-3.289	-3.285	0.004	5.84
	MgHCO3+	3.99E-05	3.33E-05	-4.399	-4.477	-0.079	5.59
	MgCO3	3.64E-05	3.67E-05	-4.439	-4.435	0.004	-17.09
	MgF+	7.80E-06	6.54E-06	-5.108	-5.185	-0.077	-10.46
	MgOH+	2.83E-06	2.41E-06	-5.549	-5.619	-0.07	0
Mn(2)	3.00E-08						
	Mn+2	1.59E-08	8.22E-09	-7.8	-8.085	-0.285	-18.95
	MnCO3	1.08E-08	1.09E-08	-7.965	-7.961	0.004	0
	MnSO4	1.39E-09	1.41E-09	-8.856	-8.852	0.004	22.54
	MnHCO3+	1.08E-09	9.07E-10	-8.968	-9.043	-0.075	0
	MnCl+	7.56E-10	6.37E-10	-9.121	-9.196	-0.075	-2.98
	MnOH+	7.23E-11	6.09E-11	-10.141	-10.215	-0.075	0
	MnCl2	5.24E-12	5.28E-12	-11.281	-11.277	0.004	85.89
	MnF+	2.91E-12	2.45E-12	-11.537	-11.612	-0.075	0
	MnCl3-	3.29E-14	2.77E-14	-13.483	-13.558	-0.075	43.59
	Mn(NO3)2	2.00E-17	2.01E-17	-16.7	-16.696	0.004	41.04
	Mn(OH)3-	3.70E-18	3.12E-18	-17.431	-17.506	-0.075	0
Mn(3)	9.31E-30						
	Mn+3	9.31E-30	2.54E-30	-29.031	-29.595	-0.564	0
N(-3)	3.00E-06						
	NH4+	2.62E-06	2.15E-06	-5.582	-5.667	-0.085	18.09
	NH3	3.51E-07	3.54E-07	-6.455	-6.451	0.004	24.42
	NH4SO4-	3.18E-08	2.67E-08	-7.497	-7.574	-0.077	37.85
N(5)	3.00E-05						
	NO3-	3.00E-05	2.48E-05	-4.523	-4.606	-0.083	29.64
	Mn(NO3)2	2.00E-17	2.01E-17	-16.7	-16.696	0.004	41.04
Na	2.20E-02						
	Na+	2.18E-02	1.84E-02	-1.661	-1.736	-0.075	-1.25
	NaSO4-	1.05E-04	8.85E-05	-3.98	-4.053	-0.073	15.16
	NaHCO3	1.27E-05	1.28E-05	-4.897	-4.893	0.004	1.8
	NaCO3-	6.83E-06	5.72E-06	-5.166	-5.242	-0.077	-0.71
	NaF	4.51E-07	4.54E-07	-6.346	-6.343	0.004	7.26
	NaOH	5.31E-18	5.36E-18	-17.275	-17.271	0.004	0
O(0)	1.14E-36						
	O2	5.70E-37	5.74E-37	-36.245	-36.241	0.004	30.4
S(6)	2.59E-03						
	SO4-2	1.92E-03	9.62E-04	-2.717	-3.017	-0.3	15.12
	MgSO4	5.14E-04	5.19E-04	-3.289	-3.285	0.004	5.84
	NaSO4-	1.05E-04	8.85E-05	-3.98	-4.053	-0.073	15.16
	CaSO4	4.83E-05	4.87E-05	-4.316	-4.313	0.004	7.5
	KSO4-	2.05E-06	1.73E-06	-5.688	-5.762	-0.073	34.26
	BaSO4	9.62E-08	9.70E-08	-7.017	-7.013	0.004	0
	NH4SO4-	3.18E-08	2.67E-08	-7.497	-7.574	-0.077	37.85

	ZnSO4	4.11E-09	4.14E-09	-8.386	-8.383	0.004	21.71
	MnSO4	1.39E-09	1.41E-09	-8.856	-8.852	0.004	22.54
	HSO4-	3.87E-10	3.24E-10	-9.412	-9.489	-0.077	40.43
	Zn(SO4)2-2	6.57E-11	3.24E-11	-10.182	-10.49	-0.307	-12.26
	FeSO4	3.23E-12	3.26E-12	-11.491	-11.487	0.004	18.97
	CuSO4	2.13E-12	2.15E-12	-11.671	-11.668	0.004	13.09
	CaHSO4+	1.32E-12	1.11E-12	-11.878	-11.955	-0.077	0
	FeSO4+	2.28E-19	1.92E-19	-18.642	-18.717	-0.075	0
	FeHSO4+	8.86E-20	7.43E-20	-19.053	-19.129	-0.077	0
	Fe(SO4)2-	4.82E-21	4.04E-21	-20.317	-20.394	-0.077	0
	FeHSO4+2	3.61E-27	1.78E-27	-26.442	-26.749	-0.307	0
Zn	1.80E-07						
	ZnCO3	6.08E-08	6.14E-08	-7.216	-7.212	0.004	0
	Zn(CO3)2-2	4.45E-08	2.20E-08	-7.351	-7.658	-0.307	0
	Zn+2	3.66E-08	1.84E-08	-7.437	-7.736	-0.299	-24.92
	Zn(OH)2	1.90E-08	1.92E-08	-7.72	-7.717	0.004	0
	ZnOH+	6.93E-09	5.81E-09	-8.159	-8.236	-0.077	0
	ZnSO4	4.11E-09	4.14E-09	-8.386	-8.383	0.004	21.71
	ZnHCO3+	3.42E-09	2.86E-09	-8.466	-8.543	-0.077	0
	ZnOHCl	3.31E-09	3.33E-09	-8.481	-8.477	0.004	0
	ZnCl+	1.13E-09	9.40E-10	-8.948	-9.027	-0.079	-13.92
	Zn(SO4)2-2	6.57E-11	3.24E-11	-10.182	-10.49	-0.307	-12.26
	Zn(OH)3-	2.09E-11	1.75E-11	-10.68	-10.757	-0.077	0
	ZnCl2	1.86E-11	1.87E-11	-10.732	-10.728	0.004	102.03
	ZnF+	1.33E-11	1.12E-11	-10.876	-10.952	-0.077	0
	ZnCl3-	4.78E-13	3.99E-13	-12.32	-12.399	-0.079	16.85
	ZnCl4-2	7.57E-15	3.80E-15	-14.121	-14.42	-0.299	145.89
	Zn(OH)4-2	1.62E-15	7.99E-16	-14.79	-15.097	-0.307	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-2.29	-6.56	-4.28	CaSO4			
Aragonite	0.01	-8.32	-8.34	CaCO3			
Barite	0.13	-9.71	-9.84	BaSO4			
Calcite	0.16	-8.32	-8.48	CaCO3			
CO2(g)	-3.55	-5.02	-1.47	CO2			
Dolomite	1.35	-15.74	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	0.75	5.64	4.89	Fe(OH)3			
Fluorite	-1.68	-12.28	-10.6	CaF2			
Goethite	6.64	5.64	-1	FeOOH			
Gypsum	-1.98	-6.56	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-5.03	-3.46	1.57	NaCl			
Hausmann	-9.61	51.42	61.03	Mn3O4			
Hematite	15.29	11.28	-4.01	Fe2O3			
Jarosite-K	-8.88	-18.09	-9.21	KFe3(SO4)2(OH)6			
Manganite	-4.05	21.29	25.34	MnOOH			

Melanterit	-11.53	-13.74	-2.21	FeSO4:7H2O
NH3(g)	-8.25	-6.45	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.37	8.83	15.2	Mn(OH)2
Pyrolusite	-7.63	33.75	41.38	MnO2:H2O
Rhodochrc	-1.73	-12.86	-11.13	MnCO3
Siderite	-4.61	-15.5	-10.89	FeCO3
Smithsonit	-2.51	-12.51	-10	ZnCO3
Sylvite	-6.21	-5.31	0.9	KCl
Witherite	-2.91	-11.47	-8.56	BaCO3
Zn(OH)2(e	-2.32	9.18	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 4

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	2.15E-03	2.15E-03
Ba	6.00E-07	6.00E-07
Ca	7.90E-04	7.90E-04
Cl	2.89E-02	2.89E-02
Cu	3.00E-08	3.00E-08
F	8.00E-05	8.00E-05
Fe	2.10E-07	2.10E-07
K	4.00E-04	4.00E-04
Mg	6.37E-03	6.37E-03
Mn	4.00E-08	4.00E-08
N(-3)	4.00E-06	4.00E-06
N(5)	4.00E-05	4.00E-05
Na	2.78E-02	2.78E-02
S(6)	3.28E-03	3.28E-03
Zn	2.30E-07	2.30E-07

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 4076
Density (g/cm³) = 0.99889
Volume (L) = 1.00342
Activity of water = 0.999
Ionic strength (mol/kgw) = 4.69E-02
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 2.04E-03
Total CO2 (mol/kg) = 2.04E-03
Temperatu (°C) = 25

```
Electrical  balance   (eq)      =          4.79E-03
Percent     error,    100*(Cat-|=                6.27
Iterations  =                 8 (29       overall)
Total       H         =         1.11E+02
Total       O         =         5.55E+01

#NAME?  couples--------------------------------

        Redox     couple    pe        Eh        (volts)

        N(-3)/N(5)    4.4425    0.2628

#NAME?  of        species----------------------------

        Log       Log       Log       mole      V
        Species   Molality  Activity  Molality  Activity  Gamma   cm³/mol

        OH-       3.57E-06  2.92E-06  -5.447    -5.535    -0.088  -3.88
        H+        4.05E-09  3.47E-09  -8.393    -8.46     -0.067  0
        H2O       5.55E+01  9.99E-01  1.744     -0.001    0       18.07
Ba        6.00E-07
        Ba+2      4.74E-07  2.18E-07  -6.324    -6.661    -0.337  -12.22
        BaSO4     1.20E-07  1.21E-07  -6.921    -6.916    0.005   0
        BaHCO3+   3.85E-09  3.17E-09  -8.415    -8.498    -0.084  0
        BaCO3     2.29E-09  2.31E-09  -8.64     -8.636    0.005   -10.7
        BaOH+     2.57E-12  2.13E-12  -11.59    -11.672   -0.081  0
C(4)      2.04E-03
        HCO3-     1.82E-03  1.52E-03  -2.739    -2.819    -0.08   24.96
        MgHCO3+   5.90E-05  4.84E-05  -4.229    -4.315    -0.086  5.61
        MgCO3     5.28E-05  5.34E-05  -4.277    -4.273    0.005   -17.09
        CO3-2     4.28E-05  2.05E-05  -4.369    -4.688    -0.319  -4.55
        NaHCO3    1.93E-05  1.95E-05  -4.714    -4.709    0.005   1.8
        CO2       1.17E-05  1.18E-05  -4.931    -4.927    0.005   34.43
        CaCO3     1.16E-05  1.17E-05  -4.937    -4.933    0.005   -14.6
        NaCO3-    1.06E-05  8.75E-06  -4.974    -5.058    -0.084  -0.64
        CaHCO3+   7.83E-06  6.56E-06  -5.106    -5.183    -0.077  9.79
        ZnCO3     7.60E-08  7.68E-08  -7.119    -7.115    0.005   0
        Zn(CO3)2-2 7.28E-08 3.37E-08  -7.138    -7.473    -0.334  0
        MnCO3     1.56E-08  1.58E-08  -7.807    -7.802    0.005   0
        ZnHCO3+   4.34E-09  3.58E-09  -8.362    -8.446    -0.084  0
        BaHCO3+   3.85E-09  3.17E-09  -8.415    -8.498    -0.084  0
        BaCO3     2.29E-09  2.31E-09  -8.64     -8.636    0.005   -10.7
        CuCO3     1.77E-09  1.79E-09  -8.752    -8.748    0.005   0
        MnHCO3+   1.58E-09  1.31E-09  -8.802    -8.884    -0.081  0
        Cu(CO3)2- 9.97E-11  4.62E-11  -10.001   -10.336   -0.334  0
        CuHCO3+   1.50E-11  1.23E-11  -10.825   -10.909   -0.084  0
        FeCO3     1.22E-11  1.23E-11  -10.915   -10.911   0.005   0
        FeHCO3+   4.59E-12  3.79E-12  -11.338   -11.422   -0.084  0
        (CO2)2    2.55E-12  2.57E-12  -11.594   -11.59    0.005   68.87
Ca        7.90E-04
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	Ca+2	7.05E-04	3.39E-04	-3.152	-3.47	-0.318	-17.64
	CaSO4	6.60E-05	6.68E-05	-4.18	-4.176	0.005	7.5
	CaCO3	1.16E-05	1.17E-05	-4.937	-4.933	0.005	-14.6
	CaHCO3+	7.83E-06	6.56E-06	-5.106	-5.183	-0.077	9.79
	CaOH+	1.96E-08	1.62E-08	-7.707	-7.791	-0.084	0
	CaHSO4+	1.84E-12	1.52E-12	-11.734	-11.818	-0.084	0
Cl	2.89E-02						
	Cl-	2.89E-02	2.37E-02	-1.539	-1.625	-0.087	18.25
	ZnOHCl	4.19E-09	4.24E-09	-8.377	-8.373	0.005	0
	ZnCl+	1.46E-09	1.20E-09	-8.836	-8.922	-0.086	-13.94
	MnCl+	1.13E-09	9.33E-10	-8.949	-9.03	-0.081	-2.97
	CuCl2-	1.84E-10	1.51E-10	-9.735	-9.821	-0.086	0
	ZnCl2	2.94E-11	2.97E-11	-10.532	-10.528	0.005	102.03
	CuCl3-2	1.20E-11	5.67E-12	-10.92	-11.246	-0.326	0
	MnCl2	9.54E-12	9.65E-12	-11.02	-11.016	0.005	85.89
	CuCl+	1.26E-12	1.03E-12	-11.899	-11.985	-0.086	0.82
	FeCl+	9.90E-13	8.16E-13	-12.005	-12.088	-0.084	0
	ZnCl3-	9.61E-13	7.88E-13	-12.017	-12.103	-0.086	16.8
	MnCl3-	7.59E-14	6.29E-14	-13.12	-13.201	-0.081	43.64
	ZnCl4-2	1.98E-14	9.36E-15	-13.703	-14.029	-0.326	146.01
	CuCl2	1.30E-14	1.32E-14	-13.886	-13.881	0.005	31.02
	CuCl3-	1.35E-18	1.11E-18	-17.87	-17.956	-0.086	0
	FeCl+2	3.61E-20	1.71E-20	-19.442	-19.768	-0.326	0
	FeCl2+	2.18E-21	1.81E-21	-20.662	-20.744	-0.081	0
	CuCl4-2	2.78E-22	1.31E-22	-21.556	-21.882	-0.326	0
	FeCl3	4.23E-24	4.28E-24	-23.374	-23.369	0.005	0
Cu(1)	1.97E-10						
	CuCl2-	1.84E-10	1.51E-10	-9.735	-9.821	-0.086	0
	CuCl3-2	1.20E-11	5.67E-12	-10.92	-11.246	-0.326	0
	Cu+	1.06E-12	8.51E-13	-11.976	-12.07	-0.094	0
Cu(2)	2.98E-08						
	Cu(OH)2	2.78E-08	2.81E-08	-7.556	-7.551	0.005	0
	CuCO3	1.77E-09	1.79E-09	-8.752	-8.748	0.005	0
	Cu(CO3)2-	9.97E-11	4.62E-11	-10.001	-10.336	-0.334	0
	CuOH+	5.70E-11	4.67E-11	-10.244	-10.33	-0.086	0
	Cu+2	3.31E-11	1.62E-11	-10.48	-10.79	-0.31	-26.13
	CuHCO3+	1.50E-11	1.23E-11	-10.825	-10.909	-0.084	0
	CuSO4	3.63E-12	3.67E-12	-11.44	-11.435	0.005	13.09
	CuCl+	1.26E-12	1.03E-12	-11.899	-11.985	-0.086	0.82
	Cu(OH)3-	5.92E-13	4.88E-13	-12.228	-12.311	-0.084	0
	CuF+	1.97E-14	1.62E-14	-13.707	-13.79	-0.084	0
	CuCl2	1.30E-14	1.32E-14	-13.886	-13.881	0.005	31.02
	Cu2(OH)2+	2.06E-15	9.56E-16	-14.685	-15.02	-0.334	0
	Cu(OH)4-2	6.06E-17	2.81E-17	-16.217	-16.552	-0.334	0
	CuCl3-	1.35E-18	1.11E-18	-17.87	-17.956	-0.086	0
	CuCl4-2	2.78E-22	1.31E-22	-21.556	-21.882	-0.326	0
F	8.00E-05						
	F-	6.73E-05	5.49E-05	-4.172	-4.26	-0.088	-1.14
	MgF+	1.20E-05	9.89E-06	-4.921	-5.005	-0.084	-10.45
	NaF	7.16E-07	7.24E-07	-6.145	-6.14	0.005	7.26

	HF	2.82E-10	2.86E-10	-9.549	-9.544	0.005	12.5
	ZnF+	1.76E-11	1.46E-11	-10.754	-10.837	-0.084	0
	MnF+	4.43E-12	3.67E-12	-11.354	-11.435	-0.081	0
	HF2-	7.29E-14	6.01E-14	-13.137	-13.221	-0.084	22.24
	CuF+	1.97E-14	1.62E-14	-13.707	-13.79	-0.084	0
	FeF+	1.66E-14	1.37E-14	-13.779	-13.863	-0.084	0
	FeF2+	5.47E-18	4.53E-18	-17.262	-17.344	-0.081	0
	FeF+2	4.39E-18	2.07E-18	-17.357	-17.683	-0.326	0
	FeF3	3.90E-19	3.95E-19	-18.409	-18.404	0.005	0
Fe(2)	7.63E-11						
	Fe+2	5.09E-11	2.50E-11	-10.293	-10.603	-0.31	-21.65
	FeCO3	1.22E-11	1.23E-11	-10.915	-10.911	0.005	0
	FeSO4	4.87E-12	4.92E-12	-11.313	-11.308	0.005	18.97
	FeHCO3+	4.59E-12	3.79E-12	-11.338	-11.422	-0.084	0
	FeOH+	2.74E-12	2.27E-12	-11.562	-11.643	-0.081	0
	FeCl+	9.90E-13	8.16E-13	-12.005	-12.088	-0.084	0
	FeF+	1.66E-14	1.37E-14	-13.779	-13.863	-0.084	0
	Fe(OH)2	5.52E-15	5.58E-15	-14.258	-14.254	0.005	0
	Fe(OH)3-	7.20E-17	5.97E-17	-16.143	-16.224	-0.081	0
	FeHSO4+	1.36E-19	1.12E-19	-18.867	-18.95	-0.084	0
Fe(3)	2.10E-07						
	Fe(OH)3	1.55E-07	1.57E-07	-6.809	-6.804	0.005	0
	Fe(OH)4-	4.96E-08	4.12E-08	-7.305	-7.385	-0.08	0
	Fe(OH)2+	5.08E-09	4.23E-09	-8.294	-8.374	-0.08	0
	FeOH+2	9.39E-14	4.43E-14	-13.027	-13.353	-0.326	0
	FeF2+	5.47E-18	4.53E-18	-17.262	-17.344	-0.081	0
	FeF+2	4.39E-18	2.07E-18	-17.357	-17.683	-0.326	0
	FeF3	3.90E-19	3.95E-19	-18.409	-18.404	0.005	0
	FeSO4+	3.50E-19	2.90E-19	-18.457	-18.538	-0.081	0
	Fe+3	9.62E-20	2.38E-20	-19.017	-19.623	-0.606	0
	FeCl+2	3.61E-20	1.71E-20	-19.442	-19.768	-0.326	0
	Fe(SO4)2-	8.52E-21	7.03E-21	-20.07	-20.153	-0.084	0
	FeCl2+	2.18E-21	1.81E-21	-20.662	-20.744	-0.081	0
	FeCl3	4.23E-24	4.28E-24	-23.374	-23.369	0.005	0
	Fe2(OH)2+	1.15E-24	5.29E-26	-23.939	-25.276	-1.338	0
	FeHSO4+2	5.81E-27	2.69E-27	-26.236	-26.57	-0.334	0
	Fe3(OH)4+	5.76E-30	4.68E-32	-29.24	-31.33	-2.09	0
H(0)	1.68E-28						
	H2	8.42E-29	8.51E-29	-28.075	-28.07	0.005	28.61
K	4.00E-04						
	K+	3.97E-04	3.24E-04	-3.401	-3.489	-0.088	9.16
	KSO4-	3.04E-06	2.53E-06	-5.518	-5.598	-0.08	34.28
Mg	6.37E-03						
	Mg+2	5.54E-03	2.73E-03	-2.256	-2.564	-0.308	-21.33
	MgSO4	7.01E-04	7.08E-04	-3.154	-3.15	0.005	5.84
	MgHCO3+	5.90E-05	4.84E-05	-4.229	-4.315	-0.086	5.61
	MgCO3	5.28E-05	5.34E-05	-4.277	-4.273	0.005	-17.09
	MgF+	1.20E-05	9.89E-06	-4.921	-5.005	-0.084	-10.45
	MgOH+	3.39E-06	2.85E-06	-5.469	-5.545	-0.076	0
Mn(2)	4.00E-08						

	Mn+2	1.97E-08	9.67E-09	-7.705	-8.015	-0.31	-18.78
	MnCO3	1.56E-08	1.58E-08	-7.807	-7.802	0.005	0
	MnSO4	1.89E-09	1.91E-09	-8.725	-8.72	0.005	22.54
	MnHCO3+	1.58E-09	1.31E-09	-8.802	-8.884	-0.081	0
	MnCl+	1.13E-09	9.33E-10	-8.949	-9.03	-0.081	-2.97
	MnOH+	8.64E-11	7.16E-11	-10.064	-10.145	-0.081	0
	MnCl2	9.54E-12	9.65E-12	-11.02	-11.016	0.005	85.89
	MnF+	4.43E-12	3.67E-12	-11.354	-11.435	-0.081	0
	MnCl3-	7.59E-14	6.29E-14	-13.12	-13.201	-0.081	43.64
	Mn(NO3)2	4.01E-17	4.05E-17	-16.397	-16.393	0.005	41.04
	Mn(OH)3-	4.42E-18	3.66E-18	-17.355	-17.436	-0.081	0
Mn(3)	1.21E-29						
	Mn+3	1.21E-29	2.99E-30	-28.919	-29.525	-0.606	0
N(-3)	4.00E-06						
	NH4+	3.49E-06	2.82E-06	-5.457	-5.55	-0.094	18.11
	NH3	4.58E-07	4.63E-07	-6.339	-6.335	0.005	24.42
	NH4SO4-	4.87E-08	4.02E-08	-7.312	-7.396	-0.084	37.9
N(5)	4.00E-05						
	NO3-	4.00E-05	3.24E-05	-4.398	-4.489	-0.091	29.67
	Mn(NO3)2	4.01E-17	4.05E-17	-16.397	-16.393	0.005	41.04
Na	2.78E-02						
	Na+	2.77E-02	2.29E-02	-1.558	-1.64	-0.082	-1.22
	NaSO4-	1.53E-04	1.27E-04	-3.816	-3.895	-0.08	15.38
	NaHCO3	1.93E-05	1.95E-05	-4.714	-4.709	0.005	1.8
	NaCO3-	1.06E-05	8.75E-06	-4.974	-5.058	-0.084	-0.64
	NaF	7.16E-07	7.24E-07	-6.145	-6.14	0.005	7.26
	NaOH	6.61E-18	6.68E-18	-17.18	-17.175	0.005	0
O(0)	1.14E-36						
	O2	5.68E-37	5.74E-37	-36.246	-36.241	0.005	30.4
S(6)	3.28E-03						
	SO4-2	2.36E-03	1.11E-03	-2.628	-2.955	-0.328	15.21
	MgSO4	7.01E-04	7.08E-04	-3.154	-3.15	0.005	5.84
	NaSO4-	1.53E-04	1.27E-04	-3.816	-3.895	-0.08	15.38
	CaSO4	6.60E-05	6.68E-05	-4.18	-4.176	0.005	7.5
	KSO4-	3.04E-06	2.53E-06	-5.518	-5.598	-0.08	34.28
	BaSO4	1.20E-07	1.21E-07	-6.921	-6.916	0.005	0
	NH4SO4-	4.87E-08	4.02E-08	-7.312	-7.396	-0.084	37.9
	ZnSO4	4.82E-09	4.87E-09	-8.317	-8.312	0.005	21.71
	MnSO4	1.89E-09	1.91E-09	-8.725	-8.72	0.005	22.54
	HSO4-	4.53E-10	3.74E-10	-9.344	-9.428	-0.084	40.45
	Zn(SO4)2-2	9.48E-11	4.39E-11	-10.023	-10.357	-0.334	-12.1
	FeSO4	4.87E-12	4.92E-12	-11.313	-11.308	0.005	18.97
	CuSO4	3.63E-12	3.67E-12	-11.44	-11.435	0.005	13.09
	CaHSO4+	1.84E-12	1.52E-12	-11.734	-11.818	-0.084	0
	FeSO4+	3.50E-19	2.90E-19	-18.457	-18.538	-0.081	0
	FeHSO4+	1.36E-19	1.12E-19	-18.867	-18.95	-0.084	0
	Fe(SO4)2-	8.52E-21	7.03E-21	-20.07	-20.153	-0.084	0
	FeHSO4+2	5.81E-27	2.69E-27	-26.236	-26.57	-0.334	0
Zn	2.30E-07						
	ZnCO3	7.60E-08	7.68E-08	-7.119	-7.115	0.005	0

Zn(CO3)2-2	7.28E-08	3.37E-08	-7.138	-7.473	-0.334	0
Zn+2	3.97E-08	1.88E-08	-7.401	-7.727	-0.326	-24.87
Zn(OH)2	1.94E-08	1.96E-08	-7.713	-7.708	0.005	0
ZnOH+	7.18E-09	5.93E-09	-8.144	-8.227	-0.084	0
ZnSO4	4.82E-09	4.87E-09	-8.317	-8.312	0.005	21.71
ZnHCO3+	4.34E-09	3.58E-09	-8.362	-8.446	-0.084	0
ZnOHCl	4.19E-09	4.24E-09	-8.377	-8.373	0.005	0
ZnCl+	1.46E-09	1.20E-09	-8.836	-8.922	-0.086	-13.94
Zn(SO4)2-2	9.48E-11	4.39E-11	-10.023	-10.357	-0.334	-12.1
ZnCl2	2.94E-11	2.97E-11	-10.532	-10.528	0.005	102.03
Zn(OH)3-	2.16E-11	1.79E-11	-10.665	-10.748	-0.084	0
ZnF+	1.76E-11	1.46E-11	-10.754	-10.837	-0.084	0
ZnCl3-	9.61E-13	7.88E-13	-12.017	-12.103	-0.086	16.8
ZnCl4-2	1.98E-14	9.36E-15	-13.703	-14.029	-0.326	146.01
Zn(OH)4-2	1.76E-15	8.15E-16	-14.754	-15.089	-0.334	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-2.15	-6.43	-4.28	CaSO4			
Aragonite	0.18	-8.16	-8.34	CaCO3			
Barite	0.23	-9.62	-9.84	BaSO4			
Calcite	0.32	-8.16	-8.48	CaCO3			
CO2(g)	-3.46	-4.93	-1.47	CO2			
Dolomite	1.67	-15.41	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	0.86	5.76	4.89	Fe(OH)3			
Fluorite	-1.39	-11.99	-10.6	CaF2			
Goethite	6.76	5.76	-1	FeOOH			
Gypsum	-1.84	-6.43	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-4.84	-3.27	1.57	NaCl			
Hausmann	-9.4	51.63	61.03	Mn3O4			
Hematite	15.52	11.51	-4.01	Fe2O3			
Jarosite-K	-8.3	-17.51	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.98	21.36	25.34	MnOOH			
Melanterit	-11.35	-13.56	-2.21	FeSO4:7H2O			
NH3(g)	-8.13	-6.33	1.8	NH3			
O2(g)	-33.35	-36.24	-2.89	O2			
Pyrochroit	-6.3	8.9	15.2	Mn(OH)2			
Pyrolusite	-7.56	33.82	41.38	MnO2:H2O			
Rhodochro	-1.57	-12.7	-11.13	MnCO3			
Siderite	-4.4	-15.29	-10.89	FeCO3			
Smithsonit	-2.41	-12.41	-10	ZnCO3			
Sylvite	-6.01	-5.11	0.9	KCl			
Witherite	-2.79	-11.35	-8.56	BaCO3			
Zn(OH)2(e	-2.31	9.19	11.5	Zn(OH)2			

**For a gas, SI = log10(fuga Fugacity = pressure

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For ideal gases, phi = 1

Initial solution 5

#NAME? composition-----------------------------

Elements Molality Moles

Alkalinity 2.56E-03 2.56E-03
Ba 3.55E-06 3.55E-06
Ca 9.40E-04 9.40E-04
Cl 3.44E-02 3.44E-02
Cu 3.00E-08 3.00E-08
F 1.00E-04 1.00E-04
Fe 2.50E-07 2.50E-07
K 4.70E-04 4.70E-04
Mg 7.58E-03 7.58E-03
Mn 4.00E-08 4.00E-08
N(-3) 5.00E-06 5.00E-06
N(5) 4.00E-05 4.00E-05
Na 3.31E-02 3.31E-02
S(6) 3.90E-03 3.90E-03
Zn 2.70E-07 2.70E-07

#NAME? of solution----------------------------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 4789
Density (g/cm³) = 0.99924
Volume (L) = 1.00351
Activity of water = 0.999
Ionic strength (mol/kgw) = 5.55E-02
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 2.42E-03
Total CO2 (mol/kg) = 2.42E-03
Temperatu (°C) = 25
Electrical balance (eq) = 5.71E-03
Percent error, 100*(Cat-| = 6.3
Iterations = 8 (37 overall)
Total H = 1.11E+02
Total O = 5.55E+01

#NAME? couples--------------------------------

Redox couple pe Eh (volts)

N(-3)/N(5) 4.4304 0.2621

#NAME? of species----------------------------
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	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	3.62E-06	2.92E-06	-5.441	-5.535	-0.095	-3.86
	H+	4.08E-09	3.47E-09	-8.389	-8.46	-0.071	0
	H2O	5.55E+01	9.99E-01	1.744	-0.001	0	18.07
Ba	3.55E-06						
	Ba+2	2.77E-06	1.22E-06	-5.557	-5.916	-0.359	-12.17
	BaSO4	7.37E-07	7.46E-07	-6.133	-6.127	0.006	0
	BaHCO3+	2.51E-08	2.05E-08	-7.6	-7.689	-0.089	0
	BaCO3	1.47E-08	1.49E-08	-7.832	-7.826	0.006	-10.7
	BaOH+	1.45E-11	1.19E-11	-10.84	-10.926	-0.087	0
C(4)	2.42E-03						
	HCO3-	2.14E-03	1.76E-03	-2.67	-2.755	-0.085	25
	MgHCO3+	7.84E-05	6.35E-05	-4.106	-4.198	-0.092	5.62
	MgCO3	6.91E-05	7.00E-05	-4.16	-4.155	0.006	-17.09
	CO3-2	5.19E-05	2.38E-05	-4.285	-4.624	-0.339	-4.48
	NaHCO3	2.63E-05	2.66E-05	-4.58	-4.575	0.006	1.8
	CaCO3	1.51E-05	1.53E-05	-4.821	-4.816	0.006	-14.6
	NaCO3-	1.46E-05	1.19E-05	-4.835	-4.924	-0.089	-0.58
	CO2	1.36E-05	1.37E-05	-4.868	-4.863	0.006	34.43
	CaHCO3+	1.04E-05	8.58E-06	-4.984	-5.066	-0.082	9.8
	Zn(CO3)2-2	1.00E-07	4.43E-08	-6.999	-7.354	-0.355	0
	ZnCO3	8.60E-08	8.71E-08	-7.066	-7.06	0.006	0
	BaHCO3+	2.51E-08	2.05E-08	-7.6	-7.689	-0.089	0
	MnCO3	1.64E-08	1.66E-08	-7.785	-7.78	0.006	0
	BaCO3	1.47E-08	1.49E-08	-7.832	-7.826	0.006	-10.7
	ZnHCO3+	4.99E-09	4.06E-09	-8.302	-8.391	-0.089	0
	CuCO3	2.02E-09	2.05E-09	-8.694	-8.689	0.006	0
	MnHCO3+	1.68E-09	1.38E-09	-8.774	-8.861	-0.087	0
	Cu(CO3)2-	1.39E-10	6.13E-11	-9.857	-10.213	-0.355	0
	CuHCO3+	1.73E-11	1.41E-11	-10.761	-10.85	-0.089	0
	FeCO3	1.67E-11	1.69E-11	-10.777	-10.771	0.006	0
	FeHCO3+	6.40E-12	5.22E-12	-11.194	-11.282	-0.089	0
	(CO2)2	3.41E-12	3.46E-12	-11.467	-11.461	0.006	68.87
Ca	9.40E-04						
	Ca+2	8.32E-04	3.83E-04	-3.08	-3.417	-0.337	-17.59
	CaSO4	8.24E-05	8.34E-05	-4.084	-4.079	0.006	7.5
	CaCO3	1.51E-05	1.53E-05	-4.821	-4.816	0.006	-14.6
	CaHCO3+	1.04E-05	8.58E-06	-4.984	-5.066	-0.082	9.8
	CaOH+	2.24E-08	1.83E-08	-7.649	-7.738	-0.089	0
	CaHSO4+	2.33E-12	1.90E-12	-11.632	-11.721	-0.089	0
Cl	3.44E-02						
	Cl-	3.44E-02	2.78E-02	-1.463	-1.556	-0.093	18.26
	ZnOHCl	4.81E-09	4.87E-09	-8.318	-8.312	0.006	0
	ZnCl+	1.70E-09	1.37E-09	-8.77	-8.862	-0.092	-13.96
	MnCl+	1.22E-09	9.96E-10	-8.915	-9.002	-0.087	-2.96
	CuCl2-	2.54E-10	2.06E-10	-9.595	-9.686	-0.092	0
	ZnCl2	3.95E-11	4.00E-11	-10.403	-10.398	0.006	102.03

	CuCl3-2	2.02E-11	9.08E-12	-10.696	-11.042	-0.347	0
	MnCl2	1.19E-11	1.21E-11	-10.923	-10.918	0.006	85.89
	ZnCl3-	1.54E-12	1.25E-12	-11.812	-11.903	-0.092	16.75
	CuCl+	1.48E-12	1.20E-12	-11.829	-11.921	-0.092	0.85
	FeCl+	1.40E-12	1.14E-12	-11.854	-11.943	-0.089	0
	MnCl3-	1.13E-13	9.26E-14	-12.947	-13.033	-0.087	43.68
	ZnCl4-2	3.87E-14	1.74E-14	-13.413	-13.759	-0.347	146.11
	CuCl2	1.77E-14	1.79E-14	-13.752	-13.746	0.006	31.02
	CuCl3-	2.19E-18	1.77E-18	-17.66	-17.752	-0.092	0
	FeCl+2	5.29E-20	2.38E-20	-19.277	-19.623	-0.347	0
	FeCl2+	3.61E-21	2.96E-21	-20.442	-20.529	-0.087	0
	CuCl4-2	5.48E-22	2.47E-22	-21.261	-21.608	-0.347	0
	FeCl3	8.12E-24	8.23E-24	-23.09	-23.085	0.006	0
Cu(1)	2.76E-10						
	CuCl2-	2.54E-10	2.06E-10	-9.595	-9.686	-0.092	0
	CuCl3-2	2.02E-11	9.08E-12	-10.696	-11.042	-0.347	0
	Cu+	1.06E-12	8.42E-13	-11.974	-12.075	-0.101	0
Cu(2)	2.97E-08						
	Cu(OH)2	2.75E-08	2.78E-08	-7.561	-7.556	0.006	0
	CuCO3	2.02E-09	2.05E-09	-8.694	-8.689	0.006	0
	Cu(CO3)2-	1.39E-10	6.13E-11	-9.857	-10.213	-0.355	0
	CuOH+	5.71E-11	4.62E-11	-10.244	-10.335	-0.092	0
	Cu+2	3.42E-11	1.60E-11	-10.466	-10.795	-0.328	-26.1
	CuHCO3+	1.73E-11	1.41E-11	-10.761	-10.85	-0.089	0
	CuSO4	3.96E-12	4.02E-12	-11.402	-11.396	0.006	13.09
	CuCl+	1.48E-12	1.20E-12	-11.829	-11.921	-0.092	0.85
	Cu(OH)3-	5.92E-13	4.83E-13	-12.228	-12.317	-0.089	0
	CuF+	2.37E-14	1.94E-14	-13.625	-13.713	-0.089	0
	CuCl2	1.77E-14	1.79E-14	-13.752	-13.746	0.006	31.02
	Cu2(OH)2+	2.12E-15	9.34E-16	-14.675	-15.03	-0.355	0
	Cu(OH)4-2	6.28E-17	2.77E-17	-16.202	-16.557	-0.355	0
	CuCl3-	2.19E-18	1.77E-18	-17.66	-17.752	-0.092	0
	CuCl4-2	5.48E-22	2.47E-22	-21.261	-21.608	-0.347	0
F	1.00E-04						
	F-	8.24E-05	6.63E-05	-4.084	-4.179	-0.095	-1.12
	MgF+	1.66E-05	1.35E-05	-4.78	-4.869	-0.089	-10.44
	NaF	1.01E-06	1.03E-06	-5.994	-5.988	0.006	7.26
	HF	3.40E-10	3.45E-10	-9.468	-9.463	0.006	12.5
	ZnF+	2.11E-11	1.72E-11	-10.676	-10.765	-0.089	0
	MnF+	4.92E-12	4.03E-12	-11.308	-11.395	-0.087	0
	HF2-	1.08E-13	8.76E-14	-12.969	-13.057	-0.089	22.25
	FeF+	2.41E-14	1.97E-14	-13.617	-13.706	-0.089	0
	CuF+	2.37E-14	1.94E-14	-13.625	-13.713	-0.089	0
	FeF2+	9.60E-18	7.86E-18	-17.018	-17.105	-0.087	0
	FeF+2	6.62E-18	2.98E-18	-17.179	-17.526	-0.347	0
	FeF3	8.15E-19	8.26E-19	-18.089	-18.083	0.006	0
Fe(2)	9.75E-11						
	Fe+2	6.32E-11	2.97E-11	-10.199	-10.527	-0.328	-21.61
	FeCO3	1.67E-11	1.69E-11	-10.777	-10.771	0.006	0
	FeHCO3+	6.40E-12	5.22E-12	-11.194	-11.282	-0.089	0

	FeSO4	6.39E-12	6.47E-12	-11.194	-11.189	0.006	18.97
	FeOH+	3.30E-12	2.71E-12	-11.481	-11.568	-0.087	0
	FeCl+	1.40E-12	1.14E-12	-11.854	-11.943	-0.089	0
	FeF+	2.41E-14	1.97E-14	-13.617	-13.706	-0.089	0
	Fe(OH)2	6.55E-15	6.63E-15	-14.184	-14.179	0.006	0
	Fe(OH)3-	8.66E-17	7.09E-17	-16.062	-16.149	-0.087	0
	FeHSO4+	1.81E-19	1.48E-19	-18.742	-18.831	-0.089	0
Fe(3)	2.50E-07						
	Fe(OH)3	1.84E-07	1.87E-07	-6.735	-6.729	0.006	0
	Fe(OH)4-	5.96E-08	4.90E-08	-7.225	-7.31	-0.085	0
	Fe(OH)2+	6.11E-09	5.03E-09	-8.214	-8.299	-0.085	0
	FeOH+2	1.17E-13	5.27E-14	-12.931	-13.278	-0.347	0
	FeF2+	9.60E-18	7.86E-18	-17.018	-17.105	-0.087	0
	FeF+2	6.62E-18	2.98E-18	-17.179	-17.526	-0.347	0
	FeF3	8.15E-19	8.26E-19	-18.089	-18.083	0.006	0
	FeSO4+	4.65E-19	3.81E-19	-18.332	-18.419	-0.087	0
	Fe+3	1.23E-19	2.84E-20	-18.91	-19.547	-0.637	0
	FeCl+2	5.29E-20	2.38E-20	-19.277	-19.623	-0.347	0
	Fe(SO4)2-	1.25E-20	1.02E-20	-19.902	-19.99	-0.089	0
	FeCl2+	3.61E-21	2.96E-21	-20.442	-20.529	-0.087	0
	FeCl3	8.12E-24	8.23E-24	-23.09	-23.085	0.006	0
	Fe2(OH)2+	1.97E-24	7.49E-26	-23.706	-25.126	-1.42	0
	FeHSO4+2	8.02E-27	3.54E-27	-26.096	-26.451	-0.355	0
	Fe3(OH)4+	1.30E-29	7.87E-32	-28.885	-31.104	-2.219	0
H(0)	1.68E-28						
	H2	8.40E-29	8.51E-29	-28.076	-28.07	0.006	28.61
K	4.70E-04						
	K+	4.66E-04	3.76E-04	-3.332	-3.425	-0.094	9.18
	KSO4-	3.93E-06	3.24E-06	-5.405	-5.49	-0.085	34.3
Mg	7.58E-03						
	Mg+2	6.54E-03	3.09E-03	-2.185	-2.511	-0.326	-21.29
	MgSO4	8.75E-04	8.87E-04	-3.058	-3.052	0.006	5.84
	MgHCO3+	7.84E-05	6.35E-05	-4.106	-4.198	-0.092	5.62
	MgCO3	6.91E-05	7.00E-05	-4.16	-4.155	0.006	-17.09
	MgF+	1.66E-05	1.35E-05	-4.78	-4.869	-0.089	-10.44
	MgOH+	3.88E-06	3.23E-06	-5.411	-5.491	-0.08	0
Mn(2)	4.00E-08						
	Mn+2	1.87E-08	8.79E-09	-7.728	-8.056	-0.328	-18.64
	MnCO3	1.64E-08	1.66E-08	-7.785	-7.78	0.006	0
	MnSO4	1.89E-09	1.92E-09	-8.723	-8.717	0.006	22.54
	MnHCO3+	1.68E-09	1.38E-09	-8.774	-8.861	-0.087	0
	MnCl+	1.22E-09	9.96E-10	-8.915	-9.002	-0.087	-2.96
	MnOH+	7.95E-11	6.51E-11	-10.1	-10.187	-0.087	0
	MnCl2	1.19E-11	1.21E-11	-10.923	-10.918	0.006	85.89
	MnF+	4.92E-12	4.03E-12	-11.308	-11.395	-0.087	0
	MnCl3-	1.13E-13	9.26E-14	-12.947	-13.033	-0.087	43.68
	Mn(NO3)2	3.53E-17	3.57E-17	-16.452	-16.447	0.006	41.04
	Mn(OH)3-	4.06E-18	3.33E-18	-17.391	-17.478	-0.087	0
Mn(3)	1.18E-29						
	Mn+3	1.18E-29	2.72E-30	-28.928	-29.566	-0.637	0

N(-3)	5.00E-06						
	NH4+	4.37E-06	3.47E-06	-5.359	-5.46	-0.101	18.12
	NH3	5.62E-07	5.70E-07	-6.25	-6.244	0.006	24.42
	NH4SO4-	6.71E-08	5.47E-08	-7.173	-7.262	-0.089	37.94
N(5)	4.00E-05						
	NO3-	4.00E-05	3.20E-05	-4.398	-4.495	-0.098	29.69
	Mn(NO3)2	3.53E-17	3.57E-17	-16.452	-16.447	0.006	41.04
Na	3.31E-02						
	Na+	3.29E-02	2.69E-02	-1.483	-1.57	-0.087	-1.2
	NaSO4-	2.01E-04	1.65E-04	-3.697	-3.781	-0.085	15.56
	NaHCO3	2.63E-05	2.66E-05	-4.58	-4.575	0.006	1.8
	NaCO3-	1.46E-05	1.19E-05	-4.835	-4.924	-0.089	-0.58
	NaF	1.01E-06	1.03E-06	-5.994	-5.988	0.006	7.26
	NaOH	7.75E-18	7.85E-18	-17.111	-17.105	0.006	0
O(0)	1.13E-36						
	O2	5.67E-37	5.74E-37	-36.247	-36.241	0.006	30.4
S(6)	3.90E-03						
	SO4-2	2.74E-03	1.23E-03	-2.563	-2.912	-0.349	15.28
	MgSO4	8.75E-04	8.87E-04	-3.058	-3.052	0.006	5.84
	NaSO4-	2.01E-04	1.65E-04	-3.697	-3.781	-0.085	15.56
	CaSO4	8.24E-05	8.34E-05	-4.084	-4.079	0.006	7.5
	KSO4-	3.93E-06	3.24E-06	-5.405	-5.49	-0.085	34.3
	BaSO4	7.37E-07	7.46E-07	-6.133	-6.127	0.006	0
	NH4SO4-	6.71E-08	5.47E-08	-7.173	-7.262	-0.089	37.94
	ZnSO4	5.21E-09	5.28E-09	-8.283	-8.278	0.006	21.71
	MnSO4	1.89E-09	1.92E-09	-8.723	-8.717	0.006	22.54
	HSO4-	5.07E-10	4.13E-10	-9.295	-9.384	-0.089	40.46
	Zn(SO4)2-2	1.19E-10	5.26E-11	-9.924	-10.279	-0.355	-11.96
	FeSO4	6.39E-12	6.47E-12	-11.194	-11.189	0.006	18.97
	CuSO4	3.96E-12	4.02E-12	-11.402	-11.396	0.006	13.09
	CaHSO4+	2.33E-12	1.90E-12	-11.632	-11.721	-0.089	0
	FeSO4+	4.65E-19	3.81E-19	-18.332	-18.419	-0.087	0
	FeHSO4+	1.81E-19	1.48E-19	-18.742	-18.831	-0.089	0
	Fe(SO4)2-	1.25E-20	1.02E-20	-19.902	-19.99	-0.089	0
	FeHSO4+2	8.02E-27	3.54E-27	-26.096	-26.451	-0.355	0
Zn	2.70E-07						
	Zn(CO3)2-2	1.00E-07	4.43E-08	-6.999	-7.354	-0.355	0
	ZnCO3	8.60E-08	8.71E-08	-7.066	-7.06	0.006	0
	Zn+2	4.08E-08	1.84E-08	-7.39	-7.736	-0.347	-24.83
	Zn(OH)2	1.89E-08	1.92E-08	-7.723	-7.717	0.006	0
	ZnOH+	7.11E-09	5.80E-09	-8.148	-8.237	-0.089	0
	ZnSO4	5.21E-09	5.28E-09	-8.283	-8.278	0.006	21.71
	ZnHCO3+	4.99E-09	4.06E-09	-8.302	-8.391	-0.089	0
	ZnOHCl	4.81E-09	4.87E-09	-8.318	-8.312	0.006	0
	ZnCl+	1.70E-09	1.37E-09	-8.77	-8.862	-0.092	-13.96
	Zn(SO4)2-2	1.19E-10	5.26E-11	-9.924	-10.279	-0.355	-11.96
	ZnCl2	3.95E-11	4.00E-11	-10.403	-10.398	0.006	102.03
	Zn(OH)3-	2.14E-11	1.75E-11	-10.669	-10.758	-0.089	0
	ZnF+	2.11E-11	1.72E-11	-10.676	-10.765	-0.089	0
	ZnCl3-	1.54E-12	1.25E-12	-11.812	-11.903	-0.092	16.75

ZnCl4-2	3.87E-14	1.74E-14	-13.413	-13.759	-0.347	146.11
Zn(OH)4-2	1.81E-15	7.97E-16	-14.743	-15.098	-0.355	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-2.05	-6.33	-4.28	CaSO4			
Aragonite	0.29	-8.04	-8.34	CaCO3			
Barite	1.02	-8.83	-9.84	BaSO4			
Calcite	0.44	-8.04	-8.48	CaCO3			
CO2(g)	-3.39	-4.86	-1.47	CO2			
Dolomite	1.91	-15.18	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	0.94	5.83	4.89	Fe(OH)3			
Fluorite	-1.17	-11.77	-10.6	CaF2			
Goethite	6.83	5.83	-1	FeOOH			
Gypsum	-1.75	-6.33	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-4.7	-3.13	1.57	NaCl			
Hausmann	-9.52	51.51	61.03	Mn3O4			
Hematite	15.67	11.66	-4.01	Fe2O3			
Jarosite-K	-7.92	-17.13	-9.21	KFe3(SO4)2(OH)6			
Manganite	-4.02	21.32	25.34	MnOOH			
Melanterit	-11.23	-13.44	-2.21	FeSO4:7H2O			
NH3(g)	-8.04	-6.24	1.8	NH3			
O2(g)	-33.35	-36.24	-2.89	O2			
Pyrochroit	-6.34	8.86	15.2	Mn(OH)2			
Pyrolusite	-7.6	33.78	41.38	MnO2:H2O			
Rhodochro	-1.55	-12.68	-11.13	MnCO3			
Siderite	-4.26	-15.15	-10.89	FeCO3			
Smithsonit	-2.36	-12.36	-10	ZnCO3			
Sylvite	-5.88	-4.98	0.9	KCl			
Witherite	-1.98	-10.54	-8.56	BaCO3			
Zn(OH)2(e	-2.32	9.18	11.5	Zn(OH)2			

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 6

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	3.02E-03	3.02E-03
Ba	4.31E-06	4.31E-06
Ca	1.11E-03	1.11E-03
Cl	4.06E-02	4.06E-02
Cu	4.00E-08	4.00E-08

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        F            1.10E-04   1.10E-04
        Fe           2.90E-07   2.90E-07
        K            5.60E-04   5.60E-04
        Mg           8.93E-03   8.93E-03
        Mn           5.00E-08   5.00E-08
        N(-3)        6.00E-06   6.00E-06
        N(5)         5.00E-05   5.00E-05
        Na           3.90E-02   3.90E-02
        S(6)         4.59E-03   4.59E-03
        Zn           3.20E-07   3.20E-07

#NAME?  of           solution----------------------------

        pH           =                  8.46
        pe           =                     4
        Specific     Conductan (µS/cm,    25°C)      =                 5571
        Density      (g/cm³)   =            0.99963
        Volume       (L)       =            1.00361
        Activity     of        water      =                0.998
        Ionic        strength  (mol/kgw)  =            6.51E-02
        Mass         of        water      (kg)       =            1.00E+00
        Total        carbon    (mol/kg)   =            2.83E-03
        Total        CO2       (mol/kg)   =            2.83E-03
        Temperatu    (°C)      =                    25
        Electrical   balance   (eq)       =            6.76E-03
        Percent      error,    100*(Cat-| =                 6.35
        Iterations   =                  9 (46        overall)
        Total        H         =            1.11E+02
        Total        O         =            5.55E+01

#NAME?  couples--------------------------------

        Redox        couple    pe         Eh         (volts)

        N(-3)/N(5)     4.4327     0.2622

#NAME?  of           species----------------------------

        Log          Log       Log        mole       V
        Species      Molality  Activity   Molality   Activity   Gamma    cm³/mol

        OH-          3.67E-06  2.91E-06     -5.435     -5.535   -0.101      -3.83
        H+           4.11E-09  3.47E-09     -8.386      -8.46   -0.074          0
        H2O          5.55E+01  9.98E-01      1.744     -0.001        0      18.07
Ba        4.31E-06
        Ba+2         3.33E-06  1.39E-06     -5.477     -5.857    -0.38     -12.13
        BaSO4        9.23E-07  9.37E-07     -6.035     -6.028    0.007          0
        BaHCO3+      3.33E-08  2.69E-08     -7.477     -7.571   -0.094          0
        BaCO3        1.93E-08  1.96E-08     -7.715     -7.708    0.007       -10.7
        BaOH+        1.68E-11  1.36E-11    -10.776    -10.868   -0.092          0
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C(4)	2.83E-03						
	HCO3-	2.48E-03	2.02E-03	-2.606	-2.696	-0.09	25.04
	MgHCO3+	1.02E-04	8.17E-05	-3.99	-4.088	-0.097	5.63
	MgCO3	8.88E-05	9.01E-05	-4.052	-4.045	0.007	-17.09
	CO3-2	6.22E-05	2.73E-05	-4.206	-4.565	-0.358	-4.4
	NaHCO3	3.50E-05	3.55E-05	-4.456	-4.45	0.007	1.8
	NaCO3-	1.97E-05	1.59E-05	-4.705	-4.799	-0.094	-0.52
	CaCO3	1.94E-05	1.97E-05	-4.713	-4.706	0.007	-14.6
	CO2	1.55E-05	1.57E-05	-4.81	-4.803	0.007	34.43
	CaHCO3+	1.35E-05	1.11E-05	-4.87	-4.957	-0.087	9.81
	Zn(CO3)2-2	1.36E-07	5.74E-08	-6.866	-7.241	-0.375	0
	ZnCO3	9.70E-08	9.85E-08	-7.013	-7.007	0.007	0
	BaHCO3+	3.33E-08	2.69E-08	-7.477	-7.571	-0.094	0
	MnCO3	2.14E-08	2.17E-08	-7.67	-7.663	0.007	0
	BaCO3	1.93E-08	1.96E-08	-7.715	-7.708	0.007	-10.7
	ZnHCO3+	5.70E-09	4.60E-09	-8.244	-8.338	-0.094	0
	CuCO3	3.05E-09	3.09E-09	-8.516	-8.51	0.007	0
	MnHCO3+	2.23E-09	1.80E-09	-8.653	-8.744	-0.092	0
	Cu(CO3)2-	2.51E-10	1.06E-10	-9.6	-9.975	-0.375	0
	CuHCO3+	2.65E-11	2.13E-11	-10.577	-10.671	-0.094	0
	FeCO3	2.22E-11	2.25E-11	-10.654	-10.648	0.007	0
	FeHCO3+	8.61E-12	6.94E-12	-11.065	-11.159	-0.094	0
	(CO2)2	4.47E-12	4.54E-12	-11.349	-11.343	0.007	68.87
Ca	1.11E-03						
	Ca+2	9.76E-04	4.30E-04	-3.011	-3.367	-0.356	-17.55
	CaSO4	1.01E-04	1.03E-04	-3.995	-3.988	0.007	7.5
	CaCO3	1.94E-05	1.97E-05	-4.713	-4.706	0.007	-14.6
	CaHCO3+	1.35E-05	1.11E-05	-4.87	-4.957	-0.087	9.81
	CaOH+	2.55E-08	2.05E-08	-7.594	-7.687	-0.094	0
	CaHSO4+	2.91E-12	2.34E-12	-11.537	-11.63	-0.094	0
Cl	4.06E-02						
	Cl-	4.06E-02	3.23E-02	-1.392	-1.491	-0.099	18.28
	ZnOHCl	5.50E-09	5.58E-09	-8.26	-8.253	0.007	0
	ZnCl+	1.97E-09	1.58E-09	-8.705	-8.803	-0.097	-13.98
	MnCl+	1.63E-09	1.32E-09	-8.788	-8.879	-0.092	-2.95
	CuCl2-	4.58E-10	3.66E-10	-9.339	-9.437	-0.097	0
	ZnCl2	5.25E-11	5.33E-11	-10.28	-10.273	0.007	102.03
	CuCl3-2	4.36E-11	1.87E-11	-10.36	-10.727	-0.367	0
	MnCl2	1.84E-11	1.86E-11	-10.736	-10.73	0.007	85.89
	ZnCl3-	2.42E-12	1.93E-12	-11.616	-11.714	-0.097	16.69
	CuCl+	2.30E-12	1.84E-12	-11.638	-11.736	-0.097	0.87
	FeCl+	1.91E-12	1.54E-12	-11.72	-11.814	-0.094	0
	MnCl3-	2.05E-13	1.66E-13	-12.689	-12.781	-0.092	43.72
	ZnCl4-2	7.28E-14	3.13E-14	-13.138	-13.505	-0.367	146.21
	CuCl2	3.14E-14	3.19E-14	-13.503	-13.497	0.007	31.02
	CuCl3-	4.57E-18	3.65E-18	-17.34	-17.437	-0.097	0
	FeCl+2	7.47E-20	3.21E-20	-19.127	-19.494	-0.367	0
	FeCl2+	5.72E-21	4.63E-21	-20.243	-20.334	-0.092	0
	CuCl4-2	1.38E-21	5.92E-22	-20.861	-21.228	-0.367	0
	FeCl3	1.47E-23	1.50E-23	-22.832	-22.825	0.007	0

Cu(1)	5.03E-10						
	CuCl2-	4.58E-10	3.66E-10	-9.339	-9.437	-0.097	0
	CuCl3-2	4.36E-11	1.87E-11	-10.36	-10.727	-0.367	0
	Cu+	1.42E-12	1.11E-12	-11.848	-11.955	-0.108	0
Cu(2)	3.95E-08						
	Cu(OH)2	3.60E-08	3.66E-08	-7.443	-7.437	0.007	0
	CuCO3	3.05E-09	3.09E-09	-8.516	-8.51	0.007	0
	Cu(CO3)2-	2.51E-10	1.06E-10	-9.6	-9.975	-0.375	0
	CuOH+	7.61E-11	6.08E-11	-10.119	-10.216	-0.097	0
	Cu+2	4.69E-11	2.11E-11	-10.329	-10.675	-0.346	-26.06
	CuHCO3+	2.65E-11	2.13E-11	-10.577	-10.671	-0.094	0
	CuSO4	5.71E-12	5.80E-12	-11.243	-11.237	0.007	13.09
	CuCl+	2.30E-12	1.84E-12	-11.638	-11.736	-0.097	0.87
	Cu(OH)3-	7.88E-13	6.35E-13	-12.104	-12.197	-0.094	0
	CuF+	3.36E-14	2.71E-14	-13.474	-13.568	-0.094	0
	CuCl2	3.14E-14	3.19E-14	-13.503	-13.497	0.007	31.02
	Cu2(OH)2+	3.84E-15	1.62E-15	-14.416	-14.791	-0.375	0
	Cu(OH)4-2	8.64E-17	3.65E-17	-16.063	-16.438	-0.375	0
	CuCl3-	4.57E-18	3.65E-18	-17.34	-17.437	-0.097	0
	CuCl4-2	1.38E-21	5.92E-22	-20.861	-21.228	-0.367	0
F	1.10E-04						
	F-	8.87E-05	7.04E-05	-4.052	-4.153	-0.101	-1.1
	MgF+	2.00E-05	1.61E-05	-4.698	-4.793	-0.094	-10.43
	NaF	1.25E-06	1.27E-06	-5.903	-5.897	0.007	7.26
	HF	3.61E-10	3.66E-10	-9.443	-9.437	0.007	12.5
	ZnF+	2.24E-11	1.80E-11	-10.651	-10.744	-0.094	0
	MnF+	6.03E-12	4.89E-12	-11.219	-11.311	-0.092	0
	HF2-	1.23E-13	9.88E-14	-12.911	-13.005	-0.094	22.27
	CuF+	3.36E-14	2.71E-14	-13.474	-13.568	-0.094	0
	FeF+	3.01E-14	2.42E-14	-13.522	-13.616	-0.094	0
	FeF2+	1.27E-17	1.03E-17	-16.897	-16.988	-0.092	0
	FeF+2	8.53E-18	3.67E-18	-17.069	-17.436	-0.367	0
	FeF3	1.13E-18	1.15E-18	-17.947	-17.941	0.007	0
Fe(2)	1.21E-10						
	Fe+2	7.64E-11	3.44E-11	-10.117	-10.463	-0.346	-21.57
	FeCO3	2.22E-11	2.25E-11	-10.654	-10.648	0.007	0
	FeHCO3+	8.61E-12	6.94E-12	-11.065	-11.159	-0.094	0
	FeSO4	8.11E-12	8.23E-12	-11.091	-11.085	0.007	18.97
	FeOH+	3.87E-12	3.14E-12	-11.412	-11.504	-0.092	0
	FeCl+	1.91E-12	1.54E-12	-11.72	-11.814	-0.094	0
	FeF+	3.01E-14	2.42E-14	-13.522	-13.616	-0.094	0
	Fe(OH)2	7.57E-15	7.68E-15	-14.121	-14.115	0.007	0
	Fe(OH)3-	1.02E-16	8.22E-17	-15.994	-16.085	-0.092	0
	FeHSO4+	2.33E-19	1.88E-19	-18.633	-18.727	-0.094	0
Fe(3)	2.90E-07						
	Fe(OH)3	2.13E-07	2.16E-07	-6.672	-6.665	0.007	0
	Fe(OH)4-	6.98E-08	5.68E-08	-7.156	-7.246	-0.09	0
	Fe(OH)2+	7.16E-09	5.83E-09	-8.145	-8.235	-0.09	0
	FeOH+2	1.42E-13	6.11E-14	-12.847	-13.214	-0.367	0
	FeF2+	1.27E-17	1.03E-17	-16.897	-16.988	-0.092	0

	FeF+2	8.53E-18	3.67E-18	-17.069	-17.436	-0.367	0
	FeF3	1.13E-18	1.15E-18	-17.947	-17.941	0.007	0
	FeSO4+	5.99E-19	4.85E-19	-18.223	-18.315	-0.092	0
	Fe+3	1.53E-19	3.29E-20	-18.816	-19.483	-0.668	0
	FeCl+2	7.47E-20	3.21E-20	-19.127	-19.494	-0.367	0
	Fe(SO4)2-	1.77E-20	1.43E-20	-19.752	-19.846	-0.094	0
	FeCl2+	5.72E-21	4.63E-21	-20.243	-20.334	-0.092	0
	FeCl3	1.47E-23	1.50E-23	-22.832	-22.825	0.007	0
	Fe2(OH)2+	3.18E-24	1.01E-25	-23.498	-24.998	-1.499	0
	FeHSO4+2	1.07E-26	4.50E-27	-25.972	-26.347	-0.375	0
	Fe3(OH)4+	2.70E-29	1.22E-31	-28.569	-30.912	-2.343	0
H(0)	1.68E-28						
	H2	8.39E-29	8.51E-29	-28.077	-28.07	0.007	28.61
K	5.60E-04						
	K+	5.55E-04	4.41E-04	-3.256	-3.355	-0.1	9.19
	KSO4-	5.12E-06	4.17E-06	-5.291	-5.38	-0.09	34.32
Mg	8.93E-03						
	Mg+2	7.64E-03	3.47E-03	-2.117	-2.46	-0.343	-21.25
	MgSO4	1.08E-03	1.09E-03	-2.968	-2.962	0.007	5.84
	MgHCO3+	1.02E-04	8.17E-05	-3.99	-4.088	-0.097	5.63
	MgCO3	8.88E-05	9.01E-05	-4.052	-4.045	0.007	-17.09
	MgF+	2.00E-05	1.61E-05	-4.698	-4.793	-0.094	-10.43
	MgOH+	4.40E-06	3.62E-06	-5.357	-5.441	-0.084	0
Mn(2)	5.00E-08						
	Mn+2	2.23E-08	1.00E-08	-7.652	-7.999	-0.346	-18.52
	MnCO3	2.14E-08	2.17E-08	-7.67	-7.663	0.007	0
	MnSO4	2.36E-09	2.40E-09	-8.627	-8.62	0.007	22.54
	MnHCO3+	2.23E-09	1.80E-09	-8.653	-8.744	-0.092	0
	MnCl+	1.63E-09	1.32E-09	-8.788	-8.879	-0.092	-2.95
	MnOH+	9.17E-11	7.43E-11	-10.038	-10.129	-0.092	0
	MnCl2	1.84E-11	1.86E-11	-10.736	-10.73	0.007	85.89
	MnF+	6.03E-12	4.89E-12	-11.219	-11.311	-0.092	0
	MnCl3-	2.05E-13	1.66E-13	-12.689	-12.781	-0.092	43.72
	Mn(NO3)2	6.10E-17	6.19E-17	-16.215	-16.209	0.007	41.04
	Mn(OH)3-	4.69E-18	3.80E-18	-17.329	-17.421	-0.092	0
Mn(3)	1.44E-29						
	Mn+3	1.44E-29	3.10E-30	-28.841	-29.509	-0.668	0
N(-3)	6.00E-06						
	NH4+	5.25E-06	4.10E-06	-5.28	-5.388	-0.108	18.13
	NH3	6.63E-07	6.73E-07	-6.178	-6.172	0.007	24.42
	NH4SO4-	8.81E-08	7.10E-08	-7.055	-7.149	-0.094	37.98
N(5)	5.00E-05						
	NO3-	5.00E-05	3.94E-05	-4.301	-4.405	-0.104	29.71
	Mn(NO3)2	6.10E-17	6.19E-17	-16.215	-16.209	0.007	41.04
Na	3.90E-02						
	Na+	3.87E-02	3.13E-02	-1.412	-1.504	-0.092	-1.17
	NaSO4-	2.60E-04	2.11E-04	-3.586	-3.675	-0.09	15.74
	NaHCO3	3.50E-05	3.55E-05	-4.456	-4.45	0.007	1.8
	NaCO3-	1.97E-05	1.59E-05	-4.705	-4.799	-0.094	-0.52
	NaF	1.25E-06	1.27E-06	-5.903	-5.897	0.007	7.26

	NaOH	9.00E-18	9.13E-18	-17.046	-17.039	0.007	0
O(0)	1.13E-36						
	O2	5.65E-37	5.74E-37	-36.248	-36.241	0.007	30.4
S(6)	4.59E-03						
	SO4-2	3.15E-03	1.34E-03	-2.502	-2.871	-0.369	15.36
	MgSO4	1.08E-03	1.09E-03	-2.968	-2.962	0.007	5.84
	NaSO4-	2.60E-04	2.11E-04	-3.586	-3.675	-0.09	15.74
	CaSO4	1.01E-04	1.03E-04	-3.995	-3.988	0.007	7.5
	KSO4-	5.12E-06	4.17E-06	-5.291	-5.38	-0.09	34.32
	BaSO4	9.23E-07	9.37E-07	-6.035	-6.028	0.007	0
	NH4SO4-	8.81E-08	7.10E-08	-7.055	-7.149	-0.094	37.98
	ZnSO4	5.63E-09	5.71E-09	-8.25	-8.243	0.007	21.71
	MnSO4	2.36E-09	2.40E-09	-8.627	-8.62	0.007	22.54
	HSO4-	5.62E-10	4.53E-10	-9.25	-9.344	-0.094	40.48
	Zn(SO4)2-2	1.48E-10	6.24E-11	-9.83	-10.205	-0.375	-11.82
	FeSO4	8.11E-12	8.23E-12	-11.091	-11.085	0.007	18.97
	CuSO4	5.71E-12	5.80E-12	-11.243	-11.237	0.007	13.09
	CaHSO4+	2.91E-12	2.34E-12	-11.537	-11.63	-0.094	0
	FeSO4+	5.99E-19	4.85E-19	-18.223	-18.315	-0.092	0
	FeHSO4+	2.33E-19	1.88E-19	-18.633	-18.727	-0.094	0
	Fe(SO4)2-	1.77E-20	1.43E-20	-19.752	-19.846	-0.094	0
	FeHSO4+2	1.07E-26	4.50E-27	-25.972	-26.347	-0.375	0
Zn	3.20E-07						
	Zn(CO3)2-2	1.36E-07	5.74E-08	-6.866	-7.241	-0.375	0
	ZnCO3	9.70E-08	9.85E-08	-7.013	-7.007	0.007	0
	Zn+2	4.22E-08	1.81E-08	-7.375	-7.742	-0.367	-24.79
	Zn(OH)2	1.86E-08	1.89E-08	-7.73	-7.723	0.007	0
	ZnOH+	7.10E-09	5.72E-09	-8.149	-8.243	-0.094	0
	ZnHCO3+	5.70E-09	4.60E-09	-8.244	-8.338	-0.094	0
	ZnSO4	5.63E-09	5.71E-09	-8.25	-8.243	0.007	21.71
	ZnOHCl	5.50E-09	5.58E-09	-8.26	-8.253	0.007	0
	ZnCl+	1.97E-09	1.58E-09	-8.705	-8.803	-0.097	-13.98
	Zn(SO4)2-2	1.48E-10	6.24E-11	-9.83	-10.205	-0.375	-11.82
	ZnCl2	5.25E-11	5.33E-11	-10.28	-10.273	0.007	102.03
	ZnF+	2.24E-11	1.80E-11	-10.651	-10.744	-0.094	0
	Zn(OH)3-	2.14E-11	1.72E-11	-10.67	-10.764	-0.094	0
	ZnCl3-	2.42E-12	1.93E-12	-11.616	-11.714	-0.097	16.69
	ZnCl4-2	7.28E-14	3.13E-14	-13.138	-13.505	-0.367	146.21
	Zn(OH)4-2	1.86E-15	7.86E-16	-14.73	-15.105	-0.375	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.96	-6.24	-4.28	CaSO4			
Aragonite	0.4	-7.93	-8.34	CaCO3			
Barite	1.12	-8.73	-9.84	BaSO4			
Calcite	0.55	-7.93	-8.48	CaCO3			
CO2(g)	-3.34	-4.8	-1.47	CO2			
Dolomite	2.13	-14.96	-17.08	CaMg(CO3)2			

Fe(OH)3(a)	1	5.89	4.89	Fe(OH)3
Fluorite	-1.07	-11.67	-10.6	CaF2
Goethite	6.9	5.9	-1	FeOOH
Gypsum	-1.66	-6.24	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-4.56	-2.99	1.57	NaCl
Hausmann	-9.35	51.68	61.03	Mn3O4
Hematite	15.8	11.79	-4.01	Fe2O3
Jarosite-K	-7.58	-16.79	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.96	21.38	25.34	MnOOH
Melanterit	-11.13	-13.34	-2.21	FeSO4:7H2O
NH3(g)	-7.97	-6.17	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.28	8.92	15.2	Mn(OH)2
Pyrolusite	-7.54	33.84	41.38	MnO2:H2O
Rhodochro	-1.43	-12.56	-11.13	MnCO3
Siderite	-4.14	-15.03	-10.89	FeCO3
Smithsonit	-2.31	-12.31	-10	ZnCO3
Sylvite	-5.75	-4.85	0.9	KCl
Witherite	-1.86	-10.42	-8.56	BaCO3
Zn(OH)2(e	-2.32	9.18	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 7

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	3.46E-03	3.46E-03
Ba	5.07E-06	5.07E-06
Ca	1.27E-03	1.27E-03
Cl	4.65E-02	4.65E-02
Cu	4.00E-08	4.00E-08
F	1.30E-04	1.30E-04
Fe	3.30E-07	3.30E-07
K	6.40E-04	6.40E-04
Mg	1.02E-02	1.02E-02
Mn	6.00E-08	6.00E-08
N(-3)	7.00E-06	7.00E-06
N(5)	6.00E-05	6.00E-05
Na	4.47E-02	4.47E-02
S(6)	5.26E-03	5.26E-03
Zn	3.60E-07	3.60E-07

#NAME? of solution----------

```
pH          =                8.46
pe          =                   4
Specific    Conductan (µS/cm,   25°C)      =                6317
Density     (g/cm³)   =                 1
Volume      (L)       =           1.00371
Activity    of        water     =              0.998
Ionic       strength  (mol/kgw) =          7.43E-02
Mass        of        water     (kg)         =          1.00E+00
Total       carbon    (mol/kg)  =          3.23E-03
Total       CO2       (mol/kg)  =          3.23E-03
Temperatu   (°C)      =                  25
Electrical  balance   (eq)      =          7.73E-03
Percent     error,    100*(Cat-|=               6.35
Iterations  =                 9 (55        overall)
Total       H         =          1.11E+02
Total       O         =          5.55E+01

#NAME?  couples--------------------------------

        Redox     couple    pe        Eh        (volts)

        N(-3)/N(5)    4.4343    0.2623

#NAME?  of        species----------------------------

        Log       Log       Log       mole      V
        Species   Molality  Activity  Molality  Activity  Gamma   cm³/mol

        OH-       3.72E-06  2.91E-06     -5.43    -5.536   -0.106      -3.8
        H+        4.14E-09  3.47E-09    -8.383     -8.46   -0.077         0
        H2O       5.55E+01  9.98E-01     1.744    -0.001        0     18.07
Ba        5.07E-06
        Ba+2      3.89E-06  1.56E-06     -5.41    -5.808   -0.398    -12.09
        BaSO4     1.11E-06  1.13E-06    -5.954    -5.946    0.007         0
        BaHCO3+   4.21E-08  3.36E-08    -7.375    -7.473   -0.098         0
        BaCO3     2.41E-08  2.45E-08    -7.618    -7.611    0.007      -10.7
        BaOH+     1.89E-11  1.52E-11   -10.723   -10.819   -0.096         0
C(4)      3.23E-03
        HCO3-     2.80E-03  2.26E-03    -2.553    -2.647   -0.094     25.08
        MgHCO3+   1.27E-04  1.01E-04    -3.895    -3.997   -0.102      5.64
        MgCO3     1.09E-04  1.11E-04    -3.962    -3.955    0.007    -17.09
        CO3-2     7.23E-05  3.05E-05    -4.141    -4.516   -0.375     -4.33
        NaHCO3    4.43E-05  4.51E-05    -4.353    -4.346    0.007       1.8
        NaCO3-    2.53E-05  2.02E-05    -4.597    -4.695   -0.098     -0.46
        CaCO3     2.37E-05  2.42E-05    -4.624    -4.617    0.007     -14.6
        CO2       1.73E-05  1.76E-05    -4.762    -4.754    0.007     34.43
        CaHCO3+   1.67E-05  1.36E-05    -4.777    -4.868    -0.09      9.82
        Zn(CO3)2-2 1.69E-07 6.88E-08    -6.771    -7.163   -0.391         0
        ZnCO3     1.04E-07  1.06E-07    -6.984    -6.977    0.007         0
        BaHCO3+   4.21E-08  3.36E-08    -7.375    -7.473   -0.098         0
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	MnCO3	2.65E-08	2.70E-08	-7.576	-7.569	0.007	0
	BaCO3	2.41E-08	2.45E-08	-7.618	-7.611	0.007	-10.7
	ZnHCO3+	6.16E-09	4.92E-09	-8.21	-8.308	-0.098	0
	CuCO3	3.36E-09	3.42E-09	-8.474	-8.466	0.007	0
	MnHCO3+	2.79E-09	2.24E-09	-8.554	-8.65	-0.096	0
	Cu(CO3)2-	3.23E-10	1.31E-10	-9.491	-9.882	-0.391	0
	CuHCO3+	2.95E-11	2.36E-11	-10.53	-10.628	-0.098	0
	FeCO3	2.82E-11	2.87E-11	-10.55	-10.543	0.007	0
	FeHCO3+	1.11E-11	8.83E-12	-10.956	-11.054	-0.098	0
	(CO2)2	5.60E-12	5.69E-12	-11.252	-11.245	0.007	68.87
Ca	1.27E-03						
	Ca+2	1.11E-03	4.72E-04	-2.955	-3.327	-0.372	-17.52
	CaSO4	1.20E-04	1.22E-04	-3.922	-3.915	0.007	7.5
	CaCO3	2.37E-05	2.42E-05	-4.624	-4.617	0.007	-14.6
	CaHCO3+	1.67E-05	1.36E-05	-4.777	-4.868	-0.09	9.82
	CaOH+	2.82E-08	2.25E-08	-7.549	-7.647	-0.098	0
	CaHSO4+	3.47E-12	2.77E-12	-11.459	-11.557	-0.098	0
Cl	4.65E-02						
	Cl-	4.65E-02	3.66E-02	-1.333	-1.436	-0.104	18.3
	ZnOHCl	5.95E-09	6.05E-09	-8.226	-8.218	0.007	0
	ZnCl+	2.16E-09	1.71E-09	-8.665	-8.768	-0.102	-14
	MnCl+	2.07E-09	1.66E-09	-8.683	-8.779	-0.096	-2.94
	CuCl2-	5.87E-10	4.64E-10	-9.231	-9.333	-0.102	0
	CuCl3-2	6.52E-11	2.69E-11	-10.186	-10.57	-0.384	0
	ZnCl2	6.44E-11	6.55E-11	-10.191	-10.184	0.007	102.03
	MnCl2	2.61E-11	2.66E-11	-10.583	-10.576	0.007	85.89
	ZnCl3-	3.40E-12	2.69E-12	-11.468	-11.57	-0.102	16.64
	CuCl+	2.60E-12	2.06E-12	-11.585	-11.687	-0.102	0.89
	FeCl+	2.48E-12	1.98E-12	-11.606	-11.703	-0.098	0
	MnCl3-	3.34E-13	2.68E-13	-12.476	-12.572	-0.096	43.76
	ZnCl4-2	1.20E-13	4.94E-14	-12.923	-13.307	-0.384	146.31
	CuCl2	3.97E-14	4.04E-14	-13.401	-13.393	0.007	31.02
	CuCl3-	6.65E-18	5.25E-18	-17.178	-17.28	-0.102	0
	FeCl+2	1.00E-19	4.14E-20	-18.999	-19.383	-0.384	0
	FeCl2+	8.44E-21	6.76E-21	-20.074	-20.17	-0.096	0
	CuCl4-2	2.33E-21	9.63E-22	-20.632	-21.016	-0.384	0
	FeCl3	2.43E-23	2.48E-23	-22.614	-22.606	0.007	0
Cu(1)	6.54E-10						
	CuCl2-	5.87E-10	4.64E-10	-9.231	-9.333	-0.102	0
	CuCl3-2	6.52E-11	2.69E-11	-10.186	-10.57	-0.384	0
	Cu+	1.42E-12	1.10E-12	-11.847	-11.961	-0.114	0
Cu(2)	3.94E-08						
	Cu(OH)2	3.55E-08	3.61E-08	-7.45	-7.442	0.007	0
	CuCO3	3.36E-09	3.42E-09	-8.474	-8.466	0.007	0
	Cu(CO3)2-	3.23E-10	1.31E-10	-9.491	-9.882	-0.391	0
	CuOH+	7.60E-11	6.01E-11	-10.119	-10.222	-0.102	0
	Cu+2	4.80E-11	2.09E-11	-10.319	-10.681	-0.362	-26.03
	CuHCO3+	2.95E-11	2.36E-11	-10.53	-10.628	-0.098	0
	CuSO4	6.07E-12	6.18E-12	-11.217	-11.209	0.007	13.09
	CuCl+	2.60E-12	2.06E-12	-11.585	-11.687	-0.102	0.89

	Cu(OH)3-	7.85E-13	6.26E-13	-12.105	-12.203	-0.098	0
	CuCl2	3.97E-14	4.04E-14	-13.401	-13.393	0.007	31.02
	CuF+	3.83E-14	3.06E-14	-13.416	-13.514	-0.098	0
	Cu2(OH)2+	3.89E-15	1.58E-15	-14.41	-14.802	-0.391	0
	Cu(OH)4-2	8.86E-17	3.60E-17	-16.052	-16.444	-0.391	0
	CuCl3-	6.65E-18	5.25E-18	-17.178	-17.28	-0.102	0
	CuCl4-2	2.33E-21	9.63E-22	-20.632	-21.016	-0.384	0
F	1.30E-04						
	F-	1.03E-04	8.06E-05	-3.988	-4.094	-0.106	-1.09
	MgF+	2.55E-05	2.03E-05	-4.593	-4.692	-0.099	-10.42
	NaF	1.62E-06	1.65E-06	-5.79	-5.783	0.007	7.26
	HF	4.12E-10	4.19E-10	-9.385	-9.378	0.007	12.5
	ZnF+	2.47E-11	1.97E-11	-10.607	-10.705	-0.098	0
	MnF+	7.75E-12	6.22E-12	-11.111	-11.207	-0.096	0
	HF2-	1.63E-13	1.30E-13	-12.789	-12.887	-0.098	22.29
	FeF+	3.96E-14	3.16E-14	-13.403	-13.501	-0.098	0
	CuF+	3.83E-14	3.06E-14	-13.416	-13.514	-0.098	0
	FeF2+	1.91E-17	1.53E-17	-16.718	-16.814	-0.096	0
	FeF+2	1.16E-17	4.78E-18	-16.937	-17.321	-0.384	0
	FeF3	1.93E-18	1.96E-18	-17.715	-17.708	0.007	0
Fe(2)	1.46E-10						
	Fe+2	9.01E-11	3.92E-11	-10.045	-10.407	-0.362	-21.54
	FeCO3	2.82E-11	2.87E-11	-10.55	-10.543	0.007	0
	FeHCO3+	1.11E-11	8.83E-12	-10.956	-11.054	-0.098	0
	FeSO4	9.93E-12	1.01E-11	-11.003	-10.995	0.007	18.97
	FeOH+	4.45E-12	3.57E-12	-11.352	-11.448	-0.096	0
	FeCl+	2.48E-12	1.98E-12	-11.606	-11.703	-0.098	0
	FeF+	3.96E-14	3.16E-14	-13.403	-13.501	-0.098	0
	Fe(OH)2	8.59E-15	8.74E-15	-14.066	-14.059	0.007	0
	Fe(OH)3-	1.17E-16	9.34E-17	-15.933	-16.03	-0.096	0
	FeHSO4+	2.89E-19	2.30E-19	-18.54	-18.638	-0.098	0
Fe(3)	3.30E-07						
	Fe(OH)3	2.42E-07	2.46E-07	-6.617	-6.61	0.007	0
	Fe(OH)4-	8.01E-08	6.45E-08	-7.097	-7.19	-0.094	0
	Fe(OH)2+	8.22E-09	6.63E-09	-8.085	-8.179	-0.094	0
	FeOH+2	1.68E-13	6.95E-14	-12.774	-13.158	-0.384	0
	FeF2+	1.91E-17	1.53E-17	-16.718	-16.814	-0.096	0
	FeF+2	1.16E-17	4.78E-18	-16.937	-17.321	-0.384	0
	FeF3	1.93E-18	1.96E-18	-17.715	-17.708	0.007	0
	FeSO4+	7.42E-19	5.95E-19	-18.129	-18.225	-0.096	0
	Fe+3	1.84E-19	3.74E-20	-18.734	-19.427	-0.693	0
	FeCl+2	1.00E-19	4.14E-20	-18.999	-19.383	-0.384	0
	Fe(SO4)2-	2.37E-20	1.89E-20	-19.626	-19.724	-0.098	0
	FeCl2+	8.44E-21	6.76E-21	-20.074	-20.17	-0.096	0
	FeCl3	2.43E-23	2.48E-23	-22.614	-22.606	0.007	0
	Fe2(OH)2+	4.79E-24	1.30E-25	-23.32	-24.886	-1.566	0
	FeHSO4+2	1.36E-26	5.53E-27	-25.866	-26.258	-0.391	0
	Fe3(OH)4+	5.04E-29	1.80E-31	-28.298	-30.744	-2.447	0
H(0)	1.67E-28						
	H2	8.37E-29	8.51E-29	-28.077	-28.07	0.007	28.61

K	6.40E-04						
	K+	6.34E-04	4.98E-04	-3.198	-3.303	-0.105	9.21
	KSO4-	6.30E-06	5.08E-06	-5.201	-5.295	-0.094	34.33
Mg	1.02E-02						
	Mg+2	8.69E-03	3.81E-03	-2.061	-2.419	-0.358	-21.22
	MgSO4	1.28E-03	1.30E-03	-2.895	-2.887	0.007	5.84
	MgHCO3+	1.27E-04	1.01E-04	-3.895	-3.997	-0.102	5.64
	MgCO3	1.09E-04	1.11E-04	-3.962	-3.955	0.007	-17.09
	MgF+	2.55E-05	2.03E-05	-4.593	-4.692	-0.099	-10.42
	MgOH+	4.88E-06	3.99E-06	-5.312	-5.4	-0.088	0
Mn(2)	6.00E-08						
	MnCO3	2.65E-08	2.70E-08	-7.576	-7.569	0.007	0
	Mn+2	2.56E-08	1.11E-08	-7.591	-7.953	-0.362	-18.41
	MnSO4	2.83E-09	2.88E-09	-8.549	-8.541	0.007	22.54
	MnHCO3+	2.79E-09	2.24E-09	-8.554	-8.65	-0.096	0
	MnCl+	2.07E-09	1.66E-09	-8.683	-8.779	-0.096	-2.94
	MnOH+	1.03E-10	8.25E-11	-9.988	-10.084	-0.096	0
	MnCl2	2.61E-11	2.66E-11	-10.583	-10.576	0.007	85.89
	MnF+	7.75E-12	6.22E-12	-11.111	-11.207	-0.096	0
	MnCl3-	3.34E-13	2.68E-13	-12.476	-12.572	-0.096	43.76
	Mn(NO3)2	9.48E-17	9.64E-17	-16.023	-16.016	0.007	41.04
	Mn(OH)3-	5.26E-18	4.21E-18	-17.279	-17.375	-0.096	0
Mn(3)	1.70E-29						
	Mn+3	1.70E-29	3.44E-30	-28.77	-29.463	-0.693	0
N(-3)	7.00E-06						
	NH4+	6.13E-06	4.72E-06	-5.213	-5.326	-0.114	18.15
	NH3	7.62E-07	7.75E-07	-6.118	-6.111	0.007	24.42
	NH4SO4-	1.10E-07	8.82E-08	-6.957	-7.055	-0.098	38.02
N(5)	6.00E-05						
	NO3-	6.00E-05	4.66E-05	-4.222	-4.331	-0.11	29.72
	Mn(NO3)2	9.48E-17	9.64E-17	-16.023	-16.016	0.007	41.04
Na	4.47E-02						
	Na+	4.43E-02	3.56E-02	-1.353	-1.449	-0.096	-1.15
	NaSO4-	3.21E-04	2.59E-04	-3.494	-3.587	-0.094	15.9
	NaHCO3	4.43E-05	4.51E-05	-4.353	-4.346	0.007	1.8
	NaCO3-	2.53E-05	2.02E-05	-4.597	-4.695	-0.098	-0.46
	NaF	1.62E-06	1.65E-06	-5.79	-5.783	0.007	7.26
	NaOH	1.02E-17	1.04E-17	-16.992	-16.985	0.007	0
O(0)	1.13E-36						
	O2	5.64E-37	5.73E-37	-36.249	-36.242	0.007	30.4
S(6)	5.26E-03						
	SO4-2	3.54E-03	1.45E-03	-2.451	-2.838	-0.387	15.42
	MgSO4	1.28E-03	1.30E-03	-2.895	-2.887	0.007	5.84
	NaSO4-	3.21E-04	2.59E-04	-3.494	-3.587	-0.094	15.9
	CaSO4	1.20E-04	1.22E-04	-3.922	-3.915	0.007	7.5
	KSO4-	6.30E-06	5.08E-06	-5.201	-5.295	-0.094	34.33
	BaSO4	1.11E-06	1.13E-06	-5.954	-5.946	0.007	0
	NH4SO4-	1.10E-07	8.82E-08	-6.957	-7.055	-0.098	38.02
	ZnSO4	5.79E-09	5.89E-09	-8.237	-8.23	0.007	21.71
	MnSO4	2.83E-09	2.88E-09	-8.549	-8.541	0.007	22.54

	HSO4-	6.13E-10	4.89E-10	-9.213	-9.311	-0.098	40.5
	Zn(SO4)2-2	1.71E-10	6.95E-11	-9.766	-10.158	-0.391	-11.68
	FeSO4	9.93E-12	1.01E-11	-11.003	-10.995	0.007	18.97
	CuSO4	6.07E-12	6.18E-12	-11.217	-11.209	0.007	13.09
	CaHSO4+	3.47E-12	2.77E-12	-11.459	-11.557	-0.098	0
	FeSO4+	7.42E-19	5.95E-19	-18.129	-18.225	-0.096	0
	FeHSO4+	2.89E-19	2.30E-19	-18.54	-18.638	-0.098	0
	Fe(SO4)2-	2.37E-20	1.89E-20	-19.626	-19.724	-0.098	0
	FeHSO4+2	1.36E-26	5.53E-27	-25.866	-26.258	-0.391	0
Zn	3.60E-07						
	Zn(CO3)2-2	1.69E-07	6.88E-08	-6.771	-7.163	-0.391	0
	ZnCO3	1.04E-07	1.06E-07	-6.984	-6.977	0.007	0
	Zn+2	4.20E-08	1.73E-08	-7.377	-7.761	-0.384	-24.76
	Zn(OH)2	1.78E-08	1.81E-08	-7.75	-7.743	0.007	0
	ZnOH+	6.85E-09	5.47E-09	-8.164	-8.262	-0.098	0
	ZnHCO3+	6.16E-09	4.92E-09	-8.21	-8.308	-0.098	0
	ZnOHCl	5.95E-09	6.05E-09	-8.226	-8.218	0.007	0
	ZnSO4	5.79E-09	5.89E-09	-8.237	-8.23	0.007	21.71
	ZnCl+	2.16E-09	1.71E-09	-8.665	-8.768	-0.102	-14
	Zn(SO4)2-2	1.71E-10	6.95E-11	-9.766	-10.158	-0.391	-11.68
	ZnCl2	6.44E-11	6.55E-11	-10.191	-10.184	0.007	102.03
	ZnF+	2.47E-11	1.97E-11	-10.607	-10.705	-0.098	0
	Zn(OH)3-	2.06E-11	1.65E-11	-10.686	-10.784	-0.098	0
	ZnCl3-	3.40E-12	2.69E-12	-11.468	-11.57	-0.102	16.64
	ZnCl4-2	1.20E-13	4.94E-14	-12.923	-13.307	-0.384	146.31
	Zn(OH)4-2	1.85E-15	7.51E-16	-14.733	-15.124	-0.391	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.89	-6.16	-4.28	CaSO4			
Aragonite	0.49	-7.84	-8.34	CaCO3			
Barite	1.2	-8.65	-9.84	BaSO4			
Calcite	0.64	-7.84	-8.48	CaCO3			
CO2(g)	-3.29	-4.75	-1.47	CO2			
Dolomite	2.31	-14.78	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.06	5.95	4.89	Fe(OH)3			
Fluorite	-0.91	-11.51	-10.6	CaF2			
Goethite	6.95	5.95	-1	FeOOH			
Gypsum	-1.58	-6.17	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-4.46	-2.89	1.57	NaCl			
Hausmann	-9.21	51.82	61.03	Mn3O4			
Hematite	15.91	11.9	-4.01	Fe2O3			
Jarosite-K	-7.3	-16.51	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.91	21.43	25.34	MnOOH			
Melanterit	-11.04	-13.25	-2.21	FeSO4:7H2O			
NH3(g)	-7.91	-6.11	1.8	NH3			

O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.23	8.97	15.2	Mn(OH)2
Pyrolusite	-7.5	33.88	41.38	MnO2:H2O
Rhodochrc	-1.34	-12.47	-11.13	MnCO3
Siderite	-4.03	-14.92	-10.89	FeCO3
Smithsonit	-2.28	-12.28	-10	ZnCO3
Sylvite	-5.64	-4.74	0.9	KCl
Witherite	-1.76	-10.32	-8.56	BaCO3
Zn(OH)2(e	-2.34	9.16	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 8

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	3.90E-03	3.90E-03
Ba	5.82E-06	5.82E-06
Ca	1.43E-03	1.43E-03
Cl	5.24E-02	5.24E-02
Cu	5.00E-08	5.00E-08
F	1.50E-04	1.50E-04
Fe	3.80E-07	3.80E-07
K	7.20E-04	7.20E-04
Mg	1.15E-02	1.15E-02
Mn	6.00E-08	6.00E-08
N(-3)	8.00E-06	8.00E-06
N(5)	7.00E-05	7.00E-05
Na	5.04E-02	5.04E-02
S(6)	5.94E-03	5.94E-03
Zn	4.10E-07	4.10E-07

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 7055
Density (g/cm³) = 1.00038
Volume (L) = 1.0038
Activity of water = 0.998
Ionic strength (mol/kgw) = 8.35E-02
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 3.63E-03
Total CO2 (mol/kg) = 3.63E-03
Temperatu (°C) = 25
Electrical balance (eq) = 8.69E-03
Percent error, 100*(Cat-|= 6.34

```
        Iterations  =                 10 (65        overall)
        Total       H          =          1.11E+02
        Total       O          =          5.55E+01

#NAME?  couples--------------------------------

        Redox       couple     pe         Eh         (volts)

        N(-3)/N(5)     4.4355     0.2624

#NAME?  of          species----------------------------

        Log         Log        Log        mole       V
        Species     Molality   Activity   Molality   Activity   Gamma    cm³/mol

        OH-          3.76E-06  2.91E-06     -5.425     -5.536   -0.111     -3.77
        H+           4.16E-09  3.47E-09     -8.381      -8.46   -0.079         0
        H2O          5.55E+01  9.98E-01      1.744     -0.001        0      18.07
Ba       5.82E-06
        Ba+2         4.44E-06  1.71E-06     -5.353     -5.767   -0.414    -12.05
        BaSO4        1.30E-06  1.33E-06     -5.885     -5.877    0.008         0
        BaHCO3+      5.15E-08  4.07E-08     -7.289      -7.39   -0.102         0
        BaCO3        2.91E-08  2.97E-08     -7.536     -7.528    0.008      -10.7
        BaOH+        2.10E-11  1.67E-11    -10.678    -10.778     -0.1         0
C(4)     3.63E-03
        HCO3-        3.11E-03  2.49E-03     -2.507     -2.604   -0.097      25.12
        MgHCO3+      1.54E-04  1.21E-04     -3.811     -3.918   -0.107       5.65
        MgCO3        1.31E-04  1.33E-04     -3.884     -3.876    0.008     -17.09
        CO3-2        8.25E-05  3.36E-05     -4.083     -4.473    -0.39      -4.26
        NaHCO3       5.45E-05  5.56E-05     -4.264     -4.255    0.008        1.8
        NaCO3-       3.14E-05  2.49E-05     -4.503     -4.604   -0.102       -0.4
        CaCO3        2.83E-05  2.89E-05     -4.548     -4.539    0.008      -14.6
        CaHCO3+      2.01E-05  1.62E-05     -4.696      -4.79   -0.094       9.82
        CO2          1.91E-05  1.94E-05      -4.72     -4.712    0.008      34.43
        Zn(CO3)2-2   2.09E-07  8.21E-08      -6.68     -7.086   -0.406         0
        ZnCO3        1.12E-07  1.14E-07     -6.951     -6.943    0.008         0
        BaHCO3+      5.15E-08  4.07E-08     -7.289      -7.39   -0.102         0
        BaCO3        2.91E-08  2.97E-08     -7.536     -7.528    0.008      -10.7
        MnCO3        2.73E-08  2.78E-08     -7.564     -7.556    0.008         0
        ZnHCO3+      6.73E-09  5.32E-09     -8.172     -8.274   -0.102         0
        CuCO3        4.56E-09  4.65E-09     -8.341     -8.333    0.008         0
        MnHCO3+      2.90E-09  2.31E-09     -8.537     -8.637     -0.1         0
        Cu(CO3)2-    5.02E-10  1.97E-10     -9.299     -9.706   -0.406         0
        CuHCO3+      4.05E-11  3.21E-11    -10.392    -10.494   -0.102         0
        FeCO3        3.57E-11  3.64E-11    -10.447    -10.439    0.008         0
        FeHCO3+      1.42E-11  1.12E-11    -10.849     -10.95   -0.102         0
        (CO2)2       6.80E-12  6.93E-12    -11.168    -11.159    0.008      68.87
Ca       1.43E-03
        Ca+2         1.24E-03  5.11E-04     -2.905     -3.291   -0.386     -17.49
        CaSO4        1.38E-04  1.41E-04     -3.859     -3.851    0.008        7.5
```

	CaCO3	2.83E-05	2.89E-05	-4.548	-4.539	0.008	-14.6
	CaHCO3+	2.01E-05	1.62E-05	-4.696	-4.79	-0.094	9.82
	CaOH+	3.08E-08	2.44E-08	-7.511	-7.612	-0.102	0
	CaHSO4+	4.06E-12	3.22E-12	-11.391	-11.493	-0.102	0
Cl	5.24E-02						
	Cl-	5.24E-02	4.09E-02	-1.281	-1.389	-0.108	18.31
	ZnOHCl	6.50E-09	6.62E-09	-8.187	-8.179	0.008	0
	ZnCl+	2.39E-09	1.87E-09	-8.621	-8.728	-0.107	-14.03
	MnCl+	2.18E-09	1.73E-09	-8.662	-8.762	-0.1	-2.93
	CuCl2-	9.12E-10	7.13E-10	-9.04	-9.147	-0.107	0
	CuCl3-2	1.16E-10	4.62E-11	-9.936	-10.336	-0.4	0
	ZnCl2	7.85E-11	8.00E-11	-10.105	-10.097	0.008	102.03
	MnCl2	3.03E-11	3.09E-11	-10.519	-10.51	0.008	85.89
	ZnCl3-	4.69E-12	3.67E-12	-11.329	-11.436	-0.107	16.58
	CuCl+	3.62E-12	2.83E-12	-11.441	-11.548	-0.107	0.91
	FeCl+	3.21E-12	2.54E-12	-11.493	-11.595	-0.102	0
	MnCl3-	4.37E-13	3.47E-13	-12.359	-12.459	-0.1	43.8
	ZnCl4-2	1.89E-13	7.51E-14	-12.725	-13.124	-0.4	146.4
	CuCl2	6.09E-14	6.21E-14	-13.215	-13.207	0.008	31.02
	CuCl3-	1.15E-17	9.00E-18	-16.939	-17.046	-0.107	0
	FeCl+2	1.33E-19	5.31E-20	-18.875	-19.275	-0.4	0
	FeCl2+	1.22E-20	9.70E-21	-19.913	-20.013	-0.1	0
	CuCl4-2	4.63E-21	1.84E-21	-20.335	-20.734	-0.4	0
	FeCl3	3.89E-23	3.96E-23	-22.41	-22.402	0.008	0
Cu(1)	1.03E-09						
	CuCl2-	9.12E-10	7.13E-10	-9.04	-9.147	-0.107	0
	CuCl3-2	1.16E-10	4.62E-11	-9.936	-10.336	-0.4	0
	Cu+	1.78E-12	1.35E-12	-11.75	-11.869	-0.119	0
Cu(2)	4.90E-08						
	Cu(OH)2	4.37E-08	4.46E-08	-7.36	-7.351	0.008	0
	CuCO3	4.56E-09	4.65E-09	-8.341	-8.333	0.008	0
	Cu(CO3)2-	5.02E-10	1.97E-10	-9.299	-9.706	-0.406	0
	CuOH+	9.47E-11	7.41E-11	-10.023	-10.13	-0.107	0
	Cu+2	6.11E-11	2.57E-11	-10.214	-10.589	-0.376	-26
	CuHCO3+	4.05E-11	3.21E-11	-10.392	-10.494	-0.102	0
	CuSO4	8.00E-12	8.16E-12	-11.097	-11.089	0.008	13.09
	CuCl+	3.62E-12	2.83E-12	-11.441	-11.548	-0.107	0.91
	Cu(OH)3-	9.76E-13	7.73E-13	-12.011	-12.112	-0.102	0
	CuCl2	6.09E-14	6.21E-14	-13.215	-13.207	0.008	31.02
	CuF+	5.35E-14	4.23E-14	-13.272	-13.373	-0.102	0
	Cu2(OH)2+	6.12E-15	2.40E-15	-14.213	-14.619	-0.406	0
	Cu(OH)4-2	1.13E-16	4.44E-17	-15.947	-16.353	-0.406	0
	CuCl3-	1.15E-17	9.00E-18	-16.939	-17.046	-0.107	0
	CuCl4-2	4.63E-21	1.84E-21	-20.335	-20.734	-0.4	0
F	1.50E-04						
	F-	1.17E-04	9.04E-05	-3.933	-4.044	-0.111	-1.07
	MgF+	3.14E-05	2.48E-05	-4.503	-4.606	-0.103	-10.41
	NaF	2.03E-06	2.07E-06	-5.693	-5.685	0.008	7.26
	HF	4.61E-10	4.70E-10	-9.336	-9.328	0.008	12.5
	ZnF+	2.74E-11	2.17E-11	-10.562	-10.663	-0.102	0

	MnF+	8.19E-12	6.50E-12	-11.087	-11.187	-0.1	0
	HF2-	2.06E-13	1.63E-13	-12.687	-12.788	-0.102	22.3
	CuF+	5.35E-14	4.23E-14	-13.272	-13.373	-0.102	0
	FeF+	5.15E-14	4.08E-14	-13.288	-13.39	-0.102	0
	FeF2+	2.79E-17	2.22E-17	-16.554	-16.654	-0.1	0
	FeF+2	1.55E-17	6.17E-18	-16.81	-17.21	-0.4	0
	FeF3	3.12E-18	3.18E-18	-17.506	-17.498	0.008	0
Fe(2)	1.78E-10						
	Fe+2	1.07E-10	4.51E-11	-9.97	-10.346	-0.376	-21.51
	FeCO3	3.57E-11	3.64E-11	-10.447	-10.439	0.008	0
	FeHCO3+	1.42E-11	1.12E-11	-10.849	-10.95	-0.102	0
	FeSO4	1.22E-11	1.25E-11	-10.913	-10.905	0.008	18.97
	FeOH+	5.17E-12	4.11E-12	-11.287	-11.387	-0.1	0
	FeCl+	3.21E-12	2.54E-12	-11.493	-11.595	-0.102	0
	FeF+	5.15E-14	4.08E-14	-13.288	-13.39	-0.102	0
	Fe(OH)2	9.86E-15	1.01E-14	-14.006	-13.998	0.008	0
	Fe(OH)3-	1.35E-16	1.08E-16	-15.869	-15.969	-0.1	0
	FeHSO4+	3.58E-19	2.84E-19	-18.446	-18.547	-0.102	0
Fe(3)	3.80E-07						
	Fe(OH)3	2.77E-07	2.83E-07	-6.557	-6.549	0.008	0
	Fe(OH)4-	9.29E-08	7.42E-08	-7.032	-7.129	-0.097	0
	Fe(OH)2+	9.55E-09	7.63E-09	-8.02	-8.118	-0.097	0
	FeOH+2	2.01E-13	8.00E-14	-12.697	-13.097	-0.4	0
	FeF2+	2.79E-17	2.22E-17	-16.554	-16.654	-0.1	0
	FeF+2	1.55E-17	6.17E-18	-16.81	-17.21	-0.4	0
	FeF3	3.12E-18	3.18E-18	-17.506	-17.498	0.008	0
	FeSO4+	9.22E-19	7.33E-19	-18.035	-18.135	-0.1	0
	Fe+3	2.24E-19	4.31E-20	-18.651	-19.366	-0.715	0
	FeCl+2	1.33E-19	5.31E-20	-18.875	-19.275	-0.4	0
	Fe(SO4)2-	3.14E-20	2.49E-20	-19.503	-19.604	-0.102	0
	FeCl2+	1.22E-20	9.70E-21	-19.913	-20.013	-0.1	0
	FeCl3	3.89E-23	3.96E-23	-22.41	-22.402	0.008	0
	Fe2(OH)2+	7.27E-24	1.72E-25	-23.138	-24.763	-1.625	0
	FeHSO4+2	1.73E-26	6.80E-27	-25.761	-26.167	-0.406	0
	Fe3(OH)4+	9.50E-29	2.75E-31	-28.022	-30.561	-2.539	0
H(0)	1.67E-28						
	H2	8.35E-29	8.51E-29	-28.078	-28.07	0.008	28.61
K	7.20E-04						
	K+	7.12E-04	5.54E-04	-3.147	-3.257	-0.109	9.22
	KSO4-	7.56E-06	6.04E-06	-5.122	-5.219	-0.097	34.35
Mg	1.15E-02						
	Mg+2	9.74E-03	4.15E-03	-2.012	-2.382	-0.371	-21.19
	MgSO4	1.48E-03	1.51E-03	-2.83	-2.821	0.008	5.84
	MgHCO3+	1.54E-04	1.21E-04	-3.811	-3.918	-0.107	5.65
	MgCO3	1.31E-04	1.33E-04	-3.884	-3.876	0.008	-17.09
	MgF+	3.14E-05	2.48E-05	-4.503	-4.606	-0.103	-10.41
	MgOH+	5.35E-06	4.34E-06	-5.272	-5.363	-0.091	0
Mn(2)	6.00E-08						
	MnCO3	2.73E-08	2.78E-08	-7.564	-7.556	0.008	0
	Mn+2	2.47E-08	1.04E-08	-7.607	-7.983	-0.376	-18.31

	MnHCO3+	2.90E-09	2.31E-09	-8.537	-8.637	-0.1	0
	MnSO4	2.82E-09	2.87E-09	-8.55	-8.542	0.008	22.54
	MnCl+	2.18E-09	1.73E-09	-8.662	-8.762	-0.1	-2.93
	MnOH+	9.69E-11	7.70E-11	-10.014	-10.114	-0.1	0
	MnCl2	3.03E-11	3.09E-11	-10.519	-10.51	0.008	85.89
	MnF+	8.19E-12	6.50E-12	-11.087	-11.187	-0.1	0
	MnCl3-	4.37E-13	3.47E-13	-12.359	-12.459	-0.1	43.8
	Mn(NO3)2	1.17E-16	1.20E-16	-15.93	-15.922	0.008	41.04
	Mn(OH)3-	4.95E-18	3.93E-18	-17.306	-17.406	-0.1	0
Mn(3)	1.67E-29						
	Mn+3	1.67E-29	3.22E-30	-28.778	-29.493	-0.715	0
N(-3)	8.00E-06						
	NH4+	7.01E-06	5.33E-06	-5.154	-5.274	-0.119	18.16
	NH3	8.59E-07	8.75E-07	-6.066	-6.058	0.008	24.42
	NH4SO4-	1.35E-07	1.07E-07	-6.871	-6.973	-0.102	38.06
N(5)	7.00E-05						
	NO3-	7.00E-05	5.38E-05	-4.155	-4.27	-0.115	29.74
	Mn(NO3)2	1.17E-16	1.20E-16	-15.93	-15.922	0.008	41.04
Na	5.04E-02						
	Na+	5.00E-02	3.97E-02	-1.302	-1.401	-0.099	-1.13
	NaSO4-	3.87E-04	3.09E-04	-3.413	-3.51	-0.097	16.05
	NaHCO3	5.45E-05	5.56E-05	-4.264	-4.255	0.008	1.8
	NaCO3-	3.14E-05	2.49E-05	-4.503	-4.604	-0.102	-0.4
	NaF	2.03E-06	2.07E-06	-5.693	-5.685	0.008	7.26
	NaOH	1.14E-17	1.16E-17	-16.945	-16.937	0.008	0
O(0)	1.12E-36						
	O2	5.62E-37	5.73E-37	-36.25	-36.242	0.008	30.4
S(6)	5.94E-03						
	SO4-2	3.93E-03	1.55E-03	-2.406	-2.809	-0.403	15.48
	MgSO4	1.48E-03	1.51E-03	-2.83	-2.821	0.008	5.84
	NaSO4-	3.87E-04	3.09E-04	-3.413	-3.51	-0.097	16.05
	CaSO4	1.38E-04	1.41E-04	-3.859	-3.851	0.008	7.5
	KSO4-	7.56E-06	6.04E-06	-5.122	-5.219	-0.097	34.35
	BaSO4	1.30E-06	1.33E-06	-5.885	-5.877	0.008	0
	NH4SO4-	1.35E-07	1.07E-07	-6.871	-6.973	-0.102	38.06
	ZnSO4	6.07E-09	6.19E-09	-8.217	-8.209	0.008	21.71
	MnSO4	2.82E-09	2.87E-09	-8.55	-8.542	0.008	22.54
	HSO4-	6.61E-10	5.23E-10	-9.18	-9.281	-0.102	40.51
	Zn(SO4)2-2	1.99E-10	7.80E-11	-9.702	-10.108	-0.406	-11.55
	FeSO4	1.22E-11	1.25E-11	-10.913	-10.905	0.008	18.97
	CuSO4	8.00E-12	8.16E-12	-11.097	-11.089	0.008	13.09
	CaHSO4+	4.06E-12	3.22E-12	-11.391	-11.493	-0.102	0
	FeSO4+	9.22E-19	7.33E-19	-18.035	-18.135	-0.1	0
	FeHSO4+	3.58E-19	2.84E-19	-18.446	-18.547	-0.102	0
	Fe(SO4)2-	3.14E-20	2.49E-20	-19.503	-19.604	-0.102	0
	FeHSO4+2	1.73E-26	6.80E-27	-25.761	-26.167	-0.406	0
Zn	4.10E-07						
	Zn(CO3)2-2	2.09E-07	8.21E-08	-6.68	-7.086	-0.406	0
	ZnCO3	1.12E-07	1.14E-07	-6.951	-6.943	0.008	0
	Zn+2	4.27E-08	1.70E-08	-7.37	-7.769	-0.4	-24.73

Zn(OH)2	1.74E-08	1.77E-08	-7.76	-7.751	0.008	0
ZnOH+	6.78E-09	5.37E-09	-8.169	-8.27	-0.102	0
ZnHCO3+	6.73E-09	5.32E-09	-8.172	-8.274	-0.102	0
ZnOHCl	6.50E-09	6.62E-09	-8.187	-8.179	0.008	0
ZnSO4	6.07E-09	6.19E-09	-8.217	-8.209	0.008	21.71
ZnCl+	2.39E-09	1.87E-09	-8.621	-8.728	-0.107	-14.03
Zn(SO4)2-2	1.99E-10	7.80E-11	-9.702	-10.108	-0.406	-11.55
ZnCl2	7.85E-11	8.00E-11	-10.105	-10.097	0.008	102.03
ZnF+	2.74E-11	2.17E-11	-10.562	-10.663	-0.102	0
Zn(OH)3-	2.04E-11	1.61E-11	-10.691	-10.792	-0.102	0
ZnCl3-	4.69E-12	3.67E-12	-11.329	-11.436	-0.107	16.58
ZnCl4-2	1.89E-13	7.51E-14	-12.725	-13.124	-0.4	146.4
Zn(OH)4-2	1.88E-15	7.36E-16	-14.727	-15.133	-0.406	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.82	-6.1	-4.28	CaSO4			
Aragonite	0.57	-7.76	-8.34	CaCO3			
Barite	1.27	-8.58	-9.84	BaSO4			
Calcite	0.72	-7.76	-8.48	CaCO3			
CO2(g)	-3.24	-4.71	-1.47	CO2			
Dolomite	2.46	-14.62	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.12	6.01	4.89	Fe(OH)3			
Fluorite	-0.78	-11.38	-10.6	CaF2			
Goethite	7.01	6.01	-1	FeOOH			
Gypsum	-1.52	-6.1	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-4.36	-2.79	1.57	NaCl			
Hausmann	-9.3	51.73	61.03	Mn3O4			
Hematite	16.03	12.03	-4.01	Fe2O3			
Jarosite-K	-7.01	-16.22	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.94	21.4	25.34	MnOOH			
Melanterit	-10.95	-13.16	-2.21	FeSO4:7H2O			
NH3(g)	-7.85	-6.06	1.8	NH3			
O2(g)	-33.35	-36.24	-2.89	O2			
Pyrochroit	-6.26	8.94	15.2	Mn(OH)2			
Pyrolusite	-7.53	33.85	41.38	MnO2:H2O			
Rhodochro	-1.33	-12.46	-11.13	MnCO3			
Siderite	-3.93	-14.82	-10.89	FeCO3			
Smithsonit	-2.24	-12.24	-10	ZnCO3			
Sylvite	-5.55	-4.65	0.9	KCl			
Witherite	-1.68	-10.24	-8.56	BaCO3			
Zn(OH)2(e	-2.35	9.15	11.5	Zn(OH)2			

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

```
Initial     solution          9

 #NAME?  composition-----------------------------

         Elements  Molality   Moles

         Alkalinity  4.34E-03  4.34E-03
         Ba          6.58E-06  6.58E-06
         Ca          1.59E-03  1.59E-03
         Cl          5.83E-02  5.83E-02
         Cu          5.00E-08  5.00E-08
         F           1.60E-04  1.60E-04
         Fe          4.20E-07  4.20E-07
         K           8.00E-04  8.00E-04
         Mg          1.28E-02  1.28E-02
         Mn          7.00E-08  7.00E-08
         N(-3)       9.00E-06  9.00E-06
         N(5)        7.00E-05  7.00E-05
         Na          5.61E-02  5.61E-02
         S(6)        6.61E-03  6.61E-03
         Zn          4.60E-07  4.60E-07

 #NAME?  of        solution----------------------------

         pH        =              8.46
         pe        =                 4
         Specific  Conductan (µS/cm,  25°C)     =              7783
         Density   (g/cm³)   =          1.00075
         Volume    (L)       =           1.0039
         Activity  of        water    =            0.998
         Ionic     strength  (mol/kgw) =         9.26E-02
         Mass      of        water    (kg)      =         1.00E+00
         Total     carbon    (mol/kg) =         4.03E-03
         Total     CO2       (mol/kg) =         4.03E-03
         Temperatu (°C)      =                25
         Electrical balance  (eq)     =         9.68E-03
         Percent   error,    100*(Cat-|=              6.36
         Iterations =                10 (75      overall)
         Total     H         =         1.11E+02
         Total     O         =         5.55E+01

 #NAME?  couples--------------------------------

         Redox     couple    pe        Eh        (volts)

         N(-3)/N(5)   4.4291     0.262

 #NAME?  of        species----------------------------

         Log       Log       Log       mole      V
```

	Species	Molality	Activity	Molality	Activity	Gamma	cm³/mol
	OH-	3.80E-06	2.91E-06	-5.421	-5.536	-0.115	-3.75
	H+	4.19E-09	3.47E-09	-8.378	-8.46	-0.082	0
	H2O	5.55E+01	9.98E-01	1.744	-0.001	0	18.07
Ba	6.58E-06						
	Ba+2	4.99E-06	1.86E-06	-5.302	-5.731	-0.429	-12.02
	BaSO4	1.50E-06	1.53E-06	-5.825	-5.816	0.009	0
	BaHCO3+	6.14E-08	4.82E-08	-7.212	-7.317	-0.105	0
	BaCO3	3.44E-08	3.52E-08	-7.463	-7.454	0.009	-10.7
	BaOH+	2.30E-11	1.81E-11	-10.639	-10.742	-0.103	0
C(4)	4.03E-03						
	HCO3-	3.42E-03	2.71E-03	-2.466	-2.567	-0.101	25.15
	MgHCO3+	1.83E-04	1.42E-04	-3.737	-3.848	-0.111	5.65
	MgCO3	1.53E-04	1.57E-04	-3.815	-3.806	0.009	-17.09
	CO3-2	9.28E-05	3.67E-05	-4.032	-4.436	-0.403	-4.2
	NaHCO3	6.55E-05	6.69E-05	-4.184	-4.175	0.009	1.8
	NaCO3-	3.81E-05	3.00E-05	-4.419	-4.523	-0.105	-0.34
	CaCO3	3.31E-05	3.39E-05	-4.48	-4.47	0.009	-14.6
	CaHCO3+	2.38E-05	1.90E-05	-4.624	-4.721	-0.097	9.83
	CO2	2.07E-05	2.12E-05	-4.683	-4.674	0.009	34.43
	Zn(CO3)2-2	2.51E-07	9.54E-08	-6.601	-7.02	-0.419	0
	ZnCO3	1.19E-07	1.22E-07	-6.924	-6.915	0.009	0
	BaHCO3+	6.14E-08	4.82E-08	-7.212	-7.317	-0.105	0
	BaCO3	3.44E-08	3.52E-08	-7.463	-7.454	0.009	-10.7
	MnCO3	3.25E-08	3.32E-08	-7.488	-7.478	0.009	0
	ZnHCO3+	7.23E-09	5.68E-09	-8.141	-8.246	-0.105	0
	CuCO3	4.90E-09	5.00E-09	-8.31	-8.301	0.009	0
	MnHCO3+	3.50E-09	2.76E-09	-8.456	-8.559	-0.103	0
	Cu(CO3)2-	6.07E-10	2.31E-10	-9.217	-9.636	-0.419	0
	CuHCO3+	4.40E-11	3.45E-11	-10.357	-10.462	-0.105	0
	FeCO3	4.29E-11	4.39E-11	-10.367	-10.358	0.009	0
	FeHCO3+	1.72E-11	1.35E-11	-10.764	-10.869	-0.105	0
	(CO2)2	8.07E-12	8.24E-12	-11.093	-11.084	0.009	68.87
Ca	1.59E-03						
	Ca+2	1.38E-03	5.49E-04	-2.861	-3.26	-0.399	-17.46
	CaSO4	1.57E-04	1.61E-04	-3.804	-3.794	0.009	7.5
	CaCO3	3.31E-05	3.39E-05	-4.48	-4.47	0.009	-14.6
	CaHCO3+	2.38E-05	1.90E-05	-4.624	-4.721	-0.097	9.83
	CaOH+	3.34E-08	2.62E-08	-7.476	-7.581	-0.105	0
	CaHSO4+	4.66E-12	3.66E-12	-11.332	-11.437	-0.105	0
Cl	5.83E-02						
	Cl-	5.83E-02	4.50E-02	-1.234	-1.346	-0.112	18.33
	ZnOHCl	6.99E-09	7.14E-09	-8.156	-8.147	0.009	0
	MnCl+	2.66E-09	2.09E-09	-8.576	-8.679	-0.103	-2.93
	ZnCl+	2.60E-09	2.02E-09	-8.585	-8.696	-0.111	-14.05
	CuCl2-	1.10E-09	8.56E-10	-8.957	-9.068	-0.111	0
	CuCl3-2	1.58E-10	6.11E-11	-9.8	-10.214	-0.414	0
	ZnCl2	9.31E-11	9.51E-11	-10.031	-10.022	0.009	102.03
	MnCl2	4.03E-11	4.12E-11	-10.395	-10.385	0.009	85.89

	ZnCl3-	6.20E-12	4.81E-12	-11.207	-11.318	-0.111	16.53
	CuCl+	3.98E-12	3.08E-12	-11.401	-11.511	-0.111	0.93
	FeCl+	3.95E-12	3.10E-12	-11.404	-11.509	-0.105	0
	MnCl3-	6.48E-13	5.11E-13	-12.188	-12.292	-0.103	43.84
	ZnCl4-2	2.82E-13	1.09E-13	-12.551	-12.965	-0.414	146.49
	CuCl2	7.29E-14	7.45E-14	-13.137	-13.128	0.009	31.02
	CuCl3-	1.54E-17	1.19E-17	-16.813	-16.924	-0.111	0
	FeCl+2	1.68E-19	6.48E-20	-18.775	-19.189	-0.414	0
	FeCl2+	1.65E-20	1.30E-20	-19.781	-19.885	-0.103	0
	CuCl4-2	6.97E-21	2.69E-21	-20.157	-20.57	-0.414	0
	FeCl3	5.75E-23	5.87E-23	-22.241	-22.231	0.009	0
Cu(1)	1.27E-09						
	CuCl2-	1.10E-09	8.56E-10	-8.957	-9.068	-0.111	0
	CuCl3-2	1.58E-10	6.11E-11	-9.8	-10.214	-0.414	0
	Cu+	1.78E-12	1.33E-12	-11.751	-11.875	-0.124	0
Cu(2)	4.87E-08						
	Cu(OH)2	4.30E-08	4.39E-08	-7.366	-7.357	0.009	0
	CuCO3	4.90E-09	5.00E-09	-8.31	-8.301	0.009	0
	Cu(CO3)2-	6.07E-10	2.31E-10	-9.217	-9.636	-0.419	0
	CuOH+	9.44E-11	7.31E-11	-10.025	-10.136	-0.111	0
	Cu+2	6.21E-11	2.54E-11	-10.207	-10.595	-0.388	-25.97
	CuHCO3+	4.40E-11	3.45E-11	-10.357	-10.462	-0.105	0
	CuSO4	8.35E-12	8.53E-12	-11.079	-11.069	0.009	13.09
	CuCl+	3.98E-12	3.08E-12	-11.401	-11.511	-0.111	0.93
	Cu(OH)3-	9.70E-13	7.62E-13	-12.013	-12.118	-0.105	0
	CuCl2	7.29E-14	7.45E-14	-13.137	-13.128	0.009	31.02
	CuF+	5.52E-14	4.34E-14	-13.258	-13.363	-0.105	0
	Cu2(OH)2+	6.14E-15	2.34E-15	-14.212	-14.631	-0.419	0
	Cu(OH)4-2	1.15E-16	4.37E-17	-15.94	-16.359	-0.419	0
	CuCl3-	1.54E-17	1.19E-17	-16.813	-16.924	-0.111	0
	CuCl4-2	6.97E-21	2.69E-21	-20.157	-20.57	-0.414	0
F	1.60E-04						
	F-	1.22E-04	9.38E-05	-3.913	-4.028	-0.115	-1.06
	MgF+	3.55E-05	2.77E-05	-4.45	-4.557	-0.107	-10.4
	NaF	2.32E-06	2.37E-06	-5.635	-5.626	0.009	7.26
	HF	4.78E-10	4.88E-10	-9.321	-9.312	0.009	12.5
	ZnF+	2.81E-11	2.20E-11	-10.552	-10.657	-0.105	0
	MnF+	9.40E-12	7.40E-12	-11.027	-11.131	-0.103	0
	HF2-	2.24E-13	1.76E-13	-12.651	-12.756	-0.105	22.32
	FeF+	5.95E-14	4.68E-14	-13.225	-13.33	-0.105	0
	CuF+	5.52E-14	4.34E-14	-13.258	-13.363	-0.105	0
	FeF2+	3.35E-17	2.64E-17	-16.474	-16.578	-0.103	0
	FeF+2	1.84E-17	7.08E-18	-16.736	-17.15	-0.414	0
	FeF3	3.85E-18	3.93E-18	-17.415	-17.406	0.009	0
Fe(2)	2.06E-10						
	Fe+2	1.22E-10	4.99E-11	-9.914	-10.302	-0.388	-21.48
	FeCO3	4.29E-11	4.39E-11	-10.367	-10.358	0.009	0
	FeHCO3+	1.72E-11	1.35E-11	-10.764	-10.869	-0.105	0
	FeSO4	1.43E-11	1.46E-11	-10.846	-10.836	0.009	18.97
	FeOH+	5.76E-12	4.54E-12	-11.24	-11.343	-0.103	0

	FeCl+	3.95E-12	3.10E-12	-11.404	-11.509	-0.105	0
	FeF+	5.95E-14	4.68E-14	-13.225	-13.33	-0.105	0
	Fe(OH)2	1.09E-14	1.11E-14	-13.964	-13.954	0.009	0
	Fe(OH)3-	1.51E-16	1.19E-16	-15.822	-15.925	-0.103	0
	FeHSO4+	4.23E-19	3.32E-19	-18.374	-18.479	-0.105	0
Fe(3)	4.20E-07						
	Fe(OH)3	3.06E-07	3.12E-07	-6.515	-6.505	0.009	0
	Fe(OH)4-	1.03E-07	8.20E-08	-6.986	-7.086	-0.101	0
	Fe(OH)2+	1.06E-08	8.43E-09	-7.974	-8.074	-0.101	0
	FeOH+2	2.30E-13	8.85E-14	-12.639	-13.053	-0.414	0
	FeF2+	3.35E-17	2.64E-17	-16.474	-16.578	-0.103	0
	FeF+2	1.84E-17	7.08E-18	-16.736	-17.15	-0.414	0
	FeF3	3.85E-18	3.93E-18	-17.415	-17.406	0.009	0
	FeSO4+	1.09E-18	8.58E-19	-17.963	-18.066	-0.103	0
	Fe+3	2.59E-19	4.76E-20	-18.587	-19.322	-0.735	0
	FeCl+2	1.68E-19	6.48E-20	-18.775	-19.189	-0.414	0
	Fe(SO4)2-	3.93E-20	3.09E-20	-19.406	-19.511	-0.105	0
	FeCl2+	1.65E-20	1.30E-20	-19.781	-19.885	-0.103	0
	FeCl3	5.75E-23	5.87E-23	-22.241	-22.231	0.009	0
	Fe2(OH)2+	1.00E-23	2.11E-25	-22.999	-24.677	-1.677	0
	FeHSO4+2	2.09E-26	7.97E-27	-25.679	-26.099	-0.419	0
	Fe3(OH)4+	1.55E-28	3.71E-31	-27.81	-30.431	-2.621	0
H(0)	1.67E-28						
	H2	8.33E-29	8.51E-29	-28.079	-28.07	0.009	28.61
K	8.00E-04						
	K+	7.91E-04	6.09E-04	-3.102	-3.215	-0.114	9.23
	KSO4-	8.87E-06	7.03E-06	-5.052	-5.153	-0.101	34.36
Mg	1.28E-02						
	Mg+2	1.08E-02	4.47E-03	-1.968	-2.35	-0.382	-21.16
	MgSO4	1.69E-03	1.72E-03	-2.773	-2.764	0.009	5.84
	MgHCO3+	1.83E-04	1.42E-04	-3.737	-3.848	-0.111	5.65
	MgCO3	1.53E-04	1.57E-04	-3.815	-3.806	0.009	-17.09
	MgF+	3.55E-05	2.77E-05	-4.45	-4.557	-0.107	-10.4
	MgOH+	5.80E-06	4.67E-06	-5.237	-5.331	-0.094	0
Mn(2)	7.00E-08						
	MnCO3	3.25E-08	3.32E-08	-7.488	-7.478	0.009	0
	Mn+2	2.79E-08	1.14E-08	-7.555	-7.943	-0.388	-18.22
	MnHCO3+	3.50E-09	2.76E-09	-8.456	-8.559	-0.103	0
	MnSO4	3.26E-09	3.34E-09	-8.486	-8.477	0.009	22.54
	MnCl+	2.66E-09	2.09E-09	-8.576	-8.679	-0.103	-2.93
	MnOH+	1.07E-10	8.44E-11	-9.97	-10.074	-0.103	0
	MnCl2	4.03E-11	4.12E-11	-10.395	-10.385	0.009	85.89
	MnF+	9.40E-12	7.40E-12	-11.027	-11.131	-0.103	0
	MnCl3-	6.48E-13	5.11E-13	-12.188	-12.292	-0.103	43.84
	Mn(NO3)2	1.26E-16	1.28E-16	-15.901	-15.891	0.009	41.04
	Mn(OH)3-	5.47E-18	4.31E-18	-17.262	-17.366	-0.103	0
Mn(3)	1.92E-29						
	Mn+3	1.92E-29	3.53E-30	-28.717	-29.453	-0.735	0
N(-3)	9.00E-06						
	NH4+	7.89E-06	5.93E-06	-5.103	-5.227	-0.124	18.17

	NH3	9.53E-07	9.74E-07	-6.021	-6.012	0.009	24.42
	NH4SO4-	1.60E-07	1.26E-07	-6.797	-6.901	-0.105	38.09
N(5)	7.00E-05						
	NO3-	7.00E-05	5.32E-05	-4.155	-4.274	-0.119	29.75
	Mn(NO3)2	1.26E-16	1.28E-16	-15.901	-15.891	0.009	41.04
Na	5.61E-02						
	Na+	5.56E-02	4.39E-02	-1.255	-1.358	-0.103	-1.11
	NaSO4-	4.56E-04	3.61E-04	-3.341	-3.442	-0.101	16.2
	NaHCO3	6.55E-05	6.69E-05	-4.184	-4.175	0.009	1.8
	NaCO3-	3.81E-05	3.00E-05	-4.419	-4.523	-0.105	-0.34
	NaF	2.32E-06	2.37E-06	-5.635	-5.626	0.009	7.26
	NaOH	1.25E-17	1.28E-17	-16.903	-16.894	0.009	0
O(0)	1.12E-36						
	O2	5.61E-37	5.73E-37	-36.251	-36.242	0.009	30.4
S(6)	6.61E-03						
	SO4-2	4.30E-03	1.64E-03	-2.367	-2.784	-0.418	15.54
	MgSO4	1.69E-03	1.72E-03	-2.773	-2.764	0.009	5.84
	NaSO4-	4.56E-04	3.61E-04	-3.341	-3.442	-0.101	16.2
	CaSO4	1.57E-04	1.61E-04	-3.804	-3.794	0.009	7.5
	KSO4-	8.87E-06	7.03E-06	-5.052	-5.153	-0.101	34.36
	BaSO4	1.50E-06	1.53E-06	-5.825	-5.816	0.009	0
	NH4SO4-	1.60E-07	1.26E-07	-6.797	-6.901	-0.105	38.09
	ZnSO4	6.27E-09	6.41E-09	-8.203	-8.193	0.009	21.71
	MnSO4	3.26E-09	3.34E-09	-8.486	-8.477	0.009	22.54
	HSO4-	7.05E-10	5.54E-10	-9.152	-9.256	-0.105	40.53
	Zn(SO4)2-2	2.25E-10	8.56E-11	-9.648	-10.068	-0.419	-11.42
	FeSO4	1.43E-11	1.46E-11	-10.846	-10.836	0.009	18.97
	CuSO4	8.35E-12	8.53E-12	-11.079	-11.069	0.009	13.09
	CaHSO4+	4.66E-12	3.66E-12	-11.332	-11.437	-0.105	0
	FeSO4+	1.09E-18	8.58E-19	-17.963	-18.066	-0.103	0
	FeHSO4+	4.23E-19	3.32E-19	-18.374	-18.479	-0.105	0
	Fe(SO4)2-	3.93E-20	3.09E-20	-19.406	-19.511	-0.105	0
	FeHSO4+2	2.09E-26	7.97E-27	-25.679	-26.099	-0.419	0
Zn	4.60E-07						
	Zn(CO3)2-2	2.51E-07	9.54E-08	-6.601	-7.02	-0.419	0
	ZnCO3	1.19E-07	1.22E-07	-6.924	-6.915	0.009	0
	Zn+2	4.31E-08	1.66E-08	-7.365	-7.779	-0.414	-24.7
	Zn(OH)2	1.70E-08	1.73E-08	-7.77	-7.761	0.009	0
	ZnHCO3+	7.23E-09	5.68E-09	-8.141	-8.246	-0.105	0
	ZnOHCl	6.99E-09	7.14E-09	-8.156	-8.147	0.009	0
	ZnOH+	6.68E-09	5.25E-09	-8.175	-8.28	-0.105	0
	ZnSO4	6.27E-09	6.41E-09	-8.203	-8.193	0.009	21.71
	ZnCl+	2.60E-09	2.02E-09	-8.585	-8.696	-0.111	-14.05
	Zn(SO4)2-2	2.25E-10	8.56E-11	-9.648	-10.068	-0.419	-11.42
	ZnCl2	9.31E-11	9.51E-11	-10.031	-10.022	0.009	102.03
	ZnF+	2.81E-11	2.20E-11	-10.552	-10.657	-0.105	0
	Zn(OH)3-	2.01E-11	1.58E-11	-10.697	-10.802	-0.105	0
	ZnCl3-	6.20E-12	4.81E-12	-11.207	-11.318	-0.111	16.53
	ZnCl4-2	2.82E-13	1.09E-13	-12.551	-12.965	-0.414	146.49
	Zn(OH)4-2	1.89E-15	7.19E-16	-14.724	-15.143	-0.419	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.77	-6.04	-4.28	CaSO4			
Aragonite	0.64	-7.7	-8.34	CaCO3			
Barite	1.33	-8.52	-9.84	BaSO4			
Calcite	0.78	-7.7	-8.48	CaCO3			
CO2(g)	-3.21	-4.67	-1.47	CO2			
Dolomite	2.6	-14.48	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.16	6.05	4.89	Fe(OH)3			
Fluorite	-0.72	-11.32	-10.6	CaF2			
Goethite	7.06	6.06	-1	FeOOH			
Gypsum	-1.46	-6.05	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-4.27	-2.7	1.57	NaCl			
Hausmann	-9.18	51.85	61.03	Mn3O4			
Hematite	16.12	12.11	-4.01	Fe2O3			
Jarosite-K	-6.79	-16	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.9	21.44	25.34	MnOOH			
Melanterit	-10.88	-13.09	-2.21	FeSO4:7H2O			
NH3(g)	-7.81	-6.01	1.8	NH3			
O2(g)	-33.35	-36.24	-2.89	O2			
Pyrochroit	-6.22	8.98	15.2	Mn(OH)2			
Pyrolusite	-7.49	33.89	41.38	MnO2:H2O			
Rhodochro	-1.25	-12.38	-11.13	MnCO3			
Siderite	-3.85	-14.74	-10.89	FeCO3			
Smithsonit	-2.21	-12.21	-10	ZnCO3			
Sylvite	-5.46	-4.56	0.9	KCl			
Witherite	-1.61	-10.17	-8.56	BaCO3			
Zn(OH)2(e	-2.36	9.14	11.5	Zn(OH)2			

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 10

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	4.78E-03	4.78E-03
Ba	7.34E-06	7.34E-06
Ca	1.75E-03	1.75E-03
Cl	6.43E-02	6.43E-02
Cu	6.00E-08	6.00E-08
F	1.80E-04	1.80E-04
Fe	4.60E-07	4.60E-07

```
            K            8.80E-04   8.80E-04
            Mg           1.42E-02   1.42E-02
            Mn           8.00E-08   8.00E-08
            N(-3)        1.00E-05   1.00E-05
            N(5)         8.00E-05   8.00E-05
            Na           6.18E-02   6.18E-02
            S(6)         7.28E-03   7.28E-03
            Zn           5.00E-07   5.00E-07

#NAME?      of           solution----------------------------

            pH           =                  8.46
            pe           =                     4
            Specific     Conductan (µS/cm,     25°C)      =                  8503
            Density      (g/cm³)   =              1.00112
            Volume       (L)       =                1.004
            Activity     of        water      =                0.997
            Ionic        strength  (mol/kgw)  =             1.02E-01
            Mass         of        water      (kg)       =            1.00E+00
            Total        carbon    (mol/kg)   =             4.43E-03
            Total        CO2       (mol/kg)   =             4.43E-03
            Temperatu    (°C)      =                   25
            Electrical   balance   (eq)       =             1.07E-02
            Percent      error,    100*(Cat-|=                  6.38
            Iterations   =                  9 (84        overall)
            Total        H         =             1.11E+02
            Total        O         =             5.55E+01

#NAME?      couples--------------------------------

            Redox        couple    pe         Eh         (volts)

            N(-3)/N(5)     4.4307     0.2621

#NAME?      of           species----------------------------

            Log          Log       Log        mole       V
            Species      Molality  Activity   Molality   Activity   Gamma    cm³/mol

            OH-          3.83E-06  2.91E-06     -5.417     -5.536    -0.119      -3.73
            H+           4.21E-09  3.47E-09     -8.376      -8.46    -0.084          0
            H2O          5.55E+01  9.97E-01      1.744     -0.001         0      18.07
Ba            7.34E-06
            Ba+2         5.54E-06  2.00E-06     -5.257       -5.7    -0.443     -11.99
            BaSO4        1.69E-06  1.73E-06     -5.772     -5.762      0.01          0
            BaHCO3+      7.19E-08  5.61E-08     -7.143     -7.251    -0.108          0
            BaCO3        3.99E-08  4.09E-08     -7.399     -7.389      0.01       -10.7
            BaOH+        2.49E-11  1.95E-11    -10.604    -10.711    -0.107          0
C(4)          4.43E-03
            HCO3-        3.72E-03  2.93E-03     -2.429     -2.533    -0.104      25.19
```

	MgHCO3+	2.14E-04	1.64E-04	-3.67	-3.785	-0.115	5.66
	MgCO3	1.77E-04	1.81E-04	-3.753	-3.742	0.01	-17.09
	CO3-2	1.03E-04	3.96E-05	-3.986	-4.402	-0.416	-4.14
	NaHCO3	7.72E-05	7.90E-05	-4.112	-4.102	0.01	1.8
	NaCO3-	4.54E-05	3.54E-05	-4.343	-4.451	-0.108	-0.28
	CaCO3	3.81E-05	3.90E-05	-4.419	-4.409	0.01	-14.6
	CaHCO3+	2.76E-05	2.19E-05	-4.559	-4.659	-0.1	9.84
	CO2	2.24E-05	2.29E-05	-4.65	-4.64	0.01	34.43
	Zn(CO3)2-2	2.88E-07	1.07E-07	-6.541	-6.972	-0.431	0
	ZnCO3	1.23E-07	1.26E-07	-6.91	-6.9	0.01	0
	BaHCO3+	7.19E-08	5.61E-08	-7.143	-7.251	-0.108	0
	BaCO3	3.99E-08	4.09E-08	-7.399	-7.389	0.01	-10.7
	MnCO3	3.79E-08	3.88E-08	-7.421	-7.411	0.01	0
	ZnHCO3+	7.52E-09	5.87E-09	-8.124	-8.231	-0.108	0
	CuCO3	6.25E-09	6.40E-09	-8.204	-8.194	0.01	0
	MnHCO3+	4.12E-09	3.22E-09	-8.385	-8.492	-0.107	0
	Cu(CO3)2-	8.62E-10	3.19E-10	-9.065	-9.496	-0.431	0
	CuHCO3+	5.66E-11	4.42E-11	-10.247	-10.355	-0.108	0
	FeCO3	5.07E-11	5.19E-11	-10.295	-10.285	0.01	0
	FeHCO3+	2.05E-11	1.60E-11	-10.688	-10.796	-0.108	0
	(CO2)2	9.41E-12	9.63E-12	-11.027	-11.016	0.01	68.87
Ca	1.75E-03						
	Ca+2	1.51E-03	5.86E-04	-2.822	-3.232	-0.41	-17.43
	CaSO4	1.76E-04	1.80E-04	-3.754	-3.744	0.01	7.5
	CaCO3	3.81E-05	3.90E-05	-4.419	-4.409	0.01	-14.6
	CaHCO3+	2.76E-05	2.19E-05	-4.559	-4.659	-0.1	9.84
	CaOH+	3.59E-08	2.80E-08	-7.445	-7.553	-0.108	0
	CaHSO4+	5.27E-12	4.11E-12	-11.278	-11.386	-0.108	0
Cl	6.43E-02						
	Cl-	6.43E-02	4.92E-02	-1.192	-1.308	-0.116	18.34
	ZnOHCl	7.28E-09	7.45E-09	-8.138	-8.128	0.01	0
	MnCl+	3.16E-09	2.47E-09	-8.501	-8.607	-0.107	-2.92
	ZnCl+	2.74E-09	2.11E-09	-8.562	-8.676	-0.115	-14.08
	CuCl2-	1.57E-09	1.21E-09	-8.803	-8.918	-0.115	0
	CuCl3-2	2.52E-10	9.41E-11	-9.599	-10.026	-0.427	0
	ZnCl2	1.06E-10	1.09E-10	-9.975	-9.965	0.01	102.03
	MnCl2	5.18E-11	5.30E-11	-10.286	-10.276	0.01	85.89
	ZnCl3-	7.79E-12	5.99E-12	-11.108	-11.223	-0.115	16.47
	CuCl+	5.18E-12	3.98E-12	-11.285	-11.4	-0.115	0.95
	FeCl+	4.75E-12	3.71E-12	-11.323	-11.431	-0.108	0
	MnCl3-	9.18E-13	7.18E-13	-12.037	-12.144	-0.107	43.87
	ZnCl4-2	3.94E-13	1.48E-13	-12.404	-12.831	-0.427	146.57
	CuCl2	1.03E-13	1.05E-13	-12.988	-12.978	0.01	31.02
	CuCl3-	2.39E-17	1.84E-17	-16.622	-16.736	-0.115	0
	FeCl+2	2.07E-19	7.75E-20	-18.684	-19.111	-0.427	0
	FeCl2+	2.18E-20	1.70E-20	-19.662	-19.769	-0.107	0
	CuCl4-2	1.21E-20	4.52E-21	-19.917	-20.345	-0.427	0
	FeCl3	8.18E-23	8.37E-23	-22.087	-22.077	0.01	0
Cu(1)	1.83E-09						
	CuCl2-	1.57E-09	1.21E-09	-8.803	-8.918	-0.115	0

	CuCl3-2	2.52E-10	9.41E-11	-9.599	-10.026	-0.427	0
	Cu+	2.12E-12	1.58E-12	-11.673	-11.802	-0.129	0
Cu(2)	5.82E-08						
	Cu(OH)2	5.08E-08	5.20E-08	-7.294	-7.284	0.01	0
	CuCO3	6.25E-09	6.40E-09	-8.204	-8.194	0.01	0
	Cu(CO3)2-	8.62E-10	3.19E-10	-9.065	-9.496	-0.431	0
	CuOH+	1.13E-10	8.65E-11	-9.948	-10.063	-0.115	0
	Cu+2	7.55E-11	3.01E-11	-10.122	-10.522	-0.4	-25.95
	CuHCO3+	5.66E-11	4.42E-11	-10.247	-10.355	-0.108	0
	CuSO4	1.04E-11	1.06E-11	-10.984	-10.974	0.01	13.09
	CuCl+	5.18E-12	3.98E-12	-11.285	-11.4	-0.115	0.95
	Cu(OH)3-	1.16E-12	9.01E-13	-11.937	-12.045	-0.108	0
	CuCl2	1.03E-13	1.05E-13	-12.988	-12.978	0.01	31.02
	CuF+	7.22E-14	5.63E-14	-13.142	-13.25	-0.108	0
	Cu2(OH)2+	8.84E-15	3.28E-15	-14.054	-14.485	-0.431	0
	Cu(OH)4-2	1.40E-16	5.17E-17	-15.855	-16.286	-0.431	0
	CuCl3-	2.39E-17	1.84E-17	-16.622	-16.736	-0.115	0
	CuCl4-2	1.21E-20	4.52E-21	-19.917	-20.345	-0.427	0
F	1.80E-04						
	F-	1.35E-04	1.03E-04	-3.869	-3.988	-0.119	-1.04
	MgF+	4.20E-05	3.25E-05	-4.377	-4.488	-0.111	-10.4
	NaF	2.77E-06	2.84E-06	-5.557	-5.547	0.01	7.26
	HF	5.22E-10	5.35E-10	-9.282	-9.272	0.01	12.5
	ZnF+	2.96E-11	2.31E-11	-10.528	-10.636	-0.108	0
	MnF+	1.12E-11	8.77E-12	-10.95	-11.057	-0.107	0
	HF2-	2.71E-13	2.11E-13	-12.568	-12.676	-0.108	22.33
	CuF+	7.22E-14	5.63E-14	-13.142	-13.25	-0.108	0
	FeF+	7.20E-14	5.62E-14	-13.143	-13.25	-0.108	0
	FeF2+	4.45E-17	3.48E-17	-16.351	-16.458	-0.107	0
	FeF+2	2.27E-17	8.50E-18	-16.643	-17.07	-0.427	0
	FeF3	5.54E-18	5.68E-18	-17.256	-17.246	0.01	0
Fe(2)	2.36E-10						
	Fe+2	1.37E-10	5.46E-11	-9.863	-10.263	-0.4	-21.46
	FeCO3	5.07E-11	5.19E-11	-10.295	-10.285	0.01	0
	FeHCO3+	2.05E-11	1.60E-11	-10.688	-10.796	-0.108	0
	FeSO4	1.64E-11	1.68E-11	-10.785	-10.775	0.01	18.97
	FeOH+	6.35E-12	4.97E-12	-11.197	-11.304	-0.107	0
	FeCl+	4.75E-12	3.71E-12	-11.323	-11.431	-0.108	0
	FeF+	7.20E-14	5.62E-14	-13.143	-13.25	-0.108	0
	Fe(OH)2	1.19E-14	1.22E-14	-13.925	-13.915	0.01	0
	Fe(OH)3-	1.66E-16	1.30E-16	-15.779	-15.886	-0.107	0
	FeHSO4+	4.91E-19	3.83E-19	-18.309	-18.417	-0.108	0
Fe(3)	4.60E-07						
	Fe(OH)3	3.34E-07	3.42E-07	-6.476	-6.466	0.01	0
	Fe(OH)4-	1.14E-07	8.97E-08	-6.943	-7.047	-0.104	0
	Fe(OH)2+	1.17E-08	9.23E-09	-7.931	-8.035	-0.104	0
	FeOH+2	2.59E-13	9.69E-14	-12.587	-13.014	-0.427	0
	FeF2+	4.45E-17	3.48E-17	-16.351	-16.458	-0.107	0
	FeF+2	2.27E-17	8.50E-18	-16.643	-17.07	-0.427	0
	FeF3	5.54E-18	5.68E-18	-17.256	-17.246	0.01	0

	FeSO4+	1.27E-18	9.89E-19	-17.898	-18.005	-0.107	0
	Fe+3	2.96E-19	5.22E-20	-18.529	-19.283	-0.754	0
	FeCl+2	2.07E-19	7.75E-20	-18.684	-19.111	-0.427	0
	Fe(SO4)2-	4.80E-20	3.74E-20	-19.319	-19.427	-0.108	0
	FeCl2+	2.18E-20	1.70E-20	-19.662	-19.769	-0.107	0
	FeCl3	8.18E-23	8.37E-23	-22.087	-22.077	0.01	0
	Fe2(OH)2+	1.34E-23	2.53E-25	-22.873	-24.597	-1.724	0
	FeHSO4+2	2.48E-26	9.19E-27	-25.606	-26.037	-0.431	0
	Fe3(OH)4+	2.41E-28	4.87E-31	-27.618	-30.312	-2.695	0
H(0)	1.66E-28						
	H2	8.31E-29	8.51E-29	-28.08	-28.07	0.01	28.61
K	8.80E-04						
	K+	8.70E-04	6.64E-04	-3.061	-3.178	-0.118	9.24
	KSO4-	1.02E-05	8.07E-06	-4.989	-5.093	-0.104	34.38
Mg	1.42E-02						
	Mg+2	1.18E-02	4.79E-03	-1.928	-2.32	-0.393	-21.13
	MgSO4	1.90E-03	1.94E-03	-2.722	-2.712	0.01	5.84
	MgHCO3+	2.14E-04	1.64E-04	-3.67	-3.785	-0.115	5.66
	MgCO3	1.77E-04	1.81E-04	-3.753	-3.742	0.01	-17.09
	MgF+	4.20E-05	3.25E-05	-4.377	-4.488	-0.111	-10.4
	MgOH+	6.25E-06	5.00E-06	-5.204	-5.301	-0.097	0
Mn(2)	8.00E-08						
	MnCO3	3.79E-08	3.88E-08	-7.421	-7.411	0.01	0
	Mn+2	3.09E-08	1.23E-08	-7.51	-7.909	-0.4	-18.14
	MnHCO3+	4.12E-09	3.22E-09	-8.385	-8.492	-0.107	0
	MnSO4	3.70E-09	3.79E-09	-8.431	-8.421	0.01	22.54
	MnCl+	3.16E-09	2.47E-09	-8.501	-8.607	-0.107	-2.92
	MnOH+	1.17E-10	9.12E-11	-9.934	-10.04	-0.107	0
	MnCl2	5.18E-11	5.30E-11	-10.286	-10.276	0.01	85.89
	MnF+	1.12E-11	8.77E-12	-10.95	-11.057	-0.107	0
	MnCl3-	9.18E-13	7.18E-13	-12.037	-12.144	-0.107	43.87
	Mn(NO3)2	1.74E-16	1.78E-16	-15.761	-15.751	0.01	41.04
	Mn(OH)3-	5.95E-18	4.65E-18	-17.226	-17.333	-0.107	0
Mn(3)	2.16E-29						
	Mn+3	2.16E-29	3.81E-30	-28.666	-29.419	-0.754	0
N(-3)	1.00E-05						
	NH4+	8.77E-06	6.52E-06	-5.057	-5.186	-0.129	18.17
	NH3	1.05E-06	1.07E-06	-5.98	-5.97	0.01	24.42
	NH4SO4-	1.86E-07	1.45E-07	-6.73	-6.838	-0.108	38.13
N(5)	8.00E-05						
	NO3-	8.00E-05	6.02E-05	-4.097	-4.221	-0.124	29.77
	Mn(NO3)2	1.74E-16	1.78E-16	-15.761	-15.751	0.01	41.04
Na	6.18E-02						
	Na+	6.12E-02	4.80E-02	-1.213	-1.319	-0.106	-1.09
	NaSO4-	5.28E-04	4.16E-04	-3.277	-3.381	-0.104	16.34
	NaHCO3	7.72E-05	7.90E-05	-4.112	-4.102	0.01	1.8
	NaCO3-	4.54E-05	3.54E-05	-4.343	-4.451	-0.108	-0.28
	NaF	2.77E-06	2.84E-06	-5.557	-5.547	0.01	7.26
	NaOH	1.36E-17	1.40E-17	-16.865	-16.855	0.01	0
O(0)	1.12E-36						

	O2	5.59E-37	5.73E-37	-36.252	-36.242	0.01	30.4
S(6)	7.28E-03						
	SO4-2	4.67E-03	1.73E-03	-2.331	-2.762	-0.431	15.6
	MgSO4	1.90E-03	1.94E-03	-2.722	-2.712	0.01	5.84
	NaSO4-	5.28E-04	4.16E-04	-3.277	-3.381	-0.104	16.34
	CaSO4	1.76E-04	1.80E-04	-3.754	-3.744	0.01	7.5
	KSO4-	1.02E-05	8.07E-06	-4.989	-5.093	-0.104	34.38
	BaSO4	1.69E-06	1.73E-06	-5.772	-5.762	0.01	0
	NH4SO4-	1.86E-07	1.45E-07	-6.73	-6.838	-0.108	38.13
	ZnSO4	6.30E-09	6.45E-09	-8.2	-8.19	0.01	21.71
	MnSO4	3.70E-09	3.79E-09	-8.431	-8.421	0.01	22.54
	HSO4-	7.47E-10	5.83E-10	-9.126	-9.234	-0.108	40.54
	Zn(SO4)2-2	2.45E-10	9.07E-11	-9.611	-10.042	-0.431	-11.3
	FeSO4	1.64E-11	1.68E-11	-10.785	-10.775	0.01	18.97
	CuSO4	1.04E-11	1.06E-11	-10.984	-10.974	0.01	13.09
	CaHSO4+	5.27E-12	4.11E-12	-11.278	-11.386	-0.108	0
	FeSO4+	1.27E-18	9.89E-19	-17.898	-18.005	-0.107	0
	FeHSO4+	4.91E-19	3.83E-19	-18.309	-18.417	-0.108	0
	Fe(SO4)2-	4.80E-20	3.74E-20	-19.319	-19.427	-0.108	0
	FeHSO4+2	2.48E-26	9.19E-27	-25.606	-26.037	-0.431	0
Zn	5.00E-07						
	Zn(CO3)2-2	2.88E-07	1.07E-07	-6.541	-6.972	-0.431	0
	ZnCO3	1.23E-07	1.26E-07	-6.91	-6.9	0.01	0
	Zn+2	4.25E-08	1.59E-08	-7.371	-7.798	-0.427	-24.68
	Zn(OH)2	1.62E-08	1.66E-08	-7.791	-7.781	0.01	0
	ZnHCO3+	7.52E-09	5.87E-09	-8.124	-8.231	-0.108	0
	ZnOHCl	7.28E-09	7.45E-09	-8.138	-8.128	0.01	0
	ZnOH+	6.43E-09	5.02E-09	-8.192	-8.299	-0.108	0
	ZnSO4	6.30E-09	6.45E-09	-8.2	-8.19	0.01	21.71
	ZnCl+	2.74E-09	2.11E-09	-8.562	-8.676	-0.115	-14.08
	Zn(SO4)2-2	2.45E-10	9.07E-11	-9.611	-10.042	-0.431	-11.3
	ZnCl2	1.06E-10	1.09E-10	-9.975	-9.965	0.01	102.03
	ZnF+	2.96E-11	2.31E-11	-10.528	-10.636	-0.108	0
	Zn(OH)3-	1.93E-11	1.51E-11	-10.714	-10.822	-0.108	0
	ZnCl3-	7.79E-12	5.99E-12	-11.108	-11.223	-0.115	16.47
	ZnCl4-2	3.94E-13	1.48E-13	-12.404	-12.831	-0.427	146.57
	Zn(OH)4-2	1.86E-15	6.87E-16	-14.732	-15.163	-0.431	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.72	-5.99	-4.28	CaSO4			
Aragonite	0.7	-7.63	-8.34	CaCO3			
Barite	1.38	-8.46	-9.84	BaSO4			
Calcite	0.85	-7.63	-8.48	CaCO3			
CO2(g)	-3.17	-4.64	-1.47	CO2			
Dolomite	2.73	-14.36	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.2	6.09	4.89	Fe(OH)3			
Fluorite	-0.61	-11.21	-10.6	CaF2			

Goethite	7.1	6.1	-1	FeOOH
Gypsum	-1.41	-6	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-4.2	-2.63	1.57	NaCl
Hausmann	-9.08	51.95	61.03	Mn3O4
Hematite	16.2	12.19	-4.01	Fe2O3
Jarosite-K	-6.59	-15.8	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.87	21.47	25.34	MnOOH
Melanterit	-10.82	-13.03	-2.21	FeSO4:7H2O
NH3(g)	-7.77	-5.97	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.19	9.01	15.2	Mn(OH)2
Pyrolusite	-7.45	33.93	41.38	MnO2:H2O
Rhodochrc	-1.18	-12.31	-11.13	MnCO3
Siderite	-3.77	-14.66	-10.89	FeCO3
Smithsonit	-2.2	-12.2	-10	ZnCO3
Sylvite	-5.39	-4.49	0.9	KCl
Witherite	-1.54	-10.1	-8.56	BaCO3
Zn(OH)2(e	-2.38	9.12	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 11

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	5.22E-03	5.22E-03
Ba	8.09E-06	8.09E-06
Ca	1.91E-03	1.91E-03
Cl	7.02E-02	7.02E-02
Cu	6.00E-08	6.00E-08
F	2.00E-04	2.00E-04
Fe	5.00E-07	5.00E-07
K	9.60E-04	9.60E-04
Mg	1.55E-02	1.55E-02
Mn	9.00E-08	9.00E-08
N(-3)	1.00E-05	1.00E-05
N(5)	9.00E-05	9.00E-05
Na	6.75E-02	6.75E-02
S(6)	7.95E-03	7.95E-03
Zn	5.50E-07	5.50E-07

#NAME? of solution----------

pH = 8.46
pe = 4

```
Specific    Conductan (µS/cm,    25°C)      =              9216
Density     (g/cm³)   =              1.0015
Volume      (L)       =              1.0041
Activity    of        water      =              0.997
Ionic       strength  (mol/kgw)  =           1.11E-01
Mass        of        water      (kg)       =          1.00E+00
Total       carbon    (mol/kg)   =           4.82E-03
Total       CO2       (mol/kg)   =           4.82E-03
Temperatu   (°C)      =                 25
Electrical  balance   (eq)       =           1.16E-02
Percent     error,    100*(Cat-| =                6.38
Iterations  =                  9 (93        overall)
Total       H         =          1.11E+02
Total       O         =          5.56E+01

#NAME?  couples--------------------------------

        Redox     couple     pe         Eh         (volts)

        N(-3)/N(5)    4.4372     0.2625

#NAME?  of        species----------------------------

        Log       Log        Log        mole       V
        Species   Molality   Activity   Molality   Activity   Gamma   cm³/mol

        OH-        3.86E-06  2.91E-06    -5.413     -5.536    -0.123     -3.7
        H+         4.22E-09  3.47E-09    -8.374      -8.46    -0.086        0
        H2O        5.55E+01  9.97E-01     1.744     -0.001         0    18.07
Ba       8.09E-06
        Ba+2       6.08E-06  2.13E-06    -5.216     -5.672    -0.456    -11.96
        BaSO4      1.88E-06  1.93E-06    -5.725     -5.714     0.011        0
        BaHCO3+    8.27E-08  6.41E-08    -7.082     -7.193     -0.11        0
        BaCO3      4.56E-08  4.68E-08    -7.341      -7.33     0.011     -10.7
        BaOH+      2.67E-11  2.08E-11   -10.573    -10.683     -0.11        0
C(4)     4.82E-03
        HCO3-      4.02E-03  3.14E-03    -2.396     -2.503    -0.107    25.22
        MgHCO3+    2.46E-04  1.87E-04     -3.61     -3.728    -0.118     5.67
        MgCO3      2.01E-04  2.06E-04    -3.696     -3.685     0.011   -17.09
        CO3-2      1.14E-04  4.25E-05    -3.944     -4.372    -0.427    -4.08
        NaHCO3     8.97E-05  9.20E-05    -4.047     -4.036     0.011      1.8
        NaCO3-     5.31E-05  4.12E-05    -4.275     -4.385     -0.11    -0.23
        CaCO3      4.33E-05  4.44E-05    -4.363     -4.352     0.011    -14.6
        CaHCO3+    3.16E-05  2.50E-05      -4.5     -4.603    -0.103     9.84
        CO2        2.40E-05  2.46E-05    -4.621      -4.61     0.011    34.43
        Zn(CO3)2-: 3.31E-07  1.20E-07     -6.48     -6.922    -0.442        0
        ZnCO3      1.29E-07  1.32E-07    -6.891      -6.88     0.011        0
        BaHCO3+    8.27E-08  6.41E-08    -7.082     -7.193     -0.11        0
        BaCO3      4.56E-08  4.68E-08    -7.341      -7.33     0.011     -10.7
        MnCO3      4.34E-08  4.45E-08    -7.363     -7.352     0.011        0
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	ZnHCO3+	7.93E-09	6.15E-09	-8.101	-8.211	-0.11	0
	CuCO3	6.60E-09	6.77E-09	-8.18	-8.169	0.011	0
	MnHCO3+	4.75E-09	3.69E-09	-8.323	-8.433	-0.11	0
	Cu(CO3)2-	1.00E-09	3.62E-10	-8.999	-9.441	-0.442	0
	CuHCO3+	6.03E-11	4.67E-11	-10.22	-10.33	-0.11	0
	FeCO3	5.90E-11	6.06E-11	-10.229	-10.218	0.011	0
	FeHCO3+	2.41E-11	1.87E-11	-10.618	-10.729	-0.11	0
	(CO2)2	1.08E-11	1.11E-11	-10.967	-10.955	0.011	68.87
Ca	1.91E-03						
	Ca+2	1.64E-03	6.22E-04	-2.785	-3.206	-0.421	-17.4
	CaSO4	1.95E-04	2.00E-04	-3.709	-3.698	0.011	7.5
	CaCO3	4.33E-05	4.44E-05	-4.363	-4.352	0.011	-14.6
	CaHCO3+	3.16E-05	2.50E-05	-4.5	-4.603	-0.103	9.84
	CaOH+	3.83E-08	2.97E-08	-7.417	-7.527	-0.11	0
	CaHSO4+	5.89E-12	4.57E-12	-11.23	-11.34	-0.11	0
Cl	7.02E-02						
	Cl-	7.02E-02	5.33E-02	-1.154	-1.273	-0.12	18.35
	ZnOHCl	7.69E-09	7.89E-09	-8.114	-8.103	0.011	0
	MnCl+	3.68E-09	2.86E-09	-8.434	-8.544	-0.11	-2.92
	ZnCl+	2.93E-09	2.23E-09	-8.534	-8.652	-0.118	-14.1
	CuCl2-	1.84E-09	1.40E-09	-8.736	-8.855	-0.118	0
	CuCl3-2	3.25E-10	1.18E-10	-9.489	-9.928	-0.439	0
	ZnCl2	1.21E-10	1.24E-10	-9.916	-9.905	0.011	102.03
	MnCl2	6.48E-11	6.65E-11	-10.188	-10.177	0.011	85.89
	ZnCl3-	9.76E-12	7.44E-12	-11.011	-11.129	-0.118	16.41
	FeCl+	5.63E-12	4.37E-12	-11.249	-11.36	-0.11	0
	CuCl+	5.58E-12	4.25E-12	-11.253	-11.371	-0.118	0.97
	MnCl3-	1.26E-12	9.76E-13	-11.901	-12.011	-0.11	43.91
	ZnCl4-2	5.46E-13	1.99E-13	-12.263	-12.702	-0.439	146.66
	CuCl2	1.19E-13	1.22E-13	-12.926	-12.915	0.011	31.02
	CuCl3-	3.02E-17	2.30E-17	-16.52	-16.638	-0.118	0
	FeCl+2	2.51E-19	9.13E-20	-18.6	-19.04	-0.439	0
	FeCl2+	2.80E-20	2.17E-20	-19.553	-19.663	-0.11	0
	CuCl4-2	1.69E-20	6.15E-21	-19.772	-20.211	-0.439	0
	FeCl3	1.13E-22	1.16E-22	-21.947	-21.936	0.011	0
Cu(1)	2.16E-09						
	CuCl2-	1.84E-09	1.40E-09	-8.736	-8.855	-0.118	0
	CuCl3-2	3.25E-10	1.18E-10	-9.489	-9.928	-0.439	0
	Cu+	2.12E-12	1.56E-12	-11.674	-11.808	-0.133	0
Cu(2)	5.78E-08						
	Cu(OH)2	5.00E-08	5.13E-08	-7.301	-7.29	0.011	0
	CuCO3	6.60E-09	6.77E-09	-8.18	-8.169	0.011	0
	Cu(CO3)2-	1.00E-09	3.62E-10	-8.999	-9.441	-0.442	0
	CuOH+	1.12E-10	8.53E-11	-9.951	-10.069	-0.118	0
	Cu+2	7.63E-11	2.97E-11	-10.118	-10.528	-0.41	-25.93
	CuHCO3+	6.03E-11	4.67E-11	-10.22	-10.33	-0.11	0
	CuSO4	1.07E-11	1.10E-11	-10.971	-10.96	0.011	13.09
	CuCl+	5.58E-12	4.25E-12	-11.253	-11.371	-0.118	0.97
	Cu(OH)3-	1.15E-12	8.88E-13	-11.941	-12.051	-0.11	0
	CuCl2	1.19E-13	1.22E-13	-12.926	-12.915	0.011	31.02

	CuF+	7.77E-14	6.02E-14	-13.11	-13.22	-0.11	0
	Cu2(OH)2+	8.81E-15	3.19E-15	-14.055	-14.497	-0.442	0
	Cu(OH)4-2	1.41E-16	5.10E-17	-15.851	-16.293	-0.442	0
	CuCl3-	3.02E-17	2.30E-17	-16.52	-16.638	-0.118	0
	CuCl4-2	1.69E-20	6.15E-21	-19.772	-20.211	-0.439	0
F	2.00E-04						
	F-	1.48E-04	1.12E-04	-3.83	-3.953	-0.123	-1.03
	MgF+	4.87E-05	3.75E-05	-4.312	-4.426	-0.114	-10.39
	NaF	3.26E-06	3.34E-06	-5.487	-5.476	0.011	7.26
	HF	5.65E-10	5.80E-10	-9.248	-9.237	0.011	12.5
	ZnF+	3.16E-11	2.45E-11	-10.501	-10.611	-0.11	0
	MnF+	1.31E-11	1.02E-11	-10.883	-10.993	-0.11	0
	HF2-	3.20E-13	2.48E-13	-12.495	-12.605	-0.11	22.35
	FeF+	8.54E-14	6.63E-14	-13.068	-13.179	-0.11	0
	CuF+	7.77E-14	6.02E-14	-13.11	-13.22	-0.11	0
	FeF2+	5.73E-17	4.45E-17	-16.242	-16.351	-0.11	0
	FeF+2	2.76E-17	1.00E-17	-16.56	-16.999	-0.439	0
	FeF3	7.68E-18	7.87E-18	-17.115	-17.104	0.011	0
Fe(2)	2.67E-10						
	Fe+2	1.53E-10	5.94E-11	-9.816	-10.226	-0.41	-21.43
	FeCO3	5.90E-11	6.06E-11	-10.229	-10.218	0.011	0
	FeHCO3+	2.41E-11	1.87E-11	-10.618	-10.729	-0.11	0
	FeSO4	1.87E-11	1.91E-11	-10.729	-10.718	0.011	18.97
	FeOH+	6.96E-12	5.40E-12	-11.158	-11.267	-0.11	0
	FeCl+	5.63E-12	4.37E-12	-11.249	-11.36	-0.11	0
	FeF+	8.54E-14	6.63E-14	-13.068	-13.179	-0.11	0
	Fe(OH)2	1.29E-14	1.32E-14	-13.89	-13.879	0.011	0
	Fe(OH)3-	1.82E-16	1.41E-16	-15.74	-15.85	-0.11	0
	FeHSO4+	5.62E-19	4.36E-19	-18.25	-18.36	-0.11	0
Fe(3)	5.00E-07						
	Fe(OH)3	3.62E-07	3.72E-07	-6.441	-6.43	0.011	0
	Fe(OH)4-	1.25E-07	9.75E-08	-6.904	-7.011	-0.107	0
	Fe(OH)2+	1.28E-08	1.00E-08	-7.892	-7.999	-0.107	0
	FeOH+2	2.90E-13	1.05E-13	-12.538	-12.977	-0.439	0
	FeF2+	5.73E-17	4.45E-17	-16.242	-16.351	-0.11	0
	FeF+2	2.76E-17	1.00E-17	-16.56	-16.999	-0.439	0
	FeF3	7.68E-18	7.87E-18	-17.115	-17.104	0.011	0
	FeSO4+	1.45E-18	1.13E-18	-17.838	-17.948	-0.11	0
	Fe+3	3.34E-19	5.67E-20	-18.476	-19.246	-0.77	0
	FeCl+2	2.51E-19	9.13E-20	-18.6	-19.04	-0.439	0
	Fe(SO4)2-	5.76E-20	4.47E-20	-19.24	-19.35	-0.11	0
	FeCl2+	2.80E-20	2.17E-20	-19.553	-19.663	-0.11	0
	FeCl3	1.13E-22	1.16E-22	-21.947	-21.936	0.011	0
	Fe2(OH)2+	1.75E-23	2.99E-25	-22.758	-24.525	-1.767	0
	FeHSO4+2	2.89E-26	1.05E-26	-25.539	-25.98	-0.442	0
	Fe3(OH)4+	3.61E-28	6.26E-31	-27.443	-30.204	-2.761	0
H(0)	1.66E-28						
	H2	8.30E-29	8.51E-29	-28.081	-28.07	0.011	28.61
K	9.60E-04						
	K+	9.48E-04	7.18E-04	-3.023	-3.144	-0.121	9.25

	KSO4-	1.17E-05	9.13E-06	-4.933	-5.039	-0.107	34.39
Mg	1.55E-02						
	Mg+2	1.28E-02	5.09E-03	-1.891	-2.293	-0.402	-21.11
	MgSO4	2.11E-03	2.16E-03	-2.676	-2.665	0.011	5.84
	MgHCO3+	2.46E-04	1.87E-04	-3.61	-3.728	-0.118	5.67
	MgCO3	2.01E-04	2.06E-04	-3.696	-3.685	0.011	-17.09
	MgF+	4.87E-05	3.75E-05	-4.312	-4.426	-0.114	-10.39
	MgOH+	6.68E-06	5.31E-06	-5.175	-5.275	-0.099	0
Mn(2)	9.00E-08						
	MnCO3	4.34E-08	4.45E-08	-7.363	-7.352	0.011	0
	Mn+2	3.39E-08	1.32E-08	-7.47	-7.88	-0.41	-18.07
	MnHCO3+	4.75E-09	3.69E-09	-8.323	-8.433	-0.11	0
	MnSO4	4.14E-09	4.24E-09	-8.383	-8.372	0.011	22.54
	MnCl+	3.68E-09	2.86E-09	-8.434	-8.544	-0.11	-2.92
	MnOH+	1.25E-10	9.74E-11	-9.902	-10.012	-0.11	0
	MnCl2	6.48E-11	6.65E-11	-10.188	-10.177	0.011	85.89
	MnF+	1.31E-11	1.02E-11	-10.883	-10.993	-0.11	0
	MnCl3-	1.26E-12	9.76E-13	-11.901	-12.011	-0.11	43.91
	Mn(NO3)2	2.30E-16	2.36E-16	-15.639	-15.628	0.011	41.04
	Mn(OH)3-	6.39E-18	4.97E-18	-17.194	-17.304	-0.11	0
Mn(3)	2.40E-29						
	Mn+3	2.40E-29	4.07E-30	-28.62	-29.39	-0.77	0
N(-3)	1.00E-05						
	NH4+	8.77E-06	6.45E-06	-5.057	-5.19	-0.133	18.18
	NH3	1.03E-06	1.06E-06	-5.986	-5.974	0.011	24.42
	NH4SO4-	1.94E-07	1.51E-07	-6.712	-6.822	-0.11	38.16
N(5)	9.00E-05						
	NO3-	9.00E-05	6.71E-05	-4.046	-4.174	-0.128	29.78
	Mn(NO3)2	2.30E-16	2.36E-16	-15.639	-15.628	0.011	41.04
Na	6.75E-02						
	Na+	6.68E-02	5.20E-02	-1.175	-1.284	-0.108	-1.07
	NaSO4-	6.04E-04	4.72E-04	-3.219	-3.326	-0.107	16.47
	NaHCO3	8.97E-05	9.20E-05	-4.047	-4.036	0.011	1.8
	NaCO3-	5.31E-05	4.12E-05	-4.275	-4.385	-0.11	-0.23
	NaF	3.26E-06	3.34E-06	-5.487	-5.476	0.011	7.26
	NaOH	1.48E-17	1.52E-17	-16.831	-16.82	0.011	0
O(0)	1.12E-36						
	O2	5.58E-37	5.72E-37	-36.254	-36.242	0.011	30.4
S(6)	7.95E-03						
	SO4-2	5.03E-03	1.81E-03	-2.298	-2.742	-0.444	15.65
	MgSO4	2.11E-03	2.16E-03	-2.676	-2.665	0.011	5.84
	NaSO4-	6.04E-04	4.72E-04	-3.219	-3.326	-0.107	16.47
	CaSO4	1.95E-04	2.00E-04	-3.709	-3.698	0.011	7.5
	KSO4-	1.17E-05	9.13E-06	-4.933	-5.039	-0.107	34.39
	BaSO4	1.88E-06	1.93E-06	-5.725	-5.714	0.011	0
	NH4SO4-	1.94E-07	1.51E-07	-6.712	-6.822	-0.11	38.16
	ZnSO4	6.43E-09	6.60E-09	-8.192	-8.18	0.011	21.71
	MnSO4	4.14E-09	4.24E-09	-8.383	-8.372	0.011	22.54
	HSO4-	7.88E-10	6.11E-10	-9.104	-9.214	-0.11	40.55
	Zn(SO4)2-2	2.69E-10	9.72E-11	-9.571	-10.012	-0.442	-11.18

	FeSO4	1.87E-11	1.91E-11	-10.729	-10.718	0.011	18.97
	CuSO4	1.07E-11	1.10E-11	-10.971	-10.96	0.011	13.09
	CaHSO4+	5.89E-12	4.57E-12	-11.23	-11.34	-0.11	0
	FeSO4+	1.45E-18	1.13E-18	-17.838	-17.948	-0.11	0
	FeHSO4+	5.62E-19	4.36E-19	-18.25	-18.36	-0.11	0
	Fe(SO4)2-	5.76E-20	4.47E-20	-19.24	-19.35	-0.11	0
	FeHSO4+2	2.89E-26	1.05E-26	-25.539	-25.98	-0.442	0
Zn	5.50E-07						
	Zn(CO3)2-2	3.31E-07	1.20E-07	-6.48	-6.922	-0.442	0
	ZnCO3	1.29E-07	1.32E-07	-6.891	-6.88	0.011	0
	Zn+2	4.27E-08	1.55E-08	-7.369	-7.808	-0.439	-24.65
	Zn(OH)2	1.58E-08	1.62E-08	-7.802	-7.791	0.011	0
	ZnHCO3+	7.93E-09	6.15E-09	-8.101	-8.211	-0.11	0
	ZnOHCl	7.69E-09	7.89E-09	-8.114	-8.103	0.011	0
	ZnSO4	6.43E-09	6.60E-09	-8.192	-8.18	0.011	21.71
	ZnOH+	6.32E-09	4.90E-09	-8.199	-8.31	-0.11	0
	ZnCl+	2.93E-09	2.23E-09	-8.534	-8.652	-0.118	-14.1
	Zn(SO4)2-2	2.69E-10	9.72E-11	-9.571	-10.012	-0.442	-11.18
	ZnCl2	1.21E-10	1.24E-10	-9.916	-9.905	0.011	102.03
	ZnF+	3.16E-11	2.45E-11	-10.501	-10.611	-0.11	0
	Zn(OH)3-	1.90E-11	1.47E-11	-10.722	-10.832	-0.11	0
	ZnCl3-	9.76E-12	7.44E-12	-11.011	-11.129	-0.118	16.41
	ZnCl4-2	5.46E-13	1.99E-13	-12.263	-12.702	-0.439	146.66
	Zn(OH)4-2	1.86E-15	6.71E-16	-14.732	-15.173	-0.442	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.67	-5.95	-4.28	CaSO4			
Aragonite	0.76	-7.58	-8.34	CaCO3			
Barite	1.43	-8.41	-9.84	BaSO4			
Calcite	0.9	-7.58	-8.48	CaCO3			
CO2(g)	-3.14	-4.61	-1.47	CO2			
Dolomite	2.84	-14.24	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.24	6.13	4.89	Fe(OH)3			
Fluorite	-0.51	-11.11	-10.6	CaF2			
Goethite	7.13	6.13	-1	FeOOH			
Gypsum	-1.37	-5.95	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-4.13	-2.56	1.57	NaCl			
Hausmann	-9	52.03	61.03	Mn3O4			
Hematite	16.27	12.26	-4.01	Fe2O3			
Jarosite-K	-6.4	-15.61	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.84	21.5	25.34	MnOOH			
Melanterit	-10.77	-12.98	-2.21	FeSO4:7H2O			
NH3(g)	-7.77	-5.97	1.8	NH3			
O2(g)	-33.35	-36.24	-2.89	O2			
Pyrochroit	-6.16	9.04	15.2	Mn(OH)2			

Pyrolusite	-7.42	33.96	41.38	MnO2:H2O
Rhodochrc	-1.12	-12.25	-11.13	MnCO3
Siderite	-3.71	-14.6	-10.89	FeCO3
Smithsonit	-2.18	-12.18	-10	ZnCO3
Sylvite	-5.32	-4.42	0.9	KCl
Witherite	-1.48	-10.04	-8.56	BaCO3
Zn(OH)2(e	-2.39	9.11	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 12

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	5.66E-03	5.66E-03
Ba	8.85E-06	8.85E-06
Ca	2.08E-03	2.08E-03
Cl	7.61E-02	7.61E-02
Cu	7.00E-08	7.00E-08
F	2.10E-04	2.10E-04
Fe	5.50E-07	5.50E-07
K	1.04E-03	1.04E-03
Mg	1.68E-02	1.68E-02
Mn	9.00E-08	9.00E-08
N(-3)	1.10E-05	1.10E-05
N(5)	1.00E-04	1.00E-04
Na	7.32E-02	7.32E-02
S(6)	8.62E-03	8.62E-03
Zn	6.00E-07	6.00E-07

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 9924
Density (g/cm³) = 1.00187
Volume (L) = 1.00419
Activity of water = 0.997
Ionic strength (mol/kgw) = 1.20E-01
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 5.21E-03
Total CO2 (mol/kg) = 5.21E-03
Temperatu (°C) = 25
Electrical balance (eq) = 1.27E-02
Percent error, 100*(Cat-| = 6.41
Iterations = 9 (102 overall)
Total H = 1.11E+02

Total O = 5.56E+01

#NAME? couples----------

Redox couple pe Eh (volts)

N(-3)/N(5) 4.4378 0.2625

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	3.89E-06	2.91E-06	-5.41	-5.536	-0.126	-3.68
	H+	4.24E-09	3.47E-09	-8.373	-8.46	-0.087	0
	H2O	5.55E+01	9.97E-01	1.744	-0.001	0	18.07
Ba	8.85E-06						
	Ba+2	6.63E-06	2.26E-06	-5.179	-5.646	-0.467	-11.93
	BaSO4	2.08E-06	2.14E-06	-5.682	-5.67	0.012	0
	BaHCO3+	9.40E-08	7.25E-08	-7.027	-7.14	-0.113	0
	BaCO3	5.14E-08	5.29E-08	-7.289	-7.277	0.012	-10.7
	BaOH+	2.85E-11	2.20E-11	-10.545	-10.657	-0.113	0
C(4)	5.21E-03						
	HCO3-	4.31E-03	3.35E-03	-2.366	-2.475	-0.109	25.25
	MgHCO3+	2.79E-04	2.11E-04	-3.554	-3.675	-0.121	5.67
	MgCO3	2.27E-04	2.33E-04	-3.645	-3.633	0.012	-17.09
	CO3-2	1.24E-04	4.53E-05	-3.906	-4.344	-0.438	-4.03
	NaHCO3	1.03E-04	1.06E-04	-3.988	-3.976	0.012	1.8
	NaCO3-	6.13E-05	4.73E-05	-4.212	-4.325	-0.113	-0.17
	CaCO3	4.89E-05	5.02E-05	-4.311	-4.299	0.012	-14.6
	CaHCO3+	3.59E-05	2.82E-05	-4.445	-4.55	-0.105	9.85
	CO2	2.55E-05	2.62E-05	-4.594	-4.582	0.012	34.43
	Zn(CO3)2-2	3.76E-07	1.33E-07	-6.425	-6.877	-0.451	0
	ZnCO3	1.34E-07	1.37E-07	-6.875	-6.863	0.012	0
	BaHCO3+	9.40E-08	7.25E-08	-7.027	-7.14	-0.113	0
	BaCO3	5.14E-08	5.29E-08	-7.289	-7.277	0.012	-10.7
	MnCO3	4.40E-08	4.52E-08	-7.357	-7.345	0.012	0
	ZnHCO3+	8.30E-09	6.40E-09	-8.081	-8.194	-0.113	0
	CuCO3	8.07E-09	8.30E-09	-8.093	-8.081	0.012	0
	MnHCO3+	4.86E-09	3.75E-09	-8.313	-8.426	-0.113	0
	Cu(CO3)2-	1.34E-09	4.73E-10	-8.873	-9.325	-0.451	0
	CuHCO3+	7.43E-11	5.73E-11	-10.129	-10.242	-0.113	0
	FeCO3	6.91E-11	7.10E-11	-10.161	-10.149	0.012	0
	FeHCO3+	2.84E-11	2.19E-11	-10.547	-10.66	-0.113	0
	(CO2)2	1.22E-11	1.26E-11	-10.912	-10.9	0.012	68.87
Ca	2.08E-03						
	Ca+2	1.78E-03	6.60E-04	-2.75	-3.18	-0.431	-17.38
	CaSO4	2.16E-04	2.22E-04	-3.666	-3.654	0.012	7.5
	CaCO3	4.89E-05	5.02E-05	-4.311	-4.299	0.012	-14.6
	CaHCO3+	3.59E-05	2.82E-05	-4.445	-4.55	-0.105	9.85

	CaOH+	4.09E-08	3.15E-08	-7.389	-7.502	-0.113	0
	CaHSO4+	6.55E-12	5.05E-12	-11.184	-11.296	-0.113	0
Cl	7.61E-02						
	Cl-	7.61E-02	5.74E-02	-1.119	-1.241	-0.123	18.37
	ZnOHCl	8.06E-09	8.29E-09	-8.094	-8.082	0.012	0
	MnCl+	3.81E-09	2.94E-09	-8.42	-8.532	-0.113	-2.91
	ZnCl+	3.10E-09	2.34E-09	-8.509	-8.63	-0.121	-14.13
	CuCl2-	2.46E-09	1.86E-09	-8.609	-8.73	-0.121	0
	CuCl3-2	4.78E-10	1.69E-10	-9.321	-9.771	-0.45	0
	ZnCl2	1.37E-10	1.41E-10	-9.864	-9.852	0.012	102.03
	MnCl2	7.15E-11	7.35E-11	-10.146	-10.134	0.012	85.89
	ZnCl3-	1.20E-11	9.05E-12	-10.922	-11.043	-0.121	16.35
	CuCl+	6.97E-12	5.27E-12	-11.157	-11.278	-0.121	0.99
	FeCl+	6.71E-12	5.18E-12	-11.173	-11.286	-0.113	0
	MnCl3-	1.50E-12	1.16E-12	-11.823	-11.935	-0.113	43.94
	ZnCl4-2	7.34E-13	2.60E-13	-12.134	-12.585	-0.45	146.74
	CuCl2	1.58E-13	1.62E-13	-12.802	-12.79	0.012	31.02
	CuCl3-	4.37E-17	3.30E-17	-16.36	-16.481	-0.121	0
	FeCl+2	3.05E-19	1.08E-19	-18.516	-18.966	-0.45	0
	FeCl2+	3.59E-20	2.77E-20	-19.445	-19.558	-0.113	0
	CuCl4-2	2.68E-20	9.49E-21	-19.573	-20.023	-0.45	0
	FeCl3	1.55E-22	1.59E-22	-21.811	-21.799	0.012	0
Cu(1)	2.94E-09						
	CuCl2-	2.46E-09	1.86E-09	-8.609	-8.73	-0.121	0
	CuCl3-2	4.78E-10	1.69E-10	-9.321	-9.771	-0.45	0
	Cu+	2.46E-12	1.79E-12	-11.609	-11.747	-0.138	0
Cu(2)	6.71E-08						
	Cu(OH)2	5.73E-08	5.89E-08	-7.242	-7.23	0.012	0
	CuCO3	8.07E-09	8.30E-09	-8.093	-8.081	0.012	0
	Cu(CO3)2-	1.34E-09	4.73E-10	-8.873	-9.325	-0.451	0
	CuOH+	1.30E-10	9.81E-11	-9.887	-10.008	-0.121	0
	Cu+2	8.97E-11	3.41E-11	-10.047	-10.467	-0.42	-25.9
	CuHCO3+	7.43E-11	5.73E-11	-10.129	-10.242	-0.113	0
	CuSO4	1.28E-11	1.32E-11	-10.893	-10.881	0.012	13.09
	CuCl+	6.97E-12	5.27E-12	-11.157	-11.278	-0.121	0.99
	Cu(OH)3-	1.32E-12	1.02E-12	-11.878	-11.991	-0.113	0
	CuCl2	1.58E-13	1.62E-13	-12.802	-12.79	0.012	31.02
	CuF+	9.21E-14	7.11E-14	-13.036	-13.148	-0.113	0
	Cu2(OH)2+	1.19E-14	4.21E-15	-13.924	-14.376	-0.451	0
	Cu(OH)4-2	1.66E-16	5.86E-17	-15.781	-16.232	-0.451	0
	CuCl3-	4.37E-17	3.30E-17	-16.36	-16.481	-0.121	0
	CuCl4-2	2.68E-20	9.49E-21	-19.573	-20.023	-0.45	0
F	2.10E-04						
	F-	1.53E-04	1.14E-04	-3.815	-3.941	-0.126	-1.02
	MgF+	5.33E-05	4.08E-05	-4.273	-4.39	-0.117	-10.39
	NaF	3.59E-06	3.69E-06	-5.445	-5.433	0.012	7.26
	HF	5.79E-10	5.95E-10	-9.237	-9.225	0.012	12.5
	ZnF+	3.18E-11	2.45E-11	-10.497	-10.61	-0.113	0
	MnF+	1.29E-11	9.95E-12	-10.89	-11.002	-0.113	0
	HF2-	3.39E-13	2.61E-13	-12.47	-12.583	-0.113	22.36

	FeF+	9.70E-14	7.48E-14	-13.013	-13.126	-0.113	0
	CuF+	9.21E-14	7.11E-14	-13.036	-13.148	-0.113	0
	FeF2+	6.69E-17	5.16E-17	-16.175	-16.287	-0.113	0
	FeF+2	3.19E-17	1.13E-17	-16.496	-16.946	-0.45	0
	FeF3	9.10E-18	9.36E-18	-17.041	-17.029	0.012	0
Fe(2)	3.05E-10						
	Fe+2	1.72E-10	6.54E-11	-9.765	-10.185	-0.42	-21.41
	FeCO3	6.91E-11	7.10E-11	-10.161	-10.149	0.012	0
	FeHCO3+	2.84E-11	2.19E-11	-10.547	-10.66	-0.113	0
	FeSO4	2.14E-11	2.20E-11	-10.671	-10.659	0.012	18.97
	FeOH+	7.70E-12	5.94E-12	-11.113	-11.226	-0.113	0
	FeCl+	6.71E-12	5.18E-12	-11.173	-11.286	-0.113	0
	FeF+	9.70E-14	7.48E-14	-13.013	-13.126	-0.113	0
	Fe(OH)2	1.42E-14	1.46E-14	-13.849	-13.837	0.012	0
	Fe(OH)3-	2.01E-16	1.55E-16	-15.696	-15.809	-0.113	0
	FeHSO4+	6.49E-19	5.00E-19	-18.188	-18.301	-0.113	0
Fe(3)	5.50E-07						
	Fe(OH)3	3.98E-07	4.09E-07	-6.401	-6.389	0.012	0
	Fe(OH)4-	1.38E-07	1.07E-07	-6.86	-6.97	-0.109	0
	Fe(OH)2+	1.42E-08	1.10E-08	-7.848	-7.957	-0.109	0
	FeOH+2	3.27E-13	1.16E-13	-12.486	-12.936	-0.45	0
	FeF2+	6.69E-17	5.16E-17	-16.175	-16.287	-0.113	0
	FeF+2	3.19E-17	1.13E-17	-16.496	-16.946	-0.45	0
	FeF3	9.10E-18	9.36E-18	-17.041	-17.029	0.012	0
	FeSO4+	1.68E-18	1.29E-18	-17.776	-17.889	-0.113	0
	Fe+3	3.81E-19	6.24E-20	-18.419	-19.205	-0.786	0
	FeCl+2	3.05E-19	1.08E-19	-18.516	-18.966	-0.45	0
	Fe(SO4)2-	6.92E-20	5.34E-20	-19.16	-19.272	-0.113	0
	FeCl2+	3.59E-20	2.77E-20	-19.445	-19.558	-0.113	0
	FeCl3	1.55E-22	1.59E-22	-21.811	-21.799	0.012	0
	Fe2(OH)2+	2.31E-23	3.62E-25	-22.636	-24.442	-1.806	0
	FeHSO4+2	3.39E-26	1.20E-26	-25.469	-25.921	-0.451	0
	Fe3(OH)4+	5.52E-28	8.34E-31	-27.258	-30.079	-2.821	0
H(0)	1.66E-28						
	H2	8.28E-29	8.51E-29	-28.082	-28.07	0.012	28.61
K	1.04E-03						
	K+	1.03E-03	7.71E-04	-2.988	-3.113	-0.125	9.26
	KSO4-	1.32E-05	1.02E-05	-4.881	-4.99	-0.109	34.4
Mg	1.68E-02						
	Mg+2	1.39E-02	5.39E-03	-1.858	-2.268	-0.411	-21.08
	MgSO4	2.32E-03	2.39E-03	-2.634	-2.622	0.012	5.84
	MgHCO3+	2.79E-04	2.11E-04	-3.554	-3.675	-0.121	5.67
	MgCO3	2.27E-04	2.33E-04	-3.645	-3.633	0.012	-17.09
	MgF+	5.33E-05	4.08E-05	-4.273	-4.39	-0.117	-10.39
	MgOH+	7.11E-06	5.63E-06	-5.148	-5.25	-0.102	0
Mn(2)	9.00E-08						
	MnCO3	4.40E-08	4.52E-08	-7.357	-7.345	0.012	0
	Mn+2	3.31E-08	1.26E-08	-7.481	-7.901	-0.42	-18
	MnHCO3+	4.86E-09	3.75E-09	-8.313	-8.426	-0.113	0
	MnSO4	4.10E-09	4.22E-09	-8.387	-8.375	0.012	22.54

	MnCl+	3.81E-09	2.94E-09	-8.42	-8.532	-0.113	-2.91
	MnOH+	1.20E-10	9.29E-11	-9.92	-10.032	-0.113	0
	MnCl2	7.15E-11	7.35E-11	-10.146	-10.134	0.012	85.89
	MnF+	1.29E-11	9.95E-12	-10.89	-11.002	-0.113	0
	MnCl3-	1.50E-12	1.16E-12	-11.823	-11.935	-0.113	43.94
	Mn(NO3)2	2.65E-16	2.73E-16	-15.576	-15.564	0.012	41.04
	Mn(OH)3-	6.14E-18	4.73E-18	-17.212	-17.325	-0.113	0
Mn(3)	2.37E-29						
	Mn+3	2.37E-29	3.88E-30	-28.625	-29.411	-0.786	0
N(-3)	1.10E-05						
	NH4+	9.65E-06	7.03E-06	-5.015	-5.153	-0.138	18.19
	NH3	1.12E-06	1.16E-06	-5.949	-5.937	0.012	24.42
	NH4SO4-	2.22E-07	1.71E-07	-6.654	-6.767	-0.113	38.2
N(5)	1.00E-04						
	NO3-	1.00E-04	7.38E-05	-4	-4.132	-0.132	29.8
	Mn(NO3)2	2.65E-16	2.73E-16	-15.576	-15.564	0.012	41.04
Na	7.32E-02						
	Na+	7.24E-02	5.61E-02	-1.14	-1.251	-0.111	-1.05
	NaSO4-	6.83E-04	5.31E-04	-3.166	-3.275	-0.109	16.59
	NaHCO3	1.03E-04	1.06E-04	-3.988	-3.976	0.012	1.8
	NaCO3-	6.13E-05	4.73E-05	-4.212	-4.325	-0.113	-0.17
	NaF	3.59E-06	3.69E-06	-5.445	-5.433	0.012	7.26
	NaOH	1.59E-17	1.63E-17	-16.799	-16.787	0.012	0
O(0)	1.11E-36						
	O2	5.56E-37	5.72E-37	-36.255	-36.243	0.012	30.4
S(6)	8.62E-03						
	SO4-2	5.39E-03	1.89E-03	-2.269	-2.724	-0.455	15.7
	MgSO4	2.32E-03	2.39E-03	-2.634	-2.622	0.012	5.84
	NaSO4-	6.83E-04	5.31E-04	-3.166	-3.275	-0.109	16.59
	CaSO4	2.16E-04	2.22E-04	-3.666	-3.654	0.012	7.5
	KSO4-	1.32E-05	1.02E-05	-4.881	-4.99	-0.109	34.4
	BaSO4	2.08E-06	2.14E-06	-5.682	-5.67	0.012	0
	NH4SO4-	2.22E-07	1.71E-07	-6.654	-6.767	-0.113	38.2
	ZnSO4	6.54E-09	6.72E-09	-8.185	-8.173	0.012	21.71
	MnSO4	4.10E-09	4.22E-09	-8.387	-8.375	0.012	22.54
	HSO4-	8.25E-10	6.37E-10	-9.083	-9.196	-0.113	40.56
	Zn(SO4)2-2	2.92E-10	1.03E-10	-9.535	-9.987	-0.451	-11.06
	FeSO4	2.14E-11	2.20E-11	-10.671	-10.659	0.012	18.97
	CuSO4	1.28E-11	1.32E-11	-10.893	-10.881	0.012	13.09
	CaHSO4+	6.55E-12	5.05E-12	-11.184	-11.296	-0.113	0
	FeSO4+	1.68E-18	1.29E-18	-17.776	-17.889	-0.113	0
	FeHSO4+	6.49E-19	5.00E-19	-18.188	-18.301	-0.113	0
	Fe(SO4)2-	6.92E-20	5.34E-20	-19.16	-19.272	-0.113	0
	FeHSO4+2	3.39E-26	1.20E-26	-25.469	-25.921	-0.451	0
Zn	6.00E-07						
	Zn(CO3)2-2	3.76E-07	1.33E-07	-6.425	-6.877	-0.451	0
	ZnCO3	1.34E-07	1.37E-07	-6.875	-6.863	0.012	0
	Zn+2	4.28E-08	1.52E-08	-7.368	-7.819	-0.45	-24.63
	Zn(OH)2	1.54E-08	1.58E-08	-7.813	-7.801	0.012	0
	ZnHCO3+	8.30E-09	6.40E-09	-8.081	-8.194	-0.113	0

ZnOHCl	8.06E-09	8.29E-09	-8.094	-8.082	0.012	0
ZnSO4	6.54E-09	6.72E-09	-8.185	-8.173	0.012	21.71
ZnOH+	6.21E-09	4.79E-09	-8.207	-8.32	-0.113	0
ZnCl+	3.10E-09	2.34E-09	-8.509	-8.63	-0.121	-14.13
Zn(SO4)2-2	2.92E-10	1.03E-10	-9.535	-9.987	-0.451	-11.06
ZnCl2	1.37E-10	1.41E-10	-9.864	-9.852	0.012	102.03
ZnF+	3.18E-11	2.45E-11	-10.497	-10.61	-0.113	0
Zn(OH)3-	1.86E-11	1.44E-11	-10.73	-10.843	-0.113	0
ZnCl3-	1.20E-11	9.05E-12	-10.922	-11.043	-0.121	16.35
ZnCl4-2	7.34E-13	2.60E-13	-12.134	-12.585	-0.45	146.74
Zn(OH)4-2	1.85E-15	6.55E-16	-14.733	-15.184	-0.451	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.63	-5.9	-4.28	CaSO4			
Aragonite	0.81	-7.52	-8.34	CaCO3			
Barite	1.47	-8.37	-9.84	BaSO4			
Calcite	0.96	-7.52	-8.48	CaCO3			
CO2(g)	-3.11	-4.58	-1.47	CO2			
Dolomite	2.95	-14.14	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.28	6.17	4.89	Fe(OH)3			
Fluorite	-0.46	-11.06	-10.6	CaF2			
Goethite	7.17	6.17	-1	FeOOH			
Gypsum	-1.32	-5.91	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-4.06	-2.49	1.57	NaCl			
Hausmann	-9.06	51.97	61.03	Mn3O4			
Hematite	16.35	12.35	-4.01	Fe2O3			
Jarosite-K	-6.21	-15.42	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.86	21.48	25.34	MnOOH			
Melanterit	-10.71	-12.92	-2.21	FeSO4:7H2O			
NH3(g)	-7.73	-5.94	1.8	NH3			
O2(g)	-33.35	-36.24	-2.89	O2			
Pyrochroit	-6.18	9.02	15.2	Mn(OH)2			
Pyrolusite	-7.44	33.94	41.38	MnO2:H2O			
Rhodochro	-1.11	-12.24	-11.13	MnCO3			
Siderite	-3.64	-14.53	-10.89	FeCO3			
Smithsonit	-2.16	-12.16	-10	ZnCO3			
Sylvite	-5.25	-4.35	0.9	KCl			
Witherite	-1.43	-9.99	-8.56	BaCO3			
Zn(OH)2(e	-2.4	9.1	11.5	Zn(OH)2			

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 13

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	6.10E-03	6.10E-03
Ba	9.61E-06	9.61E-06
Ca	2.24E-03	2.24E-03
Cl	8.21E-02	8.21E-02
Cu	7.00E-08	7.00E-08
F	2.30E-04	2.30E-04
Fe	5.90E-07	5.90E-07
K	1.12E-03	1.12E-03
Mg	1.81E-02	1.81E-02
Mn	1.00E-07	1.00E-07
N(-3)	1.20E-05	1.20E-05
N(5)	1.00E-04	1.00E-04
Na	7.89E-02	7.89E-02
S(6)	9.29E-03	9.29E-03
Zn	6.40E-07	6.40E-07

#NAME? of solution----------

pH	=	8.46			
pe	=	4			
Specific	Conductan	(µS/cm,	25°C)	=	10623
Density	(g/cm³)	=	1.00224		
Volume	(L)	=	1.00429		
Activity	of	water	=	0.997	
Ionic	strength	(mol/kgw)	=	1.29E-01	
Mass	of	water	(kg)	=	1.00E+00
Total	carbon	(mol/kg)	=	5.61E-03	
Total	CO2	(mol/kg)	=	5.61E-03	
Temperatu	(°C)	=	25		
Electrical	balance	(eq)	=	1.37E-02	
Percent	error,	100*(Cat-|	=	6.42	
Iterations	=	9	(111	overall)	
Total	H	=	1.11E+02		
Total	O	=	5.56E+01		

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4331	0.2622		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol

	OH-	3.92E-06	2.91E-06	-5.407	-5.536	-0.13	-3.66
	H+	4.25E-09	3.47E-09	-8.371	-8.46	-0.089	0
	H2O	5.55E+01	9.97E-01	1.744	-0.001	0	18.07
Ba	9.61E-06						
	Ba+2	7.17E-06	2.39E-06	-5.144	-5.623	-0.478	-11.9
	BaSO4	2.28E-06	2.35E-06	-5.643	-5.63	0.013	0
	BaHCO3+	1.06E-07	8.12E-08	-6.976	-7.091	-0.115	0
	BaCO3	5.74E-08	5.92E-08	-7.241	-7.228	0.013	-10.7
	BaOH+	3.03E-11	2.32E-11	-10.519	-10.634	-0.115	0
C(4)	5.61E-03						
	HCO3-	4.59E-03	3.55E-03	-2.338	-2.45	-0.112	25.29
	MgHCO3+	3.14E-04	2.36E-04	-3.503	-3.627	-0.124	5.68
	MgCO3	2.53E-04	2.60E-04	-3.597	-3.584	0.013	-17.09
	CO3-2	1.35E-04	4.80E-05	-3.871	-4.319	-0.448	-3.97
	NaHCO3	1.17E-04	1.20E-04	-3.934	-3.921	0.013	1.8
	NaCO3-	7.01E-05	5.38E-05	-4.155	-4.27	-0.115	-0.12
	CaCO3	5.44E-05	5.60E-05	-4.265	-4.252	0.013	-14.6
	CaHCO3+	4.03E-05	3.15E-05	-4.395	-4.502	-0.107	9.85
	CO2	2.70E-05	2.78E-05	-4.569	-4.556	0.013	34.43
	Zn(CO3)2-2	4.14E-07	1.44E-07	-6.383	-6.843	-0.46	0
	ZnCO3	1.36E-07	1.40E-07	-6.867	-6.854	0.013	0
	BaHCO3+	1.06E-07	8.12E-08	-6.976	-7.091	-0.115	0
	BaCO3	5.74E-08	5.92E-08	-7.241	-7.228	0.013	-10.7
	MnCO3	4.95E-08	5.10E-08	-7.306	-7.293	0.013	0
	ZnHCO3+	8.50E-09	6.53E-09	-8.07	-8.185	-0.115	0
	CuCO3	8.42E-09	8.67E-09	-8.075	-8.062	0.013	0
	MnHCO3+	5.51E-09	4.23E-09	-8.259	-8.374	-0.115	0
	Cu(CO3)2-	1.51E-09	5.24E-10	-8.82	-9.28	-0.46	0
	FeCO3	7.85E-11	8.08E-11	-10.105	-10.092	0.013	0
	CuHCO3+	7.80E-11	5.98E-11	-10.108	-10.223	-0.115	0
	FeHCO3+	3.25E-11	2.49E-11	-10.488	-10.604	-0.115	0
	(CO2)2	1.37E-11	1.42E-11	-10.862	-10.849	0.013	68.87
Ca	2.24E-03						
	Ca+2	1.91E-03	6.94E-04	-2.719	-3.159	-0.44	-17.36
	CaSO4	2.35E-04	2.42E-04	-3.629	-3.616	0.013	7.5
	CaCO3	5.44E-05	5.60E-05	-4.265	-4.252	0.013	-14.6
	CaHCO3+	4.03E-05	3.15E-05	-4.395	-4.502	-0.107	9.85
	CaOH+	4.32E-08	3.31E-08	-7.365	-7.48	-0.115	0
	CaHSO4+	7.19E-12	5.52E-12	-11.143	-11.258	-0.115	0
Cl	8.21E-02						
	Cl-	8.21E-02	6.14E-02	-1.086	-1.212	-0.126	18.38
	ZnOHCl	8.28E-09	8.53E-09	-8.082	-8.069	0.013	0
	MnCl+	4.36E-09	3.34E-09	-8.361	-8.476	-0.115	-2.91
	ZnCl+	3.21E-09	2.41E-09	-8.493	-8.618	-0.124	-14.16
	CuCl2-	2.80E-09	2.10E-09	-8.553	-8.677	-0.124	0
	CuCl3-2	5.91E-10	2.05E-10	-9.228	-9.689	-0.461	0
	ZnCl2	1.50E-10	1.55E-10	-9.823	-9.81	0.013	102.03
	MnCl2	8.69E-11	8.95E-11	-10.061	-10.048	0.013	85.89
	ZnCl3-	1.42E-11	1.07E-11	-10.847	-10.972	-0.124	16.29
	FeCl+	7.75E-12	5.95E-12	-11.111	-11.226	-0.115	0

	CuCl+	7.40E-12	5.56E-12	-11.131	-11.255	-0.124	1.01
	MnCl3-	1.97E-12	1.51E-12	-11.705	-11.82	-0.115	43.98
	ZnCl4-2	9.49E-13	3.28E-13	-12.023	-12.484	-0.461	146.82
	CuCl2	1.78E-13	1.83E-13	-12.75	-12.737	0.013	31.02
	CuCl3-	5.31E-17	3.99E-17	-16.275	-16.399	-0.124	0
	FeCl+2	3.59E-19	1.24E-19	-18.445	-18.906	-0.461	0
	FeCl2+	4.44E-20	3.41E-20	-19.353	-19.468	-0.115	0
	CuCl4-2	3.55E-20	1.23E-20	-19.45	-19.911	-0.461	0
	FeCl3	2.03E-22	2.09E-22	-21.693	-21.68	0.013	0
Cu(1)	3.39E-09						
	CuCl2-	2.80E-09	2.10E-09	-8.553	-8.677	-0.124	0
	CuCl3-2	5.91E-10	2.05E-10	-9.228	-9.689	-0.461	0
	Cu+	2.44E-12	1.77E-12	-11.612	-11.753	-0.141	0
Cu(2)	6.66E-08						
	Cu(OH)2	5.64E-08	5.81E-08	-7.249	-7.236	0.013	0
	CuCO3	8.42E-09	8.67E-09	-8.075	-8.062	0.013	0
	Cu(CO3)2-	1.51E-09	5.24E-10	-8.82	-9.28	-0.46	0
	CuOH+	1.29E-10	9.67E-11	-9.89	-10.015	-0.124	0
	Cu+2	9.03E-11	3.36E-11	-10.044	-10.473	-0.429	-25.88
	CuHCO3+	7.80E-11	5.98E-11	-10.108	-10.223	-0.115	0
	CuSO4	1.31E-11	1.35E-11	-10.884	-10.871	0.013	13.09
	CuCl+	7.40E-12	5.56E-12	-11.131	-11.255	-0.124	1.01
	Cu(OH)3-	1.31E-12	1.01E-12	-11.883	-11.998	-0.115	0
	CuCl2	1.78E-13	1.83E-13	-12.75	-12.737	0.013	31.02
	CuF+	9.78E-14	7.50E-14	-13.01	-13.125	-0.115	0
	Cu2(OH)2+	1.18E-14	4.09E-15	-13.928	-14.388	-0.46	0
	Cu(OH)4-2	1.66E-16	5.77E-17	-15.779	-16.239	-0.46	0
	CuCl3-	5.31E-17	3.99E-17	-16.275	-16.399	-0.124	0
	CuCl4-2	3.55E-20	1.23E-20	-19.45	-19.911	-0.461	0
F	2.30E-04						
	F-	1.65E-04	1.23E-04	-3.782	-3.912	-0.13	-1.01
	MgF+	6.06E-05	4.60E-05	-4.217	-4.337	-0.12	-10.38
	NaF	4.12E-06	4.24E-06	-5.385	-5.373	0.013	7.26
	HF	6.19E-10	6.38E-10	-9.208	-9.195	0.013	12.5
	ZnF+	3.30E-11	2.53E-11	-10.482	-10.597	-0.115	0
	MnF+	1.48E-11	1.13E-11	-10.83	-10.946	-0.115	0
	HF2-	3.91E-13	3.00E-13	-12.408	-12.523	-0.115	22.37
	FeF+	1.12E-13	8.60E-14	-12.95	-13.065	-0.115	0
	CuF+	9.78E-14	7.50E-14	-13.01	-13.125	-0.115	0
	FeF2+	8.29E-17	6.36E-17	-16.082	-16.197	-0.115	0
	FeF+2	3.76E-17	1.30E-17	-16.424	-16.885	-0.461	0
	FeF3	1.20E-17	1.24E-17	-16.921	-16.908	0.013	0
Fe(2)	3.39E-10						
	Fe+2	1.89E-10	7.02E-11	-9.725	-10.154	-0.429	-21.39
	FeCO3	7.85E-11	8.08E-11	-10.105	-10.092	0.013	0
	FeHCO3+	3.25E-11	2.49E-11	-10.488	-10.604	-0.115	0
	FeSO4	2.38E-11	2.45E-11	-10.624	-10.611	0.013	18.97
	FeOH+	8.32E-12	6.38E-12	-11.08	-11.195	-0.115	0
	FeCl+	7.75E-12	5.95E-12	-11.111	-11.226	-0.115	0
	FeF+	1.12E-13	8.60E-14	-12.95	-13.065	-0.115	0

	Fe(OH)2	1.52E-14	1.56E-14	-13.82	-13.807	0.013	0
	Fe(OH)3-	2.17E-16	1.67E-16	-15.663	-15.778	-0.115	0
	FeHSO4+	7.27E-19	5.58E-19	-18.138	-18.253	-0.115	0
Fe(3)	5.90E-07						
	Fe(OH)3	4.26E-07	4.38E-07	-6.371	-6.358	0.013	0
	Fe(OH)4-	1.49E-07	1.15E-07	-6.828	-6.94	-0.112	0
	Fe(OH)2+	1.53E-08	1.18E-08	-7.815	-7.927	-0.112	0
	FeOH+2	3.60E-13	1.24E-13	-12.444	-12.905	-0.461	0
	FeF2+	8.29E-17	6.36E-17	-16.082	-16.197	-0.115	0
	FeF+2	3.76E-17	1.30E-17	-16.424	-16.885	-0.461	0
	FeF3	1.20E-17	1.24E-17	-16.921	-16.908	0.013	0
	FeSO4+	1.88E-18	1.44E-18	-17.726	-17.841	-0.115	0
	Fe+3	4.23E-19	6.70E-20	-18.374	-19.174	-0.8	0
	FeCl+2	3.59E-19	1.24E-19	-18.445	-18.906	-0.461	0
	Fe(SO4)2-	8.06E-20	6.19E-20	-19.094	-19.209	-0.115	0
	FeCl2+	4.44E-20	3.41E-20	-19.353	-19.468	-0.115	0
	FeCl3	2.03E-22	2.09E-22	-21.693	-21.68	0.013	0
	Fe2(OH)2+	2.89E-23	4.16E-25	-22.54	-24.38	-1.841	0
	FeHSO4+2	3.86E-26	1.34E-26	-25.413	-25.873	-0.46	0
	Fe3(OH)4+	7.74E-28	1.03E-30	-27.111	-29.987	-2.876	0
H(0)	1.65E-28						
	H2	8.26E-29	8.51E-29	-28.083	-28.07	0.013	28.61
K	1.12E-03						
	K+	1.11E-03	8.24E-04	-2.957	-3.084	-0.128	9.27
	KSO4-	1.47E-05	1.14E-05	-4.833	-4.945	-0.112	34.41
Mg	1.81E-02						
	Mg+2	1.49E-02	5.68E-03	-1.827	-2.245	-0.419	-21.06
	MgSO4	2.54E-03	2.61E-03	-2.596	-2.583	0.013	5.84
	MgHCO3+	3.14E-04	2.36E-04	-3.503	-3.627	-0.124	5.68
	MgCO3	2.53E-04	2.60E-04	-3.597	-3.584	0.013	-17.09
	MgF+	6.06E-05	4.60E-05	-4.217	-4.337	-0.12	-10.38
	MgOH+	7.53E-06	5.93E-06	-5.123	-5.227	-0.104	0
Mn(2)	1.00E-07						
	MnCO3	4.95E-08	5.10E-08	-7.306	-7.293	0.013	0
	Mn+2	3.59E-08	1.34E-08	-7.445	-7.874	-0.429	-17.94
	MnHCO3+	5.51E-09	4.23E-09	-8.259	-8.374	-0.115	0
	MnSO4	4.53E-09	4.66E-09	-8.344	-8.331	0.013	22.54
	MnCl+	4.36E-09	3.34E-09	-8.361	-8.476	-0.115	-2.91
	MnOH+	1.29E-10	9.87E-11	-9.89	-10.006	-0.115	0
	MnCl2	8.69E-11	8.95E-11	-10.061	-10.048	0.013	85.89
	MnF+	1.48E-11	1.13E-11	-10.83	-10.946	-0.115	0
	MnCl3-	1.97E-12	1.51E-12	-11.705	-11.82	-0.115	43.98
	Mn(NO3)2	2.77E-16	2.85E-16	-15.558	-15.545	0.013	41.04
	Mn(OH)3-	6.56E-18	5.03E-18	-17.183	-17.298	-0.115	0
Mn(3)	2.60E-29						
	Mn+3	2.60E-29	4.13E-30	-28.584	-29.384	-0.8	0
N(-3)	1.20E-05						
	NH4+	1.05E-05	7.61E-06	-4.977	-5.119	-0.141	18.2
	NH3	1.21E-06	1.25E-06	-5.916	-5.903	0.013	24.42
	NH4SO4-	2.51E-07	1.92E-07	-6.601	-6.716	-0.115	38.23

N(5)	1.00E-04						
	NO3-	1.00E-04	7.32E-05	-4	-4.135	-0.135	29.81
	Mn(NO3)2	2.77E-16	2.85E-16	-15.558	-15.545	0.013	41.04
Na	7.89E-02						
	Na+	7.80E-02	6.01E-02	-1.108	-1.221	-0.113	-1.04
	NaSO4-	7.65E-04	5.91E-04	-3.117	-3.228	-0.112	16.72
	NaHCO3	1.17E-04	1.20E-04	-3.934	-3.921	0.013	1.8
	NaCO3-	7.01E-05	5.38E-05	-4.155	-4.27	-0.115	-0.12
	NaF	4.12E-06	4.24E-06	-5.385	-5.373	0.013	7.26
	NaOH	1.70E-17	1.75E-17	-16.77	-16.757	0.013	0
O(0)	1.11E-36						
	O2	5.55E-37	5.72E-37	-36.256	-36.243	0.013	30.4
S(6)	9.29E-03						
	SO4-2	5.74E-03	1.96E-03	-2.241	-2.707	-0.466	15.75
	MgSO4	2.54E-03	2.61E-03	-2.596	-2.583	0.013	5.84
	NaSO4-	7.65E-04	5.91E-04	-3.117	-3.228	-0.112	16.72
	CaSO4	2.35E-04	2.42E-04	-3.629	-3.616	0.013	7.5
	KSO4-	1.47E-05	1.14E-05	-4.833	-4.945	-0.112	34.41
	BaSO4	2.28E-06	2.35E-06	-5.643	-5.63	0.013	0
	NH4SO4-	2.51E-07	1.92E-07	-6.601	-6.716	-0.115	38.23
	ZnSO4	6.52E-09	6.71E-09	-8.186	-8.173	0.013	21.71
	MnSO4	4.53E-09	4.66E-09	-8.344	-8.331	0.013	22.54
	HSO4-	8.62E-10	6.61E-10	-9.065	-9.18	-0.115	40.57
	Zn(SO4)2-2	3.09E-10	1.07E-10	-9.51	-9.971	-0.46	-10.95
	FeSO4	2.38E-11	2.45E-11	-10.624	-10.611	0.013	18.97
	CuSO4	1.31E-11	1.35E-11	-10.884	-10.871	0.013	13.09
	CaHSO4+	7.19E-12	5.52E-12	-11.143	-11.258	-0.115	0
	FeSO4+	1.88E-18	1.44E-18	-17.726	-17.841	-0.115	0
	FeHSO4+	7.27E-19	5.58E-19	-18.138	-18.253	-0.115	0
	Fe(SO4)2-	8.06E-20	6.19E-20	-19.094	-19.209	-0.115	0
	FeHSO4+2	3.86E-26	1.34E-26	-25.413	-25.873	-0.46	0
Zn	6.40E-07						
	Zn(CO3)2-2	4.14E-07	1.44E-07	-6.383	-6.843	-0.46	0
	ZnCO3	1.36E-07	1.40E-07	-6.867	-6.854	0.013	0
	Zn+2	4.22E-08	1.46E-08	-7.375	-7.836	-0.461	-24.61
	Zn(OH)2	1.47E-08	1.52E-08	-7.831	-7.819	0.013	0
	ZnHCO3+	8.50E-09	6.53E-09	-8.07	-8.185	-0.115	0
	ZnOHCl	8.28E-09	8.53E-09	-8.082	-8.069	0.013	0
	ZnSO4	6.52E-09	6.71E-09	-8.186	-8.173	0.013	21.71
	ZnOH+	6.00E-09	4.60E-09	-8.222	-8.337	-0.115	0
	ZnCl+	3.21E-09	2.41E-09	-8.493	-8.618	-0.124	-14.16
	Zn(SO4)2-2	3.09E-10	1.07E-10	-9.51	-9.971	-0.46	-10.95
	ZnCl2	1.50E-10	1.55E-10	-9.823	-9.81	0.013	102.03
	ZnF+	3.30E-11	2.53E-11	-10.482	-10.597	-0.115	0
	Zn(OH)3-	1.80E-11	1.38E-11	-10.745	-10.86	-0.115	0
	ZnCl3-	1.42E-11	1.07E-11	-10.847	-10.972	-0.124	16.29
	ZnCl4-2	9.49E-13	3.28E-13	-12.023	-12.484	-0.461	146.82
	Zn(OH)4-2	1.81E-15	6.29E-16	-14.741	-15.201	-0.46	0

#NAME? indices----------

Phase	SI**	log IAP	log K(298 K, 1	
Anhydrite	-1.59	-5.87	-4.28	CaSO4
Aragonite	0.86	-7.48	-8.34	CaCO3
Barite	1.51	-8.33	-9.84	BaSO4
Calcite	1	-7.48	-8.48	CaCO3
CO2(g)	-3.09	-4.56	-1.47	CO2
Dolomite	3.04	-14.04	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.31	6.2	4.89	Fe(OH)3
Fluorite	-0.38	-10.98	-10.6	CaF2
Goethite	7.2	6.2	-1	FeOOH
Gypsum	-1.29	-5.87	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-4	-2.43	1.57	NaCl
Hausmann	-8.98	52.05	61.03	Mn3O4
Hematite	16.42	12.41	-4.01	Fe2O3
Jarosite-K	-6.06	-15.27	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.84	21.5	25.34	MnOOH
Melanterit	-10.66	-12.87	-2.21	FeSO4:7H2O
NH3(g)	-7.7	-5.9	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.16	9.04	15.2	Mn(OH)2
Pyrolusite	-7.42	33.96	41.38	MnO2:H2O
Rhodochro	-1.06	-12.19	-11.13	MnCO3
Siderite	-3.58	-14.47	-10.89	FeCO3
Smithsonit	-2.15	-12.15	-10	ZnCO3
Sylvite	-5.2	-4.3	0.9	KCl
Witherite	-1.38	-9.94	-8.56	BaCO3
Zn(OH)2(e	-2.42	9.08	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 14

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	6.55E-03	6.55E-03
Ba	1.04E-05	1.04E-05
Ca	2.40E-03	2.40E-03
Cl	8.80E-02	8.80E-02
Cu	8.00E-08	8.00E-08
F	2.50E-04	2.50E-04
Fe	6.30E-07	6.30E-07
K	1.20E-03	1.20E-03
Mg	1.94E-02	1.94E-02

```
        Mn          1.10E-07   1.10E-07
        N(-3)       1.30E-05   1.30E-05
        N(5)        1.10E-04   1.10E-04
        Na          8.47E-02   8.47E-02
        S(6)        9.97E-03   9.97E-03
        Zn          6.90E-07   6.90E-07

#NAME?  of          solution----------------------------

        pH          =                 8.46
        pe          =                    4
        Specific    Conductan (µS/cm,     25°C)      =                 11318
        Density     (g/cm³)   =             1.00261
        Volume      (L)       =             1.00439
        Activity    of        water       =                 0.996
        Ionic       strength  (mol/kgw)   =             1.38E-01
        Mass        of        water       (kg)       =            1.00E+00
        Total       carbon    (mol/kg)    =             6.00E-03
        Total       CO2       (mol/kg)    =             6.00E-03
        Temperatu   (°C)      =                   25
        Electrical  balance   (eq)        =             1.46E-02
        Percent     error,    100*(Cat-|  =                 6.41
        Iterations  =                  9  (120       overall)
        Total       H         =            1.11E+02
        Total       O         =            5.56E+01

#NAME?  couples--------------------------------

        Redox       couple    pe          Eh          (volts)

        N(-3)/N(5)     4.434     0.2623

#NAME?  of          species----------------------------

        Log         Log       Log         mole        V
        Species     Molality  Activity    Molality    Activity    Gamma    cm³/mol

        OH-         3.95E-06  2.91E-06     -5.404      -5.536     -0.133     -3.64
        H+          4.27E-09  3.47E-09      -8.37      -8.46      -0.09        0
        H2O         5.55E+01  9.97E-01      1.744      -0.002        0      18.07
Ba        1.04E-05
        Ba+2        7.71E-06  2.50E-06     -5.113      -5.601     -0.488    -11.88
        BaSO4       2.47E-06  2.55E-06     -5.607      -5.593      0.014        0
        BaHCO3+     1.18E-07  8.99E-08     -6.929      -7.046     -0.117        0
        BaCO3       6.35E-08  6.56E-08     -7.197      -7.183      0.014     -10.7
        BaOH+       3.20E-11  2.44E-11    -10.495     -10.613     -0.118        0
C(4)      6.00E-03
        HCO3-       4.88E-03  3.75E-03     -2.312      -2.426     -0.114     25.32
        MgHCO3+     3.51E-04  2.62E-04     -3.455      -3.582     -0.127      5.68
        MgCO3       2.80E-04  2.89E-04     -3.554       -3.54      0.014    -17.09
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	CO3-2	1.45E-04	5.07E-05	-3.838	-4.295	-0.457	-3.92
	NaHCO3	1.31E-04	1.35E-04	-3.883	-3.869	0.014	1.8
	NaCO3-	7.92E-05	6.05E-05	-4.101	-4.218	-0.117	-0.06
	CaCO3	6.00E-05	6.19E-05	-4.222	-4.208	0.014	-14.6
	CaHCO3+	4.47E-05	3.48E-05	-4.349	-4.459	-0.109	9.86
	CO2	2.84E-05	2.93E-05	-4.547	-4.533	0.014	34.43
	Zn(CO3)2-2	4.60E-07	1.56E-07	-6.337	-6.806	-0.468	0
	ZnCO3	1.40E-07	1.44E-07	-6.854	-6.841	0.014	0
	BaHCO3+	1.18E-07	8.99E-08	-6.929	-7.046	-0.117	0
	BaCO3	6.35E-08	6.56E-08	-7.197	-7.183	0.014	-10.7
	MnCO3	5.50E-08	5.68E-08	-7.259	-7.246	0.014	0
	CuCO3	9.98E-09	1.03E-08	-8.001	-7.987	0.014	0
	ZnHCO3+	8.82E-09	6.74E-09	-8.055	-8.172	-0.117	0
	MnHCO3+	6.18E-09	4.71E-09	-8.209	-8.327	-0.118	0
	Cu(CO3)2-	1.93E-09	6.58E-10	-8.714	-9.182	-0.468	0
	CuHCO3+	9.31E-11	7.11E-11	-10.031	-10.148	-0.117	0
	FeCO3	8.83E-11	9.12E-11	-10.054	-10.04	0.014	0
	FeHCO3+	3.68E-11	2.81E-11	-10.434	-10.551	-0.117	0
	(CO2)2	1.53E-11	1.58E-11	-10.816	-10.802	0.014	68.87
Ca	2.40E-03						
	Ca+2	2.04E-03	7.27E-04	-2.69	-3.138	-0.448	-17.33
	CaSO4	2.55E-04	2.63E-04	-3.594	-3.58	0.014	7.5
	CaCO3	6.00E-05	6.19E-05	-4.222	-4.208	0.014	-14.6
	CaHCO3+	4.47E-05	3.48E-05	-4.349	-4.459	-0.109	9.86
	CaOH+	4.54E-08	3.47E-08	-7.343	-7.46	-0.117	0
	CaHSO4+	7.85E-12	6.00E-12	-11.105	-11.222	-0.117	0
Cl	8.80E-02						
	Cl-	8.80E-02	6.54E-02	-1.056	-1.185	-0.129	18.39
	ZnOHCl	8.60E-09	8.88E-09	-8.065	-8.052	0.014	0
	MnCl+	4.93E-09	3.76E-09	-8.307	-8.425	-0.118	-2.9
	CuCl2-	3.60E-09	2.69E-09	-8.444	-8.571	-0.127	0
	ZnCl+	3.37E-09	2.51E-09	-8.473	-8.6	-0.127	-14.18
	CuCl3-2	8.23E-10	2.78E-10	-9.085	-9.556	-0.471	0
	ZnCl2	1.67E-10	1.72E-10	-9.778	-9.765	0.014	102.03
	MnCl2	1.04E-10	1.07E-10	-9.983	-9.97	0.014	85.89
	ZnCl3-	1.69E-11	1.26E-11	-10.772	-10.899	-0.127	16.24
	CuCl+	8.93E-12	6.66E-12	-11.049	-11.176	-0.127	1.02
	FeCl+	8.86E-12	6.77E-12	-11.053	-11.17	-0.117	0
	MnCl3-	2.53E-12	1.93E-12	-11.597	-11.714	-0.118	44.01
	ZnCl4-2	1.22E-12	4.13E-13	-11.913	-12.384	-0.471	146.89
	CuCl2	2.27E-13	2.34E-13	-12.645	-12.631	0.014	31.02
	CuCl3-	7.27E-17	5.43E-17	-16.138	-16.266	-0.127	0
	FeCl+2	4.18E-19	1.41E-19	-18.379	-18.85	-0.471	0
	FeCl2+	5.41E-20	4.13E-20	-19.266	-19.384	-0.118	0
	CuCl4-2	5.26E-20	1.78E-20	-19.279	-19.75	-0.471	0
	FeCl3	2.62E-22	2.70E-22	-21.583	-21.569	0.014	0
Cu(1)	4.43E-09						
	CuCl2-	3.60E-09	2.69E-09	-8.444	-8.571	-0.127	0
	CuCl3-2	8.23E-10	2.78E-10	-9.085	-9.556	-0.471	0
	Cu+	2.78E-12	1.99E-12	-11.557	-11.702	-0.145	0

Cu(2)	7.56E-08						
	Cu(OH)2	6.33E-08	6.53E-08	-7.199	-7.185	0.014	0
	CuCO3	9.98E-09	1.03E-08	-8.001	-7.987	0.014	0
	Cu(CO3)2-	1.93E-09	6.58E-10	-8.714	-9.182	-0.468	0
	CuOH+	1.46E-10	1.09E-10	-9.836	-9.963	-0.127	0
	Cu+2	1.04E-10	3.79E-11	-9.984	-10.422	-0.438	-25.87
	CuHCO3+	9.31E-11	7.11E-11	-10.031	-10.148	-0.117	0
	CuSO4	1.52E-11	1.57E-11	-10.817	-10.803	0.014	13.09
	CuCl+	8.93E-12	6.66E-12	-11.049	-11.176	-0.127	1.02
	Cu(OH)3-	1.48E-12	1.13E-12	-11.829	-11.946	-0.117	0
	CuCl2	2.27E-13	2.34E-13	-12.645	-12.631	0.014	31.02
	CuF+	1.18E-13	8.99E-14	-12.929	-13.046	-0.117	0
	Cu2(OH)2+	1.52E-14	5.18E-15	-13.817	-14.286	-0.468	0
	Cu(OH)4-2	1.91E-16	6.49E-17	-15.72	-16.188	-0.468	0
	CuCl3-	7.27E-17	5.43E-17	-16.138	-16.266	-0.127	0
	CuCl4-2	5.26E-20	1.78E-20	-19.279	-19.75	-0.471	0
F	2.50E-04						
	F-	1.77E-04	1.31E-04	-3.752	-3.884	-0.133	-1
	MgF+	6.82E-05	5.14E-05	-4.166	-4.289	-0.122	-10.38
	NaF	4.66E-06	4.81E-06	-5.331	-5.317	0.014	7.26
	HF	6.57E-10	6.79E-10	-9.182	-9.168	0.014	12.5
	ZnF+	3.45E-11	2.63E-11	-10.463	-10.58	-0.117	0
	MnF+	1.67E-11	1.27E-11	-10.777	-10.895	-0.118	0
	HF2-	4.45E-13	3.40E-13	-12.352	-12.469	-0.117	22.38
	FeF+	1.28E-13	9.79E-14	-12.892	-13.009	-0.117	0
	CuF+	1.18E-13	8.99E-14	-12.929	-13.046	-0.117	0
	FeF2+	1.01E-16	7.70E-17	-15.996	-16.114	-0.118	0
	FeF+2	4.38E-17	1.48E-17	-16.359	-16.829	-0.471	0
	FeF3	1.54E-17	1.59E-17	-16.812	-16.798	0.014	0
Fe(2)	3.75E-10						
	Fe+2	2.05E-10	7.50E-11	-9.687	-10.125	-0.438	-21.37
	FeCO3	8.83E-11	9.12E-11	-10.054	-10.04	0.014	0
	FeHCO3+	3.68E-11	2.81E-11	-10.434	-10.551	-0.117	0
	FeSO4	2.63E-11	2.71E-11	-10.58	-10.567	0.014	18.97
	FeOH+	8.94E-12	6.82E-12	-11.049	-11.167	-0.118	0
	FeCl+	8.86E-12	6.77E-12	-11.053	-11.17	-0.117	0
	FeF+	1.28E-13	9.79E-14	-12.892	-13.009	-0.117	0
	Fe(OH)2	1.62E-14	1.67E-14	-13.792	-13.778	0.014	0
	Fe(OH)3-	2.33E-16	1.78E-16	-15.632	-15.75	-0.118	0
	FeHSO4+	8.10E-19	6.18E-19	-18.092	-18.209	-0.117	0
Fe(3)	6.30E-07						
	Fe(OH)3	4.54E-07	4.68E-07	-6.343	-6.33	0.014	0
	Fe(OH)4-	1.60E-07	1.23E-07	-6.797	-6.911	-0.114	0
	Fe(OH)2+	1.65E-08	1.27E-08	-7.784	-7.898	-0.114	0
	FeOH+2	3.93E-13	1.33E-13	-12.406	-12.877	-0.471	0
	FeF2+	1.01E-16	7.70E-17	-15.996	-16.114	-0.118	0
	FeF+2	4.38E-17	1.48E-17	-16.359	-16.829	-0.471	0
	FeF3	1.54E-17	1.59E-17	-16.812	-16.798	0.014	0
	FeSO4+	2.09E-18	1.60E-18	-17.679	-17.797	-0.118	0
	Fe+3	4.65E-19	7.16E-20	-18.332	-19.145	-0.813	0

	FeCl+2	4.18E-19	1.41E-19	-18.379	-18.85	-0.471	0
	Fe(SO4)2-	9.31E-20	7.11E-20	-19.031	-19.148	-0.117	0
	FeCl2+	5.41E-20	4.13E-20	-19.266	-19.384	-0.118	0
	FeCl3	2.62E-22	2.70E-22	-21.583	-21.569	0.014	0
	Fe2(OH)2+	3.55E-23	4.75E-25	-22.45	-24.323	-1.873	0
	FeHSO4+2	4.36E-26	1.48E-26	-25.361	-25.829	-0.468	0
	Fe3(OH)4+	1.06E-27	1.26E-30	-26.975	-29.901	-2.926	0
H(0)	1.65E-28						
	H2	8.25E-29	8.51E-29	-28.084	-28.07	0.014	28.61
K	1.20E-03						
	K+	1.18E-03	8.76E-04	-2.927	-3.057	-0.131	9.28
	KSO4-	1.63E-05	1.25E-05	-4.788	-4.902	-0.114	34.43
Mg	1.94E-02						
	Mg+2	1.59E-02	5.97E-03	-1.798	-2.224	-0.426	-21.04
	MgSO4	2.76E-03	2.85E-03	-2.56	-2.546	0.014	5.84
	MgHCO3+	3.51E-04	2.62E-04	-3.455	-3.582	-0.127	5.68
	MgCO3	2.80E-04	2.89E-04	-3.554	-3.54	0.014	-17.09
	MgF+	6.82E-05	5.14E-05	-4.166	-4.289	-0.122	-10.38
	MgOH+	7.94E-06	6.23E-06	-5.1	-5.206	-0.106	0
Mn(2)	1.10E-07						
	MnCO3	5.50E-08	5.68E-08	-7.259	-7.246	0.014	0
	Mn+2	3.87E-08	1.41E-08	-7.413	-7.85	-0.438	-17.88
	MnHCO3+	6.18E-09	4.71E-09	-8.209	-8.327	-0.118	0
	MnSO4	4.95E-09	5.10E-09	-8.306	-8.292	0.014	22.54
	MnCl+	4.93E-09	3.76E-09	-8.307	-8.425	-0.118	-2.9
	MnOH+	1.37E-10	1.04E-10	-9.864	-9.982	-0.118	0
	MnCl2	1.04E-10	1.07E-10	-9.983	-9.97	0.014	85.89
	MnF+	1.67E-11	1.27E-11	-10.777	-10.895	-0.118	0
	MnCl3-	2.53E-12	1.93E-12	-11.597	-11.714	-0.118	44.01
	Mn(NO3)2	3.48E-16	3.59E-16	-15.459	-15.445	0.014	41.04
	Mn(OH)3-	6.96E-18	5.31E-18	-17.157	-17.275	-0.118	0
Mn(3)	2.83E-29						
	Mn+3	2.83E-29	4.36E-30	-28.548	-29.36	-0.813	0
N(-3)	1.30E-05						
	NH4+	1.14E-05	8.17E-06	-4.942	-5.088	-0.145	18.21
	NH3	1.30E-06	1.34E-06	-5.886	-5.872	0.014	24.42
	NH4SO4-	2.80E-07	2.14E-07	-6.552	-6.669	-0.117	38.26
N(5)	1.10E-04						
	NO3-	1.10E-04	7.99E-05	-3.959	-4.097	-0.139	29.82
	Mn(NO3)2	3.48E-16	3.59E-16	-15.459	-15.445	0.014	41.04
Na	8.47E-02						
	Na+	8.36E-02	6.41E-02	-1.078	-1.193	-0.115	-1.02
	NaSO4-	8.50E-04	6.54E-04	-3.07	-3.185	-0.114	16.83
	NaHCO3	1.31E-04	1.35E-04	-3.883	-3.869	0.014	1.8
	NaCO3-	7.92E-05	6.05E-05	-4.101	-4.218	-0.117	-0.06
	NaF	4.66E-06	4.81E-06	-5.331	-5.317	0.014	7.26
	NaOH	1.81E-17	1.87E-17	-16.743	-16.729	0.014	0
O(0)	1.11E-36						
	O2	5.54E-37	5.71E-37	-36.257	-36.243	0.014	30.4
S(6)	9.97E-03						

	SO4-2	6.09E-03	2.03E-03	-2.215	-2.692	-0.476	15.8
	MgSO4	2.76E-03	2.85E-03	-2.56	-2.546	0.014	5.84
	NaSO4-	8.50E-04	6.54E-04	-3.07	-3.185	-0.114	16.83
	CaSO4	2.55E-04	2.63E-04	-3.594	-3.58	0.014	7.5
	KSO4-	1.63E-05	1.25E-05	-4.788	-4.902	-0.114	34.43
	BaSO4	2.47E-06	2.55E-06	-5.607	-5.593	0.014	0
	NH4SO4-	2.80E-07	2.14E-07	-6.552	-6.669	-0.117	38.26
	ZnSO4	6.59E-09	6.81E-09	-8.181	-8.167	0.014	21.71
	MnSO4	4.95E-09	5.10E-09	-8.306	-8.292	0.014	22.54
	HSO4-	8.98E-10	6.86E-10	-9.047	-9.164	-0.117	40.59
	Zn(SO4)2-2	3.31E-10	1.13E-10	-9.481	-9.949	-0.468	-10.83
	FeSO4	2.63E-11	2.71E-11	-10.58	-10.567	0.014	18.97
	CuSO4	1.52E-11	1.57E-11	-10.817	-10.803	0.014	13.09
	CaHSO4+	7.85E-12	6.00E-12	-11.105	-11.222	-0.117	0
	FeSO4+	2.09E-18	1.60E-18	-17.679	-17.797	-0.118	0
	FeHSO4+	8.10E-19	6.18E-19	-18.092	-18.209	-0.117	0
	Fe(SO4)2-	9.31E-20	7.11E-20	-19.031	-19.148	-0.117	0
	FeHSO4+2	4.36E-26	1.48E-26	-25.361	-25.829	-0.468	0
Zn	6.90E-07						
	Zn(CO3)2-2	4.60E-07	1.56E-07	-6.337	-6.806	-0.468	0
	ZnCO3	1.40E-07	1.44E-07	-6.854	-6.841	0.014	0
	Zn+2	4.22E-08	1.43E-08	-7.375	-7.845	-0.471	-24.59
	Zn(OH)2	1.44E-08	1.48E-08	-7.842	-7.828	0.014	0
	ZnHCO3+	8.82E-09	6.74E-09	-8.055	-8.172	-0.117	0
	ZnOHCl	8.60E-09	8.88E-09	-8.065	-8.052	0.014	0
	ZnSO4	6.59E-09	6.81E-09	-8.181	-8.167	0.014	21.71
	ZnOH+	5.89E-09	4.50E-09	-8.23	-8.347	-0.117	0
	ZnCl+	3.37E-09	2.51E-09	-8.473	-8.6	-0.127	-14.18
	Zn(SO4)2-2	3.31E-10	1.13E-10	-9.481	-9.949	-0.468	-10.83
	ZnCl2	1.67E-10	1.72E-10	-9.778	-9.765	0.014	102.03
	ZnF+	3.45E-11	2.63E-11	-10.463	-10.58	-0.117	0
	Zn(OH)3-	1.77E-11	1.35E-11	-10.753	-10.87	-0.117	0
	ZnCl3-	1.69E-11	1.26E-11	-10.772	-10.899	-0.127	16.24
	ZnCl4-2	1.22E-12	4.13E-13	-11.913	-12.384	-0.471	146.89
	Zn(OH)4-2	1.81E-15	6.14E-16	-14.743	-15.212	-0.468	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.55	-5.83	-4.28	CaSO4			
Aragonite	0.9	-7.43	-8.34	CaCO3			
Barite	1.55	-8.29	-9.84	BaSO4			
Calcite	1.05	-7.43	-8.48	CaCO3			
CO2(g)	-3.06	-4.53	-1.47	CO2			
Dolomite	3.13	-13.95	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.34	6.23	4.89	Fe(OH)3			
Fluorite	-0.31	-10.91	-10.6	CaF2			
Goethite	7.23	6.23	-1	FeOOH			
Gypsum	-1.25	-5.83	-4.58	CaSO4:2H2O			

H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-3.95	-2.38	1.57	NaCl
Hausmann	-8.91	52.12	61.03	Mn3O4
Hematite	16.47	12.47	-4.01	Fe2O3
Jarosite-K	-5.91	-15.12	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.81	21.53	25.34	MnOOH
Melanterit	-10.62	-12.83	-2.21	FeSO4:7H2O
NH3(g)	-7.67	-5.87	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.13	9.07	15.2	Mn(OH)2
Pyrolusite	-7.4	33.98	41.38	MnO2:H2O
Rhodochrc	-1.02	-12.15	-11.13	MnCO3
Siderite	-3.53	-14.42	-10.89	FeCO3
Smithsonit	-2.14	-12.14	-10	ZnCO3
Sylvite	-5.14	-4.24	0.9	KCl
Witherite	-1.33	-9.9	-8.56	BaCO3
Zn(OH)2(e	-2.43	9.07	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 15

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	6.99E-03	6.99E-03
Ba	1.11E-05	1.11E-05
Ca	2.56E-03	2.56E-03
Cl	9.39E-02	9.39E-02
Cu	9.00E-08	9.00E-08
F	2.60E-04	2.60E-04
Fe	6.70E-07	6.70E-07
K	1.29E-03	1.29E-03
Mg	2.07E-02	2.07E-02
Mn	1.10E-07	1.10E-07
N(-3)	1.40E-05	1.40E-05
N(5)	1.20E-04	1.20E-04
Na	9.04E-02	9.04E-02
S(6)	1.06E-02	1.06E-02
Zn	7.40E-07	7.40E-07

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 12006
Density (g/cm³) = 1.00298

```
Volume (L) = 1.00449
Activity of water = 0.996
Ionic strength (mol/kgw) = 1.47E-01
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 6.38E-03
Total CO2 (mol/kg) = 6.38E-03
Temperatu (°C) = 25
Electrical balance (eq) = 1.56E-02
Percent error, 100*(Cat-|= 6.43
Iterations = 10 (130 overall)
Total H = 1.11E+02
Total O = 5.56E+01

#NAME? couples--------------------------------

Redox couple pe Eh (volts)

N(-3)/N(5) 4.4347 0.2623

#NAME? of species----------------------------
```

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	3.98E-06	2.91E-06	-5.401	-5.536	-0.136	-3.62
H+	4.28E-09	3.47E-09	-8.368	-8.46	-0.092	0
H2O	5.55E+01	9.96E-01	1.744	-0.002	0	18.07
Ba 1.11E-05						
Ba+2	8.25E-06	2.62E-06	-5.084	-5.581	-0.498	-11.85
BaSO4	2.67E-06	2.76E-06	-5.574	-5.559	0.015	0
BaHCO3+	1.30E-07	9.90E-08	-6.885	-7.004	-0.119	0
BaCO3	6.98E-08	7.22E-08	-7.156	-7.142	0.015	-10.7
BaOH+	3.37E-11	2.55E-11	-10.473	-10.593	-0.12	0
C(4) 6.38E-03						
HCO3-	5.15E-03	3.94E-03	-2.288	-2.405	-0.116	25.35
MgHCO3+	3.89E-04	2.88E-04	-3.41	-3.541	-0.13	5.69
MgCO3	3.07E-04	3.18E-04	-3.513	-3.498	0.015	-17.09
CO3-2	1.56E-04	5.33E-05	-3.808	-4.273	-0.466	-3.87
NaHCO3	1.46E-04	1.51E-04	-3.836	-3.821	0.015	1.8
NaCO3-	8.88E-05	6.76E-05	-4.051	-4.17	-0.119	-0.01
CaCO3	6.58E-05	6.80E-05	-4.182	-4.167	0.015	-14.6
CaHCO3+	4.94E-05	3.82E-05	-4.307	-4.418	-0.111	9.86
CO2	2.98E-05	3.08E-05	-4.526	-4.511	0.015	34.43
Zn(CO3)2-2	5.06E-07	1.69E-07	-6.296	-6.772	-0.476	0
ZnCO3	1.44E-07	1.49E-07	-6.843	-6.828	0.015	0
BaHCO3+	1.30E-07	9.90E-08	-6.885	-7.004	-0.119	0
BaCO3	6.98E-08	7.22E-08	-7.156	-7.142	0.015	-10.7
MnCO3	5.56E-08	5.75E-08	-7.255	-7.24	0.015	0
CuCO3	1.16E-08	1.20E-08	-7.935	-7.921	0.015	0
ZnHCO3+	9.11E-09	6.93E-09	-8.041	-8.159	-0.119	0

	MnHCO3+	6.29E-09	4.77E-09	-8.201	-8.322	-0.12	0
	Cu(CO3)2-	2.41E-09	8.05E-10	-8.619	-9.094	-0.476	0
	CuHCO3+	1.09E-10	8.28E-11	-9.963	-10.082	-0.119	0
	FeCO3	9.86E-11	1.02E-10	-10.006	-9.991	0.015	0
	FeHCO3+	4.14E-11	3.14E-11	-10.384	-10.502	-0.119	0
	(CO2)2	1.69E-11	1.74E-11	-10.773	-10.758	0.015	68.87
Ca	2.56E-03						
	Ca+2	2.17E-03	7.60E-04	-2.663	-3.119	-0.456	-17.31
	CaSO4	2.75E-04	2.84E-04	-3.562	-3.547	0.015	7.5
	CaCO3	6.58E-05	6.80E-05	-4.182	-4.167	0.015	-14.6
	CaHCO3+	4.94E-05	3.82E-05	-4.307	-4.418	-0.111	9.86
	CaOH+	4.76E-08	3.62E-08	-7.322	-7.441	-0.119	0
	CaHSO4+	8.51E-12	6.47E-12	-11.07	-11.189	-0.119	0
Cl	9.39E-02						
	Cl-	9.39E-02	6.93E-02	-1.027	-1.159	-0.132	18.4
	ZnOHCl	8.91E-09	9.22E-09	-8.05	-8.035	0.015	0
	MnCl+	5.06E-09	3.84E-09	-8.296	-8.416	-0.12	-2.9
	CuCl2-	4.52E-09	3.35E-09	-8.345	-8.475	-0.13	0
	ZnCl+	3.52E-09	2.61E-09	-8.454	-8.584	-0.13	-14.21
	CuCl3-2	1.11E-09	3.68E-10	-8.954	-9.434	-0.48	0
	ZnCl2	1.83E-10	1.89E-10	-9.738	-9.723	0.015	102.03
	MnCl2	1.12E-10	1.16E-10	-9.95	-9.935	0.015	85.89
	ZnCl3-	1.99E-11	1.47E-11	-10.702	-10.832	-0.13	16.18
	CuCl+	1.06E-11	7.83E-12	-10.976	-11.106	-0.13	1.04
	FeCl+	1.01E-11	7.64E-12	-10.998	-11.117	-0.119	0
	MnCl3-	2.92E-12	2.22E-12	-11.534	-11.654	-0.12	44.05
	ZnCl4-2	1.55E-12	5.12E-13	-11.811	-12.291	-0.48	146.97
	CuCl2	2.82E-13	2.92E-13	-12.55	-12.535	0.015	31.02
	CuCl3-	9.68E-17	7.17E-17	-16.014	-16.144	-0.13	0
	FeCl+2	4.82E-19	1.60E-19	-18.317	-18.797	-0.48	0
	CuCl4-2	7.53E-20	2.49E-20	-19.123	-19.603	-0.48	0
	FeCl2+	6.52E-20	4.94E-20	-19.186	-19.306	-0.12	0
	FeCl3	3.31E-22	3.43E-22	-21.48	-21.465	0.015	0
Cu(1)	5.63E-09						
	CuCl2-	4.52E-09	3.35E-09	-8.345	-8.475	-0.13	0
	CuCl3-2	1.11E-09	3.68E-10	-8.954	-9.434	-0.48	0
	Cu+	3.10E-12	2.20E-12	-11.509	-11.657	-0.149	0
Cu(2)	8.44E-08						
	Cu(OH)2	6.99E-08	7.24E-08	-7.155	-7.141	0.015	0
	CuCO3	1.16E-08	1.20E-08	-7.935	-7.921	0.015	0
	Cu(CO3)2-	2.41E-09	8.05E-10	-8.619	-9.094	-0.476	0
	CuOH+	1.63E-10	1.21E-10	-9.789	-9.919	-0.13	0
	Cu+2	1.17E-10	4.20E-11	-9.932	-10.377	-0.446	-25.85
	CuHCO3+	1.09E-10	8.28E-11	-9.963	-10.082	-0.119	0
	CuSO4	1.74E-11	1.80E-11	-10.76	-10.745	0.015	13.09
	CuCl+	1.06E-11	7.83E-12	-10.976	-11.106	-0.13	1.04
	Cu(OH)3-	1.65E-12	1.25E-12	-11.783	-11.902	-0.119	0
	CuCl2	2.82E-13	2.92E-13	-12.55	-12.535	0.015	31.02
	CuF+	1.34E-13	1.02E-13	-12.875	-12.994	-0.119	0
	Cu2(OH)2+	1.90E-14	6.36E-15	-13.721	-14.197	-0.476	0

	Cu(OH)4-2	2.15E-16	7.18E-17	-15.668	-16.144	-0.476	0
	CuCl3-	9.68E-17	7.17E-17	-16.014	-16.144	-0.13	0
	CuCl4-2	7.53E-20	2.49E-20	-19.123	-19.603	-0.48	0
F	2.60E-04						
	F-	1.82E-04	1.33E-04	-3.74	-3.876	-0.136	-0.98
	MgF+	7.32E-05	5.49E-05	-4.136	-4.26	-0.125	-10.37
	NaF	5.04E-06	5.21E-06	-5.298	-5.283	0.015	7.26
	HF	6.69E-10	6.92E-10	-9.175	-9.16	0.015	12.5
	ZnF+	3.45E-11	2.62E-11	-10.462	-10.581	-0.119	0
	MnF+	1.65E-11	1.25E-11	-10.783	-10.903	-0.12	0
	HF2-	4.64E-13	3.53E-13	-12.334	-12.452	-0.119	22.39
	FeF+	1.40E-13	1.06E-13	-12.855	-12.974	-0.119	0
	CuF+	1.34E-13	1.02E-13	-12.875	-12.994	-0.119	0
	FeF2+	1.12E-16	8.51E-17	-15.95	-16.07	-0.12	0
	FeF+2	4.85E-17	1.61E-17	-16.314	-16.794	-0.48	0
	FeF3	1.73E-17	1.79E-17	-16.761	-16.747	0.015	0
Fe(2)	4.11E-10						
	Fe+2	2.23E-10	7.98E-11	-9.652	-10.098	-0.446	-21.35
	FeCO3	9.86E-11	1.02E-10	-10.006	-9.991	0.015	0
	FeHCO3+	4.14E-11	3.14E-11	-10.384	-10.502	-0.119	0
	FeSO4	2.88E-11	2.98E-11	-10.54	-10.525	0.015	18.97
	FeCl+	1.01E-11	7.64E-12	-10.998	-11.117	-0.119	0
	FeOH+	9.56E-12	7.25E-12	-11.02	-11.14	-0.12	0
	FeF+	1.40E-13	1.06E-13	-12.855	-12.974	-0.119	0
	Fe(OH)2	1.71E-14	1.77E-14	-13.766	-13.751	0.015	0
	Fe(OH)3-	2.50E-16	1.89E-16	-15.603	-15.723	-0.12	0
	FeHSO4+	8.94E-19	6.80E-19	-18.049	-18.168	-0.119	0
Fe(3)	6.70E-07						
	Fe(OH)3	4.81E-07	4.98E-07	-6.317	-6.303	0.015	0
	Fe(OH)4-	1.71E-07	1.31E-07	-6.768	-6.884	-0.116	0
	Fe(OH)2+	1.76E-08	1.35E-08	-7.755	-7.871	-0.116	0
	FeOH+2	4.27E-13	1.41E-13	-12.369	-12.85	-0.48	0
	FeF2+	1.12E-16	8.51E-17	-15.95	-16.07	-0.12	0
	FeF+2	4.85E-17	1.61E-17	-16.314	-16.794	-0.48	0
	FeF3	1.73E-17	1.79E-17	-16.761	-16.747	0.015	0
	FeSO4+	2.32E-18	1.76E-18	-17.635	-17.755	-0.12	0
	Fe+3	5.10E-19	7.62E-20	-18.293	-19.118	-0.825	0
	FeCl+2	4.82E-19	1.60E-19	-18.317	-18.797	-0.48	0
	Fe(SO4)2-	1.06E-19	8.07E-20	-18.974	-19.093	-0.119	0
	FeCl2+	6.52E-20	4.94E-20	-19.186	-19.306	-0.12	0
	FeCl3	3.31E-22	3.43E-22	-21.48	-21.465	0.015	0
	Fe2(OH)2+	4.30E-23	5.38E-25	-22.367	-24.269	-1.902	0
	FeHSO4+2	4.87E-26	1.63E-26	-25.312	-25.788	-0.476	0
	Fe3(OH)4+	1.42E-27	1.51E-30	-26.848	-29.82	-2.972	0
H(0)	1.65E-28						
	H2	8.23E-29	8.51E-29	-28.085	-28.07	0.015	28.61
K	1.29E-03						
	K+	1.27E-03	9.35E-04	-2.896	-3.029	-0.134	9.29
	KSO4-	1.81E-05	1.38E-05	-4.744	-4.86	-0.116	34.44
Mg	2.07E-02						

	Mg+2	1.69E-02	6.25E-03	-1.771	-2.204	-0.433	-21.02
	MgSO4	2.98E-03	3.08E-03	-2.526	-2.512	0.015	5.84
	MgHCO3+	3.89E-04	2.88E-04	-3.41	-3.541	-0.13	5.69
	MgCO3	3.07E-04	3.18E-04	-3.513	-3.498	0.015	-17.09
	MgF+	7.32E-05	5.49E-05	-4.136	-4.26	-0.125	-10.37
	MgOH+	8.35E-06	6.52E-06	-5.078	-5.186	-0.108	0
Mn(2)	1.10E-07						
	MnCO3	5.56E-08	5.75E-08	-7.255	-7.24	0.015	0
	Mn+2	3.79E-08	1.36E-08	-7.421	-7.867	-0.446	-17.82
	MnHCO3+	6.29E-09	4.77E-09	-8.201	-8.322	-0.12	0
	MnCl+	5.06E-09	3.84E-09	-8.296	-8.416	-0.12	-2.9
	MnSO4	4.91E-09	5.08E-09	-8.309	-8.295	0.015	22.54
	MnOH+	1.32E-10	1.00E-10	-9.879	-9.999	-0.12	0
	MnCl2	1.12E-10	1.16E-10	-9.95	-9.935	0.015	85.89
	MnF+	1.65E-11	1.25E-11	-10.783	-10.903	-0.12	0
	MnCl3-	2.92E-12	2.22E-12	-11.534	-11.654	-0.12	44.05
	Mn(NO3)2	3.92E-16	4.05E-16	-15.407	-15.392	0.015	41.04
	Mn(OH)3-	6.73E-18	5.11E-18	-17.172	-17.292	-0.12	0
Mn(3)	2.81E-29						
	Mn+3	2.81E-29	4.20E-30	-28.552	-29.377	-0.825	0
N(-3)	1.40E-05						
	NH4+	1.23E-05	8.73E-06	-4.91	-5.059	-0.149	18.21
	NH3	1.39E-06	1.44E-06	-5.858	-5.843	0.015	24.42
	NH4SO4-	3.11E-07	2.36E-07	-6.508	-6.626	-0.119	38.3
N(5)	1.20E-04						
	NO3-	1.20E-04	8.65E-05	-3.921	-4.063	-0.142	29.83
	Mn(NO3)2	3.92E-16	4.05E-16	-15.407	-15.392	0.015	41.04
Na	9.04E-02						
	Na+	8.92E-02	6.81E-02	-1.05	-1.167	-0.117	-1.01
	NaSO4-	9.37E-04	7.17E-04	-3.028	-3.144	-0.116	16.95
	NaHCO3	1.46E-04	1.51E-04	-3.836	-3.821	0.015	1.8
	NaCO3-	8.88E-05	6.76E-05	-4.051	-4.17	-0.119	-0.01
	NaF	5.04E-06	5.21E-06	-5.298	-5.283	0.015	7.26
	NaOH	1.91E-17	1.98E-17	-16.718	-16.703	0.015	0
O(0)	1.10E-36						
	O2	5.52E-37	5.71E-37	-36.258	-36.243	0.015	30.4
S(6)	1.06E-02						
	SO4-2	6.43E-03	2.10E-03	-2.192	-2.678	-0.486	15.84
	MgSO4	2.98E-03	3.08E-03	-2.526	-2.512	0.015	5.84
	NaSO4-	9.37E-04	7.17E-04	-3.028	-3.144	-0.116	16.95
	CaSO4	2.75E-04	2.84E-04	-3.562	-3.547	0.015	7.5
	KSO4-	1.81E-05	1.38E-05	-4.744	-4.86	-0.116	34.44
	BaSO4	2.67E-06	2.76E-06	-5.574	-5.559	0.015	0
	NH4SO4-	3.11E-07	2.36E-07	-6.508	-6.626	-0.119	38.3
	ZnSO4	6.65E-09	6.88E-09	-8.177	-8.162	0.015	21.71
	MnSO4	4.91E-09	5.08E-09	-8.309	-8.295	0.015	22.54
	HSO4-	9.31E-10	7.08E-10	-9.031	-9.15	-0.119	40.6
	Zn(SO4)2-2	3.51E-10	1.18E-10	-9.455	-9.93	-0.476	-10.72
	FeSO4	2.88E-11	2.98E-11	-10.54	-10.525	0.015	18.97
	CuSO4	1.74E-11	1.80E-11	-10.76	-10.745	0.015	13.09

	CaHSO4+	8.51E-12	6.47E-12	-11.07	-11.189	-0.119	0
	FeSO4+	2.32E-18	1.76E-18	-17.635	-17.755	-0.12	0
	FeHSO4+	8.94E-19	6.80E-19	-18.049	-18.168	-0.119	0
	Fe(SO4)2-	1.06E-19	8.07E-20	-18.974	-19.093	-0.119	0
	FeHSO4+2	4.87E-26	1.63E-26	-25.312	-25.788	-0.476	0
Zn	7.40E-07						
	Zn(CO3)2-2	5.06E-07	1.69E-07	-6.296	-6.772	-0.476	0
	ZnCO3	1.44E-07	1.49E-07	-6.843	-6.828	0.015	0
	Zn+2	4.22E-08	1.40E-08	-7.375	-7.855	-0.48	-24.58
	Zn(OH)2	1.40E-08	1.45E-08	-7.853	-7.838	0.015	0
	ZnHCO3+	9.11E-09	6.93E-09	-8.041	-8.159	-0.119	0
	ZnOHCl	8.91E-09	9.22E-09	-8.05	-8.035	0.015	0
	ZnSO4	6.65E-09	6.88E-09	-8.177	-8.162	0.015	21.71
	ZnOH+	5.79E-09	4.40E-09	-8.238	-8.356	-0.119	0
	ZnCl+	3.52E-09	2.61E-09	-8.454	-8.584	-0.13	-14.21
	Zn(SO4)2-2	3.51E-10	1.18E-10	-9.455	-9.93	-0.476	-10.72
	ZnCl2	1.83E-10	1.89E-10	-9.738	-9.723	0.015	102.03
	ZnF+	3.45E-11	2.62E-11	-10.462	-10.581	-0.119	0
	ZnCl3-	1.99E-11	1.47E-11	-10.702	-10.832	-0.13	16.18
	Zn(OH)3-	1.73E-11	1.32E-11	-10.761	-10.88	-0.119	0
	ZnCl4-2	1.55E-12	5.12E-13	-11.811	-12.291	-0.48	146.97
	Zn(OH)4-2	1.80E-15	6.01E-16	-14.746	-15.221	-0.476	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.52	-5.8	-4.28	CaSO4			
Aragonite	0.94	-7.39	-8.34	CaCO3			
Barite	1.58	-8.26	-9.84	BaSO4			
Calcite	1.09	-7.39	-8.48	CaCO3			
CO2(g)	-3.04	-4.51	-1.47	CO2			
Dolomite	3.21	-13.87	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.37	6.26	4.89	Fe(OH)3			
Fluorite	-0.27	-10.87	-10.6	CaF2			
Goethite	7.26	6.26	-1	FeOOH			
Gypsum	-1.22	-5.8	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-3.9	-2.33	1.57	NaCl			
Hausmann	-8.96	52.07	61.03	Mn3O4			
Hematite	16.53	12.52	-4.01	Fe2O3			
Jarosite-K	-5.78	-14.99	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.83	21.51	25.34	MnOOH			
Melanterit	-10.58	-12.79	-2.21	FeSO4:7H2O			
NH3(g)	-7.64	-5.84	1.8	NH3			
O2(g)	-33.35	-36.24	-2.89	O2			
Pyrochroit	-6.15	9.05	15.2	Mn(OH)2			
Pyrolusite	-7.41	33.97	41.38	MnO2:H2O			
Rhodochro	-1.01	-12.14	-11.13	MnCO3			

Siderite	-3.48	-14.37	-10.89	FeCO3
Smithsonit	-2.13	-12.13	-10	ZnCO3
Sylvite	-5.09	-4.19	0.9	KCl
Witherite	-1.29	-9.85	-8.56	BaCO3
Zn(OH)2(e	-2.44	9.06	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 16

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	7.43E-03	7.43E-03
Ba	1.19E-05	1.19E-05
Ca	2.72E-03	2.72E-03
Cl	9.98E-02	9.98E-02
Cu	9.00E-08	9.00E-08
F	2.80E-04	2.80E-04
Fe	7.20E-07	7.20E-07
K	1.37E-03	1.37E-03
Mg	2.20E-02	2.20E-02
Mn	1.20E-07	1.20E-07
N(-3)	1.50E-05	1.50E-05
N(5)	1.30E-04	1.30E-04
Na	9.61E-02	9.61E-02
S(6)	1.13E-02	1.13E-02
Zn	7.80E-07	7.80E-07

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 12689
Density (g/cm³) = 1.00335
Volume (L) = 1.00459
Activity of water = 0.996
Ionic strength (mol/kgw) = 1.56E-01
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 6.77E-03
Total CO2 (mol/kg) = 6.77E-03
Temperatu (°C) = 25
Electrical balance (eq) = 1.66E-02
Percent error, 100*(Cat-|= 6.43
Iterations = 10 (140 overall)
Total H = 1.11E+02
Total O = 5.56E+01

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4354	0.2624		

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.00E-06	2.91E-06	-5.398	-5.536	-0.139	-3.6
	H+	4.30E-09	3.47E-09	-8.367	-8.46	-0.093	0
	H2O	5.55E+01	9.96E-01	1.744	-0.002	0	18.07
Ba	1.19E-05						
	Ba+2	8.79E-06	2.74E-06	-5.056	-5.563	-0.507	-11.83
	BaSO4	2.87E-06	2.97E-06	-5.543	-5.527	0.016	0
	BaHCO3+	1.43E-07	1.08E-07	-6.845	-6.965	-0.121	0
	BaCO3	7.62E-08	7.90E-08	-7.118	-7.102	0.016	-10.7
	BaOH+	3.53E-11	2.67E-11	-10.452	-10.574	-0.122	0
C(4)	6.77E-03						
	HCO3-	5.42E-03	4.13E-03	-2.266	-2.384	-0.118	25.38
	MgHCO3+	4.28E-04	3.15E-04	-3.369	-3.502	-0.133	5.69
	MgCO3	3.35E-04	3.48E-04	-3.475	-3.459	0.016	-17.09
	CO3-2	1.66E-04	5.58E-05	-3.779	-4.253	-0.474	-3.83
	NaHCO3	1.61E-04	1.67E-04	-3.792	-3.777	0.016	1.8
	NaCO3-	9.89E-05	7.49E-05	-4.005	-4.125	-0.121	0.04
	CaCO3	7.17E-05	7.43E-05	-4.145	-4.129	0.016	-14.6
	CaHCO3+	5.41E-05	4.17E-05	-4.267	-4.38	-0.113	9.86
	CO2	3.12E-05	3.23E-05	-4.506	-4.491	0.016	34.43
	Zn(CO3)2-2	5.45E-07	1.80E-07	-6.264	-6.746	-0.482	0
	ZnCO3	1.45E-07	1.50E-07	-6.838	-6.823	0.016	0
	BaHCO3+	1.43E-07	1.08E-07	-6.845	-6.965	-0.121	0
	BaCO3	7.62E-08	7.90E-08	-7.118	-7.102	0.016	-10.7
	MnCO3	6.12E-08	6.34E-08	-7.213	-7.198	0.016	0
	CuCO3	1.19E-08	1.24E-08	-7.923	-7.907	0.016	0
	ZnHCO3+	9.26E-09	7.02E-09	-8.033	-8.154	-0.121	0
	MnHCO3+	6.97E-09	5.26E-09	-8.157	-8.279	-0.122	0
	Cu(CO3)2-	2.64E-09	8.70E-10	-8.578	-9.06	-0.482	0
	CuHCO3+	1.13E-10	8.54E-11	-9.948	-10.068	-0.121	0
	FeCO3	1.11E-10	1.15E-10	-9.955	-9.939	0.016	0
	FeHCO3+	4.68E-11	3.54E-11	-10.33	-10.451	-0.121	0
	(CO2)2	1.85E-11	1.92E-11	-10.733	-10.718	0.016	68.87
Ca	2.72E-03						
	Ca+2	2.30E-03	7.92E-04	-2.638	-3.101	-0.463	-17.3
	CaSO4	2.94E-04	3.05E-04	-3.531	-3.516	0.016	7.5
	CaCO3	7.17E-05	7.43E-05	-4.145	-4.129	0.016	-14.6
	CaHCO3+	5.41E-05	4.17E-05	-4.267	-4.38	-0.113	9.86
	CaOH+	4.98E-08	3.78E-08	-7.303	-7.423	-0.121	0
	CaHSO4+	9.17E-12	6.95E-12	-11.037	-11.158	-0.121	0

Cl	9.98E-02						
	Cl-	9.98E-02	7.33E-02	-1.001	-1.135	-0.134	18.41
	ZnOHCl	9.08E-09	9.41E-09	-8.042	-8.026	0.016	0
	MnCl+	5.66E-09	4.27E-09	-8.247	-8.37	-0.122	-2.89
	CuCl2-	5.00E-09	3.68E-09	-8.301	-8.434	-0.133	0
	ZnCl+	3.62E-09	2.66E-09	-8.442	-8.575	-0.133	-14.24
	CuCl3-2	1.32E-09	4.27E-10	-8.88	-9.369	-0.489	0
	ZnCl2	1.97E-10	2.04E-10	-9.705	-9.69	0.016	102.03
	MnCl2	1.32E-10	1.37E-10	-9.88	-9.865	0.016	85.89
	ZnCl3-	2.28E-11	1.68E-11	-10.642	-10.775	-0.133	16.12
	FeCl+	1.15E-11	8.69E-12	-10.941	-11.061	-0.121	0
	CuCl+	1.11E-11	8.15E-12	-10.956	-11.089	-0.133	1.06
	MnCl3-	3.65E-12	2.76E-12	-11.438	-11.56	-0.122	44.08
	ZnCl4-2	1.90E-12	6.17E-13	-11.721	-12.21	-0.489	147.04
	CuCl2	3.09E-13	3.21E-13	-12.51	-12.494	0.016	31.02
	CuCl3-	1.13E-16	8.33E-17	-15.946	-16.079	-0.133	0
	FeCl+2	5.59E-19	1.81E-19	-18.252	-18.741	-0.489	0
	CuCl4-2	9.43E-20	3.06E-20	-19.025	-19.514	-0.489	0
	FeCl2+	7.87E-20	5.94E-20	-19.104	-19.226	-0.122	0
	FeCl3	4.20E-22	4.35E-22	-21.377	-21.361	0.016	0
Cu(1)	6.32E-09						
	CuCl2-	5.00E-09	3.68E-09	-8.301	-8.434	-0.133	0
	CuCl3-2	1.32E-09	4.27E-10	-8.88	-9.369	-0.489	0
	Cu+	3.08E-12	2.17E-12	-11.512	-11.664	-0.152	0
Cu(2)	8.37E-08						
	Cu(OH)2	6.87E-08	7.12E-08	-7.163	-7.148	0.016	0
	CuCO3	1.19E-08	1.24E-08	-7.923	-7.907	0.016	0
	Cu(CO3)2-	2.64E-09	8.70E-10	-8.578	-9.06	-0.482	0
	CuOH+	1.61E-10	1.19E-10	-9.793	-9.926	-0.133	0
	Cu+2	1.17E-10	4.13E-11	-9.931	-10.384	-0.453	-25.83
	CuHCO3+	1.13E-10	8.54E-11	-9.948	-10.068	-0.121	0
	CuSO4	1.76E-11	1.83E-11	-10.754	-10.739	0.016	13.09
	CuCl+	1.11E-11	8.15E-12	-10.956	-11.089	-0.133	1.06
	Cu(OH)3-	1.63E-12	1.23E-12	-11.789	-11.909	-0.121	0
	CuCl2	3.09E-13	3.21E-13	-12.51	-12.494	0.016	31.02
	CuF+	1.39E-13	1.06E-13	-12.856	-12.977	-0.121	0
	Cu2(OH)2+	1.87E-14	6.16E-15	-13.728	-14.211	-0.482	0
	Cu(OH)4-2	2.14E-16	7.06E-17	-15.669	-16.151	-0.482	0
	CuCl3-	1.13E-16	8.33E-17	-15.946	-16.079	-0.133	0
	CuCl4-2	9.43E-20	3.06E-20	-19.025	-19.514	-0.489	0
F	2.80E-04						
	F-	1.93E-04	1.41E-04	-3.714	-3.852	-0.139	-0.97
	MgF+	8.12E-05	6.05E-05	-4.091	-4.218	-0.127	-10.37
	NaF	5.62E-06	5.82E-06	-5.25	-5.235	0.016	7.26
	HF	7.05E-10	7.30E-10	-9.152	-9.136	0.016	12.5
	ZnF+	3.54E-11	2.68E-11	-10.451	-10.572	-0.121	0
	MnF+	1.84E-11	1.39E-11	-10.735	-10.857	-0.122	0
	HF2-	5.20E-13	3.94E-13	-12.284	-12.405	-0.121	22.4
	FeF+	1.59E-13	1.21E-13	-12.798	-12.919	-0.121	0
	CuF+	1.39E-13	1.06E-13	-12.856	-12.977	-0.121	0

	FeF2+	1.35E-16	1.02E-16	-15.869	-15.991	-0.122	0
	FeF+2	5.62E-17	1.83E-17	-16.25	-16.739	-0.489	0
	FeF3	2.19E-17	2.27E-17	-16.659	-16.644	0.016	0
Fe(2)	4.55E-10						
	Fe+2	2.44E-10	8.59E-11	-9.613	-10.066	-0.453	-21.33
	FeCO3	1.11E-10	1.15E-10	-9.955	-9.939	0.016	0
	FeHCO3+	4.68E-11	3.54E-11	-10.33	-10.451	-0.121	0
	FeSO4	3.19E-11	3.31E-11	-10.496	-10.481	0.016	18.97
	FeCl+	1.15E-11	8.69E-12	-10.941	-11.061	-0.121	0
	FeOH+	1.03E-11	7.80E-12	-10.986	-11.108	-0.122	0
	FeF+	1.59E-13	1.21E-13	-12.798	-12.919	-0.121	0
	Fe(OH)2	1.84E-14	1.91E-14	-13.735	-13.72	0.016	0
	Fe(OH)3-	2.70E-16	2.04E-16	-15.569	-15.691	-0.122	0
	FeHSO4+	9.95E-19	7.54E-19	-18.002	-18.123	-0.121	0
Fe(3)	7.20E-07						
	Fe(OH)3	5.16E-07	5.35E-07	-6.287	-6.271	0.016	0
	Fe(OH)4-	1.84E-07	1.40E-07	-6.735	-6.853	-0.118	0
	Fe(OH)2+	1.90E-08	1.45E-08	-7.721	-7.84	-0.118	0
	FeOH+2	4.69E-13	1.52E-13	-12.329	-12.818	-0.489	0
	FeF2+	1.35E-16	1.02E-16	-15.869	-15.991	-0.122	0
	FeF+2	5.62E-17	1.83E-17	-16.25	-16.739	-0.489	0
	FeF3	2.19E-17	2.27E-17	-16.659	-16.644	0.016	0
	FeSO4+	2.58E-18	1.95E-18	-17.588	-17.711	-0.122	0
	Fe+3	5.63E-19	8.20E-20	-18.25	-19.086	-0.836	0
	FeCl+2	5.59E-19	1.81E-19	-18.252	-18.741	-0.489	0
	Fe(SO4)2-	1.22E-19	9.22E-20	-18.915	-19.035	-0.121	0
	FeCl2+	7.87E-20	5.94E-20	-19.104	-19.226	-0.122	0
	FeCl3	4.20E-22	4.35E-22	-21.377	-21.361	0.016	0
	Fe2(OH)2+	5.28E-23	6.22E-25	-22.277	-24.206	-1.929	0
	FeHSO4+2	5.49E-26	1.81E-26	-25.261	-25.743	-0.482	0
	Fe3(OH)4+	1.94E-27	1.88E-30	-26.712	-29.726	-3.014	0
H(0)	1.64E-28						
	H2	8.21E-29	8.51E-29	-28.086	-28.07	0.016	28.61
K	1.37E-03						
	K+	1.35E-03	9.87E-04	-2.87	-3.006	-0.136	9.3
	KSO4-	1.97E-05	1.50E-05	-4.705	-4.823	-0.118	34.45
Mg	2.20E-02						
	Mg+2	1.79E-02	6.53E-03	-1.746	-2.185	-0.439	-21
	MgSO4	3.20E-03	3.31E-03	-2.495	-2.48	0.016	5.84
	MgHCO3+	4.28E-04	3.15E-04	-3.369	-3.502	-0.133	5.69
	MgCO3	3.35E-04	3.48E-04	-3.475	-3.459	0.016	-17.09
	MgF+	8.12E-05	6.05E-05	-4.091	-4.218	-0.127	-10.37
	MgOH+	8.75E-06	6.81E-06	-5.058	-5.167	-0.109	0
Mn(2)	1.20E-07						
	MnCO3	6.12E-08	6.34E-08	-7.213	-7.198	0.016	0
	Mn+2	4.06E-08	1.43E-08	-7.392	-7.845	-0.453	-17.77
	MnHCO3+	6.97E-09	5.26E-09	-8.157	-8.279	-0.122	0
	MnCl+	5.66E-09	4.27E-09	-8.247	-8.37	-0.122	-2.89
	MnSO4	5.31E-09	5.51E-09	-8.275	-8.259	0.016	22.54
	MnOH+	1.40E-10	1.06E-10	-9.854	-9.976	-0.122	0

	MnCl2	1.32E-10	1.37E-10	-9.88	-9.865	0.016	85.89
	MnF+	1.84E-11	1.39E-11	-10.735	-10.857	-0.122	0
	MnCl3-	3.65E-12	2.76E-12	-11.438	-11.56	-0.122	44.08
	Mn(NO3)2	4.76E-16	4.93E-16	-15.322	-15.307	0.016	41.04
	Mn(OH)3-	7.12E-18	5.37E-18	-17.148	-17.27	-0.122	0
Mn(3)	3.03E-29						
	Mn+3	3.03E-29	4.42E-30	-28.518	-29.355	-0.836	0
N(-3)	1.50E-05						
	NH4+	1.32E-05	9.29E-06	-4.88	-5.032	-0.152	18.22
	NH3	1.47E-06	1.53E-06	-5.832	-5.816	0.016	24.42
	NH4SO4-	3.42E-07	2.59E-07	-6.466	-6.586	-0.121	38.33
N(5)	1.30E-04						
	NO3-	1.30E-04	9.31E-05	-3.886	-4.031	-0.145	29.85
	Mn(NO3)2	4.76E-16	4.93E-16	-15.322	-15.307	0.016	41.04
Na	9.61E-02						
	Na+	9.48E-02	7.21E-02	-1.023	-1.142	-0.119	-0.99
	NaSO4-	1.03E-03	7.82E-04	-2.988	-3.107	-0.118	17.06
	NaHCO3	1.61E-04	1.67E-04	-3.792	-3.777	0.016	1.8
	NaCO3-	9.89E-05	7.49E-05	-4.005	-4.125	-0.121	0.04
	NaF	5.62E-06	5.82E-06	-5.25	-5.235	0.016	7.26
	NaOH	2.02E-17	2.10E-17	-16.694	-16.679	0.016	0
O(0)	1.10E-36						
	O2	5.51E-37	5.71E-37	-36.259	-36.243	0.016	30.4
S(6)	1.13E-02						
	SO4-2	6.77E-03	2.17E-03	-2.169	-2.664	-0.495	15.88
	MgSO4	3.20E-03	3.31E-03	-2.495	-2.48	0.016	5.84
	NaSO4-	1.03E-03	7.82E-04	-2.988	-3.107	-0.118	17.06
	CaSO4	2.94E-04	3.05E-04	-3.531	-3.516	0.016	7.5
	KSO4-	1.97E-05	1.50E-05	-4.705	-4.823	-0.118	34.45
	BaSO4	2.87E-06	2.97E-06	-5.543	-5.527	0.016	0
	NH4SO4-	3.42E-07	2.59E-07	-6.466	-6.586	-0.121	38.33
	ZnSO4	6.61E-09	6.86E-09	-8.18	-8.164	0.016	21.71
	MnSO4	5.31E-09	5.51E-09	-8.275	-8.259	0.016	22.54
	HSO4-	9.64E-10	7.30E-10	-9.016	-9.137	-0.121	40.61
	Zn(SO4)2-2	3.66E-10	1.21E-10	-9.436	-9.918	-0.482	-10.61
	FeSO4	3.19E-11	3.31E-11	-10.496	-10.481	0.016	18.97
	CuSO4	1.76E-11	1.83E-11	-10.754	-10.739	0.016	13.09
	CaHSO4+	9.17E-12	6.95E-12	-11.037	-11.158	-0.121	0
	FeSO4+	2.58E-18	1.95E-18	-17.588	-17.711	-0.122	0
	FeHSO4+	9.95E-19	7.54E-19	-18.002	-18.123	-0.121	0
	Fe(SO4)2-	1.22E-19	9.22E-20	-18.915	-19.035	-0.121	0
	FeHSO4+2	5.49E-26	1.81E-26	-25.261	-25.743	-0.482	0
Zn	7.80E-07						
	Zn(CO3)2-2	5.45E-07	1.80E-07	-6.264	-6.746	-0.482	0
	ZnCO3	1.45E-07	1.50E-07	-6.838	-6.823	0.016	0
	Zn+2	4.16E-08	1.35E-08	-7.381	-7.87	-0.489	-24.56
	Zn(OH)2	1.35E-08	1.40E-08	-7.869	-7.853	0.016	0
	ZnHCO3+	9.26E-09	7.02E-09	-8.033	-8.154	-0.121	0
	ZnOHCl	9.08E-09	9.41E-09	-8.042	-8.026	0.016	0
	ZnSO4	6.61E-09	6.86E-09	-8.18	-8.164	0.016	21.71

ZnOH+	5.61E-09	4.25E-09	-8.251	-8.371	-0.121	0
ZnCl+	3.62E-09	2.66E-09	-8.442	-8.575	-0.133	-14.24
Zn(SO4)2-2	3.66E-10	1.21E-10	-9.436	-9.918	-0.482	-10.61
ZnCl2	1.97E-10	2.04E-10	-9.705	-9.69	0.016	102.03
ZnF+	3.54E-11	2.68E-11	-10.451	-10.572	-0.121	0
ZnCl3-	2.28E-11	1.68E-11	-10.642	-10.775	-0.133	16.12
Zn(OH)3-	1.68E-11	1.27E-11	-10.774	-10.895	-0.121	0
ZnCl4-2	1.90E-12	6.17E-13	-11.721	-12.21	-0.489	147.04
Zn(OH)4-2	1.76E-15	5.80E-16	-14.754	-15.237	-0.482	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.49	-5.77	-4.28	CaSO4			
Aragonite	0.98	-7.35	-8.34	CaCO3			
Barite	1.62	-8.23	-9.84	BaSO4			
Calcite	1.13	-7.35	-8.48	CaCO3			
CO2(g)	-3.02	-4.49	-1.47	CO2			
Dolomite	3.29	-13.79	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.4	6.29	4.89	Fe(OH)3			
Fluorite	-0.21	-10.81	-10.6	CaF2			
Goethite	7.29	6.29	-1	FeOOH			
Gypsum	-1.19	-5.77	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-3.85	-2.28	1.57	NaCl			
Hausmann	-8.89	52.14	61.03	Mn3O4			
Hematite	16.59	12.58	-4.01	Fe2O3			
Jarosite-K	-5.63	-14.84	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.81	21.53	25.34	MnOOH			
Melanterit	-10.53	-12.74	-2.21	FeSO4:7H2O			
NH3(g)	-7.61	-5.82	1.8	NH3			
O2(g)	-33.35	-36.24	-2.89	O2			
Pyrochroit	-6.13	9.07	15.2	Mn(OH)2			
Pyrolusite	-7.39	33.99	41.38	MnO2:H2O			
Rhodochrc	-0.97	-12.1	-11.13	MnCO3			
Siderite	-3.43	-14.32	-10.89	FeCO3			
Smithsonit	-2.12	-12.12	-10	ZnCO3			
Sylvite	-5.04	-4.14	0.9	KCl			
Witherite	-1.25	-9.82	-8.56	BaCO3			
Zn(OH)2(e	-2.45	9.05	11.5	Zn(OH)2			

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 17

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	7.87E-03	7.87E-03
Ba	1.26E-05	1.26E-05
Ca	2.88E-03	2.88E-03
Cl	1.06E-01	1.06E-01
Cu	1.00E-07	1.00E-07
F	3.00E-04	3.00E-04
Fe	7.60E-07	7.60E-07
K	1.45E-03	1.45E-03
Mg	2.33E-02	2.33E-02
Mn	1.30E-07	1.30E-07
N(-3)	1.60E-05	1.60E-05
N(5)	1.30E-04	1.30E-04
Na	1.02E-01	1.02E-01
S(6)	1.20E-02	1.20E-02
Zn	8.30E-07	8.30E-07

#NAME? of solution----------

pH	=	8.46			
pe	=	4			
Specific	Conductan	(µS/cm,	25°C)	=	13366
Density	(g/cm³)	=	1.00372		
Volume	(L)	=	1.00469		
Activity	of	water	=	0.996	
Ionic	strength	(mol/kgw)	=	1.65E-01	
Mass	of	water	(kg)	=	1.00E+00
Total	carbon	(mol/kg)	=	7.16E-03	
Total	CO2	(mol/kg)	=	7.16E-03	
Temperatu	(°C)	=	25		
Electrical	balance	(eq)	=	1.76E-02	
Percent	error,	100*(Cat-|	=	6.44	
Iterations	=	10	(150	overall)	
Total	H	=	1.11E+02		
Total	O	=	5.56E+01		

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4319	0.2622		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.02E-06	2.91E-06	-5.395	-5.537	-0.141	-3.57
H+	4.31E-09	3.47E-09	-8.366	-8.46	-0.094	0

	H2O	5.55E+01	9.96E-01	1.744	-0.002	0	18.07
Ba	1.26E-05						
	Ba+2	9.33E-06	2.85E-06	-5.03	-5.545	-0.515	-11.81
	BaSO4	3.06E-06	3.18E-06	-5.514	-5.497	0.017	0
	BaHCO3+	1.56E-07	1.18E-07	-6.807	-6.929	-0.122	0
	BaCO3	8.26E-08	8.58E-08	-7.083	-7.066	0.017	-10.7
	BaOH+	3.69E-11	2.77E-11	-10.433	-10.557	-0.124	0
C(4)	7.16E-03						
	HCO3-	5.69E-03	4.31E-03	-2.245	-2.365	-0.12	25.42
	MgHCO3+	4.68E-04	3.43E-04	-3.33	-3.465	-0.135	5.7
	MgCO3	3.64E-04	3.78E-04	-3.439	-3.422	0.017	-17.09
	NaHCO3	1.77E-04	1.84E-04	-3.751	-3.734	0.017	1.8
	CO3-2	1.77E-04	5.83E-05	-3.753	-4.234	-0.482	-3.78
	NaCO3-	1.09E-04	8.25E-05	-3.961	-4.083	-0.122	0.1
	CaCO3	7.77E-05	8.07E-05	-4.11	-4.093	0.017	-14.6
	CaHCO3+	5.90E-05	4.53E-05	-4.229	-4.344	-0.115	9.87
	CO2	3.25E-05	3.38E-05	-4.488	-4.472	0.017	34.43
	Zn(CO3)2-2	5.91E-07	1.92E-07	-6.228	-6.717	-0.488	0
	BaHCO3+	1.56E-07	1.18E-07	-6.807	-6.929	-0.122	0
	ZnCO3	1.48E-07	1.54E-07	-6.829	-6.812	0.017	0
	BaCO3	8.26E-08	8.58E-08	-7.083	-7.066	0.017	-10.7
	MnCO3	6.68E-08	6.94E-08	-7.175	-7.159	0.017	0
	CuCO3	1.36E-08	1.41E-08	-7.866	-7.85	0.017	0
	ZnHCO3+	9.52E-09	7.19E-09	-8.021	-8.143	-0.122	0
	MnHCO3+	7.66E-09	5.76E-09	-8.116	-8.24	-0.124	0
	Cu(CO3)2-	3.20E-09	1.04E-09	-8.495	-8.984	-0.488	0
	CuHCO3+	1.29E-10	9.76E-11	-9.889	-10.011	-0.122	0
	FeCO3	1.22E-10	1.27E-10	-9.913	-9.897	0.017	0
	FeHCO3+	5.18E-11	3.91E-11	-10.286	-10.408	-0.122	0
	(CO2)2	2.01E-11	2.09E-11	-10.696	-10.68	0.017	68.87
Ca	2.88E-03						
	Ca+2	2.43E-03	8.23E-04	-2.615	-3.084	-0.47	-17.28
	CaSO4	3.14E-04	3.26E-04	-3.503	-3.487	0.017	7.5
	CaCO3	7.77E-05	8.07E-05	-4.11	-4.093	0.017	-14.6
	CaHCO3+	5.90E-05	4.53E-05	-4.229	-4.344	-0.115	9.87
	CaOH+	5.20E-08	3.92E-08	-7.284	-7.406	-0.122	0
	CaHSO4+	9.85E-12	7.43E-12	-11.007	-11.129	-0.122	0
Cl	1.06E-01						
	Cl-	1.06E-01	7.72E-02	-0.976	-1.112	-0.137	18.42
	ZnOHCl	9.36E-09	9.72E-09	-8.029	-8.012	0.017	0
	MnCl+	6.27E-09	4.71E-09	-8.203	-8.327	-0.124	-2.89
	CuCl2-	6.10E-09	4.47E-09	-8.215	-8.35	-0.135	0
	ZnCl+	3.76E-09	2.75E-09	-8.425	-8.56	-0.135	-14.27
	CuCl3-2	1.72E-09	5.46E-10	-8.765	-9.263	-0.497	0
	ZnCl2	2.14E-10	2.22E-10	-9.669	-9.653	0.017	102.03
	MnCl2	1.53E-10	1.59E-10	-9.816	-9.799	0.017	85.89
	ZnCl3-	2.63E-11	1.93E-11	-10.58	-10.715	-0.135	16.06
	CuCl+	1.28E-11	9.38E-12	-10.893	-11.028	-0.135	1.08
	FeCl+	1.28E-11	9.67E-12	-10.893	-11.015	-0.122	0
	MnCl3-	4.49E-12	3.38E-12	-11.347	-11.472	-0.124	44.12

	ZnCl4-2	2.34E-12	7.45E-13	-11.631	-12.128	-0.497	147.11
	CuCl2	3.74E-13	3.89E-13	-12.427	-12.41	0.017	31.02
	CuCl3-	1.45E-16	1.07E-16	-15.837	-15.973	-0.135	0
	FeCl+2	6.34E-19	2.02E-19	-18.198	-18.695	-0.497	0
	CuCl4-2	1.30E-19	4.12E-20	-18.888	-19.385	-0.497	0
	FeCl2+	9.27E-20	6.96E-20	-19.033	-19.157	-0.124	0
	FeCl3	5.18E-22	5.38E-22	-21.286	-21.27	0.017	0
Cu(1)	7.81E-09						
	CuCl2-	6.10E-09	4.47E-09	-8.215	-8.35	-0.135	0
	CuCl3-2	1.72E-09	5.46E-10	-8.765	-9.263	-0.497	0
	Cu+	3.39E-12	2.37E-12	-11.47	-11.625	-0.155	0
Cu(2)	9.22E-08						
	Cu(OH)2	7.49E-08	7.78E-08	-7.125	-7.109	0.017	0
	CuCO3	1.36E-08	1.41E-08	-7.866	-7.85	0.017	0
	Cu(CO3)2-	3.20E-09	1.04E-09	-8.495	-8.984	-0.488	0
	CuOH+	1.77E-10	1.30E-10	-9.752	-9.887	-0.135	0
	Cu+2	1.30E-10	4.52E-11	-9.885	-10.345	-0.46	-25.81
	CuHCO3+	1.29E-10	9.76E-11	-9.889	-10.011	-0.122	0
	CuSO4	1.98E-11	2.05E-11	-10.704	-10.688	0.017	13.09
	CuCl+	1.28E-11	9.38E-12	-10.893	-11.028	-0.135	1.08
	Cu(OH)3-	1.78E-12	1.35E-12	-11.749	-11.871	-0.122	0
	CuCl2	3.74E-13	3.89E-13	-12.427	-12.41	0.017	31.02
	CuF+	1.61E-13	1.21E-13	-12.794	-12.916	-0.122	0
	Cu2(OH)2+	2.27E-14	7.36E-15	-13.645	-14.133	-0.488	0
	Cu(OH)4-2	2.38E-16	7.72E-17	-15.624	-16.113	-0.488	0
	CuCl3-	1.45E-16	1.07E-16	-15.837	-15.973	-0.135	0
	CuCl4-2	1.30E-19	4.12E-20	-18.888	-19.385	-0.497	0
F	3.00E-04						
	F-	2.04E-04	1.48E-04	-3.689	-3.831	-0.141	-0.96
	MgF+	8.94E-05	6.63E-05	-4.049	-4.178	-0.129	-10.36
	NaF	6.22E-06	6.46E-06	-5.206	-5.19	0.017	7.26
	HF	7.39E-10	7.68E-10	-9.131	-9.115	0.017	12.5
	ZnF+	3.66E-11	2.76E-11	-10.437	-10.559	-0.122	0
	MnF+	2.04E-11	1.53E-11	-10.691	-10.815	-0.124	0
	HF2-	5.76E-13	4.35E-13	-12.239	-12.361	-0.122	22.41
	FeF+	1.77E-13	1.34E-13	-12.751	-12.873	-0.122	0
	CuF+	1.61E-13	1.21E-13	-12.794	-12.916	-0.122	0
	FeF2+	1.59E-16	1.19E-16	-15.8	-15.924	-0.124	0
	FeF+2	6.37E-17	2.03E-17	-16.196	-16.693	-0.497	0
	FeF3	2.69E-17	2.79E-17	-16.571	-16.555	0.017	0
Fe(2)	4.94E-10						
	Fe+2	2.62E-10	9.07E-11	-9.582	-10.042	-0.46	-21.31
	FeCO3	1.22E-10	1.27E-10	-9.913	-9.897	0.017	0
	FeHCO3+	5.18E-11	3.91E-11	-10.286	-10.408	-0.122	0
	FeSO4	3.46E-11	3.59E-11	-10.461	-10.445	0.017	18.97
	FeCl+	1.28E-11	9.67E-12	-10.893	-11.015	-0.122	0
	FeOH+	1.10E-11	8.24E-12	-10.96	-11.084	-0.124	0
	FeF+	1.77E-13	1.34E-13	-12.751	-12.873	-0.122	0
	Fe(OH)2	1.94E-14	2.01E-14	-13.713	-13.696	0.017	0
	Fe(OH)3-	2.86E-16	2.15E-16	-15.544	-15.668	-0.124	0

	FeHSO4+	1.09E-18	8.19E-19	-17.965	-18.087	-0.122	0
Fe(3)	7.60E-07						
	Fe(OH)3	5.44E-07	5.65E-07	-6.264	-6.248	0.017	0
	Fe(OH)4-	1.95E-07	1.48E-07	-6.709	-6.83	-0.12	0
	Fe(OH)2+	2.02E-08	1.53E-08	-7.696	-7.816	-0.12	0
	FeOH+2	5.05E-13	1.61E-13	-12.297	-12.794	-0.497	0
	FeF2+	1.59E-16	1.19E-16	-15.8	-15.924	-0.124	0
	FeF+2	6.37E-17	2.03E-17	-16.196	-16.693	-0.497	0
	FeF3	2.69E-17	2.79E-17	-16.571	-16.555	0.017	0
	FeSO4+	2.82E-18	2.12E-18	-17.55	-17.675	-0.124	0
	FeCl+2	6.34E-19	2.02E-19	-18.198	-18.695	-0.497	0
	Fe+3	6.09E-19	8.66E-20	-18.215	-19.062	-0.847	0
	Fe(SO4)2-	1.37E-19	1.03E-19	-18.865	-18.987	-0.122	0
	FeCl2+	9.27E-20	6.96E-20	-19.033	-19.157	-0.124	0
	FeCl3	5.18E-22	5.38E-22	-21.286	-21.27	0.017	0
	Fe2(OH)2+	6.24E-23	6.94E-25	-22.205	-24.158	-1.953	0
	FeHSO4+2	6.05E-26	1.96E-26	-25.218	-25.707	-0.488	0
	Fe3(OH)4+	2.50E-27	2.22E-30	-26.602	-29.654	-3.052	0
H(0)	1.64E-28						
	H2	8.19E-29	8.51E-29	-28.087	-28.07	0.017	28.61
K	1.45E-03						
	K+	1.43E-03	1.04E-03	-2.845	-2.984	-0.139	9.31
	KSO4-	2.14E-05	1.62E-05	-4.669	-4.789	-0.12	34.46
Mg	2.33E-02						
	Mg+2	1.89E-02	6.80E-03	-1.723	-2.168	-0.445	-20.98
	MgSO4	3.42E-03	3.55E-03	-2.466	-2.45	0.017	5.84
	MgHCO3+	4.68E-04	3.43E-04	-3.33	-3.465	-0.135	5.7
	MgCO3	3.64E-04	3.78E-04	-3.439	-3.422	0.017	-17.09
	MgF+	8.94E-05	6.63E-05	-4.049	-4.178	-0.129	-10.36
	MgOH+	9.15E-06	7.09E-06	-5.038	-5.149	-0.111	0
Mn(2)	1.30E-07						
	MnCO3	6.68E-08	6.94E-08	-7.175	-7.159	0.017	0
	Mn+2	4.32E-08	1.50E-08	-7.364	-7.824	-0.46	-17.72
	MnHCO3+	7.66E-09	5.76E-09	-8.116	-8.24	-0.124	0
	MnCl+	6.27E-09	4.71E-09	-8.203	-8.327	-0.124	-2.89
	MnSO4	5.71E-09	5.93E-09	-8.243	-8.227	0.017	22.54
	MnCl2	1.53E-10	1.59E-10	-9.816	-9.799	0.017	85.89
	MnOH+	1.47E-10	1.11E-10	-9.832	-9.956	-0.124	0
	MnF+	2.04E-11	1.53E-11	-10.691	-10.815	-0.124	0
	MnCl3-	4.49E-12	3.38E-12	-11.347	-11.472	-0.124	44.12
	Mn(NO3)2	4.91E-16	5.10E-16	-15.309	-15.293	0.017	41.04
	Mn(OH)3-	7.49E-18	5.62E-18	-17.126	-17.25	-0.124	0
Mn(3)	3.26E-29						
	Mn+3	3.26E-29	4.63E-30	-28.487	-29.334	-0.847	0
N(-3)	1.60E-05						
	NH4+	1.41E-05	9.84E-06	-4.852	-5.007	-0.155	18.23
	NH3	1.56E-06	1.62E-06	-5.808	-5.791	0.017	24.42
	NH4SO4-	3.74E-07	2.82E-07	-6.427	-6.549	-0.122	38.36
N(5)	1.30E-04						
	NO3-	1.30E-04	9.25E-05	-3.886	-4.034	-0.148	29.86

	Mn(NO3)2	4.91E-16	5.10E-16	-15.309	-15.293	0.017	41.04
Na	1.02E-01						
	Na+	1.00E-01	7.60E-02	-0.998	-1.119	-0.121	-0.98
	NaSO4-	1.12E-03	8.49E-04	-2.951	-3.071	-0.12	17.16
	NaHCO3	1.77E-04	1.84E-04	-3.751	-3.734	0.017	1.8
	NaCO3-	1.09E-04	8.25E-05	-3.961	-4.083	-0.122	0.1
	NaF	6.22E-06	6.46E-06	-5.206	-5.19	0.017	7.26
	NaOH	2.13E-17	2.21E-17	-16.672	-16.656	0.017	0
O(0)	1.10E-36						
	O2	5.49E-37	5.71E-37	-36.26	-36.244	0.017	30.4
S(6)	1.20E-02						
	SO4-2	7.10E-03	2.23E-03	-2.149	-2.652	-0.504	15.93
	MgSO4	3.42E-03	3.55E-03	-2.466	-2.45	0.017	5.84
	NaSO4-	1.12E-03	8.49E-04	-2.951	-3.071	-0.12	17.16
	CaSO4	3.14E-04	3.26E-04	-3.503	-3.487	0.017	7.5
	KSO4-	2.14E-05	1.62E-05	-4.669	-4.789	-0.12	34.46
	BaSO4	3.06E-06	3.18E-06	-5.514	-5.497	0.017	0
	NH4SO4-	3.74E-07	2.82E-07	-6.427	-6.549	-0.122	38.36
	ZnSO4	6.66E-09	6.91E-09	-8.177	-8.16	0.017	21.71
	MnSO4	5.71E-09	5.93E-09	-8.243	-8.227	0.017	22.54
	HSO4-	9.95E-10	7.51E-10	-9.002	-9.124	-0.122	40.62
	Zn(SO4)2-2	3.85E-10	1.25E-10	-9.414	-9.902	-0.488	-10.5
	FeSO4	3.46E-11	3.59E-11	-10.461	-10.445	0.017	18.97
	CuSO4	1.98E-11	2.05E-11	-10.704	-10.688	0.017	13.09
	CaHSO4+	9.85E-12	7.43E-12	-11.007	-11.129	-0.122	0
	FeSO4+	2.82E-18	2.12E-18	-17.55	-17.675	-0.124	0
	FeHSO4+	1.09E-18	8.19E-19	-17.965	-18.087	-0.122	0
	Fe(SO4)2-	1.37E-19	1.03E-19	-18.865	-18.987	-0.122	0
	FeHSO4+2	6.05E-26	1.96E-26	-25.218	-25.707	-0.488	0
Zn	8.30E-07						
	Zn(CO3)2-2	5.91E-07	1.92E-07	-6.228	-6.717	-0.488	0
	ZnCO3	1.48E-07	1.54E-07	-6.829	-6.812	0.017	0
	Zn+2	4.16E-08	1.32E-08	-7.381	-7.878	-0.497	-24.54
	Zn(OH)2	1.32E-08	1.38E-08	-7.878	-7.862	0.017	0
	ZnHCO3+	9.52E-09	7.19E-09	-8.021	-8.143	-0.122	0
	ZnOHCl	9.36E-09	9.72E-09	-8.029	-8.012	0.017	0
	ZnSO4	6.66E-09	6.91E-09	-8.177	-8.16	0.017	21.71
	ZnOH+	5.52E-09	4.17E-09	-8.258	-8.38	-0.122	0
	ZnCl+	3.76E-09	2.75E-09	-8.425	-8.56	-0.135	-14.27
	Zn(SO4)2-2	3.85E-10	1.25E-10	-9.414	-9.902	-0.488	-10.5
	ZnCl2	2.14E-10	2.22E-10	-9.669	-9.653	0.017	102.03
	ZnF+	3.66E-11	2.76E-11	-10.437	-10.559	-0.122	0
	ZnCl3-	2.63E-11	1.93E-11	-10.58	-10.715	-0.135	16.06
	Zn(OH)3-	1.65E-11	1.25E-11	-10.781	-10.904	-0.122	0
	ZnCl4-2	2.34E-12	7.45E-13	-11.631	-12.128	-0.497	147.11
	Zn(OH)4-2	1.75E-15	5.68E-16	-14.757	-15.245	-0.488	0

#NAME? indices----------

	Phase	SI**	log	IAP	log	K(298	K, 1

Anhydrite	-1.46	-5.74	-4.28	CaSO4
Aragonite	1.02	-7.32	-8.34	CaCO3
Barite	1.65	-8.2	-9.84	BaSO4
Calcite	1.16	-7.32	-8.48	CaCO3
CO2(g)	-3	-4.47	-1.47	CO2
Dolomite	3.36	-13.72	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.42	6.31	4.89	Fe(OH)3
Fluorite	-0.15	-10.75	-10.6	CaF2
Goethite	7.31	6.31	-1	FeOOH
Gypsum	-1.16	-5.74	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.5	0	1.5	H2O
Halite	-3.8	-2.23	1.57	NaCl
Hausmann	-8.83	52.2	61.03	Mn3O4
Hematite	16.64	12.63	-4.01	Fe2O3
Jarosite-K	-5.52	-14.73	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.79	21.55	25.34	MnOOH
Melanterit	-10.5	-12.71	-2.21	FeSO4:7H2O
NH3(g)	-7.59	-5.79	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.11	9.09	15.2	Mn(OH)2
Pyrolusite	-7.37	34.01	41.38	MnO2:H2O
Rhodochrc	-0.93	-12.06	-11.13	MnCO3
Siderite	-3.39	-14.28	-10.89	FeCO3
Smithsonit	-2.11	-12.11	-10	ZnCO3
Sylvite	-5	-4.1	0.9	KCl
Witherite	-1.22	-9.78	-8.56	BaCO3
Zn(OH)2(e	-2.46	9.04	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 18

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	8.31E-03	8.31E-03
Ba	1.34E-05	1.34E-05
Ca	3.04E-03	3.04E-03
Cl	1.12E-01	1.12E-01
Cu	1.00E-07	1.00E-07
F	3.10E-04	3.10E-04
Fe	8.00E-07	8.00E-07
K	1.53E-03	1.53E-03
Mg	2.46E-02	2.46E-02
Mn	1.40E-07	1.40E-07
N(-3)	1.70E-05	1.70E-05

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N(5)        1.40E-04  1.40E-04
Na          1.08E-01  1.08E-01
S(6)        1.27E-02  1.27E-02
Zn          8.80E-07  8.80E-07

#NAME? of       solution----------------------------

pH          =                 8.46
pe          =                    4
Specific    Conductan (µS/cm,     25°C)     =              14037
Density     (g/cm³)   =            1.00409
Volume      (L)       =            1.00479
Activity    of        water     =              0.996
Ionic       strength  (mol/kgw) =            1.74E-01
Mass        of        water     (kg)      =          1.00E+00
Total       carbon    (mol/kg)  =            7.54E-03
Total       CO2       (mol/kg)  =            7.54E-03
Temperatu   (°C)      =                   25
Electrical  balance   (eq)      =            1.86E-02
Percent     error,    100*(Cat-|=              6.45
Iterations  =                 11 (161      overall)
Total       H         =          1.11E+02
Total       O         =          5.56E+01

#NAME? couples--------------------------------

Redox       couple    pe        Eh        (volts)

N(-3)/N(5)     4.4327     0.2622

#NAME? of       species----------------------------

Log         Log       Log       mole      V
Species     Molality  Activity  Molality  Activity  Gamma   cm³/mol

OH-         4.05E-06  2.91E-06   -5.393    -5.537   -0.144    -3.56
H+          4.32E-09  3.47E-09   -8.365    -8.46    -0.095        0
H2O         5.55E+01  9.96E-01    1.744    -0.002        0    18.07
Ba          1.34E-05
Ba+2        9.87E-06  2.96E-06   -5.006    -5.529   -0.523   -11.78
BaSO4       3.26E-06  3.39E-06   -5.487    -5.469    0.017        0
BaHCO3+     1.69E-07  1.27E-07   -6.771    -6.895   -0.124        0
BaCO3       8.93E-08  9.29E-08   -7.049    -7.032    0.017     -10.7
BaOH+       3.85E-11  2.88E-11  -10.414   -10.541   -0.126        0
C(4)        7.54E-03
HCO3-       5.95E-03  4.49E-03   -2.225    -2.348   -0.122    25.45
MgHCO3+     5.10E-04  3.72E-04   -3.293     -3.43   -0.137      5.7
MgCO3       3.94E-04  4.10E-04   -3.405    -3.387    0.017   -17.09
NaHCO3      1.94E-04  2.02E-04   -3.712    -3.695    0.017      1.8
CO3-2       1.87E-04  6.08E-05   -3.727    -4.216   -0.489    -3.74
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	NaCO3-	1.20E-04	9.04E-05	-3.92	-4.044	-0.124	0.15
	CaCO3	8.38E-05	8.72E-05	-4.077	-4.06	0.017	-14.6
	CaHCO3+	6.41E-05	4.90E-05	-4.193	-4.31	-0.117	9.87
	CO2	3.38E-05	3.52E-05	-4.471	-4.454	0.017	34.43
	Zn(CO3)2-2	6.38E-07	2.05E-07	-6.195	-6.689	-0.494	0
	BaHCO3+	1.69E-07	1.27E-07	-6.771	-6.895	-0.124	0
	ZnCO3	1.51E-07	1.58E-07	-6.82	-6.803	0.017	0
	BaCO3	8.93E-08	9.29E-08	-7.049	-7.032	0.017	-10.7
	MnCO3	7.25E-08	7.54E-08	-7.14	-7.123	0.017	0
	CuCO3	1.39E-08	1.45E-08	-7.856	-7.839	0.017	0
	ZnHCO3+	9.76E-09	7.35E-09	-8.01	-8.134	-0.124	0
	MnHCO3+	8.37E-09	6.26E-09	-8.077	-8.204	-0.126	0
	Cu(CO3)2-	3.46E-09	1.11E-09	-8.461	-8.955	-0.494	0
	FeCO3	1.34E-10	1.39E-10	-9.873	-9.856	0.017	0
	CuHCO3+	1.33E-10	1.00E-10	-9.877	-10	-0.124	0
	FeHCO3+	5.71E-11	4.29E-11	-10.244	-10.367	-0.124	0
	(CO2)2	2.18E-11	2.27E-11	-10.661	-10.644	0.017	68.87
Ca	3.04E-03						
	Ca+2	2.56E-03	8.54E-04	-2.592	-3.068	-0.476	-17.26
	CaSO4	3.34E-04	3.48E-04	-3.476	-3.459	0.017	7.5
	CaCO3	8.38E-05	8.72E-05	-4.077	-4.06	0.017	-14.6
	CaHCO3+	6.41E-05	4.90E-05	-4.193	-4.31	-0.117	9.87
	CaOH+	5.41E-08	4.07E-08	-7.267	-7.39	-0.124	0
	CaHSO4+	1.05E-11	7.92E-12	-10.978	-11.101	-0.124	0
Cl	1.12E-01						
	Cl-	1.12E-01	8.11E-02	-0.952	-1.091	-0.139	18.43
	ZnOHCl	9.62E-09	1.00E-08	-8.017	-7.999	0.017	0
	MnCl+	6.90E-09	5.16E-09	-8.161	-8.287	-0.126	-2.89
	CuCl2-	6.65E-09	4.85E-09	-8.177	-8.315	-0.137	0
	ZnCl+	3.89E-09	2.84E-09	-8.41	-8.547	-0.137	-14.29
	CuCl3-2	1.99E-09	6.23E-10	-8.701	-9.206	-0.505	0
	ZnCl2	2.31E-10	2.41E-10	-9.636	-9.618	0.017	102.03
	MnCl2	1.76E-10	1.83E-10	-9.756	-9.738	0.017	85.89
	ZnCl3-	3.01E-11	2.19E-11	-10.522	-10.66	-0.137	16
	FeCl+	1.42E-11	1.07E-11	-10.847	-10.971	-0.124	0
	CuCl+	1.33E-11	9.69E-12	-10.876	-11.014	-0.137	1.09
	MnCl3-	5.46E-12	4.08E-12	-11.263	-11.389	-0.126	44.15
	ZnCl4-2	2.85E-12	8.90E-13	-11.546	-12.051	-0.505	147.18
	CuCl2	4.06E-13	4.22E-13	-12.392	-12.375	0.017	31.02
	CuCl3-	1.67E-16	1.21E-16	-15.778	-15.916	-0.137	0
	FeCl+2	7.15E-19	2.24E-19	-18.146	-18.651	-0.505	0
	CuCl4-2	1.58E-19	4.93E-20	-18.802	-19.307	-0.505	0
	FeCl2+	1.08E-19	8.09E-20	-18.966	-19.092	-0.126	0
	FeCl3	6.30E-22	6.56E-22	-21.2	-21.183	0.017	0
Cu(1)	8.65E-09						
	CuCl2-	6.65E-09	4.85E-09	-8.177	-8.315	-0.137	0
	CuCl3-2	1.99E-09	6.23E-10	-8.701	-9.206	-0.505	0
	Cu+	3.36E-12	2.33E-12	-11.474	-11.632	-0.158	0
Cu(2)	9.14E-08						
	Cu(OH)2	7.35E-08	7.65E-08	-7.134	-7.116	0.017	0

	CuCO3	1.39E-08	1.45E-08	-7.856	-7.839	0.017	0
	Cu(CO3)2-	3.46E-09	1.11E-09	-8.461	-8.955	-0.494	0
	CuOH+	1.75E-10	1.28E-10	-9.757	-9.894	-0.137	0
	CuHCO3+	1.33E-10	1.00E-10	-9.877	-10	-0.124	0
	Cu+2	1.30E-10	4.44E-11	-9.885	-10.352	-0.467	-25.8
	CuSO4	1.99E-11	2.07E-11	-10.701	-10.683	0.017	13.09
	CuCl+	1.33E-11	9.69E-12	-10.876	-11.014	-0.137	1.09
	Cu(OH)3-	1.76E-12	1.32E-12	-11.755	-11.878	-0.124	0
	CuCl2	4.06E-13	4.22E-13	-12.392	-12.375	0.017	31.02
	CuF+	1.61E-13	1.21E-13	-12.793	-12.917	-0.124	0
	Cu2(OH)2+	2.22E-14	7.12E-15	-13.654	-14.148	-0.494	0
	Cu(OH)4-2	2.37E-16	7.58E-17	-15.626	-16.12	-0.494	0
	CuCl3-	1.67E-16	1.21E-16	-15.778	-15.916	-0.137	0
	CuCl4-2	1.58E-19	4.93E-20	-18.802	-19.307	-0.505	0
F	3.10E-04						
	F-	2.09E-04	1.50E-04	-3.681	-3.824	-0.144	-0.95
	MgF+	9.47E-05	7.00E-05	-4.023	-4.155	-0.132	-10.36
	NaF	6.62E-06	6.89E-06	-5.179	-5.162	0.017	7.26
	HF	7.49E-10	7.79E-10	-9.126	-9.108	0.017	12.5
	ZnF+	3.66E-11	2.75E-11	-10.437	-10.561	-0.124	0
	MnF+	2.17E-11	1.62E-11	-10.664	-10.79	-0.126	0
	HF2-	5.95E-13	4.48E-13	-12.225	-12.349	-0.124	22.42
	FeF+	1.90E-13	1.43E-13	-12.721	-12.844	-0.124	0
	CuF+	1.61E-13	1.21E-13	-12.793	-12.917	-0.124	0
	FeF2+	1.73E-16	1.29E-16	-15.762	-15.888	-0.126	0
	FeF+2	6.93E-17	2.17E-17	-16.159	-16.664	-0.505	0
	FeF3	2.95E-17	3.07E-17	-16.53	-16.513	0.017	0
Fe(2)	5.34E-10						
	Fe+2	2.80E-10	9.56E-11	-9.553	-10.02	-0.467	-21.29
	FeCO3	1.34E-10	1.39E-10	-9.873	-9.856	0.017	0
	FeHCO3+	5.71E-11	4.29E-11	-10.244	-10.367	-0.124	0
	FeSO4	3.74E-11	3.89E-11	-10.428	-10.41	0.017	18.97
	FeCl+	1.42E-11	1.07E-11	-10.847	-10.971	-0.124	0
	FeOH+	1.16E-11	8.68E-12	-10.935	-11.062	-0.126	0
	FeF+	1.90E-13	1.43E-13	-12.721	-12.844	-0.124	0
	Fe(OH)2	2.04E-14	2.12E-14	-13.691	-13.674	0.017	0
	Fe(OH)3-	3.03E-16	2.26E-16	-15.519	-15.645	-0.126	0
	FeHSO4+	1.18E-18	8.86E-19	-17.929	-18.053	-0.124	0
Fe(3)	8.00E-07						
	Fe(OH)3	5.72E-07	5.95E-07	-6.243	-6.225	0.017	0
	Fe(OH)4-	2.07E-07	1.56E-07	-6.685	-6.807	-0.122	0
	Fe(OH)2+	2.13E-08	1.61E-08	-7.671	-7.794	-0.122	0
	FeOH+2	5.41E-13	1.69E-13	-12.267	-12.772	-0.505	0
	FeF2+	1.73E-16	1.29E-16	-15.762	-15.888	-0.126	0
	FeF+2	6.93E-17	2.17E-17	-16.159	-16.664	-0.505	0
	FeF3	2.95E-17	3.07E-17	-16.53	-16.513	0.017	0
	FeSO4+	3.06E-18	2.29E-18	-17.514	-17.64	-0.126	0
	FeCl+2	7.15E-19	2.24E-19	-18.146	-18.651	-0.505	0
	Fe+3	6.57E-19	9.13E-20	-18.182	-19.04	-0.857	0
	Fe(SO4)2-	1.52E-19	1.15E-19	-18.818	-18.941	-0.124	0

	FeCl2+	1.08E-19	8.09E-20	-18.966	-19.092	-0.126	0
	FeCl3	6.30E-22	6.56E-22	-21.2	-21.183	0.017	0
	Fe2(OH)2+	7.29E-23	7.71E-25	-22.137	-24.113	-1.976	0
	FeHSO4+2	6.63E-26	2.13E-26	-25.179	-25.673	-0.494	0
	Fe3(OH)4+	3.17E-27	2.59E-30	-26.499	-29.587	-3.088	0
H(0)	1.64E-28						
	H2	8.18E-29	8.51E-29	-28.087	-28.07	0.017	28.61
K	1.53E-03						
	K+	1.51E-03	1.09E-03	-2.822	-2.963	-0.141	9.32
	KSO4-	2.32E-05	1.75E-05	-4.635	-4.757	-0.122	34.47
Mg	2.46E-02						
	Mg+2	1.99E-02	7.07E-03	-1.7	-2.151	-0.45	-20.97
	MgSO4	3.64E-03	3.79E-03	-2.439	-2.421	0.017	5.84
	MgHCO3+	5.10E-04	3.72E-04	-3.293	-3.43	-0.137	5.7
	MgCO3	3.94E-04	4.10E-04	-3.405	-3.387	0.017	-17.09
	MgF+	9.47E-05	7.00E-05	-4.023	-4.155	-0.132	-10.36
	MgOH+	9.55E-06	7.37E-06	-5.02	-5.133	-0.113	0
Mn(2)	1.40E-07						
	MnCO3	7.25E-08	7.54E-08	-7.14	-7.123	0.017	0
	Mn+2	4.58E-08	1.56E-08	-7.339	-7.806	-0.467	-17.67
	MnHCO3+	8.37E-09	6.26E-09	-8.077	-8.204	-0.126	0
	MnCl+	6.90E-09	5.16E-09	-8.161	-8.287	-0.126	-2.89
	MnSO4	6.11E-09	6.36E-09	-8.214	-8.197	0.017	22.54
	MnCl2	1.76E-10	1.83E-10	-9.756	-9.738	0.017	85.89
	MnOH+	1.54E-10	1.15E-10	-9.812	-9.938	-0.126	0
	MnF+	2.17E-11	1.62E-11	-10.664	-10.79	-0.126	0
	MnCl3-	5.46E-12	4.08E-12	-11.263	-11.389	-0.126	44.15
	Mn(NO3)2	5.85E-16	6.09E-16	-15.233	-15.215	0.017	41.04
	Mn(OH)3-	7.84E-18	5.86E-18	-17.106	-17.232	-0.126	0
Mn(3)	3.48E-29						
	Mn+3	3.48E-29	4.83E-30	-28.459	-29.316	-0.857	0
N(-3)	1.70E-05						
	NH4+	1.50E-05	1.04E-05	-4.825	-4.984	-0.158	18.23
	NH3	1.64E-06	1.71E-06	-5.785	-5.768	0.017	24.42
	NH4SO4-	4.07E-07	3.06E-07	-6.391	-6.514	-0.124	38.39
N(5)	1.40E-04						
	NO3-	1.40E-04	9.89E-05	-3.854	-4.005	-0.151	29.87
	Mn(NO3)2	5.85E-16	6.09E-16	-15.233	-15.215	0.017	41.04
Na	1.08E-01						
	Na+	1.06E-01	8.00E-02	-0.975	-1.097	-0.122	-0.97
	NaSO4-	1.21E-03	9.16E-04	-2.916	-3.038	-0.122	17.27
	NaHCO3	1.94E-04	2.02E-04	-3.712	-3.695	0.017	1.8
	NaCO3-	1.20E-04	9.04E-05	-3.92	-4.044	-0.124	0.15
	NaF	6.62E-06	6.89E-06	-5.179	-5.162	0.017	7.26
	NaOH	2.23E-17	2.32E-17	-16.651	-16.634	0.017	0
O(0)	1.10E-36						
	O2	5.48E-37	5.70E-37	-36.261	-36.244	0.017	30.4
S(6)	1.27E-02						
	SO4-2	7.43E-03	2.29E-03	-2.129	-2.641	-0.512	15.97
	MgSO4	3.64E-03	3.79E-03	-2.439	-2.421	0.017	5.84

	NaSO4-	1.21E-03	9.16E-04	-2.916	-3.038	-0.122	17.27
	CaSO4	3.34E-04	3.48E-04	-3.476	-3.459	0.017	7.5
	KSO4-	2.32E-05	1.75E-05	-4.635	-4.757	-0.122	34.47
	BaSO4	3.26E-06	3.39E-06	-5.487	-5.469	0.017	0
	NH4SO4-	4.07E-07	3.06E-07	-6.391	-6.514	-0.124	38.39
	ZnSO4	6.69E-09	6.97E-09	-8.174	-8.157	0.017	21.71
	MnSO4	6.11E-09	6.36E-09	-8.214	-8.197	0.017	22.54
	HSO4-	1.03E-09	7.71E-10	-8.989	-9.113	-0.124	40.63
	Zn(SO4)2-2	4.04E-10	1.30E-10	-9.394	-9.888	-0.494	-10.39
	FeSO4	3.74E-11	3.89E-11	-10.428	-10.41	0.017	18.97
	CuSO4	1.99E-11	2.07E-11	-10.701	-10.683	0.017	13.09
	CaHSO4+	1.05E-11	7.92E-12	-10.978	-11.101	-0.124	0
	FeSO4+	3.06E-18	2.29E-18	-17.514	-17.64	-0.126	0
	FeHSO4+	1.18E-18	8.86E-19	-17.929	-18.053	-0.124	0
	Fe(SO4)2-	1.52E-19	1.15E-19	-18.818	-18.941	-0.124	0
	FeHSO4+2	6.63E-26	2.13E-26	-25.179	-25.673	-0.494	0
Zn	8.80E-07						
	Zn(CO3)2-2	6.38E-07	2.05E-07	-6.195	-6.689	-0.494	0
	ZnCO3	1.51E-07	1.58E-07	-6.82	-6.803	0.017	0
	Zn+2	4.16E-08	1.30E-08	-7.381	-7.886	-0.505	-24.53
	Zn(OH)2	1.30E-08	1.35E-08	-7.888	-7.87	0.017	0
	ZnHCO3+	9.76E-09	7.35E-09	-8.01	-8.134	-0.124	0
	ZnOHCl	9.62E-09	1.00E-08	-8.017	-7.999	0.017	0
	ZnSO4	6.69E-09	6.97E-09	-8.174	-8.157	0.017	21.71
	ZnOH+	5.44E-09	4.09E-09	-8.265	-8.388	-0.124	0
	ZnCl+	3.89E-09	2.84E-09	-8.41	-8.547	-0.137	-14.29
	Zn(SO4)2-2	4.04E-10	1.30E-10	-9.394	-9.888	-0.494	-10.39
	ZnCl2	2.31E-10	2.41E-10	-9.636	-9.618	0.017	102.03
	ZnF+	3.66E-11	2.75E-11	-10.437	-10.561	-0.124	0
	ZnCl3-	3.01E-11	2.19E-11	-10.522	-10.66	-0.137	16
	Zn(OH)3-	1.63E-11	1.22E-11	-10.789	-10.912	-0.124	0
	ZnCl4-2	2.85E-12	8.90E-13	-11.546	-12.051	-0.505	147.18
	Zn(OH)4-2	1.74E-15	5.57E-16	-14.76	-15.254	-0.494	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.43	-5.71	-4.28	CaSO4			
Aragonite	1.05	-7.28	-8.34	CaCO3			
Barite	1.67	-8.17	-9.84	BaSO4			
Calcite	1.2	-7.28	-8.48	CaCO3			
CO2(g)	-2.99	-4.45	-1.47	CO2			
Dolomite	3.43	-13.65	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.44	6.33	4.89	Fe(OH)3			
Fluorite	-0.12	-10.72	-10.6	CaF2			
Goethite	7.34	6.34	-1	FeOOH			
Gypsum	-1.13	-5.71	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			

Halite	-3.76	-2.19	1.57	NaCl
Hausmann	-8.78	52.25	61.03	Mn3O4
Hematite	16.68	12.67	-4.01	Fe2O3
Jarosite-K	-5.41	-14.62	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.77	21.57	25.34	MnOOH
Melanterit	-10.46	-12.67	-2.21	FeSO4:7H2O
NH3(g)	-7.56	-5.77	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.09	9.11	15.2	Mn(OH)2
Pyrolusite	-7.35	34.03	41.38	MnO2:H2O
Rhodochrc	-0.89	-12.02	-11.13	MnCO3
Siderite	-3.35	-14.24	-10.89	FeCO3
Smithsonit	-2.1	-12.1	-10	ZnCO3
Sylvite	-4.95	-4.05	0.9	KCl
Witherite	-1.18	-9.75	-8.56	BaCO3
Zn(OH)2(e	-2.47	9.03	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 19

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	8.75E-03	8.75E-03
Ba	1.42E-05	1.42E-05
Ca	3.21E-03	3.21E-03
Cl	1.18E-01	1.18E-01
Cu	1.10E-07	1.10E-07
F	3.30E-04	3.30E-04
Fe	8.50E-07	8.50E-07
K	1.61E-03	1.61E-03
Mg	2.59E-02	2.59E-02
Mn	1.40E-07	1.40E-07
N(-3)	1.70E-05	1.70E-05
N(5)	1.50E-04	1.50E-04
Na	1.13E-01	1.13E-01
S(6)	1.33E-02	1.33E-02
Zn	9.20E-07	9.20E-07

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 14706
Density (g/cm³) = 1.00446
Volume (L) = 1.00489
Activity of water = 0.995

```
Ionic      strength   (mol/kgw) =          1.83E-01
Mass       of         water     (kg)     =          1.00E+00
Total      carbon     (mol/kg)  =          7.92E-03
Total      CO2        (mol/kg)  =          7.92E-03
Temperatu  (°C)       =                25
Electrical balance    (eq)      =          1.96E-02
Percent    error,     100*(Cat-|=                6.46
Iterations =                11 (172      overall)
Total      H          =          1.11E+02
Total      O          =          5.56E+01

#NAME?  couples--------------------------------

        Redox      couple     pe         Eh         (volts)

        N(-3)/N(5)     4.4365     0.2624

#NAME?  of         species----------------------------

        Log        Log        Log        mole       V
        Species    Molality   Activity   Molality   Activity   Gamma   cm³/mol

        OH-         4.07E-06  2.91E-06     -5.391     -5.537   -0.146     -3.54
        H+          4.33E-09  3.47E-09     -8.364      -8.46   -0.096         0
        H2O         5.55E+01  9.95E-01      1.744     -0.002        0     18.07
Ba        1.42E-05
        Ba+2        1.04E-05  3.07E-06     -4.982     -5.513   -0.531    -11.76
        BaSO4       3.46E-06  3.61E-06     -5.461     -5.443    0.018         0
        BaHCO3+     1.83E-07  1.37E-07     -6.738     -6.862   -0.125         0
        BaCO3       9.60E-08  1.00E-07     -7.018         -7    0.018      -10.7
        BaOH+       4.01E-11  2.99E-11    -10.397    -10.525   -0.128         0
C(4)      7.92E-03
        HCO3-       6.21E-03  4.67E-03     -2.207     -2.331   -0.124     25.48
        MgHCO3+     5.53E-04  4.01E-04     -3.258     -3.397    -0.14      5.71
        MgCO3       4.24E-04  4.42E-04     -3.373     -3.355    0.018    -17.09
        NaHCO3      2.11E-04  2.20E-04     -3.676     -3.657    0.018       1.8
        CO3-2       1.98E-04  6.31E-05     -3.704       -4.2   -0.496     -3.69
        NaCO3-      1.31E-04  9.86E-05     -3.881     -4.006   -0.125       0.2
        CaCO3       9.03E-05  9.41E-05     -4.045     -4.026    0.018     -14.6
        CaHCO3+     6.94E-05  5.29E-05     -4.158     -4.277   -0.118      9.87
        CO2         3.51E-05  3.66E-05     -4.455     -4.437    0.018     34.43
        Zn(CO3)2-:  6.78E-07  2.15E-07     -6.169     -6.668   -0.499         0
        BaHCO3+     1.83E-07  1.37E-07     -6.738     -6.862   -0.125         0
        ZnCO3       1.53E-07  1.59E-07     -6.817     -6.799    0.018         0
        BaCO3       9.60E-08  1.00E-07     -7.018         -7    0.018      -10.7
        MnCO3       7.29E-08  7.61E-08     -7.137     -7.119    0.018         0
        CuCO3       1.56E-08  1.63E-08     -7.806     -7.788    0.018         0
        ZnHCO3+     9.89E-09  7.42E-09     -8.005      -8.13   -0.125         0
        MnHCO3+     8.48E-09  6.31E-09     -8.072       -8.2   -0.128         0
        Cu(CO3)2-   4.09E-09  1.30E-09     -8.389     -8.888   -0.499         0
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	CuHCO3+	1.50E-10	1.12E-10	-9.824	-9.949	-0.125	0
	FeCO3	1.48E-10	1.54E-10	-9.831	-9.813	0.018	0
	FeHCO3+	6.33E-11	4.75E-11	-10.199	-10.324	-0.125	0
	(CO2)2	2.35E-11	2.45E-11	-10.629	-10.61	0.018	68.87
Ca	3.21E-03						
	Ca+2	2.70E-03	8.88E-04	-2.569	-3.052	-0.482	-17.24
	CaSO4	3.55E-04	3.70E-04	-3.45	-3.432	0.018	7.5
	CaCO3	9.03E-05	9.41E-05	-4.045	-4.026	0.018	-14.6
	CaHCO3+	6.94E-05	5.29E-05	-4.158	-4.277	-0.118	9.87
	CaOH+	5.64E-08	4.23E-08	-7.249	-7.374	-0.125	0
	CaHSO4+	1.12E-11	8.43E-12	-10.949	-11.074	-0.125	0
Cl	1.18E-01						
	Cl-	1.18E-01	8.49E-02	-0.93	-1.071	-0.141	18.44
	ZnOHCl	9.77E-09	1.02E-08	-8.01	-7.992	0.018	0
	CuCl2-	7.94E-09	5.75E-09	-8.1	-8.24	-0.14	0
	MnCl+	7.05E-09	5.25E-09	-8.152	-8.28	-0.128	-2.88
	ZnCl+	3.98E-09	2.89E-09	-8.4	-8.54	-0.14	-14.32
	CuCl3-2	2.52E-09	7.75E-10	-8.598	-9.111	-0.513	0
	ZnCl2	2.46E-10	2.57E-10	-9.609	-9.591	0.018	102.03
	MnCl2	1.87E-10	1.95E-10	-9.729	-9.711	0.018	85.89
	ZnCl3-	3.38E-11	2.45E-11	-10.472	-10.611	-0.14	15.94
	FeCl+	1.59E-11	1.19E-11	-10.799	-10.924	-0.125	0
	CuCl+	1.52E-11	1.10E-11	-10.82	-10.959	-0.14	1.11
	MnCl3-	6.12E-12	4.55E-12	-11.214	-11.342	-0.128	44.18
	ZnCl4-2	3.39E-12	1.04E-12	-11.47	-11.982	-0.513	147.25
	CuCl2	4.80E-13	5.01E-13	-12.318	-12.3	0.018	31.02
	CuCl3-	2.08E-16	1.51E-16	-15.681	-15.821	-0.14	0
	FeCl+2	8.11E-19	2.49E-19	-18.091	-18.604	-0.513	0
	CuCl4-2	2.09E-19	6.43E-20	-18.679	-19.192	-0.513	0
	FeCl2+	1.27E-19	9.45E-20	-18.896	-19.025	-0.128	0
	FeCl3	7.70E-22	8.03E-22	-21.114	-21.095	0.018	0
Cu(1)	1.05E-08						
	CuCl2-	7.94E-09	5.75E-09	-8.1	-8.24	-0.14	0
	CuCl3-2	2.52E-09	7.75E-10	-8.598	-9.111	-0.513	0
	Cu+	3.66E-12	2.52E-12	-11.437	-11.598	-0.161	0
Cu(2)	9.95E-08						
	Cu(OH)2	7.93E-08	8.27E-08	-7.101	-7.082	0.018	0
	CuCO3	1.56E-08	1.63E-08	-7.806	-7.788	0.018	0
	Cu(CO3)2-	4.09E-09	1.30E-09	-8.389	-8.888	-0.499	0
	CuOH+	1.90E-10	1.38E-10	-9.721	-9.86	-0.14	0
	CuHCO3+	1.50E-10	1.12E-10	-9.824	-9.949	-0.125	0
	Cu+2	1.43E-10	4.81E-11	-9.845	-10.318	-0.473	-25.78
	CuSO4	2.21E-11	2.30E-11	-10.657	-10.638	0.018	13.09
	CuCl+	1.52E-11	1.10E-11	-10.82	-10.959	-0.14	1.11
	Cu(OH)3-	1.91E-12	1.43E-12	-11.72	-11.844	-0.125	0
	CuCl2	4.80E-13	5.01E-13	-12.318	-12.3	0.018	31.02
	CuF+	1.83E-13	1.37E-13	-12.738	-12.863	-0.125	0
	Cu2(OH)2+	2.63E-14	8.33E-15	-13.58	-14.08	-0.499	0
	Cu(OH)4-2	2.59E-16	8.20E-17	-15.587	-16.086	-0.499	0
	CuCl3-	2.08E-16	1.51E-16	-15.681	-15.821	-0.14	0

	CuCl4-2	2.09E-19	6.43E-20	-18.679	-19.192	-0.513	0
F	3.30E-04						
	F-	2.19E-04	1.57E-04	-3.659	-3.805	-0.146	-0.94
	MgF+	1.03E-04	7.60E-05	-3.986	-4.119	-0.134	-10.35
	NaF	7.25E-06	7.56E-06	-5.14	-5.121	0.018	7.26
	HF	7.81E-10	8.15E-10	-9.107	-9.089	0.018	12.5
	ZnF+	3.73E-11	2.79E-11	-10.429	-10.554	-0.125	0
	MnF+	2.21E-11	1.64E-11	-10.656	-10.784	-0.128	0
	HF2-	6.53E-13	4.90E-13	-12.185	-12.31	-0.125	22.43
	FeF+	2.12E-13	1.59E-13	-12.673	-12.798	-0.125	0
	CuF+	1.83E-13	1.37E-13	-12.738	-12.863	-0.125	0
	FeF2+	2.02E-16	1.50E-16	-15.695	-15.823	-0.128	0
	FeF+2	7.85E-17	2.41E-17	-16.105	-16.618	-0.513	0
	FeF3	3.58E-17	3.74E-17	-16.446	-16.428	0.018	0
Fe(2)	5.82E-10						
	Fe+2	3.02E-10	1.02E-10	-9.519	-9.993	-0.473	-21.28
	FeCO3	1.48E-10	1.54E-10	-9.831	-9.813	0.018	0
	FeHCO3+	6.33E-11	4.75E-11	-10.199	-10.324	-0.125	0
	FeSO4	4.06E-11	4.24E-11	-10.391	-10.373	0.018	18.97
	FeCl+	1.59E-11	1.19E-11	-10.799	-10.924	-0.125	0
	FeOH+	1.24E-11	9.23E-12	-10.907	-11.035	-0.128	0
	FeF+	2.12E-13	1.59E-13	-12.673	-12.798	-0.125	0
	Fe(OH)2	2.16E-14	2.26E-14	-13.665	-13.647	0.018	0
	Fe(OH)3-	3.23E-16	2.40E-16	-15.491	-15.619	-0.128	0
	FeHSO4+	1.29E-18	9.66E-19	-17.89	-18.015	-0.125	0
Fe(3)	8.49E-07						
	Fe(OH)3	6.06E-07	6.32E-07	-6.217	-6.199	0.018	0
	Fe(OH)4-	2.20E-07	1.66E-07	-6.657	-6.781	-0.124	0
	Fe(OH)2+	2.28E-08	1.71E-08	-7.643	-7.767	-0.124	0
	FeOH+2	5.86E-13	1.80E-13	-12.232	-12.745	-0.513	0
	FeF2+	2.02E-16	1.50E-16	-15.695	-15.823	-0.128	0
	FeF+2	7.85E-17	2.41E-17	-16.105	-16.618	-0.513	0
	FeF3	3.58E-17	3.74E-17	-16.446	-16.428	0.018	0
	FeSO4+	3.35E-18	2.50E-18	-17.475	-17.603	-0.128	0
	FeCl+2	8.11E-19	2.49E-19	-18.091	-18.604	-0.513	0
	Fe+3	7.15E-19	9.71E-20	-18.146	-19.013	-0.867	0
	Fe(SO4)2-	1.71E-19	1.28E-19	-18.768	-18.893	-0.125	0
	FeCl2+	1.27E-19	9.45E-20	-18.896	-19.025	-0.128	0
	FeCl3	7.70E-22	8.03E-22	-21.114	-21.095	0.018	0
	Fe2(OH)2+	8.65E-23	8.71E-25	-22.063	-24.06	-1.997	0
	FeHSO4+2	7.31E-26	2.32E-26	-25.136	-25.635	-0.499	0
	Fe3(OH)4+	4.11E-27	3.11E-30	-26.387	-29.507	-3.12	0
H(0)	1.63E-28						
	H2	8.16E-29	8.51E-29	-28.088	-28.07	0.018	28.61
K	1.61E-03						
	K+	1.59E-03	1.14E-03	-2.8	-2.943	-0.144	9.33
	KSO4-	2.50E-05	1.88E-05	-4.603	-4.727	-0.124	34.48
Mg	2.59E-02						
	Mg+2	2.10E-02	7.34E-03	-1.679	-2.135	-0.456	-20.95
	MgSO4	3.87E-03	4.03E-03	-2.413	-2.395	0.018	5.84

	MgHCO3+	5.53E-04	4.01E-04	-3.258	-3.397	-0.14	5.71
	MgCO3	4.24E-04	4.42E-04	-3.373	-3.355	0.018	-17.09
	MgF+	1.03E-04	7.60E-05	-3.986	-4.119	-0.134	-10.35
	MgOH+	9.94E-06	7.65E-06	-5.003	-5.117	-0.114	0
Mn(2)	1.40E-07						
	MnCO3	7.29E-08	7.61E-08	-7.137	-7.119	0.018	0
	Mn+2	4.51E-08	1.52E-08	-7.346	-7.819	-0.473	-17.62
	MnHCO3+	8.48E-09	6.31E-09	-8.072	-8.2	-0.128	0
	MnCl+	7.05E-09	5.25E-09	-8.152	-8.28	-0.128	-2.88
	MnSO4	6.06E-09	6.32E-09	-8.217	-8.199	0.018	22.54
	MnCl2	1.87E-10	1.95E-10	-9.729	-9.711	0.018	85.89
	MnOH+	1.50E-10	1.12E-10	-9.823	-9.951	-0.128	0
	MnF+	2.21E-11	1.64E-11	-10.656	-10.784	-0.128	0
	MnCl3-	6.12E-12	4.55E-12	-11.214	-11.342	-0.128	44.18
	Mn(NO3)2	6.43E-16	6.70E-16	-15.192	-15.174	0.018	41.04
	Mn(OH)3-	7.64E-18	5.69E-18	-17.117	-17.245	-0.128	0
Mn(3)	3.45E-29						
	Mn+3	3.45E-29	4.69E-30	-28.462	-29.329	-0.867	0
N(-3)	1.70E-05						
	NH4+	1.50E-05	1.03E-05	-4.825	-4.987	-0.161	18.24
	NH3	1.63E-06	1.70E-06	-5.789	-5.771	0.018	24.42
	NH4SO4-	4.15E-07	3.12E-07	-6.382	-6.507	-0.125	38.43
N(5)	1.50E-04						
	NO3-	1.50E-04	1.05E-04	-3.824	-3.977	-0.153	29.88
	Mn(NO3)2	6.43E-16	6.70E-16	-15.192	-15.174	0.018	41.04
Na	1.13E-01						
	Na+	1.12E-01	8.39E-02	-0.953	-1.076	-0.124	-0.96
	NaSO4-	1.31E-03	9.86E-04	-2.882	-3.006	-0.124	17.37
	NaHCO3	2.11E-04	2.20E-04	-3.676	-3.657	0.018	1.8
	NaCO3-	1.31E-04	9.86E-05	-3.881	-4.006	-0.125	0.2
	NaF	7.25E-06	7.56E-06	-5.14	-5.121	0.018	7.26
	NaOH	2.34E-17	2.44E-17	-16.631	-16.613	0.018	0
O(0)	1.09E-36						
	O2	5.47E-37	5.70E-37	-36.262	-36.244	0.018	30.4
S(6)	1.33E-02						
	SO4-2	7.76E-03	2.34E-03	-2.11	-2.63	-0.52	16.01
	MgSO4	3.87E-03	4.03E-03	-2.413	-2.395	0.018	5.84
	NaSO4-	1.31E-03	9.86E-04	-2.882	-3.006	-0.124	17.37
	CaSO4	3.55E-04	3.70E-04	-3.45	-3.432	0.018	7.5
	KSO4-	2.50E-05	1.88E-05	-4.603	-4.727	-0.124	34.48
	BaSO4	3.46E-06	3.61E-06	-5.461	-5.443	0.018	0
	NH4SO4-	4.15E-07	3.12E-07	-6.382	-6.507	-0.125	38.43
	ZnSO4	6.65E-09	6.94E-09	-8.177	-8.159	0.018	21.71
	MnSO4	6.06E-09	6.32E-09	-8.217	-8.199	0.018	22.54
	HSO4-	1.05E-09	7.90E-10	-8.977	-9.102	-0.125	40.63
	Zn(SO4)2-2	4.17E-10	1.32E-10	-9.38	-9.879	-0.499	-10.29
	FeSO4	4.06E-11	4.24E-11	-10.391	-10.373	0.018	18.97
	CuSO4	2.21E-11	2.30E-11	-10.657	-10.638	0.018	13.09
	CaHSO4+	1.12E-11	8.43E-12	-10.949	-11.074	-0.125	0
	FeSO4+	3.35E-18	2.50E-18	-17.475	-17.603	-0.128	0

	FeHSO4+	1.29E-18	9.66E-19	-17.89	-18.015	-0.125	0
	Fe(SO4)2-	1.71E-19	1.28E-19	-18.768	-18.893	-0.125	0
	FeHSO4+2	7.31E-26	2.32E-26	-25.136	-25.635	-0.499	0
Zn	9.20E-07						
	Zn(CO3)2-2	6.78E-07	2.15E-07	-6.169	-6.668	-0.499	0
	ZnCO3	1.53E-07	1.59E-07	-6.817	-6.799	0.018	0
	Zn+2	4.11E-08	1.26E-08	-7.386	-7.899	-0.513	-24.51
	Zn(OH)2	1.26E-08	1.31E-08	-7.901	-7.883	0.018	0
	ZnHCO3+	9.89E-09	7.42E-09	-8.005	-8.13	-0.125	0
	ZnOHCl	9.77E-09	1.02E-08	-8.01	-7.992	0.018	0
	ZnSO4	6.65E-09	6.94E-09	-8.177	-8.159	0.018	21.71
	ZnOH+	5.30E-09	3.97E-09	-8.276	-8.401	-0.125	0
	ZnCl+	3.98E-09	2.89E-09	-8.4	-8.54	-0.14	-14.32
	Zn(SO4)2-2	4.17E-10	1.32E-10	-9.38	-9.879	-0.499	-10.29
	ZnCl2	2.46E-10	2.57E-10	-9.609	-9.591	0.018	102.03
	ZnF+	3.73E-11	2.79E-11	-10.429	-10.554	-0.125	0
	ZnCl3-	3.38E-11	2.45E-11	-10.472	-10.611	-0.14	15.94
	Zn(OH)3-	1.58E-11	1.19E-11	-10.8	-10.925	-0.125	0
	ZnCl4-2	3.39E-12	1.04E-12	-11.47	-11.982	-0.513	147.25
	Zn(OH)4-2	1.71E-15	5.41E-16	-14.768	-15.267	-0.499	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.4	-5.68	-4.28	CaSO4			
Aragonite	1.08	-7.25	-8.34	CaCO3			
Barite	1.7	-8.14	-9.84	BaSO4			
Calcite	1.23	-7.25	-8.48	CaCO3			
CO2(g)	-2.97	-4.44	-1.47	CO2			
Dolomite	3.5	-13.59	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.47	6.36	4.89	Fe(OH)3			
Fluorite	-0.06	-10.66	-10.6	CaF2			
Goethite	7.36	6.36	-1	FeOOH			
Gypsum	-1.1	-5.69	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-3.72	-2.15	1.57	NaCl			
Hausmann	-8.82	52.21	61.03	Mn3O4			
Hematite	16.74	12.73	-4.01	Fe2O3			
Jarosite-K	-5.28	-14.49	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.78	21.56	25.34	MnOOH			
Melanterit	-10.43	-12.64	-2.21	FeSO4:7H2O			
NH3(g)	-7.57	-5.77	1.8	NH3			
O2(g)	-33.35	-36.24	-2.89	O2			
Pyrochroit	-6.1	9.1	15.2	Mn(OH)2			
Pyrolusite	-7.37	34.01	41.38	MnO2:H2O			
Rhodochro	-0.89	-12.02	-11.13	MnCO3			
Siderite	-3.3	-14.19	-10.89	FeCO3			
Smithsonit	-2.1	-12.1	-10	ZnCO3			

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        Sylvite          -4.91      -4.01       0.9 KCl
        Witherite        -1.15      -9.71      -8.56 BaCO3
        Zn(OH)2(e        -2.48       9.02       11.5 Zn(OH)2

**For   a        gas,     SI       =        log10(fuga Fugacity   =        pressure
        For      ideal    gases,   phi      =                  1

Initial solution        20

 #NAME? composition-----------------------------

        Elements  Molality  Moles

        Alkalinity  9.19E-03  9.19E-03
        Ba          1.49E-05  1.49E-05
        Ca          3.37E-03  3.37E-03
        Cl          1.24E-01  1.24E-01
        Cu          1.10E-07  1.10E-07
        F           3.50E-04  3.50E-04
        Fe          8.90E-07  8.90E-07
        K           1.69E-03  1.69E-03
        Mg          2.72E-02  2.72E-02
        Mn          1.50E-07  1.50E-07
        N(-3)       1.80E-05  1.80E-05
        N(5)        1.60E-04  1.60E-04
        Na          1.19E-01  1.19E-01
        S(6)        1.40E-02  1.40E-02
        Zn          9.70E-07  9.70E-07

 #NAME? of       solution----------------------------

        pH       =            8.46
        pe       =               4
        Specific Conductan (µS/cm,  25°C)    =          15369
        Density  (g/cm³)  =        1.00483
        Volume   (L)      =        1.00499
        Activity of       water    =          0.995
        Ionic    strength (mol/kgw) =       1.92E-01
        Mass     of       water    (kg)      =       1.00E+00
        Total    carbon   (mol/kg) =         8.31E-03
        Total    CO2      (mol/kg) =         8.31E-03
        Temperatu (°C)    =              25
        Electrical balance (eq)    =         2.05E-02
        Percent  error,   100*(Cat-|=            6.45
        Iterations =           12 (184     overall)
        Total    H        =        1.11E+02
        Total    O        =        5.56E+01

 #NAME? couples--------------------------------
```

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.437	0.2625		

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.09E-06	2.91E-06	-5.388	-5.537	-0.149	-3.52
	H+	4.34E-09	3.47E-09	-8.363	-8.46	-0.097	0
	H2O	5.55E+01	9.95E-01	1.744	-0.002	0	18.07
Ba	1.49E-05						
	Ba+2	1.10E-05	3.17E-06	-4.961	-5.499	-0.538	-11.74
	BaSO4	3.65E-06	3.82E-06	-5.437	-5.418	0.019	0
	BaHCO3+	1.97E-07	1.47E-07	-6.706	-6.832	-0.126	0
	BaCO3	1.03E-07	1.07E-07	-6.989	-6.969	0.019	-10.7
	BaOH+	4.16E-11	3.09E-11	-10.381	-10.511	-0.13	0
C(4)	8.31E-03						
	HCO3-	6.47E-03	4.84E-03	-2.189	-2.315	-0.126	25.51
	MgHCO3+	5.97E-04	4.30E-04	-3.224	-3.366	-0.142	5.71
	MgCO3	4.54E-04	4.75E-04	-3.343	-3.324	0.019	-17.09
	NaHCO3	2.29E-04	2.39E-04	-3.641	-3.622	0.019	1.8
	CO3-2	2.08E-04	6.55E-05	-3.681	-4.184	-0.503	-3.65
	NaCO3-	1.43E-04	1.07E-04	-3.844	-3.97	-0.126	0.25
	CaCO3	9.66E-05	1.01E-04	-4.015	-3.996	0.019	-14.6
	CaHCO3+	7.47E-05	5.67E-05	-4.127	-4.247	-0.12	9.88
	CO2	3.63E-05	3.79E-05	-4.44	-4.421	0.019	34.43
	Zn(CO3)2-2	7.25E-07	2.27E-07	-6.14	-6.644	-0.504	0
	BaHCO3+	1.97E-07	1.47E-07	-6.706	-6.832	-0.126	0
	ZnCO3	1.55E-07	1.62E-07	-6.809	-6.79	0.019	0
	BaCO3	1.03E-07	1.07E-07	-6.989	-6.969	0.019	-10.7
	MnCO3	7.86E-08	8.22E-08	-7.105	-7.085	0.019	0
	CuCO3	1.59E-08	1.66E-08	-7.799	-7.78	0.019	0
	ZnHCO3+	1.01E-08	7.57E-09	-7.995	-8.121	-0.126	0
	MnHCO3+	9.19E-09	6.82E-09	-8.037	-8.167	-0.13	0
	Cu(CO3)2-	4.37E-09	1.37E-09	-8.36	-8.864	-0.504	0
	FeCO3	1.60E-10	1.67E-10	-9.796	-9.776	0.019	0
	CuHCO3+	1.53E-10	1.15E-10	-9.815	-9.941	-0.126	0
	FeHCO3+	6.90E-11	5.16E-11	-10.161	-10.287	-0.126	0
	(CO2)2	2.53E-11	2.64E-11	-10.598	-10.578	0.019	68.87
Ca	3.37E-03						
	Ca+2	2.82E-03	9.18E-04	-2.549	-3.037	-0.488	-17.22
	CaSO4	3.75E-04	3.92E-04	-3.426	-3.407	0.019	7.5
	CaCO3	9.66E-05	1.01E-04	-4.015	-3.996	0.019	-14.6
	CaHCO3+	7.47E-05	5.67E-05	-4.127	-4.247	-0.12	9.88
	CaOH+	5.84E-08	4.37E-08	-7.233	-7.359	-0.126	0
	CaHSO4+	1.19E-11	8.93E-12	-10.923	-11.049	-0.126	0
Cl	1.24E-01						
	Cl-	1.24E-01	8.88E-02	-0.908	-1.052	-0.144	18.45

	ZnOHCl	1.00E-08	1.05E-08	-7.999	-7.98	0.019	0
	CuCl2-	8.57E-09	6.18E-09	-8.067	-8.209	-0.142	0
	MnCl+	7.71E-09	5.71E-09	-8.113	-8.243	-0.13	-2.88
	ZnCl+	4.11E-09	2.97E-09	-8.386	-8.528	-0.142	-14.35
	CuCl3-2	2.88E-09	8.70E-10	-8.541	-9.061	-0.52	0
	ZnCl2	2.64E-10	2.76E-10	-9.579	-9.559	0.019	102.03
	MnCl2	2.12E-10	2.21E-10	-9.674	-9.655	0.019	85.89
	ZnCl3-	3.81E-11	2.75E-11	-10.419	-10.561	-0.142	15.88
	FeCl+	1.75E-11	1.31E-11	-10.758	-10.884	-0.126	0
	CuCl+	1.57E-11	1.13E-11	-10.806	-10.947	-0.142	1.12
	MnCl3-	7.30E-12	5.41E-12	-11.137	-11.266	-0.13	44.21
	ZnCl4-2	4.05E-12	1.22E-12	-11.393	-11.913	-0.52	147.32
	CuCl2	5.15E-13	5.38E-13	-12.288	-12.269	0.019	31.02
	CuCl3-	2.35E-16	1.70E-16	-15.629	-15.771	-0.142	0
	FeCl+2	9.03E-19	2.73E-19	-18.044	-18.564	-0.52	0
	CuCl4-2	2.50E-19	7.55E-20	-18.603	-19.122	-0.52	0
	FeCl2+	1.46E-19	1.08E-19	-18.836	-18.966	-0.13	0
	FeCl3	9.19E-22	9.61E-22	-21.037	-21.017	0.019	0
Cu(1)	1.15E-08						
	CuCl2-	8.57E-09	6.18E-09	-8.067	-8.209	-0.142	0
	CuCl3-2	2.88E-09	8.70E-10	-8.541	-9.061	-0.52	0
	Cu+	3.62E-12	2.48E-12	-11.441	-11.606	-0.164	0
Cu(2)	9.86E-08						
	Cu(OH)2	7.78E-08	8.13E-08	-7.109	-7.09	0.019	0
	CuCO3	1.59E-08	1.66E-08	-7.799	-7.78	0.019	0
	Cu(CO3)2-	4.37E-09	1.37E-09	-8.36	-8.864	-0.504	0
	CuOH+	1.88E-10	1.36E-10	-9.726	-9.868	-0.142	0
	CuHCO3+	1.53E-10	1.15E-10	-9.815	-9.941	-0.126	0
	Cu+2	1.43E-10	4.72E-11	-9.846	-10.326	-0.48	-25.77
	CuSO4	2.22E-11	2.32E-11	-10.654	-10.635	0.019	13.09
	CuCl+	1.57E-11	1.13E-11	-10.806	-10.947	-0.142	1.12
	Cu(OH)3-	1.88E-12	1.41E-12	-11.726	-11.852	-0.126	0
	CuCl2	5.15E-13	5.38E-13	-12.288	-12.269	0.019	31.02
	CuF+	1.88E-13	1.40E-13	-12.727	-12.853	-0.126	0
	Cu2(OH)2+	2.57E-14	8.04E-15	-13.591	-14.095	-0.504	0
	Cu(OH)4-2	2.57E-16	8.05E-17	-15.59	-16.094	-0.504	0
	CuCl3-	2.35E-16	1.70E-16	-15.629	-15.771	-0.142	0
	CuCl4-2	2.50E-19	7.55E-20	-18.603	-19.122	-0.52	0
F	3.50E-04						
	F-	2.30E-04	1.63E-04	-3.638	-3.787	-0.149	-0.93
	MgF+	1.12E-04	8.20E-05	-3.951	-4.086	-0.136	-10.35
	NaF	7.90E-06	8.25E-06	-5.103	-5.083	0.019	7.26
	HF	8.13E-10	8.50E-10	-9.09	-9.071	0.019	12.5
	ZnF+	3.83E-11	2.87E-11	-10.417	-10.543	-0.126	0
	MnF+	2.41E-11	1.79E-11	-10.618	-10.748	-0.13	0
	HF2-	7.12E-13	5.33E-13	-12.148	-12.274	-0.126	22.44
	FeF+	2.33E-13	1.74E-13	-12.633	-12.759	-0.126	0
	CuF+	1.88E-13	1.40E-13	-12.727	-12.853	-0.126	0
	FeF2+	2.31E-16	1.71E-16	-15.636	-15.766	-0.13	0
	FeF+2	8.72E-17	2.64E-17	-16.059	-16.579	-0.52	0

	FeF3	4.25E-17	4.44E-17	-16.372	-16.353	0.019	0
Fe(2)	6.25E-10						
	Fe+2	3.22E-10	1.07E-10	-9.493	-9.972	-0.48	-21.26
	FeCO3	1.60E-10	1.67E-10	-9.796	-9.776	0.019	0
	FeHCO3+	6.90E-11	5.16E-11	-10.161	-10.287	-0.126	0
	FeSO4	4.36E-11	4.55E-11	-10.361	-10.342	0.019	18.97
	FeCl+	1.75E-11	1.31E-11	-10.758	-10.884	-0.126	0
	FeOH+	1.30E-11	9.67E-12	-10.885	-11.015	-0.13	0
	FeF+	2.33E-13	1.74E-13	-12.633	-12.759	-0.126	0
	Fe(OH)2	2.26E-14	2.36E-14	-13.646	-13.627	0.019	0
	Fe(OH)3-	3.40E-16	2.52E-16	-15.469	-15.599	-0.13	0
	FeHSO4+	1.39E-18	1.04E-18	-17.858	-17.984	-0.126	0
Fe(3)	8.89E-07						
	Fe(OH)3	6.34E-07	6.63E-07	-6.198	-6.179	0.019	0
	Fe(OH)4-	2.32E-07	1.73E-07	-6.635	-6.761	-0.126	0
	Fe(OH)2+	2.39E-08	1.79E-08	-7.621	-7.747	-0.126	0
	FeOH+2	6.24E-13	1.89E-13	-12.205	-12.725	-0.52	0
	FeF2+	2.31E-16	1.71E-16	-15.636	-15.766	-0.13	0
	FeF+2	8.72E-17	2.64E-17	-16.059	-16.579	-0.52	0
	FeF3	4.25E-17	4.44E-17	-16.372	-16.353	0.019	0
	FeSO4+	3.62E-18	2.68E-18	-17.442	-17.572	-0.13	0
	FeCl+2	9.03E-19	2.73E-19	-18.044	-18.564	-0.52	0
	Fe+3	7.65E-19	1.02E-19	-18.116	-18.992	-0.876	0
	Fe(SO4)2-	1.88E-19	1.41E-19	-18.725	-18.851	-0.126	0
	FeCl2+	1.46E-19	1.08E-19	-18.836	-18.966	-0.13	0
	FeCl3	9.19E-22	9.61E-22	-21.037	-21.017	0.019	0
	Fe2(OH)2+	9.93E-23	9.57E-25	-22.003	-24.019	-2.016	0
	FeHSO4+2	7.94E-26	2.49E-26	-25.1	-25.604	-0.504	0
	Fe3(OH)4+	5.06E-27	3.58E-30	-26.296	-29.446	-3.15	0
H(0)	1.63E-28						
	H2	8.14E-29	8.51E-29	-28.089	-28.07	0.019	28.61
K	1.69E-03						
	K+	1.66E-03	1.19E-03	-2.779	-2.925	-0.146	9.34
	KSO4-	2.68E-05	2.01E-05	-4.572	-4.698	-0.126	34.49
Mg	2.72E-02						
	Mg+2	2.19E-02	7.60E-03	-1.659	-2.119	-0.46	-20.93
	MgSO4	4.09E-03	4.28E-03	-2.388	-2.369	0.019	5.84
	MgHCO3+	5.97E-04	4.30E-04	-3.224	-3.366	-0.142	5.71
	MgCO3	4.54E-04	4.75E-04	-3.343	-3.324	0.019	-17.09
	MgF+	1.12E-04	8.20E-05	-3.951	-4.086	-0.136	-10.35
	MgOH+	1.03E-05	7.92E-06	-4.986	-5.102	-0.115	0
Mn(2)	1.50E-07						
	MnCO3	7.86E-08	8.22E-08	-7.105	-7.085	0.019	0
	Mn+2	4.77E-08	1.58E-08	-7.322	-7.802	-0.48	-17.58
	MnHCO3+	9.19E-09	6.82E-09	-8.037	-8.167	-0.13	0
	MnCl+	7.71E-09	5.71E-09	-8.113	-8.243	-0.13	-2.88
	MnSO4	6.45E-09	6.75E-09	-8.19	-8.171	0.019	22.54
	MnCl2	2.12E-10	2.21E-10	-9.674	-9.655	0.019	85.89
	MnOH+	1.57E-10	1.17E-10	-9.804	-9.934	-0.13	0
	MnF+	2.41E-11	1.79E-11	-10.618	-10.748	-0.13	0

	MnCl3-	7.30E-12	5.41E-12	-11.137	-11.266	-0.13	44.21
	Mn(NO3)2	7.51E-16	7.85E-16	-15.125	-15.105	0.019	41.04
	Mn(OH)3-	7.98E-18	5.92E-18	-17.098	-17.228	-0.13	0
Mn(3)	3.67E-29						
	Mn+3	3.67E-29	4.88E-30	-28.435	-29.312	-0.876	0
N(-3)	1.80E-05						
	NH4+	1.58E-05	1.09E-05	-4.8	-4.964	-0.164	18.25
	NH3	1.71E-06	1.78E-06	-5.768	-5.749	0.019	24.42
	NH4SO4-	4.49E-07	3.36E-07	-6.348	-6.474	-0.126	38.46
N(5)	1.60E-04						
	NO3-	1.60E-04	1.12E-04	-3.796	-3.952	-0.156	29.89
	Mn(NO3)2	7.51E-16	7.85E-16	-15.125	-15.105	0.019	41.04
Na	1.19E-01						
	Na+	1.17E-01	8.78E-02	-0.932	-1.057	-0.125	-0.94
	NaSO4-	1.41E-03	1.06E-03	-2.85	-2.976	-0.126	17.47
	NaHCO3	2.29E-04	2.39E-04	-3.641	-3.622	0.019	1.8
	NaCO3-	1.43E-04	1.07E-04	-3.844	-3.97	-0.126	0.25
	NaF	7.90E-06	8.25E-06	-5.103	-5.083	0.019	7.26
	NaOH	2.44E-17	2.55E-17	-16.613	-16.593	0.019	0
O(0)	1.09E-36						
	O2	5.45E-37	5.70E-37	-36.263	-36.244	0.019	30.4
S(6)	1.40E-02						
	SO4-2	8.09E-03	2.40E-03	-2.092	-2.619	-0.527	16.05
	MgSO4	4.09E-03	4.28E-03	-2.388	-2.369	0.019	5.84
	NaSO4-	1.41E-03	1.06E-03	-2.85	-2.976	-0.126	17.47
	CaSO4	3.75E-04	3.92E-04	-3.426	-3.407	0.019	7.5
	KSO4-	2.68E-05	2.01E-05	-4.572	-4.698	-0.126	34.49
	BaSO4	3.65E-06	3.82E-06	-5.437	-5.418	0.019	0
	NH4SO4-	4.49E-07	3.36E-07	-6.348	-6.474	-0.126	38.46
	ZnSO4	6.69E-09	6.99E-09	-8.175	-8.156	0.019	21.71
	MnSO4	6.45E-09	6.75E-09	-8.19	-8.171	0.019	22.54
	HSO4-	1.08E-09	8.10E-10	-8.966	-9.092	-0.126	40.64
	Zn(SO4)2-2	4.35E-10	1.36E-10	-9.361	-9.865	-0.504	-10.18
	FeSO4	4.36E-11	4.55E-11	-10.361	-10.342	0.019	18.97
	CuSO4	2.22E-11	2.32E-11	-10.654	-10.635	0.019	13.09
	CaHSO4+	1.19E-11	8.93E-12	-10.923	-11.049	-0.126	0
	FeSO4+	3.62E-18	2.68E-18	-17.442	-17.572	-0.13	0
	FeHSO4+	1.39E-18	1.04E-18	-17.858	-17.984	-0.126	0
	Fe(SO4)2-	1.88E-19	1.41E-19	-18.725	-18.851	-0.126	0
	FeHSO4+2	7.94E-26	2.49E-26	-25.1	-25.604	-0.504	0
Zn	9.70E-07						
	Zn(CO3)2-2	7.25E-07	2.27E-07	-6.14	-6.644	-0.504	0
	ZnCO3	1.55E-07	1.62E-07	-6.809	-6.79	0.019	0
	Zn+2	4.11E-08	1.24E-08	-7.386	-7.906	-0.52	-24.5
	Zn(OH)2	1.23E-08	1.29E-08	-7.91	-7.89	0.019	0
	ZnHCO3+	1.01E-08	7.57E-09	-7.995	-8.121	-0.126	0
	ZnOHCl	1.00E-08	1.05E-08	-7.999	-7.98	0.019	0
	ZnSO4	6.69E-09	6.99E-09	-8.175	-8.156	0.019	21.71
	ZnOH+	5.22E-09	3.91E-09	-8.282	-8.408	-0.126	0
	ZnCl+	4.11E-09	2.97E-09	-8.386	-8.528	-0.142	-14.35

Zn(SO4)2-2	4.35E-10	1.36E-10	-9.361	-9.865	-0.504	-10.18
ZnCl2	2.64E-10	2.76E-10	-9.579	-9.559	0.019	102.03
ZnF+	3.83E-11	2.87E-11	-10.417	-10.543	-0.126	0
ZnCl3-	3.81E-11	2.75E-11	-10.419	-10.561	-0.142	15.88
Zn(OH)3-	1.56E-11	1.17E-11	-10.807	-10.933	-0.126	0
ZnCl4-2	4.05E-12	1.22E-12	-11.393	-11.913	-0.52	147.32
Zn(OH)4-2	1.70E-15	5.31E-16	-14.771	-15.275	-0.504	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.38	-5.66	-4.28	CaSO4			
Aragonite	1.11	-7.22	-8.34	CaCO3			
Barite	1.73	-8.12	-9.84	BaSO4			
Calcite	1.26	-7.22	-8.48	CaCO3			
CO2(g)	-2.95	-4.42	-1.47	CO2			
Dolomite	3.56	-13.52	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.49	6.38	4.89	Fe(OH)3			
Fluorite	-0.01	-10.61	-10.6	CaF2			
Goethite	7.38	6.38	-1	FeOOH			
Gypsum	-1.08	-5.66	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.5	0	1.5	H2O			
Halite	-3.68	-2.11	1.57	NaCl			
Hausmann	-8.76	52.27	61.03	Mn3O4			
Hematite	16.78	12.77	-4.01	Fe2O3			
Jarosite-K	-5.18	-14.39	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.77	21.57	25.34	MnOOH			
Melanterit	-10.4	-12.61	-2.21	FeSO4:7H2O			
NH3(g)	-7.54	-5.75	1.8	NH3			
O2(g)	-33.35	-36.24	-2.89	O2			
Pyrochroit	-6.09	9.11	15.2	Mn(OH)2			
Pyrolusite	-7.35	34.03	41.38	MnO2:H2O			
Rhodochro	-0.86	-11.99	-11.13	MnCO3			
Siderite	-3.27	-14.16	-10.89	FeCO3			
Smithsonit	-2.09	-12.09	-10	ZnCO3			
Sylvite	-4.88	-3.98	0.9	KCl			
Witherite	-1.12	-9.68	-8.56	BaCO3			
Zn(OH)2(e	-2.49	9.01	11.5	Zn(OH)2			

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 21

#NAME? composition----------

Elements Molality Moles

Alkalinity	9.63E-03	9.63E-03
Ba	1.57E-05	1.57E-05
Ca	3.53E-03	3.53E-03
Cl	1.30E-01	1.30E-01
Cu	1.20E-07	1.20E-07
F	3.60E-04	3.60E-04
Fe	9.30E-07	9.30E-07
K	1.77E-03	1.77E-03
Mg	2.85E-02	2.85E-02
Mn	1.60E-07	1.60E-07
N(-3)	1.90E-05	1.90E-05
N(5)	1.60E-04	1.60E-04
Na	1.25E-01	1.25E-01
S(6)	1.47E-02	1.47E-02
Zn	1.02E-06	1.02E-06

#NAME? of solution----------

pH	=	8.46			
pe	=	4			
Specific	Conductan	(µS/cm,	25°C)	=	16027
Density	(g/cm³)	=	1.0052		
Volume	(L)	=	1.00509		
Activity	of	water	=	0.995	
Ionic	strength	(mol/kgw)	=	2.01E-01	
Mass	of	water	(kg)	=	1.00E+00
Total	carbon	(mol/kg)	=	8.69E-03	
Total	CO2	(mol/kg)	=	8.69E-03	
Temperatu	(°C)	=	25		
Electrical	balance	(eq)	=	2.15E-02	
Percent	error,	100*(Cat-|	=	6.46	
Iterations	=	12	(196	overall)	
Total	H	=	1.11E+02		
Total	O	=	5.56E+01		

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4341	0.2623		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.11E-06	2.90E-06	-5.386	-5.537	-0.151	-3.5
H+	4.35E-09	3.47E-09	-8.362	-8.46	-0.098	0
H2O	5.55E+01	9.95E-01	1.744	-0.002	0	18.07

Ba 1.57E-05

	Ba+2	1.15E-05	3.28E-06	-4.94	-5.484	-0.545	-11.72
	BaSO4	3.85E-06	4.03E-06	-5.414	-5.394	0.02	0
	BaHCO3+	2.11E-07	1.57E-07	-6.676	-6.803	-0.127	0
	BaCO3	1.10E-07	1.15E-07	-6.96	-6.94	0.02	-10.7
	BaOH+	4.32E-11	3.19E-11	-10.365	-10.497	-0.132	0
C(4)	8.69E-03						
	HCO3-	6.72E-03	5.01E-03	-2.173	-2.3	-0.127	25.54
	MgHCO3+	6.42E-04	4.61E-04	-3.193	-3.336	-0.144	5.71
	MgCO3	4.85E-04	5.08E-04	-3.314	-3.294	0.02	-17.09
	NaHCO3	2.47E-04	2.58E-04	-3.608	-3.588	0.02	1.8
	CO3-2	2.19E-04	6.78E-05	-3.66	-4.169	-0.509	-3.61
	NaCO3-	1.55E-04	1.16E-04	-3.81	-3.937	-0.127	0.3
	CaCO3	1.03E-04	1.08E-04	-3.987	-3.967	0.02	-14.6
	CaHCO3+	8.01E-05	6.06E-05	-4.096	-4.218	-0.121	9.88
	CO2	3.75E-05	3.93E-05	-4.426	-4.406	0.02	34.43
	Zn(CO3)2-2	7.72E-07	2.39E-07	-6.113	-6.621	-0.508	0
	BaHCO3+	2.11E-07	1.57E-07	-6.676	-6.803	-0.127	0
	ZnCO3	1.58E-07	1.65E-07	-6.802	-6.782	0.02	0
	BaCO3	1.10E-07	1.15E-07	-6.96	-6.94	0.02	-10.7
	MnCO3	8.43E-08	8.83E-08	-7.074	-7.054	0.02	0
	CuCO3	1.76E-08	1.84E-08	-7.755	-7.734	0.02	0
	ZnHCO3+	1.03E-08	7.71E-09	-7.986	-8.113	-0.127	0
	MnHCO3+	9.92E-09	7.32E-09	-8.004	-8.135	-0.132	0
	Cu(CO3)2-	5.07E-09	1.57E-09	-8.295	-8.803	-0.508	0
	FeCO3	1.73E-10	1.81E-10	-9.762	-9.742	0.02	0
	CuHCO3+	1.70E-10	1.27E-10	-9.769	-9.896	-0.127	0
	FeHCO3+	7.49E-11	5.59E-11	-10.126	-10.253	-0.127	0
	(CO2)2	2.70E-11	2.83E-11	-10.568	-10.548	0.02	68.87
Ca	3.53E-03						
	Ca+2	2.95E-03	9.48E-04	-2.53	-3.023	-0.493	-17.21
	CaSO4	3.95E-04	4.14E-04	-3.403	-3.383	0.02	7.5
	CaCO3	1.03E-04	1.08E-04	-3.987	-3.967	0.02	-14.6
	CaHCO3+	8.01E-05	6.06E-05	-4.096	-4.218	-0.121	9.88
	CaOH+	6.05E-08	4.51E-08	-7.219	-7.346	-0.127	0
	CaHSO4+	1.26E-11	9.43E-12	-10.898	-11.026	-0.127	0
Cl	1.30E-01						
	Cl-	1.30E-01	9.26E-02	-0.888	-1.033	-0.146	18.46
	ZnOHCl	1.03E-08	1.08E-08	-7.989	-7.969	0.02	0
	CuCl2-	1.00E-08	7.21E-09	-7.998	-8.142	-0.144	0
	MnCl+	8.38E-09	6.19E-09	-8.077	-8.209	-0.132	-2.88
	ZnCl+	4.24E-09	3.05E-09	-8.373	-8.516	-0.144	-14.38
	CuCl3-2	3.56E-09	1.06E-09	-8.449	-8.976	-0.527	0
	ZnCl2	2.82E-10	2.95E-10	-9.55	-9.53	0.02	102.03
	MnCl2	2.39E-10	2.50E-10	-9.622	-9.602	0.02	85.89
	ZnCl3-	4.27E-11	3.07E-11	-10.369	-10.513	-0.144	15.82
	FeCl+	1.91E-11	1.43E-11	-10.719	-10.846	-0.127	0
	CuCl+	1.76E-11	1.26E-11	-10.755	-10.899	-0.144	1.14
	MnCl3-	8.64E-12	6.38E-12	-11.064	-11.195	-0.132	44.25
	ZnCl4-2	4.79E-12	1.42E-12	-11.32	-11.846	-0.527	147.38
	CuCl2	5.99E-13	6.28E-13	-12.222	-12.202	0.02	31.02

	CuCl3-	2.87E-16	2.06E-16	-15.542	-15.686	-0.144	0
	FeCl+2	1.00E-18	2.98E-19	-18	-18.526	-0.527	0
	CuCl4-2	3.22E-19	9.58E-20	-18.492	-19.019	-0.527	0
	FeCl2+	1.67E-19	1.23E-19	-18.778	-18.909	-0.132	0
	FeCl3	1.09E-21	1.14E-21	-20.963	-20.943	0.02	0
Cu(1)	1.36E-08						
	CuCl2-	1.00E-08	7.21E-09	-7.998	-8.142	-0.144	0
	CuCl3-2	3.56E-09	1.06E-09	-8.449	-8.976	-0.527	0
	Cu+	3.91E-12	2.66E-12	-11.408	-11.576	-0.167	0
Cu(2)	1.06E-07						
	Cu(OH)2	8.32E-08	8.71E-08	-7.08	-7.06	0.02	0
	CuCO3	1.76E-08	1.84E-08	-7.755	-7.734	0.02	0
	Cu(CO3)2-	5.07E-09	1.57E-09	-8.295	-8.803	-0.508	0
	CuOH+	2.02E-10	1.45E-10	-9.694	-9.838	-0.144	0
	CuHCO3+	1.70E-10	1.27E-10	-9.769	-9.896	-0.127	0
	Cu+2	1.55E-10	5.06E-11	-9.81	-10.296	-0.485	-25.76
	CuSO4	2.42E-11	2.54E-11	-10.615	-10.595	0.02	13.09
	CuCl+	1.76E-11	1.26E-11	-10.755	-10.899	-0.144	1.14
	Cu(OH)3-	2.02E-12	1.51E-12	-11.695	-11.822	-0.127	0
	CuCl2	5.99E-13	6.28E-13	-12.222	-12.202	0.02	31.02
	CuF+	2.04E-13	1.52E-13	-12.69	-12.817	-0.127	0
	Cu2(OH)2+	2.98E-14	9.24E-15	-13.526	-14.034	-0.508	0
	CuCl3-	2.87E-16	2.06E-16	-15.542	-15.686	-0.144	0
	Cu(OH)4-2	2.78E-16	8.62E-17	-15.556	-16.064	-0.508	0
	CuCl4-2	3.22E-19	9.58E-20	-18.492	-19.019	-0.527	0
F	3.60E-04						
	F-	2.34E-04	1.65E-04	-3.631	-3.782	-0.151	-0.92
	MgF+	1.18E-04	8.58E-05	-3.929	-4.066	-0.137	-10.35
	NaF	8.33E-06	8.72E-06	-5.08	-5.06	0.02	7.26
	HF	8.21E-10	8.59E-10	-9.086	-9.066	0.02	12.5
	ZnF+	3.82E-11	2.85E-11	-10.418	-10.545	-0.127	0
	MnF+	2.54E-11	1.88E-11	-10.595	-10.727	-0.132	0
	HF2-	7.30E-13	5.45E-13	-12.137	-12.264	-0.127	22.45
	FeF+	2.47E-13	1.84E-13	-12.608	-12.735	-0.127	0
	CuF+	2.04E-13	1.52E-13	-12.69	-12.817	-0.127	0
	FeF2+	2.48E-16	1.83E-16	-15.605	-15.736	-0.132	0
	FeF+2	9.38E-17	2.79E-17	-16.028	-16.555	-0.527	0
	FeF3	4.59E-17	4.81E-17	-16.338	-16.318	0.02	0
Fe(2)	6.68E-10						
	Fe+2	3.41E-10	1.12E-10	-9.467	-9.953	-0.485	-21.25
	FeCO3	1.73E-10	1.81E-10	-9.762	-9.742	0.02	0
	FeHCO3+	7.49E-11	5.59E-11	-10.126	-10.253	-0.127	0
	FeSO4	4.65E-11	4.87E-11	-10.333	-10.313	0.02	18.97
	FeCl+	1.91E-11	1.43E-11	-10.719	-10.846	-0.127	0
	FeOH+	1.37E-11	1.01E-11	-10.863	-10.995	-0.132	0
	FeF+	2.47E-13	1.84E-13	-12.608	-12.735	-0.127	0
	Fe(OH)2	2.36E-14	2.47E-14	-13.627	-13.607	0.02	0
	Fe(OH)3-	3.57E-16	2.63E-16	-15.448	-15.58	-0.132	0
	FeHSO4+	1.49E-18	1.11E-18	-17.828	-17.955	-0.127	0
Fe(3)	9.29E-07						

	Fe(OH)3	6.61E-07	6.93E-07	-6.18	-6.16	0.02	0
	Fe(OH)4-	2.43E-07	1.81E-07	-6.614	-6.742	-0.127	0
	Fe(OH)2+	2.51E-08	1.87E-08	-7.6	-7.727	-0.127	0
	FeOH+2	6.63E-13	1.97E-13	-12.178	-12.705	-0.527	0
	FeF2+	2.48E-16	1.83E-16	-15.605	-15.736	-0.132	0
	FeF+2	9.38E-17	2.79E-17	-16.028	-16.555	-0.527	0
	FeF3	4.59E-17	4.81E-17	-16.338	-16.318	0.02	0
	FeSO4+	3.88E-18	2.87E-18	-17.411	-17.543	-0.132	0
	FeCl+2	1.00E-18	2.98E-19	-18	-18.526	-0.527	0
	Fe+3	8.17E-19	1.07E-19	-18.088	-18.973	-0.885	0
	Fe(SO4)2-	2.06E-19	1.54E-19	-18.685	-18.813	-0.127	0
	FeCl2+	1.67E-19	1.23E-19	-18.778	-18.909	-0.132	0
	FeCl3	1.09E-21	1.14E-21	-20.963	-20.943	0.02	0
	Fe2(OH)2+	1.13E-22	1.05E-24	-21.946	-23.98	-2.034	0
	FeHSO4+2	8.58E-26	2.66E-26	-25.067	-25.575	-0.508	0
	Fe3(OH)4+	6.17E-27	4.10E-30	-26.21	-29.387	-3.178	0
H(0)	1.63E-28						
	H2	8.13E-29	8.51E-29	-28.09	-28.07	0.02	28.61
K	1.77E-03						
	K+	1.74E-03	1.24E-03	-2.759	-2.907	-0.148	9.34
	KSO4-	2.87E-05	2.14E-05	-4.543	-4.67	-0.127	34.5
Mg	2.85E-02						
	Mg+2	2.29E-02	7.86E-03	-1.64	-2.105	-0.465	-20.92
	MgSO4	4.32E-03	4.52E-03	-2.365	-2.344	0.02	5.84
	MgHCO3+	6.42E-04	4.61E-04	-3.193	-3.336	-0.144	5.71
	MgCO3	4.85E-04	5.08E-04	-3.314	-3.294	0.02	-17.09
	MgF+	1.18E-04	8.58E-05	-3.929	-4.066	-0.137	-10.35
	MgOH+	1.07E-05	8.19E-06	-4.97	-5.087	-0.117	0
Mn(2)	1.60E-07						
	MnCO3	8.43E-08	8.83E-08	-7.074	-7.054	0.02	0
	Mn+2	5.02E-08	1.64E-08	-7.3	-7.785	-0.485	-17.54
	MnHCO3+	9.92E-09	7.32E-09	-8.004	-8.135	-0.132	0
	MnCl+	8.38E-09	6.19E-09	-8.077	-8.209	-0.132	-2.88
	MnSO4	6.84E-09	7.16E-09	-8.165	-8.145	0.02	22.54
	MnCl2	2.39E-10	2.50E-10	-9.622	-9.602	0.02	85.89
	MnOH+	1.64E-10	1.21E-10	-9.786	-9.917	-0.132	0
	MnF+	2.54E-11	1.88E-11	-10.595	-10.727	-0.132	0
	MnCl3-	8.64E-12	6.38E-12	-11.064	-11.195	-0.132	44.25
	Mn(NO3)2	7.69E-16	8.05E-16	-15.114	-15.094	0.02	41.04
	Mn(OH)3-	8.31E-18	6.14E-18	-17.08	-17.212	-0.132	0
Mn(3)	3.89E-29						
	Mn+3	3.89E-29	5.07E-30	-28.41	-29.295	-0.885	0
N(-3)	1.90E-05						
	NH4+	1.67E-05	1.14E-05	-4.776	-4.944	-0.167	18.25
	NH3	1.79E-06	1.87E-06	-5.748	-5.728	0.02	24.42
	NH4SO4-	4.83E-07	3.60E-07	-6.316	-6.443	-0.127	38.49
N(5)	1.60E-04						
	NO3-	1.60E-04	1.11E-04	-3.796	-3.954	-0.159	29.9
	Mn(NO3)2	7.69E-16	8.05E-16	-15.114	-15.094	0.02	41.04
Na	1.25E-01						

	Na+	1.23E-01	9.17E-02	-0.911	-1.038	-0.126	-0.93
	NaSO4-	1.51E-03	1.13E-03	-2.82	-2.948	-0.127	17.56
	NaHCO3	2.47E-04	2.58E-04	-3.608	-3.588	0.02	1.8
	NaCO3-	1.55E-04	1.16E-04	-3.81	-3.937	-0.127	0.3
	NaF	8.33E-06	8.72E-06	-5.08	-5.06	0.02	7.26
	NaOH	2.54E-17	2.66E-17	-16.595	-16.575	0.02	0
O(0)	1.09E-36						
	O2	5.44E-37	5.70E-37	-36.265	-36.244	0.02	30.4
S(6)	1.47E-02						
	SO4-2	8.41E-03	2.46E-03	-2.075	-2.61	-0.535	16.08
	MgSO4	4.32E-03	4.52E-03	-2.365	-2.344	0.02	5.84
	NaSO4-	1.51E-03	1.13E-03	-2.82	-2.948	-0.127	17.56
	CaSO4	3.95E-04	4.14E-04	-3.403	-3.383	0.02	7.5
	KSO4-	2.87E-05	2.14E-05	-4.543	-4.67	-0.127	34.5
	BaSO4	3.85E-06	4.03E-06	-5.414	-5.394	0.02	0
	NH4SO4-	4.83E-07	3.60E-07	-6.316	-6.443	-0.127	38.49
	MnSO4	6.84E-09	7.16E-09	-8.165	-8.145	0.02	22.54
	ZnSO4	6.71E-09	7.03E-09	-8.173	-8.153	0.02	21.71
	HSO4-	1.11E-09	8.28E-10	-8.955	-9.082	-0.127	40.65
	Zn(SO4)2-2	4.52E-10	1.40E-10	-9.344	-9.853	-0.508	-10.08
	FeSO4	4.65E-11	4.87E-11	-10.333	-10.313	0.02	18.97
	CuSO4	2.42E-11	2.54E-11	-10.615	-10.595	0.02	13.09
	CaHSO4+	1.26E-11	9.43E-12	-10.898	-11.026	-0.127	0
	FeSO4+	3.88E-18	2.87E-18	-17.411	-17.543	-0.132	0
	FeHSO4+	1.49E-18	1.11E-18	-17.828	-17.955	-0.127	0
	Fe(SO4)2-	2.06E-19	1.54E-19	-18.685	-18.813	-0.127	0
	FeHSO4+2	8.58E-26	2.66E-26	-25.067	-25.575	-0.508	0
Zn	1.02E-06						
	Zn(CO3)2-2	7.72E-07	2.39E-07	-6.113	-6.621	-0.508	0
	ZnCO3	1.58E-07	1.65E-07	-6.802	-6.782	0.02	0
	Zn+2	4.11E-08	1.22E-08	-7.386	-7.913	-0.527	-24.49
	Zn(OH)2	1.21E-08	1.27E-08	-7.918	-7.898	0.02	0
	ZnHCO3+	1.03E-08	7.71E-09	-7.986	-8.113	-0.127	0
	ZnOHCl	1.03E-08	1.08E-08	-7.989	-7.969	0.02	0
	ZnSO4	6.71E-09	7.03E-09	-8.173	-8.153	0.02	21.71
	ZnOH+	5.15E-09	3.84E-09	-8.288	-8.415	-0.127	0
	ZnCl+	4.24E-09	3.05E-09	-8.373	-8.516	-0.144	-14.38
	Zn(SO4)2-2	4.52E-10	1.40E-10	-9.344	-9.853	-0.508	-10.08
	ZnCl2	2.82E-10	2.95E-10	-9.55	-9.53	0.02	102.03
	ZnCl3-	4.27E-11	3.07E-11	-10.369	-10.513	-0.144	15.82
	ZnF+	3.82E-11	2.85E-11	-10.418	-10.545	-0.127	0
	Zn(OH)3-	1.54E-11	1.15E-11	-10.813	-10.94	-0.127	0
	ZnCl4-2	4.79E-12	1.42E-12	-11.32	-11.846	-0.527	147.38
	Zn(OH)4-2	1.68E-15	5.22E-16	-14.774	-15.282	-0.508	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.36	-5.63	-4.28	CaSO4			

Aragonite	1.14	-7.19	-8.34	CaCO3
Barite	1.75	-8.09	-9.84	BaSO4
Calcite	1.29	-7.19	-8.48	CaCO3
CO2(g)	-2.94	-4.41	-1.47	CO2
Dolomite	3.62	-13.47	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.51	6.4	4.89	Fe(OH)3
Fluorite	0.01	-10.59	-10.6	CaF2
Goethite	7.4	6.4	-1	FeOOH
Gypsum	-1.06	-5.64	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O
Halite	-3.64	-2.07	1.57	NaCl
Hausmann	-8.71	52.32	61.03	Mn3O4
Hematite	16.82	12.81	-4.01	Fe2O3
Jarosite-K	-5.09	-14.3	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.75	21.59	25.34	MnOOH
Melanterit	-10.37	-12.58	-2.21	FeSO4:7H2O
NH3(g)	-7.52	-5.73	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.07	9.13	15.2	Mn(OH)2
Pyrolusite	-7.33	34.05	41.38	MnO2:H2O
Rhodochro	-0.82	-11.95	-11.13	MnCO3
Siderite	-3.23	-14.12	-10.89	FeCO3
Smithsonit	-2.08	-12.08	-10	ZnCO3
Sylvite	-4.84	-3.94	0.9	KCl
Witherite	-1.09	-9.65	-8.56	BaCO3
Zn(OH)2(e	-2.5	9	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 22

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.01E-02	1.01E-02
Ba	1.64E-05	1.64E-05
Ca	3.69E-03	3.69E-03
Cl	1.35E-01	1.35E-01
Cu	1.20E-07	1.20E-07
F	3.80E-04	3.80E-04
Fe	9.70E-07	9.70E-07
K	1.85E-03	1.85E-03
Mg	2.98E-02	2.98E-02
Mn	1.60E-07	1.60E-07
N(-3)	2.00E-05	2.00E-05
N(5)	1.70E-04	1.70E-04
Na	1.30E-01	1.30E-01

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        S(6)        1.53E-02  1.53E-02
        Zn          1.06E-06  1.06E-06

#NAME?  of          solution----------------------------

        pH          =                 8.46
        pe          =                    4
        Specific    Conductan (µS/cm,     25°C)      =                16680
        Density     (g/cm³)   =            1.00557
        Volume      (L)       =            1.00519
        Activity    of        water       =                0.995
        Ionic       strength  (mol/kgw)   =            2.10E-01
        Mass        of        water       (kg)       =          1.00E+00
        Total       carbon    (mol/kg)    =            9.07E-03
        Total       CO2       (mol/kg)    =            9.07E-03
        Temperatu   (°C)      =                   25
        Electrical  balance   (eq)        =            2.25E-02
        Percent     error,    100*(Cat-|  =                6.47
        Iterations  =                 12  (208       overall)
        Total       H         =            1.11E+02
        Total       O         =            5.56E+01

#NAME?  couples--------------------------------

        Redox       couple    pe          Eh          (volts)

        N(-3)/N(5)    4.4347    0.2623

#NAME?  of          species----------------------------

        Log         Log       Log         mole        V
        Species     Molality  Activity    Molality    Activity    Gamma    cm³/mol

        OH-         4.13E-06  2.90E-06     -5.384      -5.537     -0.153     -3.48
        H+          4.36E-09  3.47E-09     -8.361       -8.46     -0.099         0
        H2O         5.55E+01  9.95E-01      1.744      -0.002          0     18.07
Ba        1.64E-05
        Ba+2        1.20E-05  3.38E-06      -4.92      -5.471     -0.551     -11.7
        BaSO4       4.05E-06  4.25E-06     -5.393      -5.372      0.021         0
        BaHCO3+     2.25E-07  1.68E-07     -6.647      -6.775     -0.128         0
        BaCO3       1.17E-07  1.22E-07     -6.934      -6.913      0.021      -10.7
        BaOH+       4.47E-11  3.29E-11     -10.35     -10.483     -0.133         0
C(4)      9.07E-03
        HCO3-       6.97E-03  5.18E-03     -2.157      -2.286     -0.129     25.57
        MgHCO3+     6.88E-04  4.92E-04     -3.162      -3.308     -0.146      5.72
        MgCO3       5.17E-04  5.43E-04     -3.287      -3.266      0.021    -17.09
        NaHCO3      2.65E-04  2.78E-04     -3.576      -3.555      0.021       1.8
        CO3-2       2.30E-04  7.00E-05     -3.639      -4.155     -0.516     -3.56
        NaCO3-      1.67E-04  1.25E-04     -3.776      -3.904     -0.128      0.35
        CaCO3       1.10E-04  1.15E-04     -3.961       -3.94      0.021     -14.6
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	CaHCO3+	8.56E-05	6.45E-05	-4.067	-4.19	-0.123	9.88
	CO2	3.87E-05	4.06E-05	-4.413	-4.392	0.021	34.43
	Zn(CO3)2-2	8.11E-07	2.49E-07	-6.091	-6.603	-0.512	0
	BaHCO3+	2.25E-07	1.68E-07	-6.647	-6.775	-0.128	0
	ZnCO3	1.59E-07	1.67E-07	-6.8	-6.779	0.021	0
	BaCO3	1.17E-07	1.22E-07	-6.934	-6.913	0.021	-10.7
	MnCO3	8.47E-08	8.89E-08	-7.072	-7.051	0.021	0
	CuCO3	1.78E-08	1.87E-08	-7.749	-7.728	0.021	0
	ZnHCO3+	1.04E-08	7.77E-09	-7.982	-8.11	-0.128	0
	MnHCO3+	1.00E-08	7.37E-09	-7.999	-8.132	-0.133	0
	Cu(CO3)2-	5.37E-09	1.65E-09	-8.27	-8.783	-0.512	0
	FeCO3	1.86E-10	1.96E-10	-9.73	-9.709	0.021	0
	CuHCO3+	1.73E-10	1.29E-10	-9.761	-9.889	-0.128	0
	FeHCO3+	8.10E-11	6.03E-11	-10.092	-10.22	-0.128	0
	(CO2)2	2.88E-11	3.02E-11	-10.541	-10.52	0.021	68.87
Ca	3.69E-03						
	Ca+2	3.08E-03	9.77E-04	-2.511	-3.01	-0.499	-17.19
	CaSO4	4.15E-04	4.36E-04	-3.382	-3.361	0.021	7.5
	CaCO3	1.10E-04	1.15E-04	-3.961	-3.94	0.021	-14.6
	CaHCO3+	8.56E-05	6.45E-05	-4.067	-4.19	-0.123	9.88
	CaOH+	6.25E-08	4.65E-08	-7.204	-7.332	-0.128	0
	CaHSO4+	1.33E-11	9.93E-12	-10.875	-11.003	-0.128	0
Cl	1.35E-01						
	Cl-	1.35E-01	9.64E-02	-0.868	-1.016	-0.148	18.47
	CuCl2-	1.07E-08	7.68E-09	-7.969	-8.115	-0.146	0
	ZnOHCl	1.04E-08	1.09E-08	-7.983	-7.962	0.021	0
	MnCl+	8.53E-09	6.28E-09	-8.069	-8.202	-0.133	-2.87
	ZnCl+	4.33E-09	3.09E-09	-8.364	-8.51	-0.146	-14.4
	CuCl3-2	4.00E-09	1.17E-09	-8.398	-8.931	-0.533	0
	ZnCl2	2.98E-10	3.12E-10	-9.527	-9.506	0.021	102.03
	MnCl2	2.52E-10	2.64E-10	-9.599	-9.578	0.021	85.89
	ZnCl3-	4.73E-11	3.38E-11	-10.326	-10.471	-0.146	15.76
	FeCl+	2.08E-11	1.55E-11	-10.682	-10.81	-0.128	0
	CuCl+	1.81E-11	1.29E-11	-10.743	-10.889	-0.146	1.16
	MnCl3-	9.54E-12	7.02E-12	-11.021	-11.154	-0.133	44.28
	ZnCl4-2	5.57E-12	1.63E-12	-11.254	-11.787	-0.533	147.45
	CuCl2	6.37E-13	6.68E-13	-12.196	-12.175	0.021	31.02
	CuCl3-	3.20E-16	2.29E-16	-15.495	-15.641	-0.146	0
	FeCl+2	1.11E-18	3.24E-19	-17.957	-18.49	-0.533	0
	CuCl4-2	3.77E-19	1.11E-19	-18.423	-18.957	-0.533	0
	FeCl2+	1.90E-19	1.39E-19	-18.722	-18.856	-0.133	0
	FeCl3	1.28E-21	1.34E-21	-20.893	-20.872	0.021	0
Cu(1)	1.47E-08						
	CuCl2-	1.07E-08	7.68E-09	-7.969	-8.115	-0.146	0
	CuCl3-2	4.00E-09	1.17E-09	-8.398	-8.931	-0.533	0
	Cu+	3.86E-12	2.61E-12	-11.413	-11.583	-0.17	0
Cu(2)	1.05E-07						
	Cu(OH)2	8.15E-08	8.55E-08	-7.089	-7.068	0.021	0
	CuCO3	1.78E-08	1.87E-08	-7.749	-7.728	0.021	0
	Cu(CO3)2-	5.37E-09	1.65E-09	-8.27	-8.783	-0.512	0

	CuOH+	2.00E-10	1.43E-10	-9.7	-9.846	-0.146	0
	CuHCO3+	1.73E-10	1.29E-10	-9.761	-9.889	-0.128	0
	Cu+2	1.54E-10	4.98E-11	-9.812	-10.303	-0.491	-25.74
	CuSO4	2.43E-11	2.55E-11	-10.615	-10.594	0.021	13.09
	CuCl+	1.81E-11	1.29E-11	-10.743	-10.889	-0.146	1.16
	Cu(OH)3-	1.99E-12	1.48E-12	-11.702	-11.83	-0.128	0
	CuCl2	6.37E-13	6.68E-13	-12.196	-12.175	0.021	31.02
	CuF+	2.09E-13	1.55E-13	-12.68	-12.809	-0.128	0
	Cu2(OH)2+	2.90E-14	8.91E-15	-13.538	-14.05	-0.512	0
	CuCl3-	3.20E-16	2.29E-16	-15.495	-15.641	-0.146	0
	Cu(OH)4-2	2.75E-16	8.46E-17	-15.56	-16.073	-0.512	0
	CuCl4-2	3.77E-19	1.11E-19	-18.423	-18.957	-0.533	0
F	3.80E-04						
	F-	2.44E-04	1.72E-04	-3.612	-3.765	-0.153	-0.91
	MgF+	1.27E-04	9.21E-05	-3.897	-4.036	-0.139	-10.34
	NaF	9.00E-06	9.44E-06	-5.046	-5.025	0.021	7.26
	HF	8.51E-10	8.93E-10	-9.07	-9.049	0.021	12.5
	ZnF+	3.88E-11	2.89E-11	-10.411	-10.539	-0.128	0
	MnF+	2.58E-11	1.90E-11	-10.588	-10.722	-0.133	0
	HF2-	7.90E-13	5.88E-13	-12.103	-12.231	-0.128	22.46
	FeF+	2.68E-13	2.00E-13	-12.571	-12.699	-0.128	0
	CuF+	2.09E-13	1.55E-13	-12.68	-12.809	-0.128	0
	FeF2+	2.81E-16	2.07E-16	-15.551	-15.685	-0.133	0
	FeF+2	1.03E-16	3.02E-17	-15.986	-16.519	-0.533	0
	FeF3	5.36E-17	5.62E-17	-16.271	-16.25	0.021	0
Fe(2)	7.13E-10						
	Fe+2	3.61E-10	1.16E-10	-9.443	-9.934	-0.491	-21.23
	FeCO3	1.86E-10	1.96E-10	-9.73	-9.709	0.021	0
	FeHCO3+	8.10E-11	6.03E-11	-10.092	-10.22	-0.128	0
	FeSO4	4.95E-11	5.19E-11	-10.306	-10.285	0.021	18.97
	FeCl+	2.08E-11	1.55E-11	-10.682	-10.81	-0.128	0
	FeOH+	1.44E-11	1.06E-11	-10.843	-10.976	-0.133	0
	FeF+	2.68E-13	2.00E-13	-12.571	-12.699	-0.128	0
	Fe(OH)2	2.46E-14	2.58E-14	-13.61	-13.589	0.021	0
	Fe(OH)3-	3.74E-16	2.75E-16	-15.428	-15.561	-0.133	0
	FeHSO4+	1.59E-18	1.18E-18	-17.799	-17.927	-0.128	0
Fe(3)	9.69E-07						
	Fe(OH)3	6.89E-07	7.23E-07	-6.162	-6.141	0.021	0
	Fe(OH)4-	2.54E-07	1.89E-07	-6.595	-6.723	-0.129	0
	Fe(OH)2+	2.63E-08	1.96E-08	-7.58	-7.709	-0.129	0
	FeOH+2	7.03E-13	2.06E-13	-12.153	-12.686	-0.533	0
	FeF2+	2.81E-16	2.07E-16	-15.551	-15.685	-0.133	0
	FeF+2	1.03E-16	3.02E-17	-15.986	-16.519	-0.533	0
	FeF3	5.36E-17	5.62E-17	-16.271	-16.25	0.021	0
	FeSO4+	4.16E-18	3.06E-18	-17.381	-17.515	-0.133	0
	FeCl+2	1.11E-18	3.24E-19	-17.957	-18.49	-0.533	0
	Fe+3	8.69E-19	1.11E-19	-18.061	-18.954	-0.893	0
	Fe(SO4)2-	2.25E-19	1.68E-19	-18.647	-18.776	-0.128	0
	FeCl2+	1.90E-19	1.39E-19	-18.722	-18.856	-0.133	0
	FeCl3	1.28E-21	1.34E-21	-20.893	-20.872	0.021	0

	Fe2(OH)2+	1.28E-22	1.14E-24	-21.893	-23.943	-2.05	0
	FeHSO4+2	9.24E-26	2.84E-26	-25.035	-25.547	-0.512	0
	Fe3(OH)4+	7.44E-27	4.66E-30	-26.129	-29.331	-3.203	0
H(0)	1.62E-28						
	H2	8.11E-29	8.51E-29	-28.091	-28.07	0.021	28.61
K	1.85E-03						
	K+	1.82E-03	1.29E-03	-2.74	-2.89	-0.15	9.35
	KSO4-	3.05E-05	2.27E-05	-4.515	-4.644	-0.129	34.51
Mg	2.98E-02						
	Mg+2	2.39E-02	8.12E-03	-1.621	-2.091	-0.469	-20.9
	MgSO4	4.55E-03	4.77E-03	-2.342	-2.321	0.021	5.84
	MgHCO3+	6.88E-04	4.92E-04	-3.162	-3.308	-0.146	5.72
	MgCO3	5.17E-04	5.43E-04	-3.287	-3.266	0.021	-17.09
	MgF+	1.27E-04	9.21E-05	-3.897	-4.036	-0.139	-10.34
	MgOH+	1.11E-05	8.46E-06	-4.955	-5.073	-0.118	0
Mn(2)	1.60E-07						
	MnCO3	8.47E-08	8.89E-08	-7.072	-7.051	0.021	0
	Mn+2	4.95E-08	1.60E-08	-7.305	-7.796	-0.491	-17.5
	MnHCO3+	1.00E-08	7.37E-09	-7.999	-8.132	-0.133	0
	MnCl+	8.53E-09	6.28E-09	-8.069	-8.202	-0.133	-2.87
	MnSO4	6.79E-09	7.13E-09	-8.168	-8.147	0.021	22.54
	MnCl2	2.52E-10	2.64E-10	-9.599	-9.578	0.021	85.89
	MnOH+	1.60E-10	1.18E-10	-9.795	-9.929	-0.133	0
	MnF+	2.58E-11	1.90E-11	-10.588	-10.722	-0.133	0
	MnCl3-	9.54E-12	7.02E-12	-11.021	-11.154	-0.133	44.28
	Mn(NO3)2	8.35E-16	8.76E-16	-15.078	-15.057	0.021	41.04
	Mn(OH)3-	8.13E-18	5.98E-18	-17.09	-17.223	-0.133	0
Mn(3)	3.86E-29						
	Mn+3	3.86E-29	4.94E-30	-28.413	-29.306	-0.893	0
N(-3)	2.00E-05						
	NH4+	1.76E-05	1.19E-05	-4.754	-4.924	-0.17	18.26
	NH3	1.87E-06	1.96E-06	-5.729	-5.708	0.021	24.42
	NH4SO4-	5.17E-07	3.85E-07	-6.286	-6.415	-0.128	38.52
N(5)	1.70E-04						
	NO3-	1.70E-04	1.17E-04	-3.77	-3.93	-0.161	29.91
	Mn(NO3)2	8.35E-16	8.76E-16	-15.078	-15.057	0.021	41.04
Na	1.30E-01						
	Na+	1.28E-01	9.56E-02	-0.892	-1.02	-0.128	-0.92
	NaSO4-	1.62E-03	1.20E-03	-2.791	-2.92	-0.129	17.66
	NaHCO3	2.65E-04	2.78E-04	-3.576	-3.555	0.021	1.8
	NaCO3-	1.67E-04	1.25E-04	-3.776	-3.904	-0.128	0.35
	NaF	9.00E-06	9.44E-06	-5.046	-5.025	0.021	7.26
	NaOH	2.65E-17	2.78E-17	-16.578	-16.557	0.021	0
O(0)	1.09E-36						
	O2	5.42E-37	5.69E-37	-36.266	-36.245	0.021	30.4
S(6)	1.53E-02						
	SO4-2	8.73E-03	2.51E-03	-2.059	-2.601	-0.542	16.12
	MgSO4	4.55E-03	4.77E-03	-2.342	-2.321	0.021	5.84
	NaSO4-	1.62E-03	1.20E-03	-2.791	-2.92	-0.129	17.66
	CaSO4	4.15E-04	4.36E-04	-3.382	-3.361	0.021	7.5

	KSO4-	3.05E-05	2.27E-05	-4.515	-4.644	-0.129	34.51
	BaSO4	4.05E-06	4.25E-06	-5.393	-5.372	0.021	0
	NH4SO4-	5.17E-07	3.85E-07	-6.286	-6.415	-0.128	38.52
	MnSO4	6.79E-09	7.13E-09	-8.168	-8.147	0.021	22.54
	ZnSO4	6.67E-09	7.01E-09	-8.176	-8.155	0.021	21.71
	HSO4-	1.14E-09	8.45E-10	-8.945	-9.073	-0.128	40.66
	Zn(SO4)2-2	4.65E-10	1.43E-10	-9.333	-9.845	-0.512	-9.97
	FeSO4	4.95E-11	5.19E-11	-10.306	-10.285	0.021	18.97
	CuSO4	2.43E-11	2.55E-11	-10.615	-10.594	0.021	13.09
	CaHSO4+	1.33E-11	9.93E-12	-10.875	-11.003	-0.128	0
	FeSO4+	4.16E-18	3.06E-18	-17.381	-17.515	-0.133	0
	FeHSO4+	1.59E-18	1.18E-18	-17.799	-17.927	-0.128	0
	Fe(SO4)2-	2.25E-19	1.68E-19	-18.647	-18.776	-0.128	0
	FeHSO4+2	9.24E-26	2.84E-26	-25.035	-25.547	-0.512	0
Zn	1.06E-06						
	Zn(CO3)2-2	8.11E-07	2.49E-07	-6.091	-6.603	-0.512	0
	ZnCO3	1.59E-07	1.67E-07	-6.8	-6.779	0.021	0
	Zn+2	4.07E-08	1.19E-08	-7.391	-7.924	-0.533	-24.47
	Zn(OH)2	1.18E-08	1.23E-08	-7.93	-7.909	0.021	0
	ZnHCO3+	1.04E-08	7.77E-09	-7.982	-8.11	-0.128	0
	ZnOHCl	1.04E-08	1.09E-08	-7.983	-7.962	0.021	0
	ZnSO4	6.67E-09	7.01E-09	-8.176	-8.155	0.021	21.71
	ZnOH+	5.03E-09	3.75E-09	-8.298	-8.426	-0.128	0
	ZnCl+	4.33E-09	3.09E-09	-8.364	-8.51	-0.146	-14.4
	Zn(SO4)2-2	4.65E-10	1.43E-10	-9.333	-9.845	-0.512	-9.97
	ZnCl2	2.98E-10	3.12E-10	-9.527	-9.506	0.021	102.03
	ZnCl3-	4.73E-11	3.38E-11	-10.326	-10.471	-0.146	15.76
	ZnF+	3.88E-11	2.89E-11	-10.411	-10.539	-0.128	0
	Zn(OH)3-	1.50E-11	1.12E-11	-10.823	-10.951	-0.128	0
	ZnCl4-2	5.57E-12	1.63E-12	-11.254	-11.787	-0.533	147.45
	Zn(OH)4-2	1.66E-15	5.09E-16	-14.781	-15.293	-0.512	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.33	-5.61	-4.28	CaSO4			
Aragonite	1.17	-7.16	-8.34	CaCO3			
Barite	1.77	-8.07	-9.84	BaSO4			
Calcite	1.32	-7.16	-8.48	CaCO3			
CO2(g)	-2.92	-4.39	-1.47	CO2			
Dolomite	3.67	-13.41	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.53	6.42	4.89	Fe(OH)3			
Fluorite	0.06	-10.54	-10.6	CaF2			
Goethite	7.42	6.42	-1	FeOOH			
Gypsum	-1.03	-5.62	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	0	1.5	H2O			
Halite	-3.61	-2.04	1.57	NaCl			
Hausmann	-8.75	52.28	61.03	Mn3O4			

Hematite	16.85	12.84	-4.01	Fe2O3
Jarosite-K	-5	-14.21	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.76	21.58	25.34	MnOOH
Melanterit	-10.34	-12.55	-2.21	FeSO4:7H2O
NH3(g)	-7.5	-5.71	1.8	NH3
O2(g)	-33.35	-36.24	-2.89	O2
Pyrochroit	-6.08	9.12	15.2	Mn(OH)2
Pyrolusite	-7.34	34.04	41.38	MnO2:H2O
Rhodochrc	-0.82	-11.95	-11.13	MnCO3
Siderite	-3.2	-14.09	-10.89	FeCO3
Smithsonit	-2.08	-12.08	-10	ZnCO3
Sylvite	-4.81	-3.91	0.9	KCl
Witherite	-1.06	-9.63	-8.56	BaCO3
Zn(OH)2(e	-2.51	8.99	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 23

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.05E-02	1.05E-02
Ba	1.72E-05	1.72E-05
Ca	3.85E-03	3.85E-03
Cl	1.41E-01	1.41E-01
Cu	1.30E-07	1.30E-07
F	4.00E-04	4.00E-04
Fe	1.02E-06	1.02E-06
K	1.93E-03	1.93E-03
Mg	3.11E-02	3.11E-02
Mn	1.70E-07	1.70E-07
N(-3)	2.10E-05	2.10E-05
N(5)	1.80E-04	1.80E-04
Na	1.36E-01	1.36E-01
S(6)	1.60E-02	1.60E-02
Zn	1.11E-06	1.11E-06

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 17330
Density (g/cm³) = 1.00594
Volume (L) = 1.00529
Activity of water = 0.994
Ionic strength (mol/kgw) = 2.19E-01
Mass of water (kg) = 1.00E+00

```
Total carbon (mol/kg) = 9.45E-03
Total CO2 (mol/kg) = 9.45E-03
Temperatu (°C) = 25
Electrical balance (eq) = 2.35E-02
Percent error, 100*(Cat-| = 6.47
Iterations = 10 (218 overall)
Total H = 1.11E+02
Total O = 5.56E+01

#NAME? couples----------

Redox couple pe Eh (volts)

N(-3)/N(5) 4.4352 0.2624

#NAME? of species----------
```

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.15E-06	2.90E-06	-5.382	-5.537	-0.155	-3.46
H+	4.37E-09	3.47E-09	-8.36	-8.46	-0.1	0
H2O	5.55E+01	9.94E-01	1.744	-0.002	0	18.07
Ba 1.72E-05						
Ba+2	1.26E-05	3.48E-06	-4.901	-5.458	-0.557	-11.68
BaSO4	4.24E-06	4.46E-06	-5.372	-5.35	0.022	0
BaHCO3+	2.40E-07	1.78E-07	-6.62	-6.749	-0.129	0
BaCO3	1.24E-07	1.30E-07	-6.908	-6.886	0.022	-10.7
BaOH+	4.61E-11	3.38E-11	-10.336	-10.471	-0.135	0
C(4) 9.45E-03						
HCO3-	7.21E-03	5.34E-03	-2.142	-2.272	-0.13	25.6
MgHCO3+	7.36E-04	5.23E-04	-3.133	-3.281	-0.148	5.72
MgCO3	5.49E-04	5.77E-04	-3.26	-3.239	0.022	-17.09
NaHCO3	2.84E-04	2.99E-04	-3.547	-3.525	0.022	1.8
CO3-2	2.40E-04	7.22E-05	-3.62	-4.141	-0.521	-3.52
NaCO3-	1.80E-04	1.34E-04	-3.744	-3.874	-0.129	0.4
CaCO3	1.16E-04	1.22E-04	-3.935	-3.913	0.022	-14.6
CaHCO3+	9.12E-05	6.86E-05	-4.04	-4.164	-0.124	9.88
CO2	3.98E-05	4.19E-05	-4.4	-4.378	0.022	34.43
Zn(CO3)2-2	8.58E-07	2.62E-07	-6.066	-6.582	-0.516	0
BaHCO3+	2.40E-07	1.78E-07	-6.62	-6.749	-0.129	0
ZnCO3	1.61E-07	1.69E-07	-6.793	-6.771	0.022	0
BaCO3	1.24E-07	1.30E-07	-6.908	-6.886	0.022	-10.7
MnCO3	9.04E-08	9.51E-08	-7.044	-7.022	0.022	0
CuCO3	1.95E-08	2.05E-08	-7.709	-7.688	0.022	0
MnHCO3+	1.08E-08	7.89E-09	-7.968	-8.103	-0.135	0
ZnHCO3+	1.06E-08	7.90E-09	-7.973	-8.102	-0.129	0
Cu(CO3)2-	6.13E-09	1.87E-09	-8.213	-8.729	-0.516	0
FeCO3	2.02E-10	2.12E-10	-9.695	-9.673	0.022	0
CuHCO3+	1.91E-10	1.42E-10	-9.72	-9.849	-0.129	0

	FeHCO3+	8.81E-11	6.55E-11	-10.055	-10.184	-0.129	0
	(CO2)2	3.06E-11	3.22E-11	-10.514	-10.492	0.022	68.87
Ca	3.85E-03						
	Ca+2	3.21E-03	1.01E-03	-2.494	-2.997	-0.503	-17.18
	CaSO4	4.35E-04	4.58E-04	-3.361	-3.339	0.022	7.5
	CaCO3	1.16E-04	1.22E-04	-3.935	-3.913	0.022	-14.6
	CaHCO3+	9.12E-05	6.86E-05	-4.04	-4.164	-0.124	9.88
	CaOH+	6.45E-08	4.79E-08	-7.191	-7.32	-0.129	0
	CaHSO4+	1.40E-11	1.04E-11	-10.853	-10.982	-0.129	0
Cl	1.41E-01						
	Cl-	1.41E-01	1.00E-01	-0.85	-0.999	-0.149	18.48
	CuCl2-	1.24E-08	8.82E-09	-7.907	-8.055	-0.148	0
	ZnOHCl	1.06E-08	1.12E-08	-7.973	-7.952	0.022	0
	MnCl+	9.23E-09	6.76E-09	-8.035	-8.17	-0.135	-2.87
	CuCl3-2	4.85E-09	1.40E-09	-8.314	-8.854	-0.54	0
	ZnCl+	4.45E-09	3.17E-09	-8.351	-8.499	-0.148	-14.43
	ZnCl2	3.16E-10	3.33E-10	-9.5	-9.478	0.022	102.03
	MnCl2	2.81E-10	2.96E-10	-9.551	-9.529	0.022	85.89
	ZnCl3-	5.25E-11	3.74E-11	-10.28	-10.427	-0.148	15.7
	FeCl+	2.28E-11	1.70E-11	-10.642	-10.771	-0.129	0
	CuCl+	2.01E-11	1.43E-11	-10.698	-10.845	-0.148	1.17
	MnCl3-	1.11E-11	8.16E-12	-10.953	-11.088	-0.135	44.31
	ZnCl4-2	6.50E-12	1.88E-12	-11.187	-11.726	-0.54	147.51
	CuCl2	7.30E-13	7.68E-13	-12.136	-12.115	0.022	31.02
	CuCl3-	3.84E-16	2.73E-16	-15.416	-15.564	-0.148	0
	FeCl+2	1.23E-18	3.54E-19	-17.911	-18.451	-0.54	0
	CuCl4-2	4.75E-19	1.37E-19	-18.323	-18.863	-0.54	0
	FeCl2+	2.16E-19	1.59E-19	-18.665	-18.8	-0.135	0
	FeCl3	1.51E-21	1.59E-21	-20.821	-20.799	0.022	0
Cu(1)	1.73E-08						
	CuCl2-	1.24E-08	8.82E-09	-7.907	-8.055	-0.148	0
	CuCl3-2	4.85E-09	1.40E-09	-8.314	-8.854	-0.54	0
	Cu+	4.13E-12	2.78E-12	-11.384	-11.556	-0.172	0
Cu(2)	1.13E-07						
	Cu(OH)2	8.65E-08	9.10E-08	-7.063	-7.041	0.022	0
	CuCO3	1.95E-08	2.05E-08	-7.709	-7.688	0.022	0
	Cu(CO3)2-	6.13E-09	1.87E-09	-8.213	-8.729	-0.516	0
	CuOH+	2.13E-10	1.52E-10	-9.671	-9.819	-0.148	0
	CuHCO3+	1.91E-10	1.42E-10	-9.72	-9.849	-0.129	0
	Cu+2	1.66E-10	5.29E-11	-9.78	-10.276	-0.496	-25.73
	CuSO4	2.63E-11	2.76E-11	-10.58	-10.558	0.022	13.09
	CuCl+	2.01E-11	1.43E-11	-10.698	-10.845	-0.148	1.17
	Cu(OH)3-	2.12E-12	1.57E-12	-11.675	-11.804	-0.129	0
	CuCl2	7.30E-13	7.68E-13	-12.136	-12.115	0.022	31.02
	CuF+	2.31E-13	1.71E-13	-12.637	-12.766	-0.129	0
	Cu2(OH)2+	3.31E-14	1.01E-14	-13.48	-13.996	-0.516	0
	CuCl3-	3.84E-16	2.73E-16	-15.416	-15.564	-0.148	0
	Cu(OH)4-2	2.95E-16	8.99E-17	-15.53	-16.046	-0.516	0
	CuCl4-2	4.75E-19	1.37E-19	-18.323	-18.863	-0.54	0
F	4.00E-04						

	F-	2.54E-04	1.78E-04	-3.595	-3.75	-0.155	-0.91
	MgF+	1.36E-04	9.84E-05	-3.866	-4.007	-0.141	-10.34
	NaF	9.68E-06	1.02E-05	-5.014	-4.992	0.022	7.26
	HF	8.79E-10	9.25E-10	-9.056	-9.034	0.022	12.5
	ZnF+	3.97E-11	2.95E-11	-10.401	-10.53	-0.129	0
	MnF+	2.78E-11	2.04E-11	-10.556	-10.691	-0.135	0
	HF2-	8.49E-13	6.31E-13	-12.071	-12.2	-0.129	22.47
	FeF+	2.93E-13	2.18E-13	-12.533	-12.662	-0.129	0
	CuF+	2.31E-13	1.71E-13	-12.637	-12.766	-0.129	0
	FeF2+	3.19E-16	2.34E-16	-15.497	-15.632	-0.135	0
	FeF+2	1.14E-16	3.30E-17	-15.942	-16.482	-0.54	0
	FeF3	6.26E-17	6.58E-17	-16.204	-16.182	0.022	0
Fe(2)	7.66E-10						
	Fe+2	3.84E-10	1.23E-10	-9.415	-9.912	-0.496	-21.22
	FeCO3	2.02E-10	2.12E-10	-9.695	-9.673	0.022	0
	FeHCO3+	8.81E-11	6.55E-11	-10.055	-10.184	-0.129	0
	FeSO4	5.30E-11	5.58E-11	-10.276	-10.254	0.022	18.97
	FeCl+	2.28E-11	1.70E-11	-10.642	-10.771	-0.129	0
	FeOH+	1.52E-11	1.11E-11	-10.819	-10.954	-0.135	0
	FeF+	2.93E-13	2.18E-13	-12.533	-12.662	-0.129	0
	Fe(OH)2	2.58E-14	2.71E-14	-13.588	-13.567	0.022	0
	Fe(OH)3-	3.94E-16	2.89E-16	-15.404	-15.539	-0.135	0
	FeHSO4+	1.71E-18	1.27E-18	-17.767	-17.896	-0.129	0
Fe(3)	1.02E-06						
	Fe(OH)3	7.23E-07	7.60E-07	-6.141	-6.119	0.022	0
	Fe(OH)4-	2.69E-07	1.99E-07	-6.571	-6.701	-0.13	0
	Fe(OH)2+	2.78E-08	2.06E-08	-7.556	-7.687	-0.13	0
	FeOH+2	7.51E-13	2.17E-13	-12.125	-12.664	-0.54	0
	FeF2+	3.19E-16	2.34E-16	-15.497	-15.632	-0.135	0
	FeF+2	1.14E-16	3.30E-17	-15.942	-16.482	-0.54	0
	FeF3	6.26E-17	6.58E-17	-16.204	-16.182	0.022	0
	FeSO4+	4.48E-18	3.28E-18	-17.349	-17.484	-0.135	0
	FeCl+2	1.23E-18	3.54E-19	-17.911	-18.451	-0.54	0
	Fe+3	9.32E-19	1.17E-19	-18.031	-18.932	-0.901	0
	Fe(SO4)2-	2.47E-19	1.84E-19	-18.607	-18.736	-0.129	0
	FeCl2+	2.16E-19	1.59E-19	-18.665	-18.8	-0.135	0
	FeCl3	1.51E-21	1.59E-21	-20.821	-20.799	0.022	0
	Fe2(OH)2+	1.47E-22	1.26E-24	-21.834	-23.898	-2.065	0
	FeHSO4+2	1.00E-25	3.05E-26	-25	-25.516	-0.516	0
	Fe3(OH)4+	9.15E-27	5.44E-30	-26.039	-29.265	-3.226	0
H(0)	1.62E-28						
	H2	8.09E-29	8.51E-29	-28.092	-28.07	0.022	28.61
K	1.93E-03						
	K+	1.90E-03	1.34E-03	-2.722	-2.874	-0.152	9.36
	KSO4-	3.25E-05	2.40E-05	-4.489	-4.619	-0.13	34.52
Mg	3.11E-02						
	Mg+2	2.49E-02	8.38E-03	-1.604	-2.077	-0.473	-20.89
	MgSO4	4.78E-03	5.02E-03	-2.321	-2.299	0.022	5.84
	MgHCO3+	7.36E-04	5.23E-04	-3.133	-3.281	-0.148	5.72
	MgCO3	5.49E-04	5.77E-04	-3.26	-3.239	0.022	-17.09

	MgF+	1.36E-04	9.84E-05	-3.866	-4.007	-0.141	-10.34
	MgOH+	1.15E-05	8.72E-06	-4.94	-5.059	-0.119	0
Mn(2)	1.70E-07						
	MnCO3	9.04E-08	9.51E-08	-7.044	-7.022	0.022	0
	Mn+2	5.20E-08	1.66E-08	-7.284	-7.781	-0.496	-17.46
	MnHCO3+	1.08E-08	7.89E-09	-7.968	-8.103	-0.135	0
	MnCl+	9.23E-09	6.76E-09	-8.035	-8.17	-0.135	-2.87
	MnSO4	7.17E-09	7.54E-09	-8.145	-8.123	0.022	22.54
	MnCl2	2.81E-10	2.96E-10	-9.551	-9.529	0.022	85.89
	MnOH+	1.67E-10	1.22E-10	-9.778	-9.913	-0.135	0
	MnF+	2.78E-11	2.04E-11	-10.556	-10.691	-0.135	0
	MnCl3-	1.11E-11	8.16E-12	-10.953	-11.088	-0.135	44.31
	Mn(NO3)2	9.58E-16	1.01E-15	-15.019	-14.997	0.022	41.04
	Mn(OH)3-	8.45E-18	6.19E-18	-17.073	-17.208	-0.135	0
Mn(3)	4.08E-29						
	Mn+3	4.08E-29	5.12E-30	-28.39	-29.291	-0.901	0
N(-3)	2.10E-05						
	NH4+	1.85E-05	1.24E-05	-4.733	-4.905	-0.172	18.26
	NH3	1.95E-06	2.05E-06	-5.711	-5.689	0.022	24.42
	NH4SO4-	5.52E-07	4.10E-07	-6.258	-6.387	-0.129	38.55
N(5)	1.80E-04						
	NO3-	1.80E-04	1.24E-04	-3.745	-3.908	-0.163	29.92
	Mn(NO3)2	9.58E-16	1.01E-15	-15.019	-14.997	0.022	41.04
Na	1.36E-01						
	Na+	1.34E-01	9.95E-02	-0.874	-1.002	-0.129	-0.91
	NaSO4-	1.72E-03	1.28E-03	-2.764	-2.894	-0.13	17.75
	NaHCO3	2.84E-04	2.99E-04	-3.547	-3.525	0.022	1.8
	NaCO3-	1.80E-04	1.34E-04	-3.744	-3.874	-0.129	0.4
	NaF	9.68E-06	1.02E-05	-5.014	-4.992	0.022	7.26
	NaOH	2.75E-17	2.89E-17	-16.561	-16.539	0.022	0
O(0)	1.08E-36						
	O2	5.41E-37	5.69E-37	-36.267	-36.245	0.022	30.4
S(6)	1.60E-02						
	SO4-2	9.04E-03	2.56E-03	-2.044	-2.592	-0.548	16.16
	MgSO4	4.78E-03	5.02E-03	-2.321	-2.299	0.022	5.84
	NaSO4-	1.72E-03	1.28E-03	-2.764	-2.894	-0.13	17.75
	CaSO4	4.35E-04	4.58E-04	-3.361	-3.339	0.022	7.5
	KSO4-	3.25E-05	2.40E-05	-4.489	-4.619	-0.13	34.52
	BaSO4	4.24E-06	4.46E-06	-5.372	-5.35	0.022	0
	NH4SO4-	5.52E-07	4.10E-07	-6.258	-6.387	-0.129	38.55
	MnSO4	7.17E-09	7.54E-09	-8.145	-8.123	0.022	22.54
	ZnSO4	6.70E-09	7.05E-09	-8.174	-8.152	0.022	21.71
	HSO4-	1.16E-09	8.62E-10	-8.935	-9.064	-0.129	40.67
	Zn(SO4)2-2	4.81E-10	1.47E-10	-9.318	-9.834	-0.516	-9.87
	FeSO4	5.30E-11	5.58E-11	-10.276	-10.254	0.022	18.97
	CuSO4	2.63E-11	2.76E-11	-10.58	-10.558	0.022	13.09
	CaHSO4+	1.40E-11	1.04E-11	-10.853	-10.982	-0.129	0
	FeSO4+	4.48E-18	3.28E-18	-17.349	-17.484	-0.135	0
	FeHSO4+	1.71E-18	1.27E-18	-17.767	-17.896	-0.129	0
	Fe(SO4)2-	2.47E-19	1.84E-19	-18.607	-18.736	-0.129	0

	FeHSO4+2	1.00E-25	3.05E-26	-25	-25.516	-0.516	0
Zn	1.11E-06						
	Zn(CO3)2-2	8.58E-07	2.62E-07	-6.066	-6.582	-0.516	0
	ZnCO3	1.61E-07	1.69E-07	-6.793	-6.771	0.022	0
	Zn+2	4.07E-08	1.18E-08	-7.39	-7.93	-0.54	-24.46
	Zn(OH)2	1.16E-08	1.22E-08	-7.937	-7.915	0.022	0
	ZnHCO3+	1.06E-08	7.90E-09	-7.973	-8.102	-0.129	0
	ZnOHCl	1.06E-08	1.12E-08	-7.973	-7.952	0.022	0
	ZnSO4	6.70E-09	7.05E-09	-8.174	-8.152	0.022	21.71
	ZnOH+	4.97E-09	3.70E-09	-8.303	-8.432	-0.129	0
	ZnCl+	4.45E-09	3.17E-09	-8.351	-8.499	-0.148	-14.43
	Zn(SO4)2-2	4.81E-10	1.47E-10	-9.318	-9.834	-0.516	-9.87
	ZnCl2	3.16E-10	3.33E-10	-9.5	-9.478	0.022	102.03
	ZnCl3-	5.25E-11	3.74E-11	-10.28	-10.427	-0.148	15.7
	ZnF+	3.97E-11	2.95E-11	-10.401	-10.53	-0.129	0
	Zn(OH)3-	1.49E-11	1.10E-11	-10.828	-10.957	-0.129	0
	ZnCl4-2	6.50E-12	1.88E-12	-11.187	-11.726	-0.54	147.51
	Zn(OH)4-2	1.65E-15	5.01E-16	-14.784	-15.3	-0.516	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.31	-5.59	-4.28	CaSO4			
Aragonite	1.2	-7.14	-8.34	CaCO3			
Barite	1.79	-8.05	-9.84	BaSO4			
Calcite	1.34	-7.14	-8.48	CaCO3			
CO2(g)	-2.91	-4.38	-1.47	CO2			
Dolomite	3.73	-13.36	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.55	6.44	4.89	Fe(OH)3			
Fluorite	0.1	-10.5	-10.6	CaF2			
Goethite	7.44	6.44	-1	FeOOH			
Gypsum	-1.01	-5.59	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	0	1.5	H2O			
Halite	-3.57	-2	1.57	NaCl			
Hausmann	-8.7	52.33	61.03	Mn3O4			
Hematite	16.9	12.89	-4.01	Fe2O3			
Jarosite-K	-4.9	-14.11	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.75	21.59	25.34	MnOOH			
Melanterit	-10.31	-12.52	-2.21	FeSO4:7H2O			
NH3(g)	-7.49	-5.69	1.8	NH3			
O2(g)	-33.35	-36.24	-2.89	O2			
Pyrochroit	-6.07	9.13	15.2	Mn(OH)2			
Pyrolusite	-7.33	34.05	41.38	MnO2:H2O			
Rhodochro	-0.79	-11.92	-11.13	MnCO3			
Siderite	-3.16	-14.05	-10.89	FeCO3			
Smithsonit	-2.07	-12.07	-10	ZnCO3			
Sylvite	-4.77	-3.87	0.9	KCl			
Witherite	-1.04	-9.6	-8.56	BaCO3			

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            Zn(OH)2(e       -2.51        8.99        11.5 Zn(OH)2

**For       a           gas,        SI          =           log10(fuga Fugacity    =           pressure
            For         ideal       gases,      phi         =                      1

Initial     solution            24

 #NAME?     composition-----------------------------

            Elements    Molality    Moles

            Alkalinity   1.10E-02   1.10E-02
            Ba           1.79E-05   1.79E-05
            Ca           4.01E-03   4.01E-03
            Cl           1.47E-01   1.47E-01
            Cu           1.30E-07   1.30E-07
            F            4.10E-04   4.10E-04
            Fe           1.06E-06   1.06E-06
            K            2.02E-03   2.02E-03
            Mg           3.24E-02   3.24E-02
            Mn           1.80E-07   1.80E-07
            N(-3)        2.20E-05   2.20E-05
            N(5)         1.90E-04   1.90E-04
            Na           1.42E-01   1.42E-01
            S(6)         1.67E-02   1.67E-02
            Zn           1.15E-06   1.15E-06

 #NAME?     of          solution---------------------------

            pH          =                   8.46
            pe          =                      4
            Specific    Conductan (µS/cm,       25°C)       =                 17976
            Density     (g/cm³)   =               1.0063
            Volume      (L)       =              1.00539
            Activity    of        water         =                 0.994
            Ionic       strength  (mol/kgw)     =             2.28E-01
            Mass        of        water         (kg)        =            1.00E+00
            Total       carbon    (mol/kg)      =             9.83E-03
            Total       CO2       (mol/kg)      =             9.83E-03
            Temperatu   (°C)      =                     25
            Electrical  balance   (eq)          =             2.45E-02
            Percent     error,    100*(Cat-|=                     6.48
            Iterations  =                   10 (228         overall)
            Total       H         =             1.11E+02
            Total       O         =             5.56E+01

 #NAME?     couples--------------------------------

            Redox       couple    pe          Eh          (volts)
```

N(-3)/N(5) 4.4356 0.2624

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.17E-06	2.90E-06	-5.38	-5.537	-0.157	-3.44
	H+	4.38E-09	3.47E-09	-8.359	-8.46	-0.101	0
	H2O	5.55E+01	9.94E-01	1.744	-0.003	0	18.07
Ba	1.79E-05						
	Ba+2	1.31E-05	3.58E-06	-4.883	-5.446	-0.563	-11.67
	BaSO4	4.44E-06	4.68E-06	-5.353	-5.33	0.023	0
	BaHCO3+	2.55E-07	1.89E-07	-6.594	-6.724	-0.13	0
	BaCO3	1.31E-07	1.38E-07	-6.884	-6.861	0.023	-10.7
	BaOH+	4.76E-11	3.48E-11	-10.322	-10.459	-0.136	0
C(4)	9.83E-03						
	HCO3-	7.45E-03	5.50E-03	-2.128	-2.26	-0.132	25.63
	MgHCO3+	7.84E-04	5.56E-04	-3.106	-3.255	-0.15	5.72
	MgCO3	5.82E-04	6.13E-04	-3.235	-3.213	0.023	-17.09
	NaHCO3	3.04E-04	3.20E-04	-3.518	-3.495	0.023	1.8
	CO3-2	2.51E-04	7.44E-05	-3.601	-4.128	-0.527	-3.48
	NaCO3-	1.93E-04	1.43E-04	-3.714	-3.844	-0.13	0.46
	CaCO3	1.23E-04	1.29E-04	-3.911	-3.888	0.023	-14.6
	CaHCO3+	9.70E-05	7.27E-05	-4.013	-4.139	-0.125	9.89
	CO2	4.09E-05	4.31E-05	-4.388	-4.365	0.023	34.43
	Zn(CO3)2-2	8.98E-07	2.71E-07	-6.047	-6.566	-0.52	0
	BaHCO3+	2.55E-07	1.89E-07	-6.594	-6.724	-0.13	0
	ZnCO3	1.62E-07	1.71E-07	-6.791	-6.768	0.023	0
	BaCO3	1.31E-07	1.38E-07	-6.884	-6.861	0.023	-10.7
	MnCO3	9.61E-08	1.01E-07	-7.017	-6.994	0.023	0
	CuCO3	1.97E-08	2.08E-08	-7.705	-7.683	0.023	0
	MnHCO3+	1.15E-08	8.40E-09	-7.939	-8.076	-0.136	0
	ZnHCO3+	1.07E-08	7.96E-09	-7.969	-8.099	-0.13	0
	Cu(CO3)2-	6.44E-09	1.95E-09	-8.191	-8.711	-0.52	0
	FeCO3	2.16E-10	2.28E-10	-9.666	-9.643	0.023	0
	CuHCO3+	1.93E-10	1.43E-10	-9.714	-9.844	-0.13	0
	FeHCO3+	9.46E-11	7.02E-11	-10.024	-10.154	-0.13	0
	(CO2)2	3.24E-11	3.42E-11	-10.489	-10.466	0.023	68.87
Ca	4.01E-03						
	Ca+2	3.34E-03	1.04E-03	-2.477	-2.985	-0.508	-17.16
	CaSO4	4.55E-04	4.80E-04	-3.342	-3.319	0.023	7.5
	CaCO3	1.23E-04	1.29E-04	-3.911	-3.888	0.023	-14.6
	CaHCO3+	9.70E-05	7.27E-05	-4.013	-4.139	-0.125	9.89
	CaOH+	6.64E-08	4.93E-08	-7.178	-7.308	-0.13	0
	CaHSO4+	1.48E-11	1.09E-11	-10.831	-10.961	-0.13	0
Cl	1.47E-01						
	Cl-	1.47E-01	1.04E-01	-0.832	-0.983	-0.151	18.48
	CuCl2-	1.32E-08	9.32E-09	-7.881	-8.03	-0.15	0
	ZnOHCl	1.08E-08	1.13E-08	-7.968	-7.945	0.023	0

	MnCl+	9.94E-09	7.26E-09	-8.003	-8.139	-0.136	-2.87
	CuCl3-2	5.40E-09	1.54E-09	-8.268	-8.814	-0.546	0
	ZnCl+	4.54E-09	3.22E-09	-8.343	-8.493	-0.15	-14.46
	ZnCl2	3.32E-10	3.50E-10	-9.479	-9.456	0.023	102.03
	MnCl2	3.13E-10	3.29E-10	-9.505	-9.482	0.023	85.89
	ZnCl3-	5.76E-11	4.08E-11	-10.239	-10.389	-0.15	15.64
	FeCl+	2.47E-11	1.83E-11	-10.608	-10.737	-0.13	0
	CuCl+	2.05E-11	1.45E-11	-10.688	-10.837	-0.15	1.19
	MnCl3-	1.29E-11	9.43E-12	-10.889	-11.025	-0.136	44.34
	ZnCl4-2	7.48E-12	2.13E-12	-11.126	-11.672	-0.546	147.58
	CuCl2	7.71E-13	8.12E-13	-12.113	-12.09	0.023	31.02
	CuCl3-	4.23E-16	3.00E-16	-15.374	-15.524	-0.15	0
	FeCl+2	1.34E-18	3.82E-19	-17.872	-18.417	-0.546	0
	CuCl4-2	5.48E-19	1.56E-19	-18.261	-18.807	-0.546	0
	FeCl2+	2.43E-19	1.78E-19	-18.614	-18.751	-0.136	0
	FeCl3	1.75E-21	1.85E-21	-20.756	-20.734	0.023	0
Cu(1)	1.86E-08						
	CuCl2-	1.32E-08	9.32E-09	-7.881	-8.03	-0.15	0
	CuCl3-2	5.40E-09	1.54E-09	-8.268	-8.814	-0.546	0
	Cu+	4.08E-12	2.73E-12	-11.39	-11.564	-0.175	0
Cu(2)	1.11E-07						
	Cu(OH)2	8.47E-08	8.92E-08	-7.072	-7.049	0.023	0
	CuCO3	1.97E-08	2.08E-08	-7.705	-7.683	0.023	0
	Cu(CO3)2-	6.44E-09	1.95E-09	-8.191	-8.711	-0.52	0
	CuOH+	2.10E-10	1.49E-10	-9.677	-9.827	-0.15	0
	CuHCO3+	1.93E-10	1.43E-10	-9.714	-9.844	-0.13	0
	Cu+2	1.65E-10	5.20E-11	-9.783	-10.284	-0.502	-25.72
	CuSO4	2.63E-11	2.77E-11	-10.581	-10.558	0.023	13.09
	CuCl+	2.05E-11	1.45E-11	-10.688	-10.837	-0.15	1.19
	Cu(OH)3-	2.08E-12	1.54E-12	-11.682	-11.812	-0.13	0
	CuCl2	7.71E-13	8.12E-13	-12.113	-12.09	0.023	31.02
	CuF+	2.29E-13	1.70E-13	-12.64	-12.77	-0.13	0
	Cu2(OH)2+	3.21E-14	9.71E-15	-13.493	-14.013	-0.52	0
	CuCl3-	4.23E-16	3.00E-16	-15.374	-15.524	-0.15	0
	Cu(OH)4-2	2.92E-16	8.82E-17	-15.535	-16.055	-0.52	0
	CuCl4-2	5.48E-19	1.56E-19	-18.261	-18.807	-0.546	0
F	4.10E-04						
	F-	2.58E-04	1.80E-04	-3.589	-3.746	-0.157	-0.9
	MgF+	1.42E-04	1.02E-04	-3.847	-3.99	-0.143	-10.34
	NaF	1.01E-05	1.07E-05	-4.994	-4.972	0.023	7.26
	HF	8.86E-10	9.33E-10	-9.053	-9.03	0.023	12.5
	ZnF+	3.93E-11	2.91E-11	-10.406	-10.536	-0.13	0
	MnF+	2.91E-11	2.13E-11	-10.536	-10.672	-0.136	0
	HF2-	8.67E-13	6.43E-13	-12.062	-12.192	-0.13	22.48
	FeF+	3.09E-13	2.29E-13	-12.51	-12.64	-0.13	0
	CuF+	2.29E-13	1.70E-13	-12.64	-12.77	-0.13	0
	FeF2+	3.39E-16	2.48E-16	-15.47	-15.606	-0.136	0
	FeF+2	1.22E-16	3.46E-17	-15.915	-16.46	-0.546	0
	FeF3	6.68E-17	7.04E-17	-16.175	-16.152	0.023	0
Fe(2)	8.12E-10						

	Fe+2	4.05E-10	1.28E-10	-9.393	-9.894	-0.502	-21.2
	FeCO3	2.16E-10	2.28E-10	-9.666	-9.643	0.023	0
	FeHCO3+	9.46E-11	7.02E-11	-10.024	-10.154	-0.13	0
	FeSO4	5.61E-11	5.91E-11	-10.251	-10.228	0.023	18.97
	FeCl+	2.47E-11	1.83E-11	-10.608	-10.737	-0.13	0
	FeOH+	1.58E-11	1.16E-11	-10.801	-10.937	-0.136	0
	FeF+	3.09E-13	2.29E-13	-12.51	-12.64	-0.13	0
	Fe(OH)2	2.68E-14	2.82E-14	-13.572	-13.55	0.023	0
	Fe(OH)3-	4.12E-16	3.01E-16	-15.386	-15.522	-0.136	0
	FeHSO4+	1.82E-18	1.35E-18	-17.741	-17.871	-0.13	0
Fe(3)	1.06E-06						
	Fe(OH)3	7.50E-07	7.91E-07	-6.125	-6.102	0.023	0
	Fe(OH)4-	2.80E-07	2.07E-07	-6.553	-6.685	-0.132	0
	Fe(OH)2+	2.90E-08	2.14E-08	-7.538	-7.67	-0.132	0
	FeOH+2	7.92E-13	2.25E-13	-12.101	-12.647	-0.546	0
	FeF2+	3.39E-16	2.48E-16	-15.47	-15.606	-0.136	0
	FeF+2	1.22E-16	3.46E-17	-15.915	-16.46	-0.546	0
	FeF3	6.68E-17	7.04E-17	-16.175	-16.152	0.023	0
	FeSO4+	4.77E-18	3.48E-18	-17.322	-17.458	-0.136	0
	FeCl+2	1.34E-18	3.82E-19	-17.872	-18.417	-0.546	0
	Fe+3	9.86E-19	1.22E-19	-18.006	-18.914	-0.908	0
	Fe(SO4)2-	2.68E-19	1.99E-19	-18.572	-18.702	-0.13	0
	FeCl2+	2.43E-19	1.78E-19	-18.614	-18.751	-0.136	0
	FeCl3	1.75E-21	1.85E-21	-20.756	-20.734	0.023	0
	Fe2(OH)2+	1.64E-22	1.37E-24	-21.786	-23.864	-2.078	0
	FeHSO4+2	1.07E-25	3.23E-26	-24.971	-25.491	-0.52	0
	Fe3(OH)4+	1.08E-26	6.12E-30	-25.966	-29.213	-3.247	0
H(0)	1.62E-28						
	H2	8.08E-29	8.51E-29	-28.093	-28.07	0.023	28.61
K	2.02E-03						
	K+	1.99E-03	1.39E-03	-2.702	-2.856	-0.154	9.37
	KSO4-	3.46E-05	2.55E-05	-4.461	-4.593	-0.132	34.52
Mg	3.24E-02						
	Mg+2	2.59E-02	8.63E-03	-1.587	-2.064	-0.477	-20.88
	MgSO4	5.01E-03	5.27E-03	-2.301	-2.278	0.023	5.84
	MgHCO3+	7.84E-04	5.56E-04	-3.106	-3.255	-0.15	5.72
	MgCO3	5.82E-04	6.13E-04	-3.235	-3.213	0.023	-17.09
	MgF+	1.42E-04	1.02E-04	-3.847	-3.99	-0.143	-10.34
	MgOH+	1.19E-05	8.99E-06	-4.926	-5.046	-0.121	0
Mn(2)	1.80E-07						
	MnCO3	9.61E-08	1.01E-07	-7.017	-6.994	0.023	0
	Mn+2	5.44E-08	1.71E-08	-7.265	-7.766	-0.502	-17.42
	MnHCO3+	1.15E-08	8.40E-09	-7.939	-8.076	-0.136	0
	MnCl+	9.94E-09	7.26E-09	-8.003	-8.139	-0.136	-2.87
	MnSO4	7.54E-09	7.94E-09	-8.123	-8.1	0.023	22.54
	MnCl2	3.13E-10	3.29E-10	-9.505	-9.482	0.023	85.89
	MnOH+	1.73E-10	1.26E-10	-9.762	-9.899	-0.136	0
	MnF+	2.91E-11	2.13E-11	-10.536	-10.672	-0.136	0
	MnCl3-	1.29E-11	9.43E-12	-10.889	-11.025	-0.136	44.34
	Mn(NO3)2	1.09E-15	1.15E-15	-14.962	-14.94	0.023	41.04

	Mn(OH)3-	8.76E-18	6.40E-18	-17.057	-17.194	-0.136	0
Mn(3)	4.29E-29						
	Mn+3	4.29E-29	5.30E-30	-28.368	-29.276	-0.908	0
N(-3)	2.20E-05						
	NH4+	1.94E-05	1.30E-05	-4.712	-4.887	-0.175	18.27
	NH3	2.02E-06	2.13E-06	-5.694	-5.671	0.023	24.42
	NH4SO4-	5.87E-07	4.35E-07	-6.231	-6.361	-0.13	38.58
N(5)	1.90E-04						
	NO3-	1.90E-04	1.30E-04	-3.721	-3.887	-0.165	29.93
	Mn(NO3)2	1.09E-15	1.15E-15	-14.962	-14.94	0.023	41.04
Na	1.42E-01						
	Na+	1.39E-01	1.03E-01	-0.856	-0.986	-0.13	-0.9
	NaSO4-	1.83E-03	1.35E-03	-2.738	-2.87	-0.132	17.84
	NaHCO3	3.04E-04	3.20E-04	-3.518	-3.495	0.023	1.8
	NaCO3-	1.93E-04	1.43E-04	-3.714	-3.844	-0.13	0.46
	NaF	1.01E-05	1.07E-05	-4.994	-4.972	0.023	7.26
	NaOH	2.85E-17	3.00E-17	-16.546	-16.523	0.023	0
O(0)	1.08E-36						
	O2	5.40E-37	5.69E-37	-36.268	-36.245	0.023	30.4
S(6)	1.67E-02						
	SO4-2	9.35E-03	2.61E-03	-2.029	-2.584	-0.555	16.19
	MgSO4	5.01E-03	5.27E-03	-2.301	-2.278	0.023	5.84
	NaSO4-	1.83E-03	1.35E-03	-2.738	-2.87	-0.132	17.84
	CaSO4	4.55E-04	4.80E-04	-3.342	-3.319	0.023	7.5
	KSO4-	3.46E-05	2.55E-05	-4.461	-4.593	-0.132	34.52
	BaSO4	4.44E-06	4.68E-06	-5.353	-5.33	0.023	0
	NH4SO4-	5.87E-07	4.35E-07	-6.231	-6.361	-0.13	38.58
	MnSO4	7.54E-09	7.94E-09	-8.123	-8.1	0.023	22.54
	ZnSO4	6.66E-09	7.02E-09	-8.176	-8.153	0.023	21.71
	HSO4-	1.19E-09	8.79E-10	-8.926	-9.056	-0.13	40.68
	Zn(SO4)2-2	4.92E-10	1.49E-10	-9.308	-9.827	-0.52	-9.77
	FeSO4	5.61E-11	5.91E-11	-10.251	-10.228	0.023	18.97
	CuSO4	2.63E-11	2.77E-11	-10.581	-10.558	0.023	13.09
	CaHSO4+	1.48E-11	1.09E-11	-10.831	-10.961	-0.13	0
	FeSO4+	4.77E-18	3.48E-18	-17.322	-17.458	-0.136	0
	FeHSO4+	1.82E-18	1.35E-18	-17.741	-17.871	-0.13	0
	Fe(SO4)2-	2.68E-19	1.99E-19	-18.572	-18.702	-0.13	0
	FeHSO4+2	1.07E-25	3.23E-26	-24.971	-25.491	-0.52	0
Zn	1.15E-06						
	Zn(CO3)2-2	8.98E-07	2.71E-07	-6.047	-6.566	-0.52	0
	ZnCO3	1.62E-07	1.71E-07	-6.791	-6.768	0.023	0
	Zn+2	4.04E-08	1.15E-08	-7.394	-7.94	-0.546	-24.45
	Zn(OH)2	1.13E-08	1.19E-08	-7.947	-7.925	0.023	0
	ZnOHCl	1.08E-08	1.13E-08	-7.968	-7.945	0.023	0
	ZnHCO3+	1.07E-08	7.96E-09	-7.969	-8.099	-0.13	0
	ZnSO4	6.66E-09	7.02E-09	-8.176	-8.153	0.023	21.71
	ZnOH+	4.87E-09	3.61E-09	-8.312	-8.442	-0.13	0
	ZnCl+	4.54E-09	3.22E-09	-8.343	-8.493	-0.15	-14.46
	Zn(SO4)2-2	4.92E-10	1.49E-10	-9.308	-9.827	-0.52	-9.77
	ZnCl2	3.32E-10	3.50E-10	-9.479	-9.456	0.023	102.03

ZnCl3-	5.76E-11	4.08E-11	-10.239	-10.389	-0.15	15.64
ZnF+	3.93E-11	2.91E-11	-10.406	-10.536	-0.13	0
Zn(OH)3-	1.45E-11	1.08E-11	-10.837	-10.967	-0.13	0
ZnCl4-2	7.48E-12	2.13E-12	-11.126	-11.672	-0.546	147.58
Zn(OH)4-2	1.62E-15	4.90E-16	-14.79	-15.31	-0.52	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.29	-5.57	-4.28	CaSO4			
Aragonite	1.22	-7.11	-8.34	CaCO3			
Barite	1.81	-8.03	-9.84	BaSO4			
Calcite	1.37	-7.11	-8.48	CaCO3			
CO2(g)	-2.9	-4.37	-1.47	CO2			
Dolomite	3.78	-13.31	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.57	6.46	4.89	Fe(OH)3			
Fluorite	0.12	-10.48	-10.6	CaF2			
Goethite	7.46	6.46	-1	FeOOH			
Gypsum	-0.99	-5.57	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	0	1.5	H2O			
Halite	-3.54	-1.97	1.57	NaCl			
Hausmann	-8.66	52.37	61.03	Mn3O4			
Hematite	16.93	12.92	-4.01	Fe2O3			
Jarosite-K	-4.81	-14.02	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.73	21.61	25.34	MnOOH			
Melanterit	-10.29	-12.5	-2.21	FeSO4:7H2O			
NH3(g)	-7.47	-5.67	1.8	NH3			
O2(g)	-33.35	-36.25	-2.89	O2			
Pyrochroit	-6.05	9.15	15.2	Mn(OH)2			
Pyrolusite	-7.31	34.07	41.38	MnO2:H2O			
Rhodochro	-0.76	-11.89	-11.13	MnCO3			
Siderite	-3.13	-14.02	-10.89	FeCO3			
Smithsonit	-2.07	-12.07	-10	ZnCO3			
Sylvite	-4.74	-3.84	0.9	KCl			
Witherite	-1.01	-9.57	-8.56	BaCO3			
Zn(OH)2(e	-2.52	8.98	11.5	Zn(OH)2			

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 25

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.14E-02	1.14E-02
Ba	1.87E-05	1.87E-05

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        Ca          4.18E-03   4.18E-03
        Cl          1.53E-01   1.53E-01
        Cu          1.40E-07   1.40E-07
        F           4.30E-04   4.30E-04
        Fe          1.10E-06   1.10E-06
        K           2.10E-03   2.10E-03
        Mg          3.37E-02   3.37E-02
        Mn          1.90E-07   1.90E-07
        N(-3)       2.30E-05   2.30E-05
        N(5)        1.90E-04   1.90E-04
        Na          1.47E-01   1.47E-01
        S(6)        1.74E-02   1.74E-02
        Zn          1.20E-06   1.20E-06

#NAME?  of          solution----------------------------

        pH          =                 8.46
        pe          =                    4
        Specific    Conductan (µS/cm,    25°C)      =                18617
        Density     (g/cm³)   =            1.00667
        Volume      (L)       =            1.00549
        Activity    of        water      =                 0.994
        Ionic       strength  (mol/kgw)  =            2.36E-01
        Mass        of        water      (kg)       =           1.00E+00
        Total       carbon    (mol/kg)   =            1.02E-02
        Total       CO2       (mol/kg)   =            1.02E-02
        Temperatu   (°C)      =                  25
        Electrical  balance   (eq)       =            2.55E-02
        Percent     error,    100*(Cat-|=                 6.49
        Iterations  =                 10 (238       overall)
        Total       H         =            1.11E+02
        Total       O         =            5.56E+01

#NAME?  couples--------------------------------

        Redox       couple    pe         Eh         (volts)

        N(-3)/N(5)     4.4333     0.2623

#NAME?  of          species----------------------------

        Log         Log       Log        mole       V
        Species     Molality  Activity   Molality   Activity   Gamma    cm³/mol

        OH-          4.19E-06  2.90E-06    -5.378     -5.537    -0.159     -3.42
        H+           4.38E-09  3.47E-09    -8.358      -8.46    -0.102         0
        H2O          5.55E+01  9.94E-01     1.744     -0.003         0      18.07
Ba        1.87E-05
        Ba+2         1.37E-05  3.68E-06    -4.865     -5.434    -0.569    -11.65
        BaSO4        4.64E-06  4.90E-06    -5.334      -5.31     0.024         0
```

	BaHCO3+	2.70E-07	2.00E-07	-6.569	-6.7	-0.131	0
	BaCO3	1.38E-07	1.46E-07	-6.861	-6.837	0.024	-10.7
	BaOH+	4.91E-11	3.58E-11	-10.309	-10.447	-0.138	0
C(4)	1.02E-02						
	HCO3-	7.69E-03	5.66E-03	-2.114	-2.247	-0.133	25.65
	MgHCO3+	8.34E-04	5.88E-04	-3.079	-3.23	-0.151	5.73
	MgCO3	6.15E-04	6.49E-04	-3.211	-3.188	0.024	-17.09
	NaHCO3	3.23E-04	3.41E-04	-3.491	-3.467	0.024	1.8
	CO3-2	2.61E-04	7.65E-05	-3.584	-4.116	-0.533	-3.44
	NaCO3-	2.07E-04	1.53E-04	-3.685	-3.816	-0.131	0.51
	CaCO3	1.30E-04	1.37E-04	-3.887	-3.863	0.024	-14.6
	CaHCO3+	1.03E-04	7.70E-05	-3.987	-4.114	-0.127	9.89
	CO2	4.20E-05	4.44E-05	-4.376	-4.353	0.024	34.43
	Zn(CO3)2-2	9.45E-07	2.84E-07	-6.024	-6.547	-0.523	0
	BaHCO3+	2.70E-07	2.00E-07	-6.569	-6.7	-0.131	0
	ZnCO3	1.64E-07	1.73E-07	-6.785	-6.761	0.024	0
	BaCO3	1.38E-07	1.46E-07	-6.861	-6.837	0.024	-10.7
	MnCO3	1.02E-07	1.08E-07	-6.992	-6.968	0.024	0
	CuCO3	2.14E-08	2.26E-08	-7.67	-7.646	0.024	0
	MnHCO3+	1.23E-08	8.92E-09	-7.912	-8.05	-0.138	0
	ZnHCO3+	1.09E-08	8.09E-09	-7.962	-8.092	-0.131	0
	Cu(CO3)2-	7.25E-09	2.18E-09	-8.14	-8.662	-0.523	0
	FeCO3	2.30E-10	2.43E-10	-9.638	-9.614	0.024	0
	CuHCO3+	2.11E-10	1.56E-10	-9.677	-9.808	-0.131	0
	FeHCO3+	1.01E-10	7.50E-11	-9.994	-10.125	-0.131	0
	(CO2)2	3.43E-11	3.62E-11	-10.465	-10.442	0.024	68.87
Ca	4.18E-03						
	Ca+2	3.47E-03	1.07E-03	-2.46	-2.972	-0.512	-17.15
	CaSO4	4.77E-04	5.03E-04	-3.322	-3.298	0.024	7.5
	CaCO3	1.30E-04	1.37E-04	-3.887	-3.863	0.024	-14.6
	CaHCO3+	1.03E-04	7.70E-05	-3.987	-4.114	-0.127	9.89
	CaOH+	6.85E-08	5.07E-08	-7.164	-7.295	-0.131	0
	CaHSO4+	1.55E-11	1.15E-11	-10.81	-10.94	-0.131	0
Cl	1.53E-01						
	Cl-	1.53E-01	1.08E-01	-0.815	-0.968	-0.153	18.49
	CuCl2-	1.50E-08	1.06E-08	-7.824	-7.976	-0.151	0
	ZnOHCl	1.10E-08	1.16E-08	-7.959	-7.935	0.024	0
	MnCl+	1.07E-08	7.76E-09	-7.972	-8.11	-0.138	-2.86
	CuCl3-2	6.43E-09	1.81E-09	-8.192	-8.743	-0.551	0
	ZnCl+	4.66E-09	3.29E-09	-8.331	-8.483	-0.151	-14.49
	ZnCl2	3.52E-10	3.71E-10	-9.454	-9.43	0.024	102.03
	MnCl2	3.46E-10	3.65E-10	-9.461	-9.438	0.024	85.89
	ZnCl3-	6.36E-11	4.49E-11	-10.197	-10.348	-0.151	15.58
	FeCl+	2.66E-11	1.97E-11	-10.575	-10.705	-0.131	0
	CuCl+	2.26E-11	1.59E-11	-10.647	-10.798	-0.151	1.2
	MnCl3-	1.49E-11	1.08E-11	-10.828	-10.966	-0.138	44.37
	ZnCl4-2	8.62E-12	2.42E-12	-11.064	-11.616	-0.551	147.64
	CuCl2	8.72E-13	9.21E-13	-12.059	-12.036	0.024	31.02
	CuCl3-	4.99E-16	3.52E-16	-15.302	-15.453	-0.151	0
	FeCl+2	1.47E-18	4.12E-19	-17.834	-18.385	-0.551	0

	CuCl4-2	6.77E-19	1.90E-19	-18.17	-18.721	-0.551	0
	FeCl2+	2.72E-19	1.98E-19	-18.565	-18.703	-0.138	0
	FeCl3	2.02E-21	2.13E-21	-20.695	-20.671	0.024	0
Cu(1)	2.14E-08						
	CuCl2-	1.50E-08	1.06E-08	-7.824	-7.976	-0.151	0
	CuCl3-2	6.43E-09	1.81E-09	-8.192	-8.743	-0.551	0
	Cu+	4.34E-12	2.88E-12	-11.363	-11.54	-0.177	0
Cu(2)	1.19E-07						
	Cu(OH)2	8.93E-08	9.43E-08	-7.049	-7.026	0.024	0
	CuCO3	2.14E-08	2.26E-08	-7.67	-7.646	0.024	0
	Cu(CO3)2-	7.25E-09	2.18E-09	-8.14	-8.662	-0.523	0
	CuOH+	2.23E-10	1.57E-10	-9.652	-9.803	-0.151	0
	CuHCO3+	2.11E-10	1.56E-10	-9.677	-9.808	-0.131	0
	Cu+2	1.76E-10	5.49E-11	-9.754	-10.26	-0.507	-25.7
	CuSO4	2.82E-11	2.98E-11	-10.55	-10.526	0.024	13.09
	CuCl+	2.26E-11	1.59E-11	-10.647	-10.798	-0.151	1.2
	Cu(OH)3-	2.20E-12	1.63E-12	-11.658	-11.788	-0.131	0
	CuCl2	8.72E-13	9.21E-13	-12.059	-12.036	0.024	31.02
	CuF+	2.50E-13	1.85E-13	-12.601	-12.732	-0.131	0
	Cu2(OH)2+	3.61E-14	1.09E-14	-13.442	-13.965	-0.523	0
	CuCl3-	4.99E-16	3.52E-16	-15.302	-15.453	-0.151	0
	Cu(OH)4-2	3.10E-16	9.31E-17	-15.508	-16.031	-0.523	0
	CuCl4-2	6.77E-19	1.90E-19	-18.17	-18.721	-0.551	0
F	4.30E-04						
	F-	2.67E-04	1.85E-04	-3.573	-3.732	-0.159	-0.89
	MgF+	1.52E-04	1.09E-04	-3.819	-3.963	-0.144	-10.34
	NaF	1.08E-05	1.14E-05	-4.965	-4.942	0.024	7.26
	HF	9.13E-10	9.64E-10	-9.039	-9.016	0.024	12.5
	ZnF+	4.02E-11	2.97E-11	-10.396	-10.527	-0.131	0
	MnF+	3.12E-11	2.27E-11	-10.506	-10.644	-0.138	0
	HF2-	9.27E-13	6.86E-13	-12.033	-12.164	-0.131	22.49
	FeF+	3.32E-13	2.46E-13	-12.479	-12.61	-0.131	0
	CuF+	2.50E-13	1.85E-13	-12.601	-12.732	-0.131	0
	FeF2+	3.77E-16	2.75E-16	-15.424	-15.561	-0.138	0
	FeF+2	1.32E-16	3.72E-17	-15.878	-16.43	-0.551	0
	FeF3	7.64E-17	8.07E-17	-16.117	-16.093	0.024	0
Fe(2)	8.60E-10						
	Fe+2	4.25E-10	1.33E-10	-9.371	-9.878	-0.507	-21.19
	FeCO3	2.30E-10	2.43E-10	-9.638	-9.614	0.024	0
	FeHCO3+	1.01E-10	7.50E-11	-9.994	-10.125	-0.131	0
	FeSO4	5.92E-11	6.25E-11	-10.227	-10.204	0.024	18.97
	FeCl+	2.66E-11	1.97E-11	-10.575	-10.705	-0.131	0
	FeOH+	1.65E-11	1.20E-11	-10.783	-10.92	-0.138	0
	FeF+	3.32E-13	2.46E-13	-12.479	-12.61	-0.131	0
	Fe(OH)2	2.78E-14	2.93E-14	-13.557	-13.533	0.024	0
	Fe(OH)3-	4.29E-16	3.12E-16	-15.368	-15.506	-0.138	0
	FeHSO4+	1.93E-18	1.43E-18	-17.715	-17.846	-0.131	0
Fe(3)	1.10E-06						
	Fe(OH)3	7.77E-07	8.21E-07	-6.109	-6.086	0.024	0
	Fe(OH)4-	2.92E-07	2.15E-07	-6.535	-6.668	-0.133	0

	Fe(OH)2+	3.02E-08	2.22E-08	-7.52	-7.653	-0.133	0
	FeOH+2	8.34E-13	2.34E-13	-12.079	-12.63	-0.551	0
	FeF2+	3.77E-16	2.75E-16	-15.424	-15.561	-0.138	0
	FeF+2	1.32E-16	3.72E-17	-15.878	-16.43	-0.551	0
	FeF3	7.64E-17	8.07E-17	-16.117	-16.093	0.024	0
	FeSO4+	5.06E-18	3.68E-18	-17.296	-17.434	-0.138	0
	FeCl+2	1.47E-18	4.12E-19	-17.834	-18.385	-0.551	0
	Fe+3	1.04E-18	1.27E-19	-17.982	-18.898	-0.916	0
	Fe(SO4)2-	2.89E-19	2.14E-19	-18.539	-18.67	-0.131	0
	FeCl2+	2.72E-19	1.98E-19	-18.565	-18.703	-0.138	0
	FeCl3	2.02E-21	2.13E-21	-20.695	-20.671	0.024	0
	Fe2(OH)2+	1.82E-22	1.48E-24	-21.74	-23.831	-2.091	0
	FeHSO4+2	1.14E-25	3.42E-26	-24.943	-25.466	-0.523	0
	Fe3(OH)4+	1.27E-26	6.86E-30	-25.897	-29.164	-3.267	0
H(0)	1.61E-28						
	H2	8.06E-29	8.51E-29	-28.094	-28.07	0.024	28.61
K	2.10E-03						
	K+	2.06E-03	1.44E-03	-2.685	-2.841	-0.156	9.37
	KSO4-	3.66E-05	2.69E-05	-4.437	-4.57	-0.133	34.53
Mg	3.37E-02						
	Mg+2	2.69E-02	8.89E-03	-1.571	-2.051	-0.481	-20.86
	MgSO4	5.24E-03	5.53E-03	-2.281	-2.257	0.024	5.84
	MgHCO3+	8.34E-04	5.88E-04	-3.079	-3.23	-0.151	5.73
	MgCO3	6.15E-04	6.49E-04	-3.211	-3.188	0.024	-17.09
	MgF+	1.52E-04	1.09E-04	-3.819	-3.963	-0.144	-10.34
	MgOH+	1.22E-05	9.25E-06	-4.912	-5.034	-0.122	0
Mn(2)	1.90E-07						
	MnCO3	1.02E-07	1.08E-07	-6.992	-6.968	0.024	0
	Mn+2	5.68E-08	1.77E-08	-7.246	-7.752	-0.507	-17.39
	MnHCO3+	1.23E-08	8.92E-09	-7.912	-8.05	-0.138	0
	MnCl+	1.07E-08	7.76E-09	-7.972	-8.11	-0.138	-2.86
	MnSO4	7.91E-09	8.35E-09	-8.102	-8.078	0.024	22.54
	MnCl2	3.46E-10	3.65E-10	-9.461	-9.438	0.024	85.89
	MnOH+	1.79E-10	1.30E-10	-9.747	-9.885	-0.138	0
	MnF+	3.12E-11	2.27E-11	-10.506	-10.644	-0.138	0
	MnCl3-	1.49E-11	1.08E-11	-10.828	-10.966	-0.138	44.37
	Mn(NO3)2	1.11E-15	1.18E-15	-14.954	-14.93	0.024	41.04
	Mn(OH)3-	9.07E-18	6.60E-18	-17.042	-17.18	-0.138	0
Mn(3)	4.50E-29						
	Mn+3	4.50E-29	5.47E-30	-28.347	-29.262	-0.916	0
N(-3)	2.30E-05						
	NH4+	2.03E-05	1.35E-05	-4.693	-4.87	-0.177	18.27
	NH3	2.10E-06	2.22E-06	-5.678	-5.654	0.024	24.42
	NH4SO4-	6.23E-07	4.61E-07	-6.206	-6.336	-0.131	38.61
N(5)	1.90E-04						
	NO3-	1.90E-04	1.29E-04	-3.721	-3.889	-0.168	29.94
	Mn(NO3)2	1.11E-15	1.18E-15	-14.954	-14.93	0.024	41.04
Na	1.47E-01						
	Na+	1.45E-01	1.07E-01	-0.839	-0.97	-0.131	-0.89
	NaSO4-	1.94E-03	1.43E-03	-2.713	-2.846	-0.133	17.93

	NaHCO3	3.23E-04	3.41E-04	-3.491	-3.467	0.024	1.8
	NaCO3-	2.07E-04	1.53E-04	-3.685	-3.816	-0.131	0.51
	NaF	1.08E-05	1.14E-05	-4.965	-4.942	0.024	7.26
	NaOH	2.95E-17	3.11E-17	-16.531	-16.507	0.024	0
O(0)	1.08E-36						
	O2	5.38E-37	5.68E-37	-36.269	-36.245	0.024	30.4
S(6)	1.74E-02						
	SO4-2	9.66E-03	2.65E-03	-2.015	-2.576	-0.561	16.23
	MgSO4	5.24E-03	5.53E-03	-2.281	-2.257	0.024	5.84
	NaSO4-	1.94E-03	1.43E-03	-2.713	-2.846	-0.133	17.93
	CaSO4	4.77E-04	5.03E-04	-3.322	-3.298	0.024	7.5
	KSO4-	3.66E-05	2.69E-05	-4.437	-4.57	-0.133	34.53
	BaSO4	4.64E-06	4.90E-06	-5.334	-5.31	0.024	0
	NH4SO4-	6.23E-07	4.61E-07	-6.206	-6.336	-0.131	38.61
	MnSO4	7.91E-09	8.35E-09	-8.102	-8.078	0.024	22.54
	ZnSO4	6.69E-09	7.06E-09	-8.175	-8.151	0.024	21.71
	HSO4-	1.21E-09	8.95E-10	-8.918	-9.048	-0.131	40.69
	Zn(SO4)2-2	5.08E-10	1.52E-10	-9.294	-9.817	-0.523	-9.67
	FeSO4	5.92E-11	6.25E-11	-10.227	-10.204	0.024	18.97
	CuSO4	2.82E-11	2.98E-11	-10.55	-10.526	0.024	13.09
	CaHSO4+	1.55E-11	1.15E-11	-10.81	-10.94	-0.131	0
	FeSO4+	5.06E-18	3.68E-18	-17.296	-17.434	-0.138	0
	FeHSO4+	1.93E-18	1.43E-18	-17.715	-17.846	-0.131	0
	Fe(SO4)2-	2.89E-19	2.14E-19	-18.539	-18.67	-0.131	0
	FeHSO4+2	1.14E-25	3.42E-26	-24.943	-25.466	-0.523	0
Zn	1.20E-06						
	Zn(CO3)2-2	9.45E-07	2.84E-07	-6.024	-6.547	-0.523	0
	ZnCO3	1.64E-07	1.73E-07	-6.785	-6.761	0.024	0
	Zn+2	4.04E-08	1.14E-08	-7.393	-7.945	-0.551	-24.44
	Zn(OH)2	1.11E-08	1.17E-08	-7.954	-7.93	0.024	0
	ZnOHCl	1.10E-08	1.16E-08	-7.959	-7.935	0.024	0
	ZnHCO3+	1.09E-08	8.09E-09	-7.962	-8.092	-0.131	0
	ZnSO4	6.69E-09	7.06E-09	-8.175	-8.151	0.024	21.71
	ZnOH+	4.82E-09	3.57E-09	-8.317	-8.448	-0.131	0
	ZnCl+	4.66E-09	3.29E-09	-8.331	-8.483	-0.151	-14.49
	Zn(SO4)2-2	5.08E-10	1.52E-10	-9.294	-9.817	-0.523	-9.67
	ZnCl2	3.52E-10	3.71E-10	-9.454	-9.43	0.024	102.03
	ZnCl3-	6.36E-11	4.49E-11	-10.197	-10.348	-0.151	15.58
	ZnF+	4.02E-11	2.97E-11	-10.396	-10.527	-0.131	0
	Zn(OH)3-	1.44E-11	1.06E-11	-10.842	-10.973	-0.131	0
	ZnCl4-2	8.62E-12	2.42E-12	-11.064	-11.616	-0.551	147.64
	Zn(OH)4-2	1.61E-15	4.84E-16	-14.793	-15.316	-0.523	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.27	-5.55	-4.28	CaSO4			
Aragonite	1.25	-7.09	-8.34	CaCO3			
Barite	1.83	-8.01	-9.84	BaSO4			

Calcite	1.39	-7.09	-8.48	CaCO3
CO2(g)	-2.88	-4.35	-1.47	CO2
Dolomite	3.83	-13.26	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.58	6.47	4.89	Fe(OH)3
Fluorite	0.16	-10.44	-10.6	CaF2
Goethite	7.48	6.48	-1	FeOOH
Gypsum	-0.97	-5.55	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O
Halite	-3.51	-1.94	1.57	NaCl
Hausmann	-8.62	52.41	61.03	Mn3O4
Hematite	16.96	12.96	-4.01	Fe2O3
Jarosite-K	-4.73	-13.94	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.72	21.62	25.34	MnOOH
Melanterit	-10.26	-12.47	-2.21	FeSO4:7H2O
NH3(g)	-7.45	-5.65	1.8	NH3
O2(g)	-33.35	-36.25	-2.89	O2
Pyrochroit	-6.04	9.16	15.2	Mn(OH)2
Pyrolusite	-7.3	34.08	41.38	MnO2:H2O
Rhodochro	-0.74	-11.87	-11.13	MnCO3
Siderite	-3.1	-13.99	-10.89	FeCO3
Smithsonit	-2.06	-12.06	-10	ZnCO3
Sylvite	-4.71	-3.81	0.9	KCl
Witherite	-0.99	-9.55	-8.56	BaCO3
Zn(OH)2(e	-2.53	8.97	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 26

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.18E-02	1.18E-02
Ba	1.94E-05	1.94E-05
Ca	4.34E-03	4.34E-03
Cl	1.59E-01	1.59E-01
Cu	1.50E-07	1.50E-07
F	4.50E-04	4.50E-04
Fe	1.14E-06	1.14E-06
K	2.18E-03	2.18E-03
Mg	3.50E-02	3.50E-02
Mn	1.90E-07	1.90E-07
N(-3)	2.40E-05	2.40E-05
N(5)	2.00E-04	2.00E-04
Na	1.53E-01	1.53E-01
S(6)	1.80E-02	1.80E-02
Zn	1.25E-06	1.25E-06

#NAME? of solution----------

pH	=	8.46		
pe	=	4		
Specific	Conductan	(µS/cm,	25°C)	= 19255
Density	(g/cm³)	=	1.00704	
Volume	(L)	=	1.00559	
Activity	of	water	=	0.994
Ionic	strength	(mol/kgw)	=	2.45E-01
Mass	of	water	(kg)	= 1.00E+00
Total	carbon	(mol/kg)	=	1.06E-02
Total	CO2	(mol/kg)	=	1.06E-02
Temperatu	(°C)	=	25	
Electrical	balance	(eq)	=	2.65E-02
Percent	error,	100*(Cat-|	=	6.5
Iterations	=	10	(248	overall)
Total	H	=	1.11E+02	
Total	O	=	5.56E+01	

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4338	0.2623		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.20E-06	2.90E-06	-5.377	-5.538	-0.161	-3.4
H+	4.39E-09	3.47E-09	-8.357	-8.46	-0.103	0
H2O	5.55E+01	9.94E-01	1.744	-0.003	0	18.07
Ba	1.94E-05					
Ba+2	1.42E-05	3.78E-06	-4.848	-5.423	-0.575	-11.63
BaSO4	4.83E-06	5.11E-06	-5.316	-5.291	0.025	0
BaHCO3+	2.85E-07	2.11E-07	-6.545	-6.677	-0.131	0
BaCO3	1.45E-07	1.53E-07	-6.839	-6.814	0.025	-10.7
BaOH+	5.05E-11	3.67E-11	-10.296	-10.436	-0.139	0
C(4)	1.06E-02					
HCO3-	7.92E-03	5.81E-03	-2.101	-2.236	-0.134	25.68
MgHCO3+	8.84E-04	6.22E-04	-3.053	-3.206	-0.153	5.73
MgCO3	6.48E-04	6.86E-04	-3.188	-3.164	0.025	-17.09
NaHCO3	3.43E-04	3.63E-04	-3.464	-3.44	0.025	1.8
CO3-2	2.71E-04	7.86E-05	-3.567	-4.104	-0.538	-3.41
NaCO3-	2.20E-04	1.63E-04	-3.657	-3.789	-0.131	0.56
CaCO3	1.37E-04	1.45E-04	-3.864	-3.84	0.025	-14.6
CaHCO3+	1.09E-04	8.12E-05	-3.963	-4.09	-0.128	9.89
CO2	4.31E-05	4.56E-05	-4.365	-4.341	0.025	34.43

	Zn(CO3)2-2	9.93E-07	2.96E-07	-6.003	-6.529	-0.526	0
	BaHCO3+	2.85E-07	2.11E-07	-6.545	-6.677	-0.131	0
	ZnCO3	1.66E-07	1.76E-07	-6.779	-6.754	0.025	0
	BaCO3	1.45E-07	1.53E-07	-6.839	-6.814	0.025	-10.7
	MnCO3	1.02E-07	1.08E-07	-6.991	-6.966	0.025	0
	CuCO3	2.30E-08	2.44E-08	-7.637	-7.613	0.025	0
	MnHCO3+	1.24E-08	8.97E-09	-7.908	-8.047	-0.139	0
	ZnHCO3+	1.11E-08	8.21E-09	-7.954	-8.086	-0.131	0
	Cu(CO3)2-	8.10E-09	2.41E-09	-8.092	-8.617	-0.526	0
	FeCO3	2.45E-10	2.59E-10	-9.611	-9.586	0.025	0
	CuHCO3+	2.28E-10	1.68E-10	-9.643	-9.774	-0.131	0
	FeHCO3+	1.08E-10	7.99E-11	-9.966	-10.097	-0.131	0
	(CO2)2	3.61E-11	3.82E-11	-10.443	-10.418	0.025	68.87
Ca	4.34E-03						
	Ca+2	3.60E-03	1.10E-03	-2.444	-2.961	-0.517	-17.14
	CaSO4	4.97E-04	5.26E-04	-3.304	-3.279	0.025	7.5
	CaCO3	1.37E-04	1.45E-04	-3.864	-3.84	0.025	-14.6
	CaHCO3+	1.09E-04	8.12E-05	-3.963	-4.09	-0.128	9.89
	CaOH+	7.05E-08	5.21E-08	-7.152	-7.283	-0.131	0
	CaHSO4+	1.62E-11	1.20E-11	-10.79	-10.921	-0.131	0
Cl	1.59E-01						
	Cl-	1.59E-01	1.12E-01	-0.798	-0.953	-0.155	18.5
	CuCl2-	1.69E-08	1.19E-08	-7.771	-7.924	-0.153	0
	ZnOHCl	1.12E-08	1.19E-08	-7.95	-7.926	0.025	0
	MnCl+	1.08E-08	7.86E-09	-7.965	-8.105	-0.139	-2.86
	CuCl3-2	7.58E-09	2.10E-09	-8.12	-8.677	-0.557	0
	ZnCl+	4.79E-09	3.37E-09	-8.32	-8.473	-0.153	-14.52
	ZnCl2	3.71E-10	3.93E-10	-9.43	-9.406	0.025	102.03
	MnCl2	3.61E-10	3.82E-10	-9.442	-9.418	0.025	85.89
	ZnCl3-	6.99E-11	4.91E-11	-10.156	-10.309	-0.153	15.52
	FeCl+	2.86E-11	2.12E-11	-10.543	-10.675	-0.131	0
	CuCl+	2.46E-11	1.73E-11	-10.608	-10.761	-0.153	1.22
	MnCl3-	1.62E-11	1.17E-11	-10.791	-10.93	-0.139	44.4
	ZnCl4-2	9.90E-12	2.74E-12	-11.005	-11.562	-0.557	147.71
	CuCl2	9.80E-13	1.04E-12	-12.009	-11.984	0.025	31.02
	CuCl3-	5.83E-16	4.10E-16	-15.234	-15.387	-0.153	0
	FeCl+2	1.59E-18	4.42E-19	-17.797	-18.355	-0.557	0
	CuCl4-2	8.26E-19	2.29E-19	-18.083	-18.64	-0.557	0
	FeCl2+	3.03E-19	2.20E-19	-18.518	-18.658	-0.139	0
	FeCl3	2.32E-21	2.45E-21	-20.635	-20.61	0.025	0
Cu(1)	2.45E-08						
	CuCl2-	1.69E-08	1.19E-08	-7.771	-7.924	-0.153	0
	CuCl3-2	7.58E-09	2.10E-09	-8.12	-8.677	-0.557	0
	Cu+	4.58E-12	3.03E-12	-11.339	-11.519	-0.18	0
Cu(2)	1.26E-07						
	Cu(OH)2	9.36E-08	9.91E-08	-7.029	-7.004	0.025	0
	CuCO3	2.30E-08	2.44E-08	-7.637	-7.613	0.025	0
	Cu(CO3)2-	8.10E-09	2.41E-09	-8.092	-8.617	-0.526	0
	CuOH+	2.35E-10	1.66E-10	-9.628	-9.781	-0.153	0
	CuHCO3+	2.28E-10	1.68E-10	-9.643	-9.774	-0.131	0

	Cu+2	1.87E-10	5.77E-11	-9.727	-10.239	-0.511	-25.69
	CuSO4	3.01E-11	3.18E-11	-10.522	-10.497	0.025	13.09
	CuCl+	2.46E-11	1.73E-11	-10.608	-10.761	-0.153	1.22
	Cu(OH)3-	2.32E-12	1.71E-12	-11.635	-11.767	-0.131	0
	CuCl2	9.80E-13	1.04E-12	-12.009	-11.984	0.025	31.02
	CuF+	2.72E-13	2.01E-13	-12.566	-12.697	-0.131	0
	Cu2(OH)2+	4.02E-14	1.20E-14	-13.396	-13.922	-0.526	0
	CuCl3-	5.83E-16	4.10E-16	-15.234	-15.387	-0.153	0
	Cu(OH)4-2	3.28E-16	9.78E-17	-15.484	-16.01	-0.526	0
	CuCl4-2	8.26E-19	2.29E-19	-18.083	-18.64	-0.557	0
F	4.50E-04						
	F-	2.77E-04	1.91E-04	-3.558	-3.719	-0.161	-0.88
	MgF+	1.62E-04	1.15E-04	-3.792	-3.938	-0.146	-10.33
	NaF	1.16E-05	1.22E-05	-4.937	-4.913	0.025	7.26
	HF	9.40E-10	9.94E-10	-9.027	-9.003	0.025	12.5
	ZnF+	4.10E-11	3.03E-11	-10.387	-10.519	-0.131	0
	MnF+	3.16E-11	2.29E-11	-10.501	-10.64	-0.139	0
	HF2-	9.87E-13	7.29E-13	-12.006	-12.137	-0.131	22.5
	FeF+	3.56E-13	2.63E-13	-12.449	-12.58	-0.131	0
	CuF+	2.72E-13	2.01E-13	-12.566	-12.697	-0.131	0
	FeF2+	4.17E-16	3.03E-16	-15.38	-15.519	-0.139	0
	FeF+2	1.44E-16	3.98E-17	-15.843	-16.4	-0.557	0
	FeF3	8.67E-17	9.18E-17	-16.062	-16.037	0.025	0
Fe(2)	9.08E-10						
	Fe+2	4.46E-10	1.38E-10	-9.35	-9.862	-0.511	-21.17
	FeCO3	2.45E-10	2.59E-10	-9.611	-9.586	0.025	0
	FeHCO3+	1.08E-10	7.99E-11	-9.966	-10.097	-0.131	0
	FeSO4	6.24E-11	6.60E-11	-10.205	-10.18	0.025	18.97
	FeCl+	2.86E-11	2.12E-11	-10.543	-10.675	-0.131	0
	FeOH+	1.72E-11	1.25E-11	-10.765	-10.904	-0.139	0
	FeF+	3.56E-13	2.63E-13	-12.449	-12.58	-0.131	0
	Fe(OH)2	2.87E-14	3.04E-14	-13.542	-13.517	0.025	0
	Fe(OH)3-	4.46E-16	3.24E-16	-15.351	-15.49	-0.139	0
	FeHSO4+	2.04E-18	1.51E-18	-17.691	-17.823	-0.131	0
Fe(3)	1.14E-06						
	Fe(OH)3	8.05E-07	8.51E-07	-6.094	-6.07	0.025	0
	Fe(OH)4-	3.03E-07	2.23E-07	-6.518	-6.653	-0.134	0
	Fe(OH)2+	3.14E-08	2.31E-08	-7.503	-7.637	-0.134	0
	FeOH+2	8.76E-13	2.43E-13	-12.057	-12.614	-0.557	0
	FeF2+	4.17E-16	3.03E-16	-15.38	-15.519	-0.139	0
	FeF+2	1.44E-16	3.98E-17	-15.843	-16.4	-0.557	0
	FeF3	8.67E-17	9.18E-17	-16.062	-16.037	0.025	0
	FeSO4+	5.36E-18	3.89E-18	-17.271	-17.41	-0.139	0
	FeCl+2	1.59E-18	4.42E-19	-17.797	-18.355	-0.557	0
	Fe+3	1.10E-18	1.31E-19	-17.959	-18.882	-0.923	0
	Fe(SO4)2-	3.11E-19	2.30E-19	-18.507	-18.639	-0.131	0
	FeCl2+	3.03E-19	2.20E-19	-18.518	-18.658	-0.139	0
	FeCl3	2.32E-21	2.45E-21	-20.635	-20.61	0.025	0
	Fe2(OH)2+	2.01E-22	1.59E-24	-21.697	-23.799	-2.102	0
	FeHSO4+2	1.21E-25	3.61E-26	-24.917	-25.443	-0.526	0

	Fe3(OH)4+	1.48E-26	7.65E-30	-25.831	-29.116	-3.285	0
H(0)	1.61E-28						
	H2	8.04E-29	8.51E-29	-28.095	-28.07	0.025	28.61
K	2.18E-03						
	K+	2.14E-03	1.49E-03	-2.669	-2.827	-0.157	9.38
	KSO4-	3.86E-05	2.83E-05	-4.414	-4.548	-0.134	34.54
Mg	3.50E-02						
	Mg+2	2.79E-02	9.14E-03	-1.555	-2.039	-0.484	-20.85
	MgSO4	5.47E-03	5.79E-03	-2.262	-2.238	0.025	5.84
	MgHCO3+	8.84E-04	6.22E-04	-3.053	-3.206	-0.153	5.73
	MgCO3	6.48E-04	6.86E-04	-3.188	-3.164	0.025	-17.09
	MgF+	1.62E-04	1.15E-04	-3.792	-3.938	-0.146	-10.33
	MgOH+	1.26E-05	9.51E-06	-4.899	-5.022	-0.123	0
Mn(2)	1.90E-07						
	MnCO3	1.02E-07	1.08E-07	-6.991	-6.966	0.025	0
	Mn+2	5.62E-08	1.73E-08	-7.25	-7.762	-0.511	-17.35
	MnHCO3+	1.24E-08	8.97E-09	-7.908	-8.047	-0.139	0
	MnCl+	1.08E-08	7.86E-09	-7.965	-8.105	-0.139	-2.86
	MnSO4	7.86E-09	8.31E-09	-8.105	-8.08	0.025	22.54
	MnCl2	3.61E-10	3.82E-10	-9.442	-9.418	0.025	85.89
	MnOH+	1.76E-10	1.28E-10	-9.755	-9.894	-0.139	0
	MnF+	3.16E-11	2.29E-11	-10.501	-10.64	-0.139	0
	MnCl3-	1.62E-11	1.17E-11	-10.791	-10.93	-0.139	44.4
	Mn(NO3)2	1.19E-15	1.26E-15	-14.924	-14.899	0.025	41.04
	Mn(OH)3-	8.90E-18	6.46E-18	-17.051	-17.19	-0.139	0
Mn(3)	4.48E-29						
	Mn+3	4.48E-29	5.35E-30	-28.349	-29.272	-0.923	0
N(-3)	2.40E-05						
	NH4+	2.12E-05	1.40E-05	-4.674	-4.854	-0.18	18.28
	NH3	2.17E-06	2.30E-06	-5.663	-5.638	0.025	24.42
	NH4SO4-	6.59E-07	4.87E-07	-6.181	-6.312	-0.131	38.64
N(5)	2.00E-04						
	NO3-	2.00E-04	1.35E-04	-3.699	-3.869	-0.17	29.95
	Mn(NO3)2	1.19E-15	1.26E-15	-14.924	-14.899	0.025	41.04
Na	1.53E-01						
	Na+	1.51E-01	1.11E-01	-0.823	-0.954	-0.132	-0.87
	NaSO4-	2.05E-03	1.50E-03	-2.688	-2.823	-0.134	18.02
	NaHCO3	3.43E-04	3.63E-04	-3.464	-3.44	0.025	1.8
	NaCO3-	2.20E-04	1.63E-04	-3.657	-3.789	-0.131	0.56
	NaF	1.16E-05	1.22E-05	-4.937	-4.913	0.025	7.26
	NaOH	3.05E-17	3.22E-17	-16.516	-16.492	0.025	0
O(0)	1.07E-36						
	O2	5.37E-37	5.68E-37	-36.27	-36.246	0.025	30.4
S(6)	1.80E-02						
	SO4-2	9.96E-03	2.70E-03	-2.002	-2.569	-0.567	16.26
	MgSO4	5.47E-03	5.79E-03	-2.262	-2.238	0.025	5.84
	NaSO4-	2.05E-03	1.50E-03	-2.688	-2.823	-0.134	18.02
	CaSO4	4.97E-04	5.26E-04	-3.304	-3.279	0.025	7.5
	KSO4-	3.86E-05	2.83E-05	-4.414	-4.548	-0.134	34.54
	BaSO4	4.83E-06	5.11E-06	-5.316	-5.291	0.025	0

NH4SO4-	6.59E-07	4.87E-07	-6.181	-6.312	-0.131	38.64
MnSO4	7.86E-09	8.31E-09	-8.105	-8.08	0.025	22.54
ZnSO4	6.71E-09	7.10E-09	-8.173	-8.149	0.025	21.71
HSO4-	1.23E-09	9.10E-10	-8.909	-9.041	-0.131	40.69
Zn(SO4)2-2	5.23E-10	1.56E-10	-9.282	-9.807	-0.526	-9.57
FeSO4	6.24E-11	6.60E-11	-10.205	-10.18	0.025	18.97
CuSO4	3.01E-11	3.18E-11	-10.522	-10.497	0.025	13.09
CaHSO4+	1.62E-11	1.20E-11	-10.79	-10.921	-0.131	0
FeSO4+	5.36E-18	3.89E-18	-17.271	-17.41	-0.139	0
FeHSO4+	2.04E-18	1.51E-18	-17.691	-17.823	-0.131	0
Fe(SO4)2-	3.11E-19	2.30E-19	-18.507	-18.639	-0.131	0
FeHSO4+2	1.21E-25	3.61E-26	-24.917	-25.443	-0.526	0
Zn	1.25E-06					
Zn(CO3)2-2	9.93E-07	2.96E-07	-6.003	-6.529	-0.526	0
ZnCO3	1.66E-07	1.76E-07	-6.779	-6.754	0.025	0
Zn+2	4.05E-08	1.12E-08	-7.393	-7.95	-0.557	-24.43
ZnOHCl	1.12E-08	1.19E-08	-7.95	-7.926	0.025	0
ZnHCO3+	1.11E-08	8.21E-09	-7.954	-8.086	-0.131	0
Zn(OH)2	1.10E-08	1.16E-08	-7.96	-7.936	0.025	0
ZnSO4	6.71E-09	7.10E-09	-8.173	-8.149	0.025	21.71
ZnCl+	4.79E-09	3.37E-09	-8.32	-8.473	-0.153	-14.52
ZnOH+	4.77E-09	3.53E-09	-8.321	-8.453	-0.131	0
Zn(SO4)2-2	5.23E-10	1.56E-10	-9.282	-9.807	-0.526	-9.57
ZnCl2	3.71E-10	3.93E-10	-9.43	-9.406	0.025	102.03
ZnCl3-	6.99E-11	4.91E-11	-10.156	-10.309	-0.153	15.52
ZnF+	4.10E-11	3.03E-11	-10.387	-10.519	-0.131	0
Zn(OH)3-	1.42E-11	1.05E-11	-10.847	-10.978	-0.131	0
ZnCl4-2	9.90E-12	2.74E-12	-11.005	-11.562	-0.557	147.71
Zn(OH)4-2	1.60E-15	4.77E-16	-14.795	-15.321	-0.526	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.25	-5.53	-4.28	CaSO4			
Aragonite	1.27	-7.07	-8.34	CaCO3			
Barite	1.85	-7.99	-9.84	BaSO4			
Calcite	1.41	-7.07	-8.48	CaCO3			
CO2(g)	-2.87	-4.34	-1.47	CO2			
Dolomite	3.88	-13.21	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.6	6.49	4.89	Fe(OH)3			
Fluorite	0.2	-10.4	-10.6	CaF2			
Goethite	7.49	6.49	-1	FeOOH			
Gypsum	-0.95	-5.53	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	0	1.5	H2O			
Halite	-3.48	-1.91	1.57	NaCl			
Hausmann	-8.65	52.38	61.03	Mn3O4			
Hematite	17	12.99	-4.01	Fe2O3			
Jarosite-K	-4.66	-13.87	-9.21	KFe3(SO4)2(OH)6			

Manganite	-3.73	21.61	25.34	MnOOH
Melanterit	-10.24	-12.45	-2.21	FeSO4:7H2O
NH3(g)	-7.43	-5.64	1.8	NH3
O2(g)	-33.35	-36.25	-2.89	O2
Pyrochroit	-6.05	9.15	15.2	Mn(OH)2
Pyrolusite	-7.31	34.07	41.38	MnO2:H2O
Rhodochrc	-0.74	-11.87	-11.13	MnCO3
Siderite	-3.08	-13.97	-10.89	FeCO3
Smithsonit	-2.05	-12.05	-10	ZnCO3
Sylvite	-4.68	-3.78	0.9	KCl
Witherite	-0.97	-9.53	-8.56	BaCO3
Zn(OH)2(e	-2.54	8.96	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 27

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.23E-02	1.23E-02
Ba	2.02E-05	2.02E-05
Ca	4.50E-03	4.50E-03
Cl	1.65E-01	1.65E-01
Cu	1.50E-07	1.50E-07
F	4.60E-04	4.60E-04
Fe	1.19E-06	1.19E-06
K	2.26E-03	2.26E-03
Mg	3.63E-02	3.63E-02
Mn	2.00E-07	2.00E-07
N(-3)	2.50E-05	2.50E-05
N(5)	2.10E-04	2.10E-04
Na	1.59E-01	1.59E-01
S(6)	1.87E-02	1.87E-02
Zn	1.29E-06	1.29E-06

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 19889
Density (g/cm³) = 1.00741
Volume (L) = 1.0057
Activity of water = 0.993
Ionic strength (mol/kgw) = 2.54E-01
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 1.10E-02
Total CO2 (mol/kg) = 1.10E-02

```
Temperatu (°C)          =                    25
Electrical  balance     (eq)        =            2.74E-02
Percent     error,      100*(Cat-|=                   6.5
Iterations  =                   10 (258        overall)
Total       H           =           1.11E+02
Total       O           =           5.56E+01

#NAME?  couples--------------------------------

        Redox       couple      pe          Eh          (volts)

        N(-3)/N(5)     4.4343      0.2623

#NAME?  of          species----------------------------

        Log         Log         Log         mole        V
        Species     Molality    Activity    Molality    Activity    Gamma    cm³/mol

        OH-          4.22E-06   2.90E-06      -5.375      -5.538     -0.163      -3.39
        H+           4.40E-09   3.47E-09      -8.357       -8.46     -0.103          0
        H2O          5.55E+01   9.93E-01       1.744      -0.003          0      18.07
Ba        2.02E-05
        Ba+2         1.47E-05   3.87E-06      -4.832      -5.412      -0.58     -11.61
        BaSO4        5.03E-06   5.33E-06      -5.298      -5.273      0.025          0
        BaHCO3+      3.00E-07   2.22E-07      -6.523      -6.655     -0.132          0
        BaCO3        1.52E-07   1.62E-07      -6.817      -6.792      0.025       -10.7
        BaOH+        5.20E-11   3.76E-11     -10.284     -10.425     -0.141          0
C(4)      1.10E-02
        HCO3-        8.16E-03   5.97E-03      -2.089      -2.224     -0.136      25.71
        MgHCO3+      9.36E-04   6.56E-04      -3.029      -3.183     -0.155       5.73
        MgCO3        6.82E-04   7.23E-04      -3.166      -3.141      0.025     -17.09
        NaHCO3       3.64E-04   3.86E-04      -3.439      -3.414      0.025        1.8
        CO3-2        2.82E-04   8.07E-05       -3.55      -4.093     -0.543      -3.37
        NaCO3-       2.34E-04   1.73E-04       -3.63      -3.763     -0.132       0.61
        CaCO3        1.44E-04   1.52E-04      -3.843      -3.817      0.025      -14.6
        CaHCO3+      1.15E-04   8.55E-05      -3.939      -4.068     -0.129       9.89
        CO2          4.42E-05   4.68E-05      -4.355       -4.33      0.025      34.43
        Zn(CO3)2-:   1.03E-06   3.06E-07      -5.986      -6.515     -0.528          0
        BaHCO3+      3.00E-07   2.22E-07      -6.523      -6.655     -0.132          0
        ZnCO3        1.67E-07   1.77E-07      -6.777      -6.751      0.025          0
        BaCO3        1.52E-07   1.62E-07      -6.817      -6.792      0.025       -10.7
        MnCO3        1.08E-07   1.14E-07      -6.967      -6.942      0.025          0
        CuCO3        2.32E-08   2.45E-08      -7.635       -7.61      0.025          0
        MnHCO3+      1.31E-08   9.49E-09      -7.882      -8.023     -0.141          0
        ZnHCO3+      1.12E-08   8.27E-09       -7.95      -8.083     -0.132          0
        Cu(CO3)2-    8.42E-09   2.49E-09      -8.075      -8.603     -0.528          0
        FeCO3        2.62E-10   2.78E-10      -9.581      -9.556      0.025          0
        CuHCO3+      2.30E-10   1.69E-10      -9.639      -9.771     -0.132          0
        FeHCO3+      1.16E-10   8.58E-11      -9.935     -10.067     -0.132          0
        (CO2)2       3.80E-11   4.02E-11     -10.421     -10.395      0.025      68.87
```

Ca	4.50E-03						
	Ca+2	3.72E-03	1.12E-03	-2.429	-2.95	-0.521	-17.12
	CaSO4	5.17E-04	5.49E-04	-3.286	-3.261	0.025	7.5
	CaCO3	1.44E-04	1.52E-04	-3.843	-3.817	0.025	-14.6
	CaHCO3+	1.15E-04	8.55E-05	-3.939	-4.068	-0.129	9.89
	CaOH+	7.24E-08	5.34E-08	-7.14	-7.273	-0.132	0
	CaHSO4+	1.69E-11	1.25E-11	-10.771	-10.903	-0.132	0
Cl	1.65E-01						
	Cl-	1.65E-01	1.15E-01	-0.782	-0.939	-0.156	18.51
	CuCl2-	1.78E-08	1.25E-08	-7.75	-7.904	-0.155	0
	MnCl+	1.16E-08	8.37E-09	-7.936	-8.077	-0.141	-2.86
	ZnOHCl	1.14E-08	1.20E-08	-7.945	-7.92	0.025	0
	CuCl3-2	8.31E-09	2.28E-09	-8.08	-8.643	-0.563	0
	ZnCl+	4.87E-09	3.41E-09	-8.312	-8.467	-0.155	-14.54
	MnCl2	3.97E-10	4.21E-10	-9.401	-9.376	0.025	85.89
	ZnCl2	3.88E-10	4.12E-10	-9.411	-9.386	0.025	102.03
	ZnCl3-	7.59E-11	5.32E-11	-10.12	-10.274	-0.155	15.46
	FeCl+	3.10E-11	2.29E-11	-10.509	-10.641	-0.132	0
	CuCl+	2.51E-11	1.76E-11	-10.601	-10.756	-0.155	1.23
	MnCl3-	1.85E-11	1.34E-11	-10.734	-10.874	-0.141	44.43
	ZnCl4-2	1.12E-11	3.07E-12	-10.95	-11.513	-0.563	147.77
	CuCl2	1.02E-12	1.09E-12	-11.99	-11.964	0.025	31.02
	CuCl3-	6.34E-16	4.44E-16	-15.198	-15.353	-0.155	0
	FeCl+2	1.74E-18	4.77E-19	-17.759	-18.321	-0.563	0
	CuCl4-2	9.36E-19	2.56E-19	-18.029	-18.591	-0.563	0
	FeCl2+	3.40E-19	2.46E-19	-18.469	-18.61	-0.141	0
	FeCl3	2.67E-21	2.83E-21	-20.574	-20.548	0.025	0
Cu(1)	2.61E-08						
	CuCl2-	1.78E-08	1.25E-08	-7.75	-7.904	-0.155	0
	CuCl3-2	8.31E-09	2.28E-09	-8.08	-8.643	-0.563	0
	Cu+	4.52E-12	2.97E-12	-11.345	-11.527	-0.182	0
Cu(2)	1.24E-07						
	Cu(OH)2	9.16E-08	9.71E-08	-7.038	-7.013	0.025	0
	CuCO3	2.32E-08	2.45E-08	-7.635	-7.61	0.025	0
	Cu(CO3)2-	8.42E-09	2.49E-09	-8.075	-8.603	-0.528	0
	CuOH+	2.32E-10	1.62E-10	-9.635	-9.79	-0.155	0
	CuHCO3+	2.30E-10	1.69E-10	-9.639	-9.771	-0.132	0
	Cu+2	1.86E-10	5.66E-11	-9.731	-10.247	-0.516	-25.68
	CuSO4	3.00E-11	3.18E-11	-10.523	-10.498	0.025	13.09
	CuCl+	2.51E-11	1.76E-11	-10.601	-10.756	-0.155	1.23
	Cu(OH)3-	2.27E-12	1.68E-12	-11.643	-11.776	-0.132	0
	CuCl2	1.02E-12	1.09E-12	-11.99	-11.964	0.025	31.02
	CuF+	2.69E-13	1.99E-13	-12.57	-12.702	-0.132	0
	Cu2(OH)2+	3.89E-14	1.15E-14	-13.41	-13.939	-0.528	0
	CuCl3-	6.34E-16	4.44E-16	-15.198	-15.353	-0.155	0
	Cu(OH)4-2	3.24E-16	9.59E-17	-15.49	-16.018	-0.528	0
	CuCl4-2	9.36E-19	2.56E-19	-18.029	-18.591	-0.563	0
F	4.60E-04						
	F-	2.80E-04	1.93E-04	-3.552	-3.715	-0.163	-0.87
	MgF+	1.68E-04	1.20E-04	-3.775	-3.923	-0.147	-10.33

	NaF	1.20E-05	1.28E-05	-4.92	-4.895	0.025	7.26
	HF	9.45E-10	1.00E-09	-9.025	-8.999	0.025	12.5
	ZnF+	4.06E-11	3.00E-11	-10.391	-10.524	-0.132	0
	MnF+	3.29E-11	2.38E-11	-10.483	-10.624	-0.141	0
	HF2-	1.00E-12	7.41E-13	-11.998	-12.131	-0.132	22.51
	FeF+	3.75E-13	2.77E-13	-12.426	-12.558	-0.132	0
	CuF+	2.69E-13	1.99E-13	-12.57	-12.702	-0.132	0
	FeF2+	4.44E-16	3.21E-16	-15.352	-15.493	-0.141	0
	FeF+2	1.53E-16	4.19E-17	-15.815	-16.378	-0.563	0
	FeF3	9.26E-17	9.81E-17	-16.034	-16.008	0.025	0
Fe(2)	9.66E-10						
	Fe+2	4.71E-10	1.44E-10	-9.327	-9.842	-0.516	-21.16
	FeCO3	2.62E-10	2.78E-10	-9.581	-9.556	0.025	0
	FeHCO3+	1.16E-10	8.58E-11	-9.935	-10.067	-0.132	0
	FeSO4	6.62E-11	7.02E-11	-10.179	-10.154	0.025	18.97
	FeCl+	3.10E-11	2.29E-11	-10.509	-10.641	-0.132	0
	FeOH+	1.80E-11	1.30E-11	-10.745	-10.885	-0.141	0
	FeF+	3.75E-13	2.77E-13	-12.426	-12.558	-0.132	0
	Fe(OH)2	3.00E-14	3.18E-14	-13.524	-13.498	0.025	0
	Fe(OH)3-	4.67E-16	3.38E-16	-15.33	-15.471	-0.141	0
	FeHSO4+	2.17E-18	1.60E-18	-17.664	-17.796	-0.132	0
Fe(3)	1.19E-06						
	Fe(OH)3	8.39E-07	8.89E-07	-6.076	-6.051	0.025	0
	Fe(OH)4-	3.18E-07	2.32E-07	-6.498	-6.634	-0.136	0
	Fe(OH)2+	3.29E-08	2.41E-08	-7.482	-7.618	-0.136	0
	FeOH+2	9.27E-13	2.54E-13	-12.033	-12.595	-0.563	0
	FeF2+	4.44E-16	3.21E-16	-15.352	-15.493	-0.141	0
	FeF+2	1.53E-16	4.19E-17	-15.815	-16.378	-0.563	0
	FeF3	9.26E-17	9.81E-17	-16.034	-16.008	0.025	0
	FeSO4+	5.72E-18	4.13E-18	-17.243	-17.384	-0.141	0
	FeCl+2	1.74E-18	4.77E-19	-17.759	-18.321	-0.563	0
	Fe+3	1.17E-18	1.37E-19	-17.933	-18.862	-0.929	0
	FeCl2+	3.40E-19	2.46E-19	-18.469	-18.61	-0.141	0
	Fe(SO4)2-	3.37E-19	2.48E-19	-18.473	-18.605	-0.132	0
	FeCl3	2.67E-21	2.83E-21	-20.574	-20.548	0.025	0
	Fe2(OH)2+	2.25E-22	1.74E-24	-21.648	-23.761	-2.113	0
	FeHSO4+2	1.30E-25	3.84E-26	-24.888	-25.416	-0.528	0
	Fe3(OH)4+	1.75E-26	8.73E-30	-25.758	-29.059	-3.301	0
H(0)	1.61E-28						
	H2	8.03E-29	8.51E-29	-28.095	-28.07	0.025	28.61
K	2.26E-03						
	K+	2.22E-03	1.54E-03	-2.654	-2.813	-0.159	9.39
	KSO4-	4.06E-05	2.97E-05	-4.391	-4.527	-0.136	34.55
Mg	3.63E-02						
	Mg+2	2.88E-02	9.39E-03	-1.54	-2.027	-0.487	-20.84
	MgSO4	5.70E-03	6.05E-03	-2.244	-2.219	0.025	5.84
	MgHCO3+	9.36E-04	6.56E-04	-3.029	-3.183	-0.155	5.73
	MgCO3	6.82E-04	7.23E-04	-3.166	-3.141	0.025	-17.09
	MgF+	1.68E-04	1.20E-04	-3.775	-3.923	-0.147	-10.33
	MgOH+	1.30E-05	9.77E-06	-4.886	-5.01	-0.124	0

Mn(2)	2.00E-07						
	MnCO3	1.08E-07	1.14E-07	-6.967	-6.942	0.025	0
	Mn+2	5.85E-08	1.79E-08	-7.233	-7.748	-0.516	-17.32
	MnHCO3+	1.31E-08	9.49E-09	-7.882	-8.023	-0.141	0
	MnCl+	1.16E-08	8.37E-09	-7.936	-8.077	-0.141	-2.86
	MnSO4	8.22E-09	8.72E-09	-8.085	-8.06	0.025	22.54
	MnCl2	3.97E-10	4.21E-10	-9.401	-9.376	0.025	85.89
	MnOH+	1.82E-10	1.31E-10	-9.741	-9.881	-0.141	0
	MnF+	3.29E-11	2.38E-11	-10.483	-10.624	-0.141	0
	MnCl3-	1.85E-11	1.34E-11	-10.734	-10.874	-0.141	44.43
	Mn(NO3)2	1.34E-15	1.42E-15	-14.873	-14.847	0.025	41.04
	Mn(OH)3-	9.20E-18	6.65E-18	-17.036	-17.177	-0.141	0
Mn(3)	4.69E-29						
	Mn+3	4.69E-29	5.52E-30	-28.329	-29.258	-0.929	0
N(-3)	2.50E-05						
	NH4+	2.21E-05	1.45E-05	-4.656	-4.838	-0.182	18.28
	NH3	2.25E-06	2.39E-06	-5.648	-5.623	0.025	24.42
	NH4SO4-	6.96E-07	5.14E-07	-6.157	-6.289	-0.132	38.67
N(5)	2.10E-04						
	NO3-	2.10E-04	1.41E-04	-3.678	-3.85	-0.172	29.96
	Mn(NO3)2	1.34E-15	1.42E-15	-14.873	-14.847	0.025	41.04
Na	1.59E-01						
	Na+	1.56E-01	1.15E-01	-0.807	-0.939	-0.133	-0.86
	NaSO4-	2.16E-03	1.58E-03	-2.665	-2.801	-0.136	18.1
	NaHCO3	3.64E-04	3.86E-04	-3.439	-3.414	0.025	1.8
	NaCO3-	2.34E-04	1.73E-04	-3.63	-3.763	-0.132	0.61
	NaF	1.20E-05	1.28E-05	-4.92	-4.895	0.025	7.26
	NaOH	3.15E-17	3.33E-17	-16.502	-16.477	0.025	0
O(0)	1.07E-36						
	O2	5.36E-37	5.68E-37	-36.271	-36.246	0.025	30.4
S(6)	1.87E-02						
	SO4-2	1.03E-02	2.75E-03	-1.988	-2.561	-0.573	16.3
	MgSO4	5.70E-03	6.05E-03	-2.244	-2.219	0.025	5.84
	NaSO4-	2.16E-03	1.58E-03	-2.665	-2.801	-0.136	18.1
	CaSO4	5.17E-04	5.49E-04	-3.286	-3.261	0.025	7.5
	KSO4-	4.06E-05	2.97E-05	-4.391	-4.527	-0.136	34.55
	BaSO4	5.03E-06	5.33E-06	-5.298	-5.273	0.025	0
	NH4SO4-	6.96E-07	5.14E-07	-6.157	-6.289	-0.132	38.67
	MnSO4	8.22E-09	8.72E-09	-8.085	-8.06	0.025	22.54
	ZnSO4	6.69E-09	7.09E-09	-8.175	-8.149	0.025	21.71
	HSO4-	1.26E-09	9.26E-10	-8.901	-9.033	-0.132	40.7
	Zn(SO4)2-2	5.34E-10	1.58E-10	-9.272	-9.801	-0.528	-9.47
	FeSO4	6.62E-11	7.02E-11	-10.179	-10.154	0.025	18.97
	CuSO4	3.00E-11	3.18E-11	-10.523	-10.498	0.025	13.09
	CaHSO4+	1.69E-11	1.25E-11	-10.771	-10.903	-0.132	0
	FeSO4+	5.72E-18	4.13E-18	-17.243	-17.384	-0.141	0
	FeHSO4+	2.17E-18	1.60E-18	-17.664	-17.796	-0.132	0
	Fe(SO4)2-	3.37E-19	2.48E-19	-18.473	-18.605	-0.132	0
	FeHSO4+2	1.30E-25	3.84E-26	-24.888	-25.416	-0.528	0
Zn	1.29E-06						

Zn(CO3)2-2	1.03E-06	3.06E-07	-5.986	-6.515	-0.528	0
ZnCO3	1.67E-07	1.77E-07	-6.777	-6.751	0.025	0
Zn+2	4.02E-08	1.10E-08	-7.396	-7.958	-0.563	-24.41
ZnOHCl	1.14E-08	1.20E-08	-7.945	-7.92	0.025	0
ZnHCO3+	1.12E-08	8.27E-09	-7.95	-8.083	-0.132	0
Zn(OH)2	1.07E-08	1.14E-08	-7.969	-7.944	0.025	0
ZnSO4	6.69E-09	7.09E-09	-8.175	-8.149	0.025	21.71
ZnCl+	4.87E-09	3.41E-09	-8.312	-8.467	-0.155	-14.54
ZnOH+	4.69E-09	3.46E-09	-8.329	-8.461	-0.132	0
Zn(SO4)2-2	5.34E-10	1.58E-10	-9.272	-9.801	-0.528	-9.47
ZnCl2	3.88E-10	4.12E-10	-9.411	-9.386	0.025	102.03
ZnCl3-	7.59E-11	5.32E-11	-10.12	-10.274	-0.155	15.46
ZnF+	4.06E-11	3.00E-11	-10.391	-10.524	-0.132	0
Zn(OH)3-	1.40E-11	1.03E-11	-10.855	-10.987	-0.132	0
ZnCl4-2	1.12E-11	3.07E-12	-10.95	-11.513	-0.563	147.77
Zn(OH)4-2	1.58E-15	4.68E-16	-14.802	-15.33	-0.528	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.23	-5.51	-4.28	CaSO4			
Aragonite	1.29	-7.04	-8.34	CaCO3			
Barite	1.87	-7.97	-9.84	BaSO4			
Calcite	1.44	-7.04	-8.48	CaCO3			
CO2(g)	-2.86	-4.33	-1.47	CO2			
Dolomite	3.92	-13.16	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.62	6.51	4.89	Fe(OH)3			
Fluorite	0.22	-10.38	-10.6	CaF2			
Goethite	7.51	6.51	-1	FeOOH			
Gypsum	-0.93	-5.52	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	0	1.5	H2O			
Halite	-3.45	-1.88	1.57	NaCl			
Hausmann	-8.61	52.42	61.03	Mn3O4			
Hematite	17.03	13.03	-4.01	Fe2O3			
Jarosite-K	-4.57	-13.78	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.71	21.63	25.34	MnOOH			
Melanterit	-10.21	-12.42	-2.21	FeSO4:7H2O			
NH3(g)	-7.42	-5.62	1.8	NH3			
O2(g)	-33.35	-36.25	-2.89	O2			
Pyrochroit	-6.03	9.17	15.2	Mn(OH)2			
Pyrolusite	-7.3	34.08	41.38	MnO2:H2O			
Rhodochro	-0.71	-11.84	-11.13	MnCO3			
Siderite	-3.05	-13.94	-10.89	FeCO3			
Smithsonit	-2.05	-12.05	-10	ZnCO3			
Sylvite	-4.65	-3.75	0.9	KCl			
Witherite	-0.94	-9.51	-8.56	BaCO3			
Zn(OH)2(e	-2.54	8.96	11.5	Zn(OH)2			

```
**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 28

#NAME? composition-----------------------------

Elements Molality Moles

Alkalinity 1.27E-02 1.27E-02
Ba 2.10E-05 2.10E-05
Ca 4.66E-03 4.66E-03
Cl 1.71E-01 1.71E-01
Cu 1.60E-07 1.60E-07
F 4.80E-04 4.80E-04
Fe 1.23E-06 1.23E-06
K 2.34E-03 2.34E-03
Mg 3.77E-02 3.77E-02
Mn 2.10E-07 2.10E-07
N(-3) 2.50E-05 2.50E-05
N(5) 2.20E-04 2.20E-04
Na 1.65E-01 1.65E-01
S(6) 1.94E-02 1.94E-02
Zn 1.34E-06 1.34E-06

#NAME? of solution---------------------------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 20519
Density (g/cm³) = 1.00777
Volume (L) = 1.0058
Activity of water = 0.993
Ionic strength (mol/kgw) = 2.63E-01
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 1.13E-02
Total CO2 (mol/kg) = 1.13E-02
Temperatu (°C) = 25
Electrical balance (eq) = 2.84E-02
Percent error, 100*(Cat-| = 6.5
Iterations = 10 (268 overall)
Total H = 1.11E+02
Total O = 5.56E+01

#NAME? couples--------------------------------

Redox couple pe Eh (volts)

N(-3)/N(5) 4.4369 0.2625
```

#NAME? of species----------

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.24E-06	2.90E-06	-5.373	-5.538	-0.165	-3.37
	H+	4.41E-09	3.47E-09	-8.356	-8.46	-0.104	0
	H2O	5.55E+01	9.93E-01	1.744	-0.003	0	18.07
Ba	2.10E-05						
	Ba+2	1.53E-05	3.97E-06	-4.817	-5.401	-0.585	-11.59
	BaSO4	5.22E-06	5.55E-06	-5.282	-5.256	0.026	0
	BaHCO3+	3.16E-07	2.33E-07	-6.501	-6.633	-0.133	0
	BaCO3	1.60E-07	1.70E-07	-6.797	-6.771	0.026	-10.7
	BaOH+	5.34E-11	3.85E-11	-10.272	-10.414	-0.142	0
C(4)	1.13E-02						
	HCO3-	8.38E-03	6.12E-03	-2.077	-2.213	-0.137	25.74
	MgHCO3+	9.89E-04	6.90E-04	-3.005	-3.161	-0.156	5.74
	MgCO3	7.16E-04	7.61E-04	-3.145	-3.119	0.026	-17.09
	NaHCO3	3.85E-04	4.09E-04	-3.415	-3.389	0.026	1.8
	CO3-2	2.92E-04	8.27E-05	-3.535	-4.082	-0.548	-3.33
	NaCO3-	2.49E-04	1.83E-04	-3.605	-3.737	-0.133	0.66
	CaCO3	1.51E-04	1.60E-04	-3.822	-3.796	0.026	-14.6
	CaHCO3+	1.21E-04	8.98E-05	-3.917	-4.047	-0.13	9.9
	CO2	4.52E-05	4.80E-05	-4.345	-4.319	0.026	34.43
	Zn(CO3)2-2	1.08E-06	3.18E-07	-5.967	-6.497	-0.531	0
	BaHCO3+	3.16E-07	2.33E-07	-6.501	-6.633	-0.133	0
	ZnCO3	1.69E-07	1.80E-07	-6.771	-6.745	0.026	0
	BaCO3	1.60E-07	1.70E-07	-6.797	-6.771	0.026	-10.7
	MnCO3	1.14E-07	1.21E-07	-6.944	-6.918	0.026	0
	CuCO3	2.48E-08	2.63E-08	-7.606	-7.58	0.026	0
	MnHCO3+	1.39E-08	1.00E-08	-7.857	-7.999	-0.142	0
	ZnHCO3+	1.14E-08	8.39E-09	-7.944	-8.076	-0.133	0
	Cu(CO3)2-	9.30E-09	2.74E-09	-8.031	-8.562	-0.531	0
	FeCO3	2.78E-10	2.95E-10	-9.556	-9.53	0.026	0
	CuHCO3+	2.47E-10	1.82E-10	-9.608	-9.741	-0.133	0
	FeHCO3+	1.24E-10	9.10E-11	-9.908	-10.041	-0.133	0
	(CO2)2	3.98E-11	4.23E-11	-10.4	-10.374	0.026	68.87
Ca	4.66E-03						
	Ca+2	3.85E-03	1.15E-03	-2.414	-2.939	-0.524	-17.11
	CaSO4	5.38E-04	5.71E-04	-3.27	-3.243	0.026	7.5
	CaCO3	1.51E-04	1.60E-04	-3.822	-3.796	0.026	-14.6
	CaHCO3+	1.21E-04	8.98E-05	-3.917	-4.047	-0.13	9.9
	CaOH+	7.43E-08	5.47E-08	-7.129	-7.262	-0.133	0
	CaHSO4+	1.77E-11	1.30E-11	-10.753	-10.885	-0.133	0
Cl	1.71E-01						
	Cl-	1.71E-01	1.19E-01	-0.767	-0.925	-0.158	18.52
	CuCl2-	1.99E-08	1.39E-08	-7.701	-7.857	-0.156	0
	MnCl+	1.23E-08	8.90E-09	-7.909	-8.051	-0.142	-2.86
	ZnOHCl	1.16E-08	1.23E-08	-7.937	-7.911	0.026	0
	CuCl3-2	9.68E-09	2.62E-09	-8.014	-8.582	-0.568	0

	ZnCl+	5.00E-09	3.49E-09	-8.301	-8.458	-0.156	-14.57
	MnCl2	4.35E-10	4.62E-10	-9.362	-9.336	0.026	85.89
	ZnCl2	4.09E-10	4.34E-10	-9.389	-9.362	0.026	102.03
	ZnCl3-	8.30E-11	5.79E-11	-10.081	-10.237	-0.156	15.4
	FeCl+	3.31E-11	2.44E-11	-10.48	-10.612	-0.133	0
	CuCl+	2.72E-11	1.90E-11	-10.566	-10.722	-0.156	1.25
	MnCl3-	2.10E-11	1.51E-11	-10.679	-10.82	-0.142	44.46
	ZnCl4-2	1.28E-11	3.45E-12	-10.894	-11.462	-0.568	147.83
	CuCl2	1.14E-12	1.21E-12	-11.943	-11.917	0.026	31.02
	CuCl3-	7.32E-16	5.11E-16	-15.136	-15.292	-0.156	0
	FeCl+2	1.89E-18	5.10E-19	-17.725	-18.292	-0.568	0
	CuCl4-2	1.12E-18	3.04E-19	-17.949	-18.517	-0.568	0
	FeCl2+	3.76E-19	2.71E-19	-18.425	-18.567	-0.142	0
	FeCl3	3.03E-21	3.22E-21	-20.518	-20.492	0.026	0
Cu(1)	2.96E-08						
	CuCl2-	1.99E-08	1.39E-08	-7.701	-7.857	-0.156	0
	CuCl3-2	9.68E-09	2.62E-09	-8.014	-8.582	-0.568	0
	Cu+	4.75E-12	3.11E-12	-11.323	-11.507	-0.184	0
Cu(2)	1.30E-07						
	Cu(OH)2	9.56E-08	1.02E-07	-7.02	-6.993	0.026	0
	CuCO3	2.48E-08	2.63E-08	-7.606	-7.58	0.026	0
	Cu(CO3)2-	9.30E-09	2.74E-09	-8.031	-8.562	-0.531	0
	CuHCO3+	2.47E-10	1.82E-10	-9.608	-9.741	-0.133	0
	CuOH+	2.43E-10	1.70E-10	-9.614	-9.77	-0.156	0
	Cu+2	1.96E-10	5.92E-11	-9.707	-10.227	-0.52	-25.67
	CuSO4	3.18E-11	3.38E-11	-10.498	-10.472	0.026	13.09
	CuCl+	2.72E-11	1.90E-11	-10.566	-10.722	-0.156	1.25
	Cu(OH)3-	2.38E-12	1.75E-12	-11.624	-11.756	-0.133	0
	CuCl2	1.14E-12	1.21E-12	-11.943	-11.917	0.026	31.02
	CuF+	2.90E-13	2.14E-13	-12.538	-12.67	-0.133	0
	Cu2(OH)2+	4.28E-14	1.26E-14	-13.369	-13.9	-0.531	0
	CuCl3-	7.32E-16	5.11E-16	-15.136	-15.292	-0.156	0
	Cu(OH)4-2	3.40E-16	1.00E-16	-15.469	-15.999	-0.531	0
	CuCl4-2	1.12E-18	3.04E-19	-17.949	-18.517	-0.568	0
F	4.80E-04						
	F-	2.90E-04	1.98E-04	-3.538	-3.703	-0.165	-0.86
	MgF+	1.78E-04	1.26E-04	-3.75	-3.899	-0.149	-10.33
	NaF	1.28E-05	1.36E-05	-4.894	-4.868	0.026	7.26
	HF	9.70E-10	1.03E-09	-9.013	-8.987	0.026	12.5
	ZnF+	4.14E-11	3.05E-11	-10.383	-10.516	-0.133	0
	MnF+	3.49E-11	2.52E-11	-10.457	-10.599	-0.142	0
	HF2-	1.06E-12	7.84E-13	-11.973	-12.106	-0.133	22.51
	FeF+	4.00E-13	2.95E-13	-12.398	-12.53	-0.133	0
	CuF+	2.90E-13	2.14E-13	-12.538	-12.67	-0.133	0
	FeF2+	4.88E-16	3.52E-16	-15.311	-15.453	-0.142	0
	FeF+2	1.65E-16	4.46E-17	-15.783	-16.35	-0.568	0
	FeF3	1.04E-16	1.11E-16	-15.983	-15.956	0.026	0
Fe(2)	1.02E-09						
	Fe+2	4.93E-10	1.49E-10	-9.307	-9.828	-0.52	-21.15
	FeCO3	2.78E-10	2.95E-10	-9.556	-9.53	0.026	0

	FeHCO3+	1.24E-10	9.10E-11	-9.908	-10.041	-0.133	0
	FeSO4	6.95E-11	7.38E-11	-10.158	-10.132	0.026	18.97
	FeCl+	3.31E-11	2.44E-11	-10.48	-10.612	-0.133	0
	FeOH+	1.87E-11	1.35E-11	-10.729	-10.87	-0.142	0
	FeF+	4.00E-13	2.95E-13	-12.398	-12.53	-0.133	0
	Fe(OH)2	3.09E-14	3.29E-14	-13.51	-13.483	0.026	0
	Fe(OH)3-	4.85E-16	3.50E-16	-15.314	-15.456	-0.142	0
	FeHSO4+	2.28E-18	1.68E-18	-17.641	-17.774	-0.133	0
Fe(3)	1.23E-06						
	Fe(OH)3	8.66E-07	9.20E-07	-6.063	-6.036	0.026	0
	Fe(OH)4-	3.29E-07	2.40E-07	-6.482	-6.619	-0.137	0
	Fe(OH)2+	3.42E-08	2.49E-08	-7.467	-7.603	-0.137	0
	FeOH+2	9.71E-13	2.63E-13	-12.013	-12.58	-0.568	0
	FeF2+	4.88E-16	3.52E-16	-15.311	-15.453	-0.142	0
	FeF+2	1.65E-16	4.46E-17	-15.783	-16.35	-0.568	0
	FeF3	1.04E-16	1.11E-16	-15.983	-15.956	0.026	0
	FeSO4+	6.03E-18	4.35E-18	-17.22	-17.362	-0.142	0
	FeCl+2	1.89E-18	5.10E-19	-17.725	-18.292	-0.568	0
	Fe+3	1.23E-18	1.42E-19	-17.912	-18.848	-0.936	0
	FeCl2+	3.76E-19	2.71E-19	-18.425	-18.567	-0.142	0
	Fe(SO4)2-	3.60E-19	2.65E-19	-18.443	-18.576	-0.133	0
	FeCl3	3.03E-21	3.22E-21	-20.518	-20.492	0.026	0
	Fe2(OH)2+	2.46E-22	1.86E-24	-21.609	-23.731	-2.122	0
	FeHSO4+2	1.37E-25	4.04E-26	-24.863	-25.394	-0.531	0
	Fe3(OH)4+	2.00E-26	9.67E-30	-25.698	-29.014	-3.316	0
H(0)	1.60E-28						
	H2	8.01E-29	8.51E-29	-28.096	-28.07	0.026	28.61
K	2.34E-03						
	K+	2.30E-03	1.59E-03	-2.639	-2.799	-0.161	9.4
	KSO4-	4.27E-05	3.11E-05	-4.37	-4.507	-0.137	34.56
Mg	3.77E-02						
	Mg+2	2.98E-02	9.64E-03	-1.526	-2.016	-0.49	-20.82
	MgSO4	5.94E-03	6.31E-03	-2.227	-2.2	0.026	5.84
	MgHCO3+	9.89E-04	6.90E-04	-3.005	-3.161	-0.156	5.74
	MgCO3	7.16E-04	7.61E-04	-3.145	-3.119	0.026	-17.09
	MgF+	1.78E-04	1.26E-04	-3.75	-3.899	-0.149	-10.33
	MgOH+	1.34E-05	1.00E-05	-4.874	-4.999	-0.125	0
Mn(2)	2.10E-07						
	MnCO3	1.14E-07	1.21E-07	-6.944	-6.918	0.026	0
	Mn+2	6.09E-08	1.84E-08	-7.216	-7.736	-0.52	-17.29
	MnHCO3+	1.39E-08	1.00E-08	-7.857	-7.999	-0.142	0
	MnCl+	1.23E-08	8.90E-09	-7.909	-8.051	-0.142	-2.86
	MnSO4	8.58E-09	9.12E-09	-8.066	-8.04	0.026	22.54
	MnCl2	4.35E-10	4.62E-10	-9.362	-9.336	0.026	85.89
	MnOH+	1.88E-10	1.35E-10	-9.727	-9.869	-0.142	0
	MnF+	3.49E-11	2.52E-11	-10.457	-10.599	-0.142	0
	MnCl3-	2.10E-11	1.51E-11	-10.679	-10.82	-0.142	44.46
	Mn(NO3)2	1.50E-15	1.59E-15	-14.825	-14.798	0.026	41.04
	Mn(OH)3-	9.49E-18	6.84E-18	-17.023	-17.165	-0.142	0
Mn(3)	4.89E-29						

	Mn+3	4.89E-29	5.68E-30	-28.31	-29.246	-0.936	0
N(-3)	2.50E-05						
	NH4+	2.21E-05	1.44E-05	-4.656	-4.84	-0.184	18.29
	NH3	2.23E-06	2.37E-06	-5.651	-5.625	0.026	24.42
	NH4SO4-	7.05E-07	5.19E-07	-6.152	-6.285	-0.133	38.7
N(5)	2.20E-04						
	NO3-	2.20E-04	1.48E-04	-3.658	-3.831	-0.174	29.97
	Mn(NO3)2	1.50E-15	1.59E-15	-14.825	-14.798	0.026	41.04
Na	1.65E-01						
	Na+	1.62E-01	1.19E-01	-0.792	-0.925	-0.133	-0.85
	NaSO4-	2.28E-03	1.66E-03	-2.642	-2.779	-0.137	18.19
	NaHCO3	3.85E-04	4.09E-04	-3.415	-3.389	0.026	1.8
	NaCO3-	2.49E-04	1.83E-04	-3.605	-3.737	-0.133	0.66
	NaF	1.28E-05	1.36E-05	-4.894	-4.868	0.026	7.26
	NaOH	3.24E-17	3.45E-17	-16.489	-16.463	0.026	0
O(0)	1.07E-36						
	O2	5.34E-37	5.68E-37	-36.272	-36.246	0.026	30.4
S(6)	1.94E-02						
	SO4-2	1.06E-02	2.79E-03	-1.976	-2.554	-0.578	16.33
	MgSO4	5.94E-03	6.31E-03	-2.227	-2.2	0.026	5.84
	NaSO4-	2.28E-03	1.66E-03	-2.642	-2.779	-0.137	18.19
	CaSO4	5.38E-04	5.71E-04	-3.27	-3.243	0.026	7.5
	KSO4-	4.27E-05	3.11E-05	-4.37	-4.507	-0.137	34.56
	BaSO4	5.22E-06	5.55E-06	-5.282	-5.256	0.026	0
	NH4SO4-	7.05E-07	5.19E-07	-6.152	-6.285	-0.133	38.7
	MnSO4	8.58E-09	9.12E-09	-8.066	-8.04	0.026	22.54
	ZnSO4	6.71E-09	7.13E-09	-8.173	-8.147	0.026	21.71
	HSO4-	1.28E-09	9.41E-10	-8.894	-9.027	-0.133	40.71
	Zn(SO4)2-2	5.49E-10	1.62E-10	-9.261	-9.791	-0.531	-9.37
	FeSO4	6.95E-11	7.38E-11	-10.158	-10.132	0.026	18.97
	CuSO4	3.18E-11	3.38E-11	-10.498	-10.472	0.026	13.09
	CaHSO4+	1.77E-11	1.30E-11	-10.753	-10.885	-0.133	0
	FeSO4+	6.03E-18	4.35E-18	-17.22	-17.362	-0.142	0
	FeHSO4+	2.28E-18	1.68E-18	-17.641	-17.774	-0.133	0
	Fe(SO4)2-	3.60E-19	2.65E-19	-18.443	-18.576	-0.133	0
	FeHSO4+2	1.37E-25	4.04E-26	-24.863	-25.394	-0.531	0
Zn	1.34E-06						
	Zn(CO3)2-2	1.08E-06	3.18E-07	-5.967	-6.497	-0.531	0
	ZnCO3	1.69E-07	1.80E-07	-6.771	-6.745	0.026	0
	Zn+2	4.03E-08	1.09E-08	-7.395	-7.963	-0.568	-24.4
	ZnOHCl	1.16E-08	1.23E-08	-7.937	-7.911	0.026	0
	ZnHCO3+	1.14E-08	8.39E-09	-7.944	-8.076	-0.133	0
	Zn(OH)2	1.06E-08	1.13E-08	-7.975	-7.949	0.026	0
	ZnSO4	6.71E-09	7.13E-09	-8.173	-8.147	0.026	21.71
	ZnCl+	5.00E-09	3.49E-09	-8.301	-8.458	-0.156	-14.57
	ZnOH+	4.65E-09	3.42E-09	-8.333	-8.466	-0.133	0
	Zn(SO4)2-2	5.49E-10	1.62E-10	-9.261	-9.791	-0.531	-9.37
	ZnCl2	4.09E-10	4.34E-10	-9.389	-9.362	0.026	102.03
	ZnCl3-	8.30E-11	5.79E-11	-10.081	-10.237	-0.156	15.4
	ZnF+	4.14E-11	3.05E-11	-10.383	-10.516	-0.133	0

Zn(OH)3-	1.38E-11	1.02E-11	-10.859	-10.992	-0.133	0
ZnCl4-2	1.28E-11	3.45E-12	-10.894	-11.462	-0.568	147.83
Zn(OH)4-2	1.57E-15	4.63E-16	-14.804	-15.335	-0.531	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.22	-5.49	-4.28	CaSO4			
Aragonite	1.31	-7.02	-8.34	CaCO3			
Barite	1.89	-7.96	-9.84	BaSO4			
Calcite	1.46	-7.02	-8.48	CaCO3			
CO2(g)	-2.85	-4.32	-1.47	CO2			
Dolomite	3.96	-13.12	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.63	6.52	4.89	Fe(OH)3			
Fluorite	0.25	-10.34	-10.6	CaF2			
Goethite	7.53	6.53	-1	FeOOH			
Gypsum	-0.92	-5.5	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	0	1.5	H2O			
Halite	-3.42	-1.85	1.57	NaCl			
Hausmann	-8.57	52.46	61.03	Mn3O4			
Hematite	17.06	13.06	-4.01	Fe2O3			
Jarosite-K	-4.5	-13.71	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.7	21.64	25.34	MnOOH			
Melanterit	-10.19	-12.4	-2.21	FeSO4:7H2O			
NH3(g)	-7.42	-5.62	1.8	NH3			
O2(g)	-33.35	-36.25	-2.89	O2			
Pyrochroit	-6.02	9.18	15.2	Mn(OH)2			
Pyrolusite	-7.28	34.1	41.38	MnO2:H2O			
Rhodochrc	-0.69	-11.82	-11.13	MnCO3			
Siderite	-3.02	-13.91	-10.89	FeCO3			
Smithsonit	-2.05	-12.05	-10	ZnCO3			
Sylvite	-4.62	-3.72	0.9	KCl			
Witherite	-0.92	-9.48	-8.56	BaCO3			
Zn(OH)2(e	-2.55	8.95	11.5	Zn(OH)2			

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 29

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.32E-02	1.32E-02
Ba	2.17E-05	2.17E-05
Ca	4.82E-03	4.82E-03
Cl	1.77E-01	1.77E-01

Cu	1.60E-07	1.60E-07
F	5.00E-04	5.00E-04
Fe	1.27E-06	1.27E-06
K	2.42E-03	2.42E-03
Mg	3.90E-02	3.90E-02
Mn	2.20E-07	2.20E-07
N(-3)	2.60E-05	2.60E-05
N(5)	2.20E-04	2.20E-04
Na	1.70E-01	1.70E-01
S(6)	2.00E-02	2.00E-02
Zn	1.39E-06	1.39E-06

#NAME? of solution----------

pH	=	8.46			
pe	=	4			
Specific	Conductan	(µS/cm,	25°C)	=	21146
Density	(g/cm³)	=	1.00814		
Volume	(L)	=	1.0059		
Activity	of	water	=	0.993	
Ionic	strength	(mol/kgw)	=	2.72E-01	
Mass	of	water	(kg)	=	1.00E+00
Total	carbon	(mol/kg)	=	1.17E-02	
Total	CO2	(mol/kg)	=	1.17E-02	
Temperatu	(°C)	=	25		
Electrical	balance	(eq)	=	2.94E-02	
Percent	error,	100*(Cat-|	=	6.5	
Iterations	=	10	(278	overall)	
Total	H	=	1.11E+02		
Total	O	=	5.56E+01		

#NAME? couples----------

Redox	couple	pe	Eh	(volts)
N(-3)/N(5)	4.4348	0.2623		

#NAME? of species----------

Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
OH-	4.25E-06	2.90E-06	-5.372	-5.538	-0.166	-3.35
H+	4.41E-09	3.47E-09	-8.355	-8.46	-0.105	0
H2O	5.55E+01	9.93E-01	1.744	-0.003	0	18.07
Ba	2.17E-05					
Ba+2	1.58E-05	4.06E-06	-4.802	-5.391	-0.59	-11.58
BaSO4	5.42E-06	5.77E-06	-5.266	-5.239	0.027	0
BaHCO3+	3.32E-07	2.44E-07	-6.479	-6.613	-0.133	0
BaCO3	1.67E-07	1.78E-07	-6.777	-6.75	0.027	-10.7

	BaOH+	5.48E-11	3.94E-11	-10.261	-10.404	-0.143	0
C(4)	1.17E-02						
	HCO3-	8.61E-03	6.27E-03	-2.065	-2.203	-0.138	25.77
	MgHCO3+	1.04E-03	7.25E-04	-2.982	-3.14	-0.158	5.74
	MgCO3	7.51E-04	7.99E-04	-3.124	-3.097	0.027	-17.09
	NaHCO3	4.06E-04	4.32E-04	-3.391	-3.364	0.027	1.8
	CO3-2	3.02E-04	8.47E-05	-3.519	-4.072	-0.553	-3.3
	NaCO3-	2.63E-04	1.94E-04	-3.58	-3.713	-0.133	0.71
	CaCO3	1.58E-04	1.68E-04	-3.802	-3.775	0.027	-14.6
	CaHCO3+	1.27E-04	9.42E-05	-3.895	-4.026	-0.131	9.9
	CO2	4.62E-05	4.92E-05	-4.335	-4.308	0.027	34.43
	Zn(CO3)2-2	1.13E-06	3.31E-07	-5.948	-6.481	-0.533	0
	BaHCO3+	3.32E-07	2.44E-07	-6.479	-6.613	-0.133	0
	ZnCO3	1.71E-07	1.82E-07	-6.766	-6.739	0.027	0
	BaCO3	1.67E-07	1.78E-07	-6.777	-6.75	0.027	-10.7
	MnCO3	1.19E-07	1.27E-07	-6.923	-6.896	0.027	0
	CuCO3	2.48E-08	2.64E-08	-7.605	-7.578	0.027	0
	MnHCO3+	1.47E-08	1.05E-08	-7.834	-7.977	-0.143	0
	ZnHCO3+	1.16E-08	8.51E-09	-7.937	-8.07	-0.133	0
	Cu(CO3)2-	9.61E-09	2.82E-09	-8.017	-8.55	-0.533	0
	FeCO3	2.94E-10	3.13E-10	-9.532	-9.505	0.027	0
	CuHCO3+	2.48E-10	1.82E-10	-9.606	-9.739	-0.133	0
	FeHCO3+	1.31E-10	9.64E-11	-9.883	-10.016	-0.133	0
	(CO2)2	4.17E-11	4.44E-11	-10.38	-10.353	0.027	68.87
Ca	4.82E-03						
	Ca+2	3.98E-03	1.18E-03	-2.4	-2.929	-0.528	-17.1
	CaSO4	5.58E-04	5.94E-04	-3.253	-3.226	0.027	7.5
	CaCO3	1.58E-04	1.68E-04	-3.802	-3.775	0.027	-14.6
	CaHCO3+	1.27E-04	9.42E-05	-3.895	-4.026	-0.131	9.9
	CaOH+	7.61E-08	5.60E-08	-7.118	-7.252	-0.133	0
	CaHSO4+	1.84E-11	1.35E-11	-10.735	-10.868	-0.133	0
Cl	1.77E-01						
	Cl-	1.77E-01	1.23E-01	-0.752	-0.912	-0.159	18.52
	CuCl2-	2.08E-08	1.45E-08	-7.681	-7.839	-0.158	0
	MnCl+	1.31E-08	9.43E-09	-7.882	-8.026	-0.143	-2.85
	ZnOHCl	1.18E-08	1.25E-08	-7.929	-7.902	0.027	0
	CuCl3-2	1.05E-08	2.81E-09	-7.978	-8.551	-0.573	0
	ZnCl+	5.12E-09	3.56E-09	-8.291	-8.449	-0.158	-14.6
	MnCl2	4.74E-10	5.05E-10	-9.324	-9.297	0.027	85.89
	ZnCl2	4.29E-10	4.57E-10	-9.367	-9.34	0.027	102.03
	ZnCl3-	9.04E-11	6.29E-11	-10.044	-10.202	-0.158	15.34
	FeCl+	3.54E-11	2.60E-11	-10.451	-10.585	-0.133	0
	CuCl+	2.76E-11	1.92E-11	-10.56	-10.718	-0.158	1.26
	MnCl3-	2.37E-11	1.70E-11	-10.625	-10.769	-0.143	44.49
	ZnCl4-2	1.44E-11	3.86E-12	-10.84	-11.413	-0.573	147.89
	CuCl2	1.19E-12	1.26E-12	-11.926	-11.899	0.027	31.02
	CuCl3-	7.89E-16	5.49E-16	-15.103	-15.261	-0.158	0
	FeCl+2	2.03E-18	5.44E-19	-17.692	-18.265	-0.573	0
	CuCl4-2	1.26E-18	3.37E-19	-17.899	-18.472	-0.573	0
	FeCl2+	4.14E-19	2.98E-19	-18.383	-18.526	-0.143	0

	FeCl3	3.43E-21	3.65E-21	-20.465	-20.438	0.027	0
Cu(1)	3.14E-08						
	CuCl2-	2.08E-08	1.45E-08	-7.681	-7.839	-0.158	0
	CuCl3-2	1.05E-08	2.81E-09	-7.978	-8.551	-0.573	0
	Cu+	4.68E-12	3.05E-12	-11.33	-11.516	-0.186	0
Cu(2)	1.29E-07						
	Cu(OH)2	9.35E-08	9.95E-08	-7.029	-7.002	0.027	0
	CuCO3	2.48E-08	2.64E-08	-7.605	-7.578	0.027	0
	Cu(CO3)2-	9.61E-09	2.82E-09	-8.017	-8.55	-0.533	0
	CuHCO3+	2.48E-10	1.82E-10	-9.606	-9.739	-0.133	0
	CuOH+	2.39E-10	1.66E-10	-9.621	-9.779	-0.158	0
	Cu+2	1.94E-10	5.81E-11	-9.711	-10.236	-0.525	-25.66
	CuSO4	3.16E-11	3.36E-11	-10.501	-10.474	0.027	13.09
	CuCl+	2.76E-11	1.92E-11	-10.56	-10.718	-0.158	1.26
	Cu(OH)3-	2.33E-12	1.72E-12	-11.632	-11.765	-0.133	0
	CuCl2	1.19E-12	1.26E-12	-11.926	-11.899	0.027	31.02
	CuF+	2.92E-13	2.15E-13	-12.534	-12.667	-0.133	0
	Cu2(OH)2+	4.13E-14	1.21E-14	-13.384	-13.917	-0.533	0
	CuCl3-	7.89E-16	5.49E-16	-15.103	-15.261	-0.158	0
	Cu(OH)4-2	3.35E-16	9.81E-17	-15.476	-16.008	-0.533	0
	CuCl4-2	1.26E-18	3.37E-19	-17.899	-18.472	-0.573	0
F	5.00E-04						
	F-	2.99E-04	2.04E-04	-3.525	-3.691	-0.166	-0.85
	MgF+	1.88E-04	1.33E-04	-3.726	-3.876	-0.15	-10.32
	NaF	1.35E-05	1.44E-05	-4.87	-4.842	0.027	7.26
	HF	9.95E-10	1.06E-09	-9.002	-8.975	0.027	12.5
	ZnF+	4.22E-11	3.10E-11	-10.375	-10.508	-0.133	0
	MnF+	3.70E-11	2.66E-11	-10.432	-10.575	-0.143	0
	HF2-	1.12E-12	8.27E-13	-11.949	-12.082	-0.133	22.52
	FeF+	4.26E-13	3.13E-13	-12.371	-12.504	-0.133	0
	CuF+	2.92E-13	2.15E-13	-12.534	-12.667	-0.133	0
	FeF2+	5.34E-16	3.84E-16	-15.272	-15.415	-0.143	0
	FeF+2	1.77E-16	4.74E-17	-15.751	-16.324	-0.573	0
	FeF3	1.17E-16	1.24E-16	-15.934	-15.907	0.027	0
Fe(2)	1.07E-09						
	Fe+2	5.15E-10	1.54E-10	-9.288	-9.813	-0.525	-21.14
	FeCO3	2.94E-10	3.13E-10	-9.532	-9.505	0.027	0
	FeHCO3+	1.31E-10	9.64E-11	-9.883	-10.016	-0.133	0
	FeSO4	7.28E-11	7.75E-11	-10.138	-10.111	0.027	18.97
	FeCl+	3.54E-11	2.60E-11	-10.451	-10.585	-0.133	0
	FeOH+	1.94E-11	1.39E-11	-10.713	-10.856	-0.143	0
	FeF+	4.26E-13	3.13E-13	-12.371	-12.504	-0.133	0
	Fe(OH)2	3.19E-14	3.40E-14	-13.496	-13.469	0.027	0
	Fe(OH)3-	5.02E-16	3.61E-16	-15.299	-15.442	-0.143	0
	FeHSO4+	2.40E-18	1.77E-18	-17.62	-17.753	-0.133	0
Fe(3)	1.27E-06						
	Fe(OH)3	8.93E-07	9.50E-07	-6.049	-6.022	0.027	0
	Fe(OH)4-	3.41E-07	2.48E-07	-6.467	-6.605	-0.138	0
	Fe(OH)2+	3.54E-08	2.58E-08	-7.451	-7.589	-0.138	0
	FeOH+2	1.02E-12	2.72E-13	-11.993	-12.566	-0.573	0

	FeF2+	5.34E-16	3.84E-16	-15.272	-15.415	-0.143	0
	FeF+2	1.77E-16	4.74E-17	-15.751	-16.324	-0.573	0
	FeF3	1.17E-16	1.24E-16	-15.934	-15.907	0.027	0
	FeSO4+	6.35E-18	4.56E-18	-17.197	-17.341	-0.143	0
	FeCl+2	2.03E-18	5.44E-19	-17.692	-18.265	-0.573	0
	Fe+3	1.28E-18	1.47E-19	-17.891	-18.833	-0.942	0
	FeCl2+	4.14E-19	2.98E-19	-18.383	-18.526	-0.143	0
	Fe(SO4)2-	3.84E-19	2.83E-19	-18.415	-18.548	-0.133	0
	FeCl3	3.43E-21	3.65E-21	-20.465	-20.438	0.027	0
	Fe2(OH)2+	2.68E-22	1.99E-24	-21.571	-23.702	-2.131	0
	FeHSO4+2	1.45E-25	4.24E-26	-24.84	-25.373	-0.533	0
	Fe3(OH)4+	2.28E-26	1.07E-29	-25.642	-28.971	-3.33	0
H(0)	1.60E-28						
	H2	8.00E-29	8.51E-29	-28.097	-28.07	0.027	28.61
K	2.42E-03						
	K+	2.38E-03	1.64E-03	-2.624	-2.786	-0.162	9.4
	KSO4-	4.48E-05	3.26E-05	-4.349	-4.487	-0.138	34.57
Mg	3.90E-02						
	Mg+2	3.08E-02	9.89E-03	-1.512	-2.005	-0.493	-20.81
	MgSO4	6.17E-03	6.57E-03	-2.21	-2.183	0.027	5.84
	MgHCO3+	1.04E-03	7.25E-04	-2.982	-3.14	-0.158	5.74
	MgCO3	7.51E-04	7.99E-04	-3.124	-3.097	0.027	-17.09
	MgF+	1.88E-04	1.33E-04	-3.726	-3.876	-0.15	-10.32
	MgOH+	1.37E-05	1.03E-05	-4.862	-4.988	-0.126	0
Mn(2)	2.20E-07						
	MnCO3	1.19E-07	1.27E-07	-6.923	-6.896	0.027	0
	Mn+2	6.32E-08	1.89E-08	-7.199	-7.724	-0.525	-17.25
	MnHCO3+	1.47E-08	1.05E-08	-7.834	-7.977	-0.143	0
	MnCl+	1.31E-08	9.43E-09	-7.882	-8.026	-0.143	-2.85
	MnSO4	8.94E-09	9.52E-09	-8.049	-8.022	0.027	22.54
	MnCl2	4.74E-10	5.05E-10	-9.324	-9.297	0.027	85.89
	MnOH+	1.93E-10	1.39E-10	-9.714	-9.857	-0.143	0
	MnF+	3.70E-11	2.66E-11	-10.432	-10.575	-0.143	0
	MnCl3-	2.37E-11	1.70E-11	-10.625	-10.769	-0.143	44.49
	Mn(NO3)2	1.52E-15	1.62E-15	-14.818	-14.79	0.027	41.04
	Mn(OH)3-	9.78E-18	7.03E-18	-17.01	-17.153	-0.143	0
Mn(3)	5.10E-29						
	Mn+3	5.10E-29	5.84E-30	-28.292	-29.234	-0.942	0
N(-3)	2.60E-05						
	NH4+	2.30E-05	1.50E-05	-4.639	-4.825	-0.186	18.29
	NH3	2.31E-06	2.46E-06	-5.637	-5.61	0.027	24.42
	NH4SO4-	7.42E-07	5.46E-07	-6.13	-6.263	-0.133	38.73
N(5)	2.20E-04						
	NO3-	2.20E-04	1.47E-04	-3.658	-3.833	-0.176	29.98
	Mn(NO3)2	1.52E-15	1.62E-15	-14.818	-14.79	0.027	41.04
Na	1.70E-01						
	Na+	1.67E-01	1.23E-01	-0.777	-0.911	-0.134	-0.84
	NaSO4-	2.40E-03	1.74E-03	-2.621	-2.759	-0.138	18.27
	NaHCO3	4.06E-04	4.32E-04	-3.391	-3.364	0.027	1.8
	NaCO3-	2.63E-04	1.94E-04	-3.58	-3.713	-0.133	0.71

	NaF	1.35E-05	1.44E-05	-4.87	-4.842	0.027	7.26
	NaOH	3.34E-17	3.56E-17	-16.476	-16.449	0.027	0
O(0)	1.07E-36						
	O2	5.33E-37	5.67E-37	-36.273	-36.246	0.027	30.4
S(6)	2.00E-02						
	SO4-2	1.09E-02	2.83E-03	-1.964	-2.548	-0.584	16.36
	MgSO4	6.17E-03	6.57E-03	-2.21	-2.183	0.027	5.84
	NaSO4-	2.40E-03	1.74E-03	-2.621	-2.759	-0.138	18.27
	CaSO4	5.58E-04	5.94E-04	-3.253	-3.226	0.027	7.5
	KSO4-	4.48E-05	3.26E-05	-4.349	-4.487	-0.138	34.57
	BaSO4	5.42E-06	5.77E-06	-5.266	-5.239	0.027	0
	NH4SO4-	7.42E-07	5.46E-07	-6.13	-6.263	-0.133	38.73
	MnSO4	8.94E-09	9.52E-09	-8.049	-8.022	0.027	22.54
	ZnSO4	6.73E-09	7.17E-09	-8.172	-8.145	0.027	21.71
	HSO4-	1.30E-09	9.55E-10	-8.887	-9.02	-0.133	40.72
	Zn(SO4)2-2	5.63E-10	1.65E-10	-9.25	-9.782	-0.533	-9.27
	FeSO4	7.28E-11	7.75E-11	-10.138	-10.111	0.027	18.97
	CuSO4	3.16E-11	3.36E-11	-10.501	-10.474	0.027	13.09
	CaHSO4+	1.84E-11	1.35E-11	-10.735	-10.868	-0.133	0
	FeSO4+	6.35E-18	4.56E-18	-17.197	-17.341	-0.143	0
	FeHSO4+	2.40E-18	1.77E-18	-17.62	-17.753	-0.133	0
	Fe(SO4)2-	3.84E-19	2.83E-19	-18.415	-18.548	-0.133	0
	FeHSO4+2	1.45E-25	4.24E-26	-24.84	-25.373	-0.533	0
Zn	1.39E-06						
	Zn(CO3)2-2	1.13E-06	3.31E-07	-5.948	-6.481	-0.533	0
	ZnCO3	1.71E-07	1.82E-07	-6.766	-6.739	0.027	0
	Zn+2	4.04E-08	1.08E-08	-7.394	-7.967	-0.573	-24.39
	ZnOHCl	1.18E-08	1.25E-08	-7.929	-7.902	0.027	0
	ZnHCO3+	1.16E-08	8.51E-09	-7.937	-8.07	-0.133	0
	Zn(OH)2	1.05E-08	1.11E-08	-7.98	-7.953	0.027	0
	ZnSO4	6.73E-09	7.17E-09	-8.172	-8.145	0.027	21.71
	ZnCl+	5.12E-09	3.56E-09	-8.291	-8.449	-0.158	-14.6
	ZnOH+	4.60E-09	3.39E-09	-8.337	-8.47	-0.133	0
	Zn(SO4)2-2	5.63E-10	1.65E-10	-9.25	-9.782	-0.533	-9.27
	ZnCl2	4.29E-10	4.57E-10	-9.367	-9.34	0.027	102.03
	ZnCl3-	9.04E-11	6.29E-11	-10.044	-10.202	-0.158	15.34
	ZnF+	4.22E-11	3.10E-11	-10.375	-10.508	-0.133	0
	ZnCl4-2	1.44E-11	3.86E-12	-10.84	-11.413	-0.573	147.89
	Zn(OH)3-	1.37E-11	1.01E-11	-10.863	-10.996	-0.133	0
	Zn(OH)4-2	1.56E-15	4.58E-16	-14.806	-15.339	-0.533	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.2	-5.48	-4.28	CaSO4			
Aragonite	1.34	-7	-8.34	CaCO3			
Barite	1.91	-7.94	-9.84	BaSO4			
Calcite	1.48	-7	-8.48	CaCO3			
CO2(g)	-2.84	-4.31	-1.47	CO2			

Dolomite	4.01	-13.08	-17.08	CaMg(CO3)2
Fe(OH)3(a)	1.65	6.54	4.89	Fe(OH)3
Fluorite	0.29	-10.31	-10.6	CaF2
Goethite	7.54	6.54	-1	FeOOH
Gypsum	-0.9	-5.48	-4.58	CaSO4:2H2O
H2(g)	-24.97	-28.07	-3.1	H2
H2O(g)	-1.51	0	1.5	H2O
Halite	-3.39	-1.82	1.57	NaCl
Hausmann	-8.53	52.5	61.03	Mn3O4
Hematite	17.09	13.08	-4.01	Fe2O3
Jarosite-K	-4.43	-13.64	-9.21	KFe3(SO4)2(OH)6
Manganite	-3.69	21.65	25.34	MnOOH
Melanterit	-10.17	-12.38	-2.21	FeSO4:7H2O
NH3(g)	-7.41	-5.61	1.8	NH3
O2(g)	-33.35	-36.25	-2.89	O2
Pyrochroit	-6.01	9.19	15.2	Mn(OH)2
Pyrolusite	-7.27	34.11	41.38	MnO2:H2O
Rhodochro	-0.67	-11.8	-11.13	MnCO3
Siderite	-3	-13.89	-10.89	FeCO3
Smithsonit	-2.04	-12.04	-10	ZnCO3
Sylvite	-4.6	-3.7	0.9	KCl
Witherite	-0.9	-9.46	-8.56	BaCO3
Zn(OH)2(e	-2.55	8.95	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 30

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.36E-02	1.36E-02
Ba	2.25E-05	2.25E-05
Ca	4.98E-03	4.98E-03
Cl	1.83E-01	1.83E-01
Cu	1.70E-07	1.70E-07
F	5.10E-04	5.10E-04
Fe	1.31E-06	1.31E-06
K	2.50E-03	2.50E-03
Mg	4.03E-02	4.03E-02
Mn	2.20E-07	2.20E-07
N(-3)	2.70E-05	2.70E-05
N(5)	2.30E-04	2.30E-04
Na	1.76E-01	1.76E-01
S(6)	2.07E-02	2.07E-02
Zn	1.43E-06	1.43E-06

#NAME? of solution----------

```
pH          =                8.46
pe          =                   4
Specific    Conductan (µS/cm,    25°C)      =              21769
Density     (g/cm³)   =              1.0085
Volume      (L)       =               1.006
Activity    of        water      =              0.993
Ionic       strength  (mol/kgw) =           2.81E-01
Mass        of        water      (kg)       =          1.00E+00
Total       carbon    (mol/kg)   =           1.21E-02
Total       CO2       (mol/kg)   =           1.21E-02
Temperatu   (°C)      =                  25
Electrical  balance   (eq)       =           3.04E-02
Percent     error,    100*(Cat-| =                6.51
Iterations  =                 10 (288       overall)
Total       H         =           1.11E+02
Total       O         =           5.56E+01

#NAME?  couples--------------------------------

        Redox     couple     pe          Eh          (volts)

        N(-3)/N(5)    4.4352     0.2624

#NAME?  of        species----------------------------

        Log       Log        Log        mole       V
        Species   Molality   Activity   Molality   Activity   Gamma   cm³/mol

        OH-        4.27E-06  2.90E-06     -5.37     -5.538    -0.168     -3.33
        H+         4.42E-09  3.47E-09    -8.355      -8.46    -0.105         0
        H2O        5.55E+01  9.93E-01     1.744     -0.003         0     18.07
Ba        2.25E-05
        Ba+2       1.63E-05  4.16E-06    -4.787     -5.381    -0.594    -11.56
        BaSO4      5.62E-06  5.99E-06    -5.251     -5.223     0.028         0
        BaHCO3+    3.48E-07  2.55E-07    -6.459     -6.593    -0.134         0
        BaCO3      1.75E-07  1.86E-07    -6.758      -6.73     0.028      -10.7
        BaOH+      5.63E-11  4.03E-11    -10.25    -10.394    -0.144         0
C(4)      1.21E-02
        HCO3-      8.83E-03  6.41E-03    -2.054     -2.193    -0.139      25.8
        MgHCO3+    1.10E-03  7.60E-04     -2.96     -3.119    -0.159      5.74
        MgCO3      7.86E-04  8.39E-04    -3.105     -3.076     0.028    -17.09
        NaHCO3     4.28E-04  4.56E-04    -3.369     -3.341     0.028       1.8
        CO3-2      3.13E-04  8.67E-05    -3.505     -4.062    -0.557     -3.26
        NaCO3-     2.78E-04  2.04E-04    -3.556      -3.69    -0.134      0.75
        CaCO3      1.65E-04  1.76E-04    -3.783     -3.755     0.028     -14.6
        CaHCO3+    1.34E-04  9.87E-05    -3.874     -4.006    -0.132       9.9
        CO2        4.72E-05  5.03E-05    -4.326     -4.298     0.028     34.43
        Zn(CO3)2-: 1.17E-06  3.40E-07    -5.933     -6.468    -0.535         0
        BaHCO3+    3.48E-07  2.55E-07    -6.459     -6.593    -0.134         0
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	BaCO3	1.75E-07	1.86E-07	-6.758	-6.73	0.028	-10.7
	ZnCO3	1.72E-07	1.84E-07	-6.764	-6.736	0.028	0
	MnCO3	1.20E-07	1.28E-07	-6.922	-6.894	0.028	0
	CuCO3	2.64E-08	2.82E-08	-7.579	-7.55	0.028	0
	MnHCO3+	1.48E-08	1.06E-08	-7.831	-7.975	-0.144	0
	ZnHCO3+	1.17E-08	8.57E-09	-7.933	-8.067	-0.134	0
	Cu(CO3)2-	1.05E-08	3.07E-09	-7.978	-8.512	-0.535	0
	FeCO3	3.10E-10	3.30E-10	-9.509	-9.481	0.028	0
	CuHCO3+	2.64E-10	1.94E-10	-9.578	-9.712	-0.134	0
	FeHCO3+	1.39E-10	1.02E-10	-9.858	-9.992	-0.134	0
	(CO2)2	4.36E-11	4.65E-11	-10.361	-10.333	0.028	68.87
Ca	4.98E-03						
	Ca+2	4.10E-03	1.21E-03	-2.387	-2.918	-0.532	-17.09
	CaSO4	5.78E-04	6.17E-04	-3.238	-3.21	0.028	7.5
	CaCO3	1.65E-04	1.76E-04	-3.783	-3.755	0.028	-14.6
	CaHCO3+	1.34E-04	9.87E-05	-3.874	-4.006	-0.132	9.9
	CaOH+	7.80E-08	5.73E-08	-7.108	-7.242	-0.134	0
	CaHSO4+	1.91E-11	1.41E-11	-10.718	-10.852	-0.134	0
Cl	1.83E-01						
	Cl-	1.83E-01	1.26E-01	-0.738	-0.899	-0.161	18.53
	CuCl2-	2.31E-08	1.60E-08	-7.637	-7.796	-0.159	0
	MnCl+	1.33E-08	9.54E-09	-7.876	-8.021	-0.144	-2.85
	CuCl3-2	1.21E-08	3.20E-09	-7.917	-8.495	-0.578	0
	ZnOHCl	1.19E-08	1.27E-08	-7.924	-7.896	0.028	0
	ZnCl+	5.21E-09	3.61E-09	-8.283	-8.443	-0.159	-14.63
	MnCl2	4.93E-10	5.26E-10	-9.307	-9.279	0.028	85.89
	ZnCl2	4.47E-10	4.77E-10	-9.349	-9.321	0.028	102.03
	ZnCl3-	9.75E-11	6.76E-11	-10.011	-10.17	-0.159	15.28
	FeCl+	3.77E-11	2.77E-11	-10.424	-10.558	-0.134	0
	CuCl+	2.97E-11	2.06E-11	-10.528	-10.687	-0.159	1.28
	MnCl3-	2.55E-11	1.83E-11	-10.594	-10.738	-0.144	44.52
	ZnCl4-2	1.62E-11	4.28E-12	-10.791	-11.369	-0.578	147.95
	CuCl2	1.31E-12	1.39E-12	-11.884	-11.856	0.028	31.02
	CuCl3-	9.01E-16	6.24E-16	-15.045	-15.205	-0.159	0
	FeCl+2	2.19E-18	5.79E-19	-17.66	-18.238	-0.578	0
	CuCl4-2	1.50E-18	3.95E-19	-17.825	-18.403	-0.578	0
	FeCl2+	4.55E-19	3.26E-19	-18.342	-18.486	-0.144	0
	FeCl3	3.86E-21	4.12E-21	-20.413	-20.385	0.028	0
Cu(1)	3.52E-08						
	CuCl2-	2.31E-08	1.60E-08	-7.637	-7.796	-0.159	0
	CuCl3-2	1.21E-08	3.20E-09	-7.917	-8.495	-0.578	0
	Cu+	4.90E-12	3.17E-12	-11.31	-11.498	-0.188	0
Cu(2)	1.35E-07						
	Cu(OH)2	9.71E-08	1.04E-07	-7.013	-6.985	0.028	0
	CuCO3	2.64E-08	2.82E-08	-7.579	-7.55	0.028	0
	Cu(CO3)2-	1.05E-08	3.07E-09	-7.978	-8.512	-0.535	0
	CuHCO3+	2.64E-10	1.94E-10	-9.578	-9.712	-0.134	0
	CuOH+	2.50E-10	1.73E-10	-9.602	-9.762	-0.159	0
	Cu+2	2.04E-10	6.05E-11	-9.69	-10.218	-0.529	-25.65
	CuSO4	3.33E-11	3.55E-11	-10.478	-10.45	0.028	13.09

	CuCl+	2.97E-11	2.06E-11	-10.528	-10.687	-0.159	1.28
	Cu(OH)3-	2.43E-12	1.79E-12	-11.614	-11.748	-0.134	0
	CuCl2	1.31E-12	1.39E-12	-11.884	-11.856	0.028	31.02
	CuF+	3.07E-13	2.25E-13	-12.513	-12.647	-0.134	0
	Cu2(OH)2+	4.49E-14	1.31E-14	-13.347	-13.882	-0.535	0
	CuCl3-	9.01E-16	6.24E-16	-15.045	-15.205	-0.159	0
	Cu(OH)4-2	3.50E-16	1.02E-16	-15.456	-15.991	-0.535	0
	CuCl4-2	1.50E-18	3.95E-19	-17.825	-18.403	-0.578	0
F	5.10E-04						
	F-	3.02E-04	2.05E-04	-3.521	-3.689	-0.168	-0.85
	MgF+	1.95E-04	1.37E-04	-3.711	-3.863	-0.152	-10.32
	NaF	1.40E-05	1.49E-05	-4.854	-4.826	0.028	7.26
	HF	9.99E-10	1.07E-09	-9.001	-8.973	0.028	12.5
	ZnF+	4.18E-11	3.07E-11	-10.379	-10.512	-0.134	0
	MnF+	3.66E-11	2.63E-11	-10.436	-10.58	-0.144	0
	HF2-	1.14E-12	8.37E-13	-11.943	-12.077	-0.134	22.53
	FeF+	4.43E-13	3.26E-13	-12.354	-12.488	-0.134	0
	CuF+	3.07E-13	2.25E-13	-12.513	-12.647	-0.134	0
	FeF2+	5.60E-16	4.02E-16	-15.252	-15.396	-0.144	0
	FeF+2	1.86E-16	4.93E-17	-15.73	-16.308	-0.578	0
	FeF3	1.22E-16	1.30E-16	-15.913	-15.885	0.028	0
Fe(2)	1.12E-09						
	Fe+2	5.37E-10	1.59E-10	-9.27	-9.799	-0.529	-21.12
	FeCO3	3.10E-10	3.30E-10	-9.509	-9.481	0.028	0
	FeHCO3+	1.39E-10	1.02E-10	-9.858	-9.992	-0.134	0
	FeSO4	7.61E-11	8.12E-11	-10.118	-10.09	0.028	18.97
	FeCl+	3.77E-11	2.77E-11	-10.424	-10.558	-0.134	0
	FeOH+	2.01E-11	1.44E-11	-10.698	-10.842	-0.144	0
	FeF+	4.43E-13	3.26E-13	-12.354	-12.488	-0.134	0
	Fe(OH)2	3.29E-14	3.51E-14	-13.483	-13.455	0.028	0
	Fe(OH)3-	5.20E-16	3.73E-16	-15.284	-15.428	-0.144	0
	FeHSO4+	2.52E-18	1.85E-18	-17.599	-17.733	-0.134	0
Fe(3)	1.31E-06						
	Fe(OH)3	9.19E-07	9.81E-07	-6.037	-6.008	0.028	0
	Fe(OH)4-	3.53E-07	2.56E-07	-6.452	-6.592	-0.139	0
	Fe(OH)2+	3.66E-08	2.66E-08	-7.436	-7.575	-0.139	0
	FeOH+2	1.06E-12	2.81E-13	-11.974	-12.552	-0.578	0
	FeF2+	5.60E-16	4.02E-16	-15.252	-15.396	-0.144	0
	FeF+2	1.86E-16	4.93E-17	-15.73	-16.308	-0.578	0
	FeF3	1.22E-16	1.30E-16	-15.913	-15.885	0.028	0
	FeSO4+	6.67E-18	4.78E-18	-17.176	-17.32	-0.144	0
	FeCl+2	2.19E-18	5.79E-19	-17.66	-18.238	-0.578	0
	Fe+3	1.35E-18	1.52E-19	-17.871	-18.819	-0.948	0
	FeCl2+	4.55E-19	3.26E-19	-18.342	-18.486	-0.144	0
	Fe(SO4)2-	4.09E-19	3.01E-19	-18.388	-18.522	-0.134	0
	FeCl3	3.86E-21	4.12E-21	-20.413	-20.385	0.028	0
	Fe2(OH)2+	2.91E-22	2.12E-24	-21.535	-23.674	-2.139	0
	FeHSO4+2	1.52E-25	4.44E-26	-24.818	-25.353	-0.535	0
	Fe3(OH)4+	2.58E-26	1.18E-29	-25.588	-28.93	-3.342	0
H(0)	1.60E-28						

	H2	7.98E-29	8.51E-29	-28.098	-28.07	0.028	28.61
K	2.50E-03						
	K+	2.45E-03	1.68E-03	-2.61	-2.774	-0.164	9.41
	KSO4-	4.69E-05	3.40E-05	-4.329	-4.469	-0.139	34.57
Mg	4.03E-02						
	Mg+2	3.18E-02	1.01E-02	-1.498	-1.994	-0.496	-20.8
	MgSO4	6.40E-03	6.83E-03	-2.194	-2.165	0.028	5.84
	MgHCO3+	1.10E-03	7.60E-04	-2.96	-3.119	-0.159	5.74
	MgCO3	7.86E-04	8.39E-04	-3.105	-3.076	0.028	-17.09
	MgF+	1.95E-04	1.37E-04	-3.711	-3.863	-0.152	-10.32
	MgOH+	1.41E-05	1.05E-05	-4.851	-4.977	-0.127	0
Mn(2)	2.20E-07						
	MnCO3	1.20E-07	1.28E-07	-6.922	-6.894	0.028	0
	Mn+2	6.26E-08	1.85E-08	-7.203	-7.732	-0.529	-17.22
	MnHCO3+	1.48E-08	1.06E-08	-7.831	-7.975	-0.144	0
	MnCl+	1.33E-08	9.54E-09	-7.876	-8.021	-0.144	-2.85
	MnSO4	8.89E-09	9.48E-09	-8.051	-8.023	0.028	22.54
	MnCl2	4.93E-10	5.26E-10	-9.307	-9.279	0.028	85.89
	MnOH+	1.90E-10	1.36E-10	-9.721	-9.865	-0.144	0
	MnF+	3.66E-11	2.63E-11	-10.436	-10.58	-0.144	0
	MnCl3-	2.55E-11	1.83E-11	-10.594	-10.738	-0.144	44.52
	Mn(NO3)2	1.62E-15	1.72E-15	-14.792	-14.763	0.028	41.04
	Mn(OH)3-	9.62E-18	6.90E-18	-17.017	-17.161	-0.144	0
Mn(3)	5.08E-29						
	Mn+3	5.08E-29	5.73E-30	-28.294	-29.242	-0.948	0
N(-3)	2.70E-05						
	NH4+	2.38E-05	1.55E-05	-4.623	-4.811	-0.188	18.29
	NH3	2.38E-06	2.54E-06	-5.623	-5.595	0.028	24.42
	NH4SO4-	7.79E-07	5.72E-07	-6.109	-6.242	-0.134	38.76
N(5)	2.30E-04						
	NO3-	2.30E-04	1.53E-04	-3.638	-3.816	-0.177	29.98
	Mn(NO3)2	1.62E-15	1.72E-15	-14.792	-14.763	0.028	41.04
Na	1.76E-01						
	Na+	1.73E-01	1.27E-01	-0.763	-0.898	-0.135	-0.83
	NaSO4-	2.51E-03	1.82E-03	-2.6	-2.739	-0.139	18.35
	NaHCO3	4.28E-04	4.56E-04	-3.369	-3.341	0.028	1.8
	NaCO3-	2.78E-04	2.04E-04	-3.556	-3.69	-0.134	0.75
	NaF	1.40E-05	1.49E-05	-4.854	-4.826	0.028	7.26
	NaOH	3.44E-17	3.67E-17	-16.464	-16.436	0.028	0
O(0)	1.06E-36						
	O2	5.32E-37	5.67E-37	-36.274	-36.246	0.028	30.4
S(6)	2.07E-02						
	SO4-2	1.12E-02	2.88E-03	-1.952	-2.541	-0.589	16.39
	MgSO4	6.40E-03	6.83E-03	-2.194	-2.165	0.028	5.84
	NaSO4-	2.51E-03	1.82E-03	-2.6	-2.739	-0.139	18.35
	CaSO4	5.78E-04	6.17E-04	-3.238	-3.21	0.028	7.5
	KSO4-	4.69E-05	3.40E-05	-4.329	-4.469	-0.139	34.57
	BaSO4	5.62E-06	5.99E-06	-5.251	-5.223	0.028	0
	NH4SO4-	7.79E-07	5.72E-07	-6.109	-6.242	-0.134	38.76
	MnSO4	8.89E-09	9.48E-09	-8.051	-8.023	0.028	22.54

	ZnSO4	6.71E-09	7.16E-09	-8.173	-8.145	0.028	21.71
	HSO4-	1.32E-09	9.69E-10	-8.88	-9.014	-0.134	40.72
	Zn(SO4)2-2	5.73E-10	1.67E-10	-9.242	-9.777	-0.535	-9.17
	FeSO4	7.61E-11	8.12E-11	-10.118	-10.09	0.028	18.97
	CuSO4	3.33E-11	3.55E-11	-10.478	-10.45	0.028	13.09
	CaHSO4+	1.91E-11	1.41E-11	-10.718	-10.852	-0.134	0
	FeSO4+	6.67E-18	4.78E-18	-17.176	-17.32	-0.144	0
	FeHSO4+	2.52E-18	1.85E-18	-17.599	-17.733	-0.134	0
	Fe(SO4)2-	4.09E-19	3.01E-19	-18.388	-18.522	-0.134	0
	FeHSO4+2	1.52E-25	4.44E-26	-24.818	-25.353	-0.535	0
Zn	1.43E-06						
	Zn(CO3)2-2	1.17E-06	3.40E-07	-5.933	-6.468	-0.535	0
	ZnCO3	1.72E-07	1.84E-07	-6.764	-6.736	0.028	0
	Zn+2	4.02E-08	1.06E-08	-7.396	-7.974	-0.578	-24.38
	ZnOHCl	1.19E-08	1.27E-08	-7.924	-7.896	0.028	0
	ZnHCO3+	1.17E-08	8.57E-09	-7.933	-8.067	-0.134	0
	Zn(OH)2	1.03E-08	1.10E-08	-7.988	-7.96	0.028	0
	ZnSO4	6.71E-09	7.16E-09	-8.173	-8.145	0.028	21.71
	ZnCl+	5.21E-09	3.61E-09	-8.283	-8.443	-0.159	-14.63
	ZnOH+	4.54E-09	3.33E-09	-8.343	-8.477	-0.134	0
	Zn(SO4)2-2	5.73E-10	1.67E-10	-9.242	-9.777	-0.535	-9.17
	ZnCl2	4.47E-10	4.77E-10	-9.349	-9.321	0.028	102.03
	ZnCl3-	9.75E-11	6.76E-11	-10.011	-10.17	-0.159	15.28
	ZnF+	4.18E-11	3.07E-11	-10.379	-10.512	-0.134	0
	ZnCl4-2	1.62E-11	4.28E-12	-10.791	-11.369	-0.578	147.95
	Zn(OH)3-	1.35E-11	9.92E-12	-10.87	-11.003	-0.134	0
	Zn(OH)4-2	1.54E-15	4.50E-16	-14.812	-15.347	-0.535	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.18	-5.46	-4.28	CaSO4			
Aragonite	1.36	-6.98	-8.34	CaCO3			
Barite	1.92	-7.92	-9.84	BaSO4			
Calcite	1.5	-6.98	-8.48	CaCO3			
CO2(g)	-2.83	-4.3	-1.47	CO2			
Dolomite	4.05	-13.04	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.66	6.55	4.89	Fe(OH)3			
Fluorite	0.3	-10.3	-10.6	CaF2			
Goethite	7.55	6.55	-1	FeOOH			
Gypsum	-0.88	-5.47	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	0	1.5	H2O			
Halite	-3.37	-1.8	1.57	NaCl			
Hausmann	-8.56	52.47	61.03	Mn3O4			
Hematite	17.12	13.11	-4.01	Fe2O3			
Jarosite-K	-4.36	-13.57	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.7	21.64	25.34	MnOOH			
Melanterit	-10.15	-12.36	-2.21	FeSO4:7H2O			

NH3(g)	-7.39	-5.6	1.8	NH3
O2(g)	-33.35	-36.25	-2.89	O2
Pyrochroit	-6.02	9.18	15.2	Mn(OH)2
Pyrolusite	-7.28	34.1	41.38	MnO2:H2O
Rhodochrc	-0.66	-11.79	-11.13	MnCO3
Siderite	-2.97	-13.86	-10.89	FeCO3
Smithsonit	-2.04	-12.04	-10	ZnCO3
Sylvite	-4.57	-3.67	0.9	KCl
Witherite	-0.88	-9.44	-8.56	BaCO3
Zn(OH)2(e	-2.56	8.94	11.5	Zn(OH)2

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

Initial solution 31

#NAME? composition----------

Elements	Molality	Moles
Alkalinity	1.40E-02	1.40E-02
Ba	2.32E-05	2.32E-05
Ca	5.15E-03	5.15E-03
Cl	1.89E-01	1.89E-01
Cu	1.70E-07	1.70E-07
F	5.30E-04	5.30E-04
Fe	1.36E-06	1.36E-06
K	2.58E-03	2.58E-03
Mg	4.16E-02	4.16E-02
Mn	2.30E-07	2.30E-07
N(-3)	2.80E-05	2.80E-05
N(5)	2.40E-04	2.40E-04
Na	1.82E-01	1.82E-01
S(6)	2.14E-02	2.14E-02
Zn	1.48E-06	1.48E-06

#NAME? of solution----------

pH = 8.46
pe = 4
Specific Conductan (µS/cm, 25°C) = 22389
Density (g/cm³) = 1.00887
Volume (L) = 1.0061
Activity of water = 0.993
Ionic strength (mol/kgw) = 2.89E-01
Mass of water (kg) = 1.00E+00
Total carbon (mol/kg) = 1.25E-02
Total CO2 (mol/kg) = 1.25E-02
Temperatu (°C) = 25
Electrical balance (eq) = 3.14E-02

```
Percent error, 100*(Cat-|=                6.52
Iterations =                10 (298      overall)
Total H =          1.11E+02
Total O =          5.56E+01

#NAME? couples--------------------------------

Redox couple pe Eh (volts)

N(-3)/N(5) 4.4356 0.2624

#NAME? of species----------------------------

Log Log Log mole V
Species Molality Activity Molality Activity Gamma cm³/mol

OH- 4.28E-06 2.90E-06 -5.369 -5.538 -0.17 -3.32
H+ 4.43E-09 3.47E-09 -8.354 -8.46 -0.106 0
H2O 5.55E+01 9.93E-01 1.744 -0.003 0 18.07
Ba 2.32E-05
Ba+2 1.69E-05 4.25E-06 -4.773 -5.372 -0.599 -11.55
BaSO4 5.81E-06 6.21E-06 -5.236 -5.207 0.029 0
BaHCO3+ 3.63E-07 2.67E-07 -6.44 -6.574 -0.134 0
BaCO3 1.82E-07 1.95E-07 -6.74 -6.711 0.029 -10.7
BaOH+ 5.76E-11 4.12E-11 -10.239 -10.385 -0.146 0
C(4) 1.25E-02
HCO3- 9.05E-03 6.55E-03 -2.043 -2.184 -0.14 25.83
MgHCO3+ 1.15E-03 7.96E-04 -2.938 -3.099 -0.161 5.75
MgCO3 8.21E-04 8.78E-04 -3.085 -3.057 0.029 -17.09
NaHCO3 4.50E-04 4.81E-04 -3.347 -3.318 0.029 1.8
CO3-2 3.23E-04 8.86E-05 -3.491 -4.052 -0.562 -3.22
NaCO3- 2.93E-04 2.15E-04 -3.533 -3.667 -0.134 0.8
CaCO3 1.72E-04 1.84E-04 -3.764 -3.735 0.029 -14.6
CaHCO3+ 1.41E-04 1.03E-04 -3.852 -3.986 -0.133 9.9
CO2 4.82E-05 5.15E-05 -4.317 -4.288 0.029 34.43
Zn(CO3)2-2 1.21E-06 3.53E-07 -5.916 -6.452 -0.536 0
BaHCO3+ 3.63E-07 2.67E-07 -6.44 -6.574 -0.134 0
BaCO3 1.82E-07 1.95E-07 -6.74 -6.711 0.029 -10.7
ZnCO3 1.74E-07 1.86E-07 -6.759 -6.73 0.029 0
MnCO3 1.25E-07 1.34E-07 -6.902 -6.873 0.029 0
CuCO3 2.64E-08 2.82E-08 -7.579 -7.55 0.029 0
MnHCO3+ 1.56E-08 1.11E-08 -7.808 -7.954 -0.146 0
ZnHCO3+ 1.18E-08 8.69E-09 -7.927 -8.061 -0.134 0
Cu(CO3)2- 1.08E-08 3.15E-09 -7.966 -8.502 -0.536 0
FeCO3 3.29E-10 3.51E-10 -9.483 -9.455 0.029 0
CuHCO3+ 2.65E-10 1.95E-10 -9.577 -9.711 -0.134 0
FeHCO3+ 1.47E-10 1.08E-10 -9.832 -9.966 -0.134 0
(CO2)2 4.55E-11 4.86E-11 -10.342 -10.313 0.029 68.87
Ca 5.15E-03
Ca+2 4.24E-03 1.24E-03 -2.373 -2.908 -0.535 -17.07
```

	CaSO4	6.00E-04	6.41E-04	-3.222	-3.193	0.029	7.5
	CaCO3	1.72E-04	1.84E-04	-3.764	-3.735	0.029	-14.6
	CaHCO3+	1.41E-04	1.03E-04	-3.852	-3.986	-0.133	9.9
	CaOH+	8.00E-08	5.87E-08	-7.097	-7.231	-0.134	0
	CaHSO4+	1.99E-11	1.46E-11	-10.701	-10.835	-0.134	0
Cl	1.89E-01						
	Cl-	1.89E-01	1.30E-01	-0.724	-0.886	-0.162	18.54
	CuCl2-	2.40E-08	1.66E-08	-7.619	-7.78	-0.161	0
	MnCl+	1.41E-08	1.01E-08	-7.851	-7.997	-0.146	-2.85
	CuCl3-2	1.31E-08	3.42E-09	-7.884	-8.466	-0.583	0
	ZnOHCl	1.21E-08	1.30E-08	-7.916	-7.887	0.029	0
	ZnCl+	5.33E-09	3.68E-09	-8.273	-8.434	-0.161	-14.66
	MnCl2	5.35E-10	5.72E-10	-9.272	-9.243	0.029	85.89
	ZnCl2	4.69E-10	5.01E-10	-9.329	-9.3	0.029	102.03
	ZnCl3-	1.06E-10	7.31E-11	-9.976	-10.136	-0.161	15.22
	FeCl+	4.03E-11	2.96E-11	-10.394	-10.528	-0.134	0
	CuCl+	3.00E-11	2.07E-11	-10.523	-10.684	-0.161	1.29
	MnCl3-	2.86E-11	2.05E-11	-10.544	-10.689	-0.146	44.55
	ZnCl4-2	1.82E-11	4.76E-12	-10.74	-11.323	-0.583	148.01
	CuCl2	1.35E-12	1.45E-12	-11.869	-11.84	0.029	31.02
	CuCl3-	9.65E-16	6.67E-16	-15.015	-15.176	-0.161	0
	FeCl+2	2.37E-18	6.19E-19	-17.626	-18.208	-0.583	0
	CuCl4-2	1.66E-18	4.34E-19	-17.78	-18.362	-0.583	0
	FeCl2+	5.02E-19	3.59E-19	-18.299	-18.445	-0.146	0
	FeCl3	4.37E-21	4.67E-21	-20.36	-20.331	0.029	0
Cu(1)	3.71E-08						
	CuCl2-	2.40E-08	1.66E-08	-7.619	-7.78	-0.161	0
	CuCl3-2	1.31E-08	3.42E-09	-7.884	-8.466	-0.583	0
	Cu+	4.82E-12	3.11E-12	-11.317	-11.507	-0.19	0
Cu(2)	1.33E-07						
	Cu(OH)2	9.49E-08	1.01E-07	-7.023	-6.994	0.029	0
	CuCO3	2.64E-08	2.82E-08	-7.579	-7.55	0.029	0
	Cu(CO3)2-	1.08E-08	3.15E-09	-7.966	-8.502	-0.536	0
	CuHCO3+	2.65E-10	1.95E-10	-9.577	-9.711	-0.134	0
	CuOH+	2.46E-10	1.70E-10	-9.61	-9.771	-0.161	0
	Cu+2	2.02E-10	5.93E-11	-9.695	-10.227	-0.533	-25.64
	CuSO4	3.30E-11	3.53E-11	-10.481	-10.453	0.029	13.09
	CuCl+	3.00E-11	2.07E-11	-10.523	-10.684	-0.161	1.29
	Cu(OH)3-	2.38E-12	1.75E-12	-11.623	-11.757	-0.134	0
	CuCl2	1.35E-12	1.45E-12	-11.869	-11.84	0.029	31.02
	CuF+	3.09E-13	2.27E-13	-12.511	-12.645	-0.134	0
	Cu2(OH)2+	4.33E-14	1.26E-14	-13.364	-13.9	-0.536	0
	CuCl3-	9.65E-16	6.67E-16	-15.015	-15.176	-0.161	0
	Cu(OH)4-2	3.44E-16	9.99E-17	-15.464	-16	-0.536	0
	CuCl4-2	1.66E-18	4.34E-19	-17.78	-18.362	-0.583	0
F	5.30E-04						
	F-	3.10E-04	2.10E-04	-3.508	-3.678	-0.17	-0.84
	MgF+	2.05E-04	1.44E-04	-3.689	-3.841	-0.153	-10.32
	NaF	1.48E-05	1.58E-05	-4.831	-4.802	0.029	7.26
	HF	1.02E-09	1.09E-09	-8.991	-8.962	0.029	12.5

	ZnF+	4.26E-11	3.13E-11	-10.371	-10.505	-0.134	0
	MnF+	3.87E-11	2.77E-11	-10.412	-10.558	-0.146	0
	HF2-	1.20E-12	8.81E-13	-11.921	-12.055	-0.134	22.54
	FeF+	4.73E-13	3.47E-13	-12.326	-12.46	-0.134	0
	CuF+	3.09E-13	2.27E-13	-12.511	-12.645	-0.134	0
	FeF2+	6.14E-16	4.39E-16	-15.212	-15.357	-0.146	0
	FeF+2	2.01E-16	5.25E-17	-15.697	-16.28	-0.583	0
	FeF3	1.37E-16	1.46E-16	-15.864	-15.835	0.029	0
Fe(2)	1.18E-09						
	Fe+2	5.63E-10	1.65E-10	-9.249	-9.782	-0.533	-21.11
	FeCO3	3.29E-10	3.51E-10	-9.483	-9.455	0.029	0
	FeHCO3+	1.47E-10	1.08E-10	-9.832	-9.966	-0.134	0
	FeSO4	8.01E-11	8.56E-11	-10.096	-10.067	0.029	18.97
	FeCl+	4.03E-11	2.96E-11	-10.394	-10.528	-0.134	0
	FeOH+	2.09E-11	1.50E-11	-10.68	-10.825	-0.146	0
	FeF+	4.73E-13	3.47E-13	-12.326	-12.46	-0.134	0
	Fe(OH)2	3.41E-14	3.64E-14	-13.468	-13.439	0.029	0
	Fe(OH)3-	5.42E-16	3.87E-16	-15.266	-15.412	-0.146	0
	FeHSO4+	2.66E-18	1.95E-18	-17.575	-17.71	-0.134	0
Fe(3)	1.36E-06						
	Fe(OH)3	9.53E-07	1.02E-06	-6.021	-5.992	0.029	0
	Fe(OH)4-	3.68E-07	2.66E-07	-6.435	-6.575	-0.14	0
	Fe(OH)2+	3.82E-08	2.76E-08	-7.418	-7.559	-0.14	0
	FeOH+2	1.12E-12	2.92E-13	-11.953	-12.535	-0.583	0
	FeF2+	6.14E-16	4.39E-16	-15.212	-15.357	-0.146	0
	FeF+2	2.01E-16	5.25E-17	-15.697	-16.28	-0.583	0
	FeF3	1.37E-16	1.46E-16	-15.864	-15.835	0.029	0
	FeSO4+	7.05E-18	5.04E-18	-17.152	-17.297	-0.146	0
	FeCl+2	2.37E-18	6.19E-19	-17.626	-18.208	-0.583	0
	Fe+3	1.42E-18	1.58E-19	-17.849	-18.802	-0.953	0
	FeCl2+	5.02E-19	3.59E-19	-18.299	-18.445	-0.146	0
	Fe(SO4)2-	4.38E-19	3.22E-19	-18.359	-18.493	-0.134	0
	FeCl3	4.37E-21	4.67E-21	-20.36	-20.331	0.029	0
	Fe2(OH)2+	3.20E-22	2.29E-24	-21.495	-23.641	-2.146	0
	FeHSO4+2	1.61E-25	4.68E-26	-24.793	-25.33	-0.536	0
	Fe3(OH)4+	2.98E-26	1.32E-29	-25.526	-28.879	-3.353	0
H(0)	1.59E-28						
	H2	7.96E-29	8.51E-29	-28.099	-28.07	0.029	28.61
K	2.58E-03						
	K+	2.53E-03	1.73E-03	-2.597	-2.762	-0.165	9.42
	KSO4-	4.90E-05	3.55E-05	-4.31	-4.45	-0.14	34.58
Mg	4.16E-02						
	Mg+2	3.27E-02	1.04E-02	-1.485	-1.984	-0.499	-20.79
	MgSO4	6.64E-03	7.10E-03	-2.178	-2.149	0.029	5.84
	MgHCO3+	1.15E-03	7.96E-04	-2.938	-3.099	-0.161	5.75
	MgCO3	8.21E-04	8.78E-04	-3.085	-3.057	0.029	-17.09
	MgF+	2.05E-04	1.44E-04	-3.689	-3.841	-0.153	-10.32
	MgOH+	1.45E-05	1.08E-05	-4.839	-4.967	-0.128	0
Mn(2)	2.30E-07						
	MnCO3	1.25E-07	1.34E-07	-6.902	-6.873	0.029	0

	Mn+2	6.49E-08	1.90E-08	-7.188	-7.72	-0.533	-17.19
	MnHCO3+	1.56E-08	1.11E-08	-7.808	-7.954	-0.146	0
	MnCl+	1.41E-08	1.01E-08	-7.851	-7.997	-0.146	-2.85
	MnSO4	9.24E-09	9.87E-09	-8.035	-8.006	0.029	22.54
	MnCl2	5.35E-10	5.72E-10	-9.272	-9.243	0.029	85.89
	MnOH+	1.96E-10	1.40E-10	-9.708	-9.854	-0.146	0
	MnF+	3.87E-11	2.77E-11	-10.412	-10.558	-0.146	0
	MnCl3-	2.86E-11	2.05E-11	-10.544	-10.689	-0.146	44.55
	Mn(NO3)2	1.79E-15	1.91E-15	-14.747	-14.718	0.029	41.04
	Mn(OH)3-	9.90E-18	7.08E-18	-17.004	-17.15	-0.146	0
Mn(3)	5.28E-29						
	Mn+3	5.28E-29	5.88E-30	-28.277	-29.23	-0.953	0
N(-3)	2.80E-05						
	NH4+	2.47E-05	1.60E-05	-4.607	-4.797	-0.19	18.3
	NH3	2.45E-06	2.62E-06	-5.61	-5.581	0.029	24.42
	NH4SO4-	8.16E-07	5.99E-07	-6.088	-6.222	-0.134	38.79
N(5)	2.40E-04						
	NO3-	2.40E-04	1.59E-04	-3.62	-3.799	-0.179	29.99
	Mn(NO3)2	1.79E-15	1.91E-15	-14.747	-14.718	0.029	41.04
Na	1.82E-01						
	Na+	1.78E-01	1.30E-01	-0.749	-0.885	-0.136	-0.82
	NaSO4-	2.63E-03	1.91E-03	-2.58	-2.72	-0.14	18.43
	NaHCO3	4.50E-04	4.81E-04	-3.347	-3.318	0.029	1.8
	NaCO3-	2.93E-04	2.15E-04	-3.533	-3.667	-0.134	0.8
	NaF	1.48E-05	1.58E-05	-4.831	-4.802	0.029	7.26
	NaOH	3.54E-17	3.78E-17	-16.452	-16.423	0.029	0
O(0)	1.06E-36						
	O2	5.30E-37	5.67E-37	-36.275	-36.247	0.029	30.4
S(6)	2.14E-02						
	SO4-2	1.15E-02	2.92E-03	-1.941	-2.535	-0.594	16.42
	MgSO4	6.64E-03	7.10E-03	-2.178	-2.149	0.029	5.84
	NaSO4-	2.63E-03	1.91E-03	-2.58	-2.72	-0.14	18.43
	CaSO4	6.00E-04	6.41E-04	-3.222	-3.193	0.029	7.5
	KSO4-	4.90E-05	3.55E-05	-4.31	-4.45	-0.14	34.58
	BaSO4	5.81E-06	6.21E-06	-5.236	-5.207	0.029	0
	NH4SO4-	8.16E-07	5.99E-07	-6.088	-6.222	-0.134	38.79
	MnSO4	9.24E-09	9.87E-09	-8.035	-8.006	0.029	22.54
	ZnSO4	6.73E-09	7.20E-09	-8.172	-8.143	0.029	21.71
	HSO4-	1.34E-09	9.83E-10	-8.873	-9.007	-0.134	40.73
	Zn(SO4)2-2	5.87E-10	1.71E-10	-9.232	-9.768	-0.536	-9.08
	FeSO4	8.01E-11	8.56E-11	-10.096	-10.067	0.029	18.97
	CuSO4	3.30E-11	3.53E-11	-10.481	-10.453	0.029	13.09
	CaHSO4+	1.99E-11	1.46E-11	-10.701	-10.835	-0.134	0
	FeSO4+	7.05E-18	5.04E-18	-17.152	-17.297	-0.146	0
	FeHSO4+	2.66E-18	1.95E-18	-17.575	-17.71	-0.134	0
	Fe(SO4)2-	4.38E-19	3.22E-19	-18.359	-18.493	-0.134	0
	FeHSO4+2	1.61E-25	4.68E-26	-24.793	-25.33	-0.536	0
Zn	1.48E-06						
	Zn(CO3)2-2	1.21E-06	3.53E-07	-5.916	-6.452	-0.536	0
	ZnCO3	1.74E-07	1.86E-07	-6.759	-6.73	0.029	0

Zn+2	4.03E-08	1.05E-08	-7.395	-7.978	-0.583	-24.37
ZnOHCl	1.21E-08	1.30E-08	-7.916	-7.887	0.029	0
ZnHCO3+	1.18E-08	8.69E-09	-7.927	-8.061	-0.134	0
Zn(OH)2	1.02E-08	1.09E-08	-7.993	-7.964	0.029	0
ZnSO4	6.73E-09	7.20E-09	-8.172	-8.143	0.029	21.71
ZnCl+	5.33E-09	3.68E-09	-8.273	-8.434	-0.161	-14.66
ZnOH+	4.50E-09	3.31E-09	-8.347	-8.481	-0.134	0
Zn(SO4)2-2	5.87E-10	1.71E-10	-9.232	-9.768	-0.536	-9.08
ZnCl2	4.69E-10	5.01E-10	-9.329	-9.3	0.029	102.03
ZnCl3-	1.06E-10	7.31E-11	-9.976	-10.136	-0.161	15.22
ZnF+	4.26E-11	3.13E-11	-10.371	-10.505	-0.134	0
ZnCl4-2	1.82E-11	4.76E-12	-10.74	-11.323	-0.583	148.01
Zn(OH)3-	1.34E-11	9.83E-12	-10.873	-11.007	-0.134	0
Zn(OH)4-2	1.53E-15	4.46E-16	-14.814	-15.351	-0.536	0

#NAME? indices----------

Phase	SI**	log	IAP	log	K(298	K,	1
Anhydrite	-1.17	-5.44	-4.28	CaSO4			
Aragonite	1.38	-6.96	-8.34	CaCO3			
Barite	1.94	-7.91	-9.84	BaSO4			
Calcite	1.52	-6.96	-8.48	CaCO3			
CO2(g)	-2.82	-4.29	-1.47	CO2			
Dolomite	4.09	-13	-17.08	CaMg(CO3)2			
Fe(OH)3(a)	1.68	6.57	4.89	Fe(OH)3			
Fluorite	0.34	-10.26	-10.6	CaF2			
Goethite	7.57	6.57	-1	FeOOH			
Gypsum	-0.87	-5.45	-4.58	CaSO4:2H2O			
H2(g)	-24.97	-28.07	-3.1	H2			
H2O(g)	-1.51	0	1.5	H2O			
Halite	-3.34	-1.77	1.57	NaCl			
Hausmann	-8.52	52.51	61.03	Mn3O4			
Hematite	17.15	13.15	-4.01	Fe2O3			
Jarosite-K	-4.29	-13.5	-9.21	KFe3(SO4)2(OH)6			
Manganite	-3.69	21.65	25.34	MnOOH			
Melanterit	-10.13	-12.34	-2.21	FeSO4:7H2O			
NH3(g)	-7.38	-5.58	1.8	NH3			
O2(g)	-33.35	-36.25	-2.89	O2			
Pyrochroit	-6.01	9.19	15.2	Mn(OH)2			
Pyrolusite	-7.27	34.11	41.38	MnO2:H2O			
Rhodochro	-0.64	-11.77	-11.13	MnCO3			
Siderite	-2.94	-13.83	-10.89	FeCO3			
Smithsonit	-2.03	-12.03	-10	ZnCO3			
Sylvite	-4.55	-3.65	0.9	KCl			
Witherite	-0.86	-9.42	-8.56	BaCO3			
Zn(OH)2(e	-2.56	8.94	11.5	Zn(OH)2			

**For a gas, SI = log10(fuga Fugacity = pressure
For ideal gases, phi = 1

```
Initial     solution          32

 #NAME?  composition-----------------------------

         Elements  Molality   Moles

         Alkalinity  1.45E-02  1.45E-02
         Ba          2.40E-05  2.40E-05
         Ca          5.31E-03  5.31E-03
         Cl          1.95E-01  1.95E-01
         Cu          1.80E-07  1.80E-07
         F           5.50E-04  5.50E-04
         Fe          1.40E-06  1.40E-06
         K           2.66E-03  2.66E-03
         Mg          4.29E-02  4.29E-02
         Mn          2.40E-07  2.40E-07
         N(-3)       2.90E-05  2.90E-05
         N(5)        2.50E-04  2.50E-04
         Na          1.87E-01  1.87E-01
         S(6)        2.21E-02  2.21E-02
         Zn          1.53E-06  1.53E-06

 #NAME?  of        solution----------------------------

         pH        =                 8.46
         pe        =                    4
         Specific  Conductan (µS/cm,  25°C)     =              23005
         Density   (g/cm³)   =          1.00923
         Volume    (L)       =          1.00621
         Activity  of        water    =              0.992
         Ionic     strength  (mol/kgw) =          2.98E-01
         Mass      of        water    (kg)      =          1.00E+00
         Total     carbon    (mol/kg) =          1.28E-02
         Total     CO2       (mol/kg) =          1.28E-02
         Temperatu (°C)      =                 25
         Electrical balance  (eq)     =          3.23E-02
         Percent   error,    100*(Cat-|=              6.52
         Iterations =                10 (308      overall)
         Total     H         =          1.11E+02
         Total     O         =          5.56E+01

 #NAME?  couples--------------------------------

         Redox     couple    pe        Eh        (volts)

         N(-3)/N(5)    4.436    0.2624

 #NAME?  of        species----------------------------
```

	Log Species	Log Molality	Log Activity	mole Molality	V Activity	Gamma	cm³/mol
	OH-	4.30E-06	2.90E-06	-5.367	-5.538	-0.171	-3.3
	H+	4.43E-09	3.47E-09	-8.353	-8.46	-0.107	0
	H2O	5.55E+01	9.92E-01	1.744	-0.003	0	18.07
Ba	2.40E-05						
	Ba+2	1.74E-05	4.34E-06	-4.759	-5.362	-0.603	-11.53
	BaSO4	6.01E-06	6.43E-06	-5.222	-5.192	0.03	0
	BaHCO3+	3.80E-07	2.79E-07	-6.421	-6.555	-0.135	0
	BaCO3	1.90E-07	2.03E-07	-6.722	-6.692	0.03	-10.7
	BaOH+	5.90E-11	4.21E-11	-10.229	-10.376	-0.147	0
C(4)	1.28E-02						
	HCO3-	9.27E-03	6.69E-03	-2.033	-2.174	-0.141	25.85
	MgHCO3+	1.21E-03	8.32E-04	-2.918	-3.08	-0.162	5.75
	MgCO3	8.57E-04	9.18E-04	-3.067	-3.037	0.03	-17.09
	NaHCO3	4.72E-04	5.05E-04	-3.326	-3.296	0.03	1.8
	CO3-2	3.33E-04	9.05E-05	-3.477	-4.043	-0.566	-3.19
	NaCO3-	3.09E-04	2.26E-04	-3.511	-3.645	-0.135	0.85
	CaCO3	1.80E-04	1.92E-04	-3.746	-3.716	0.03	-14.6
	CaHCO3+	1.47E-04	1.08E-04	-3.833	-3.967	-0.134	9.91
	CO2	4.91E-05	5.26E-05	-4.309	-4.279	0.03	34.43
	Zn(CO3)2-2	1.26E-06	3.65E-07	-5.899	-6.437	-0.538	0
	BaHCO3+	3.80E-07	2.79E-07	-6.421	-6.555	-0.135	0
	BaCO3	1.90E-07	2.03E-07	-6.722	-6.692	0.03	-10.7
	ZnCO3	1.76E-07	1.89E-07	-6.754	-6.724	0.03	0
	MnCO3	1.31E-07	1.41E-07	-6.882	-6.852	0.03	0
	CuCO3	2.79E-08	2.99E-08	-7.554	-7.525	0.03	0
	MnHCO3+	1.63E-08	1.17E-08	-7.787	-7.934	-0.147	0
	ZnHCO3+	1.20E-08	8.81E-09	-7.921	-8.055	-0.135	0
	Cu(CO3)2-	1.18E-08	3.41E-09	-7.93	-8.468	-0.538	0
	FeCO3	3.45E-10	3.70E-10	-9.462	-9.432	0.03	0
	CuHCO3+	2.81E-10	2.06E-10	-9.551	-9.686	-0.135	0
	FeHCO3+	1.55E-10	1.14E-10	-9.809	-9.943	-0.135	0
	(CO2)2	4.74E-11	5.08E-11	-10.324	-10.295	0.03	68.87
Ca	5.31E-03						
	Ca+2	4.36E-03	1.26E-03	-2.36	-2.898	-0.538	-17.06
	CaSO4	6.20E-04	6.64E-04	-3.207	-3.178	0.03	7.5
	CaCO3	1.80E-04	1.92E-04	-3.746	-3.716	0.03	-14.6
	CaHCO3+	1.47E-04	1.08E-04	-3.833	-3.967	-0.134	9.91
	CaOH+	8.18E-08	6.00E-08	-7.087	-7.222	-0.135	0
	CaHSO4+	2.06E-11	1.51E-11	-10.685	-10.82	-0.135	0
Cl	1.95E-01						
	Cl-	1.95E-01	1.34E-01	-0.711	-0.874	-0.164	18.55
	CuCl2-	2.64E-08	1.82E-08	-7.578	-7.74	-0.162	0
	MnCl+	1.49E-08	1.06E-08	-7.827	-7.973	-0.147	-2.85
	CuCl3-2	1.49E-08	3.85E-09	-7.827	-8.414	-0.587	0
	ZnOHCl	1.24E-08	1.32E-08	-7.908	-7.878	0.03	0
	ZnCl+	5.46E-09	3.76E-09	-8.263	-8.425	-0.162	-14.69
	MnCl2	5.79E-10	6.20E-10	-9.238	-9.208	0.03	85.89

	ZnCl2	4.91E-10	5.26E-10	-9.309	-9.279	0.03	102.03
	ZnCl3-	1.14E-10	7.88E-11	-9.941	-10.104	-0.162	15.16
	FeCl+	4.28E-11	3.14E-11	-10.369	-10.503	-0.135	0
	CuCl+	3.21E-11	2.21E-11	-10.493	-10.656	-0.162	1.31
	MnCl3-	3.20E-11	2.28E-11	-10.495	-10.642	-0.147	44.58
	ZnCl4-2	2.04E-11	5.28E-12	-10.691	-11.278	-0.587	148.07
	CuCl2	1.48E-12	1.59E-12	-11.83	-11.8	0.03	31.02
	CuCl3-	1.09E-15	7.51E-16	-14.962	-15.124	-0.162	0
	FeCl+2	2.54E-18	6.56E-19	-17.596	-18.183	-0.587	0
	CuCl4-2	1.95E-18	5.03E-19	-17.711	-18.298	-0.587	0
	FeCl2+	5.49E-19	3.91E-19	-18.261	-18.407	-0.147	0
	FeCl3	4.88E-21	5.23E-21	-20.311	-20.282	0.03	0
Cu(1)	4.14E-08						
	CuCl2-	2.64E-08	1.82E-08	-7.578	-7.74	-0.162	0
	CuCl3-2	1.49E-08	3.85E-09	-7.827	-8.414	-0.587	0
	Cu+	5.02E-12	3.23E-12	-11.299	-11.491	-0.192	0
Cu(2)	1.39E-07						
	Cu(OH)2	9.82E-08	1.05E-07	-7.008	-6.978	0.03	0
	CuCO3	2.79E-08	2.99E-08	-7.554	-7.525	0.03	0
	Cu(CO3)2-	1.18E-08	3.41E-09	-7.93	-8.468	-0.538	0
	CuHCO3+	2.81E-10	2.06E-10	-9.551	-9.686	-0.135	0
	CuOH+	2.56E-10	1.76E-10	-9.593	-9.755	-0.162	0
	Cu+2	2.11E-10	6.15E-11	-9.675	-10.211	-0.537	-25.63
	CuSO4	3.46E-11	3.71E-11	-10.461	-10.431	0.03	13.09
	CuCl+	3.21E-11	2.21E-11	-10.493	-10.656	-0.162	1.31
	Cu(OH)3-	2.47E-12	1.81E-12	-11.607	-11.742	-0.135	0
	CuCl2	1.48E-12	1.59E-12	-11.83	-11.8	0.03	31.02
	CuF+	3.28E-13	2.41E-13	-12.484	-12.619	-0.135	0
	Cu2(OH)2+	4.67E-14	1.35E-14	-13.33	-13.868	-0.538	0
	CuCl3-	1.09E-15	7.51E-16	-14.962	-15.124	-0.162	0
	Cu(OH)4-2	3.57E-16	1.04E-16	-15.447	-15.985	-0.538	0
	CuCl4-2	1.95E-18	5.03E-19	-17.711	-18.298	-0.587	0
F	5.50E-04						
	F-	3.19E-04	2.15E-04	-3.496	-3.667	-0.171	-0.83
	MgF+	2.15E-04	1.51E-04	-3.667	-3.821	-0.154	-10.32
	NaF	1.55E-05	1.66E-05	-4.809	-4.779	0.03	7.26
	HF	1.05E-09	1.12E-09	-8.981	-8.951	0.03	12.5
	ZnF+	4.33E-11	3.18E-11	-10.364	-10.498	-0.135	0
	MnF+	4.08E-11	2.91E-11	-10.39	-10.536	-0.147	0
	HF2-	1.26E-12	9.24E-13	-11.9	-12.034	-0.135	22.55
	FeF+	4.99E-13	3.66E-13	-12.302	-12.436	-0.135	0
	CuF+	3.28E-13	2.41E-13	-12.484	-12.619	-0.135	0
	FeF2+	6.66E-16	4.75E-16	-15.177	-15.323	-0.147	0
	FeF+2	2.14E-16	5.55E-17	-15.669	-16.256	-0.587	0
	FeF3	1.51E-16	1.62E-16	-15.82	-15.791	0.03	0
Fe(2)	1.24E-09						
	Fe+2	5.86E-10	1.70E-10	-9.232	-9.769	-0.537	-21.1
	FeCO3	3.45E-10	3.70E-10	-9.462	-9.432	0.03	0
	FeHCO3+	1.55E-10	1.14E-10	-9.809	-9.943	-0.135	0
	FeSO4	8.35E-11	8.95E-11	-10.078	-10.048	0.03	18.97

	FeCl+	4.28E-11	3.14E-11	-10.369	-10.503	-0.135	0
	FeOH+	2.16E-11	1.54E-11	-10.665	-10.812	-0.147	0
	FeF+	4.99E-13	3.66E-13	-12.302	-12.436	-0.135	0
	Fe(OH)2	3.50E-14	3.75E-14	-13.455	-13.426	0.03	0
	Fe(OH)3-	5.60E-16	3.99E-16	-15.252	-15.399	-0.147	0
	FeHSO4+	2.78E-18	2.04E-18	-17.556	-17.691	-0.135	0
Fe(3)	1.40E-06						
	Fe(OH)3	9.80E-07	1.05E-06	-6.009	-5.979	0.03	0
	Fe(OH)4-	3.79E-07	2.74E-07	-6.421	-6.562	-0.141	0
	Fe(OH)2+	3.94E-08	2.85E-08	-7.404	-7.546	-0.141	0
	FeOH+2	1.16E-12	3.00E-13	-11.935	-12.522	-0.587	0
	FeF2+	6.66E-16	4.75E-16	-15.177	-15.323	-0.147	0
	FeF+2	2.14E-16	5.55E-17	-15.669	-16.256	-0.587	0
	FeF3	1.51E-16	1.62E-16	-15.82	-15.791	0.03	0
	FeSO4+	7.39E-18	5.27E-18	-17.131	-17.278	-0.147	0
	FeCl+2	2.54E-18	6.56E-19	-17.596	-18.183	-0.587	0
	Fe+3	1.48E-18	1.63E-19	-17.83	-18.789	-0.959	0
	FeCl2+	5.49E-19	3.91E-19	-18.261	-18.407	-0.147	0
	Fe(SO4)2-	4.64E-19	3.41E-19	-18.333	-18.468	-0.135	0
	FeCl3	4.88E-21	5.23E-21	-20.311	-20.282	0.03	0
	Fe2(OH)2+	3.45E-22	2.43E-24	-21.462	-23.614	-2.152	0
	FeHSO4+2	1.69E-25	4.89E-26	-24.772	-25.311	-0.538	0
	Fe3(OH)4+	3.33E-26	1.45E-29	-25.477	-28.84	-3.363	0
H(0)	1.59E-28						
	H2	7.95E-29	8.51E-29	-28.1	-28.07	0.03	28.61
K	2.66E-03						
	K+	2.61E-03	1.78E-03	-2.584	-2.75	-0.167	9.42
	KSO4-	5.11E-05	3.69E-05	-4.291	-4.433	-0.141	34.59
Mg	4.29E-02						
	Mg+2	3.37E-02	1.06E-02	-1.472	-1.974	-0.501	-20.78
	MgSO4	6.88E-03	7.36E-03	-2.163	-2.133	0.03	5.84
	MgHCO3+	1.21E-03	8.32E-04	-2.918	-3.08	-0.162	5.75
	MgCO3	8.57E-04	9.18E-04	-3.067	-3.037	0.03	-17.09
	MgF+	2.15E-04	1.51E-04	-3.667	-3.821	-0.154	-10.32
	MgOH+	1.49E-05	1.10E-05	-4.828	-4.957	-0.129	0
Mn(2)	2.40E-07						
	MnCO3	1.31E-07	1.41E-07	-6.882	-6.852	0.03	0
	Mn+2	6.72E-08	1.95E-08	-7.173	-7.709	-0.537	-17.17
	MnHCO3+	1.63E-08	1.17E-08	-7.787	-7.934	-0.147	0
	MnCl+	1.49E-08	1.06E-08	-7.827	-7.973	-0.147	-2.85
	MnSO4	9.58E-09	1.03E-08	-8.018	-7.989	0.03	22.54
	MnCl2	5.79E-10	6.20E-10	-9.238	-9.208	0.03	85.89
	MnOH+	2.02E-10	1.44E-10	-9.696	-9.843	-0.147	0
	MnF+	4.08E-11	2.91E-11	-10.39	-10.536	-0.147	0
	MnCl3-	3.20E-11	2.28E-11	-10.495	-10.642	-0.147	44.58
	Mn(NO3)2	1.97E-15	2.11E-15	-14.705	-14.675	0.03	41.04
	Mn(OH)3-	1.02E-17	7.26E-18	-16.993	-17.139	-0.147	0
Mn(3)	5.49E-29						
	Mn+3	5.49E-29	6.04E-30	-28.261	-29.219	-0.959	0
N(-3)	2.90E-05						

	NH4+	2.56E-05	1.65E-05	-4.591	-4.784	-0.192	18.3
	NH3	2.53E-06	2.71E-06	-5.598	-5.568	0.03	24.42
	NH4SO4-	8.54E-07	6.27E-07	-6.069	-6.203	-0.135	38.81
N(5)	2.50E-04						
	NO3-	2.50E-04	1.65E-04	-3.602	-3.783	-0.181	30
	Mn(NO3)2	1.97E-15	2.11E-15	-14.705	-14.675	0.03	41.04
Na	1.87E-01						
	Na+	1.84E-01	1.34E-01	-0.736	-0.872	-0.136	-0.82
	NaSO4-	2.75E-03	1.99E-03	-2.56	-2.701	-0.141	18.51
	NaHCO3	4.72E-04	5.05E-04	-3.326	-3.296	0.03	1.8
	NaCO3-	3.09E-04	2.26E-04	-3.511	-3.645	-0.135	0.85
	NaF	1.55E-05	1.66E-05	-4.809	-4.779	0.03	7.26
	NaOH	3.63E-17	3.89E-17	-16.44	-16.41	0.03	0
O(0)	1.06E-36						
	O2	5.29E-37	5.67E-37	-36.277	-36.247	0.03	30.4
S(6)	2.21E-02						
	SO4-2	1.17E-02	2.96E-03	-1.93	-2.529	-0.599	16.45
	MgSO4	6.88E-03	7.36E-03	-2.163	-2.133	0.03	5.84
	NaSO4-	2.75E-03	1.99E-03	-2.56	-2.701	-0.141	18.51
	CaSO4	6.20E-04	6.64E-04	-3.207	-3.178	0.03	7.5
	KSO4-	5.11E-05	3.69E-05	-4.291	-4.433	-0.141	34.59
	BaSO4	6.01E-06	6.43E-06	-5.222	-5.192	0.03	0
	NH4SO4-	8.54E-07	6.27E-07	-6.069	-6.203	-0.135	38.81
	MnSO4	9.58E-09	1.03E-08	-8.018	-7.989	0.03	22.54
	ZnSO4	6.76E-09	7.24E-09	-8.17	-8.14	0.03	21.71
	HSO4-	1.36E-09	9.96E-10	-8.867	-9.002	-0.135	40.74
	Zn(SO4)2-2	6.00E-10	1.74E-10	-9.222	-9.76	-0.538	-8.98
	FeSO4	8.35E-11	8.95E-11	-10.078	-10.048	0.03	18.97
	CuSO4	3.46E-11	3.71E-11	-10.461	-10.431	0.03	13.09
	CaHSO4+	2.06E-11	1.51E-11	-10.685	-10.82	-0.135	0
	FeSO4+	7.39E-18	5.27E-18	-17.131	-17.278	-0.147	0
	FeHSO4+	2.78E-18	2.04E-18	-17.556	-17.691	-0.135	0
	Fe(SO4)2-	4.64E-19	3.41E-19	-18.333	-18.468	-0.135	0
	FeHSO4+2	1.69E-25	4.89E-26	-24.772	-25.311	-0.538	0
Zn	1.53E-06						
	Zn(CO3)2-2	1.26E-06	3.65E-07	-5.899	-6.437	-0.538	0
	ZnCO3	1.76E-07	1.89E-07	-6.754	-6.724	0.03	0
	Zn+2	4.04E-08	1.05E-08	-7.394	-7.981	-0.587	-24.37
	ZnOHCl	1.24E-08	1.32E-08	-7.908	-7.878	0.03	0
	ZnHCO3+	1.20E-08	8.81E-09	-7.921	-8.055	-0.135	0
	Zn(OH)2	1.01E-08	1.08E-08	-7.997	-7.968	0.03	0
	ZnSO4	6.76E-09	7.24E-09	-8.17	-8.14	0.03	21.71
	ZnCl+	5.46E-09	3.76E-09	-8.263	-8.425	-0.162	-14.69
	ZnOH+	4.47E-09	3.28E-09	-8.35	-8.484	-0.135	0
	Zn(SO4)2-2	6.00E-10	1.74E-10	-9.222	-9.76	-0.538	-8.98
	ZnCl2	4.91E-10	5.26E-10	-9.309	-9.279	0.03	102.03
	ZnCl3-	1.14E-10	7.88E-11	-9.941	-10.104	-0.162	15.16
	ZnF+	4.33E-11	3.18E-11	-10.364	-10.498	-0.135	0
	ZnCl4-2	2.04E-11	5.28E-12	-10.691	-11.278	-0.587	148.07
	Zn(OH)3-	1.33E-11	9.75E-12	-10.876	-11.011	-0.135	0

```
Zn(OH)4-2   1.53E-15   4.42E-16    -14.816    -15.354     -0.538          0

#NAME?  indices------------------------------

        Phase       SI**        log         IAP         log         K(298       K,                      1

        Anhydrite     -1.15      -5.43      -4.28  CaSO4
        Aragonite      1.39      -6.94      -8.34  CaCO3
        Barite         1.95      -7.89      -9.84  BaSO4
        Calcite        1.54      -6.94      -8.48  CaCO3
        CO2(g)        -2.81      -4.28      -1.47  CO2
        Dolomite       4.13     -12.96     -17.08  CaMg(CO3)2
        Fe(OH)3(a)     1.69       6.58       4.89  Fe(OH)3
        Fluorite       0.37     -10.23      -10.6  CaF2
        Goethite       7.58       6.58         -1  FeOOH
        Gypsum        -0.85      -5.43      -4.58  CaSO4:2H2O
        H2(g)        -24.97     -28.07       -3.1  H2
        H2O(g)        -1.51          0        1.5  H2O
        Halite        -3.32      -1.75       1.57  NaCl
        Hausmann      -8.49      52.54      61.03  Mn3O4
        Hematite      17.18      13.17      -4.01  Fe2O3
        Jarosite-K    -4.23     -13.44      -9.21  KFe3(SO4)2(OH)6
        Manganite     -3.68      21.66      25.34  MnOOH
        Melanterit   -10.11     -12.32      -2.21  FeSO4:7H2O
        NH3(g)        -7.36      -5.57       1.8  NH3
        O2(g)        -33.35     -36.25      -2.89  O2
        Pyrochroit       -6        9.2       15.2  Mn(OH)2
        Pyrolusite    -7.26      34.12      41.38  MnO2:H2O
        Rhodochrc     -0.62     -11.75     -11.13  MnCO3
        Siderite      -2.92     -13.81     -10.89  FeCO3
        Smithsonit    -2.02     -12.02        -10  ZnCO3
        Sylvite       -4.52      -3.62        0.9  KCl
        Witherite     -0.84      -9.41      -8.56  BaCO3
        Zn(OH)2(e     -2.57       8.93       11.5  Zn(OH)2

**For   a       gas,    SI      =       log10(fuga Fugacity     =       pressure
        For     ideal   gases,  phi     =                       1

------------------
End     of      simulation.
------------------

-----------------------------------
Reading input   data    for     simulation      2
-----------------------------------

------------------------------
End     of      Run     after           0.22 Seconds.
------------------------------
```

APPENDIX F TSF CONSEQUENCE CATEGORY ASSESSMENT

REPORT

BLUE CAP MINING PTY LTD
ABN: 44 133 660 045

Tick Hill Mine

Tailings Reclamation Project - Consequence Category Assessment

120100.01-R02 Rev 1
JUNE 2022

TAILINGS.WATER.WASTE.

Document Control

Project Name:	Tick Hill Mine
Document Title:	Tailings Reclamation Project - Consequence Category Assessment
File Location:	N:\Synergy\Projects\120\120100 Tick Hill\02 Consequence Category Assessment\Documents\R01\Text\120100.02.R01_0.docx
Project Number:	120100.02
Revision Status:	Amended Final Issue

Revision History

Revision	Issue	Prepared by	Reviewed by
A	Draft Issue	James Parker	Allan Watson
B	Revised Draft	James Parker	Allan Watson
0	Final Issue	James Parker	Allan Watson
1	Amended Final Issue	James Parker	Allan Watson

Issue Register

Distribution List	Date
Blue Cap Mining Pty Ltd, Andy Cullum PA Scott Consulting	Rev A – 21/04/2022, Rev B - 24/05/2022, Rev 0 – 27/05/2022, Rev 1 – 13/06/2022

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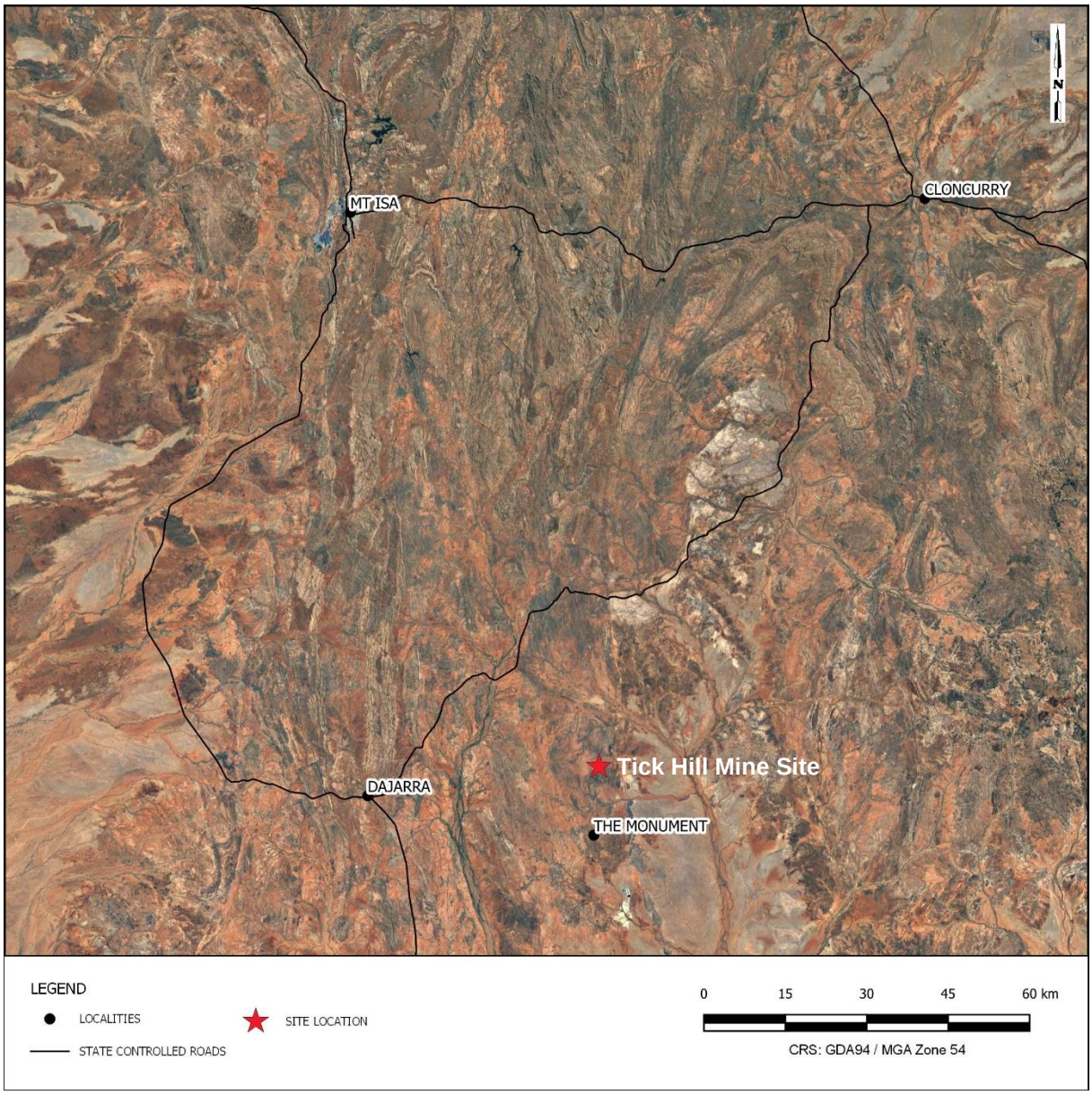
1 INTRODUCTION

1.1 Background and Scope

The Tick Hill Mine is owned by Carnaby Resources and operated by Blue Cap Mining Pty Ltd (Blue Cap). The site is located on mining leases (ML) ML 7094, ML 7096 and ML 7097, and is regulated under Environmental Authority (EA) EPML00820613, dated 1 April 2022 **[1]**.

The Tick Hill mine is in north-western Queensland, approximately 112 km southeast of Mt Isa and 43 km east of Dajarra. The location of the site is shown on **Map 1**.

MAP 1: TICK HILL MINE SITE LOCATION



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ATC Williams Pty Ltd (ATCW) has been commissioned by Blue Cap to undertake a consequence category assessment (CCA) for the existing tailings storage facility (TSF) forming part of the proposed tailings reclamation project (TRP). The CCA has been undertaken in accordance with the 'Manual for Assessing Consequence Categories and Hydraulic Performance of Structures' **[2]** (the Manual).

The purpose of the CCA is to characterise potential impacts on downstream receiving environments in the event of a failure for the TSF, and based on the assigned consequence category, to identify hydraulic design criteria from the Manual **[2]** relevant to TSF design and operational constraints.

The CCA presented in this report is at a high level, based on desk top characterisation of the downstream receiving environments, but excluding a detailed dam break modelling. Given the setting of the site and near region, runout distances under a dam break and release scenario have been estimated empirically. It is noted that no consequence category has been specified for the existing TSF in the EA **[1]**. Furthermore, no engineering analyses have been undertaken to assess the stability or integrity of the TSF, being interpreted from available documentation; with no site inspection to ground truth existing site conditions included as part of the study scope.

1.2 Site Description

The Tick Hill Mine site is currently not in operation. Subsequent to previous mineral exploration and processing at the site, the TSF, waste rock dump, process areas and other mine impacted areas were rehabilitated. The existing site layout is depicted on **Map 2**. The Mine Infrastructure Area (MIA) includes the ROM Pad, Processing Plant, Workshop, Administration Office and Borrow Pit.

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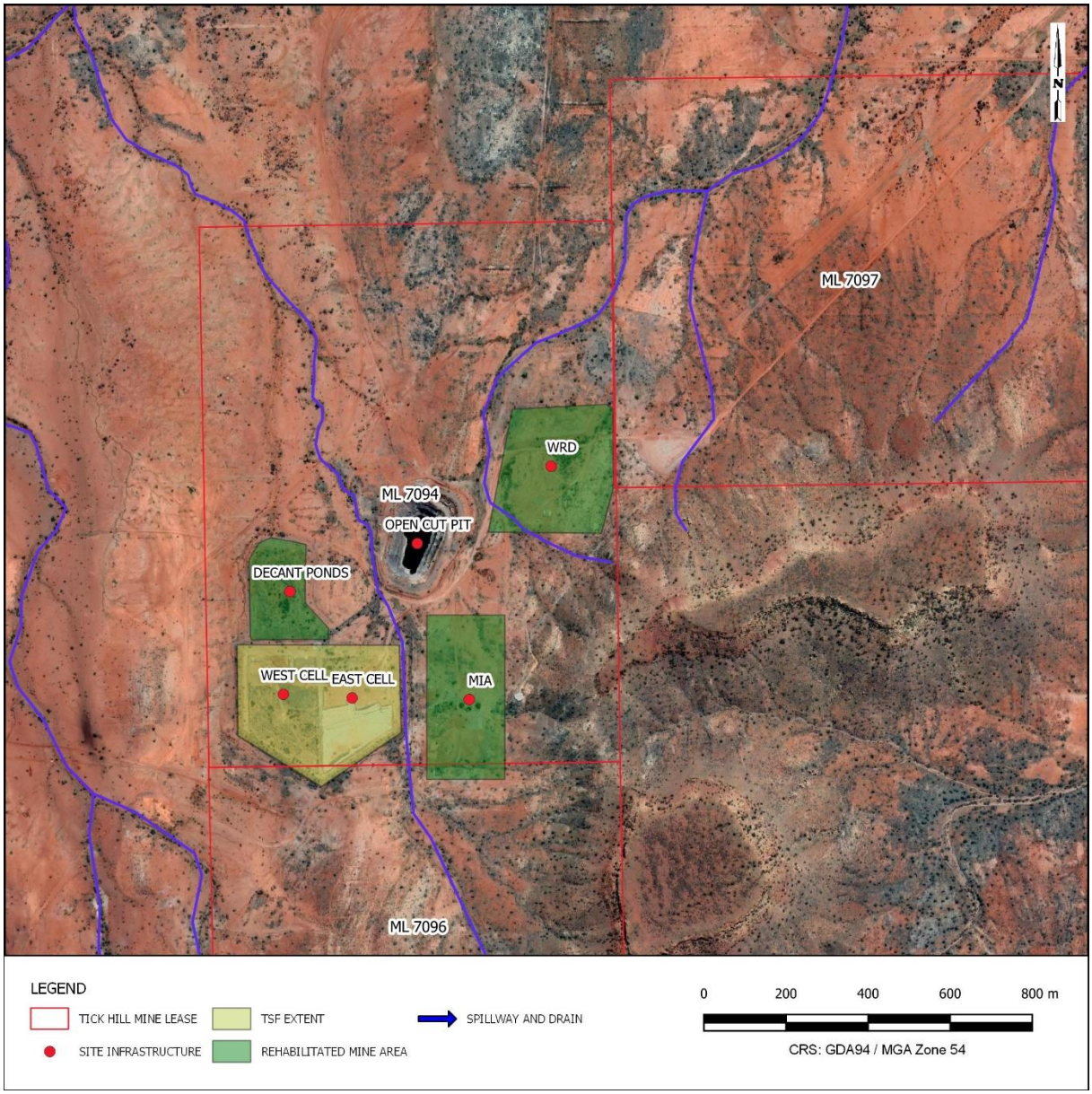
MAP 2: MINE SITE LAYOUT



1.3 Existing TSF Configuration

The existing TSF is comprised of an East Cell and West Cell, separated by an internal bund. An emergency spillway is located on the northern face, which directs flows towards the open cut pit via a constructed drain. The historical decant water storage pond was formed immediately north of the West Cell, however this area has since been rehabilitated.

The TSF was formed as an elevated impoundment, and it inferred that perimeter embankments have been constructed in single stages using earthfill materials. As such the storage has no external catchment, with rainfall and runoff over the TSF surface area forming the only (post-closure) inputs.

It is understood that the floor of the storage is clay lined.

The existing configuration of the TSF is detailed in **Table 1**. This configuration represents conditions prior to reclamation works. Including capping materials, the existing TSF has a total in situ volume of approximately 600,000 m³.

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TABLE 1: TSF CONFIGURATION

Parameter	West Cell	East Cell
Maximum Landform Elevation (RL m)	351.5	352.0
Full Supply Level (RL m) (Internal Bund Spillway)	348.5	-
Full Supply Level (RL m) (Emergency Spillway Elevation)	-	346.7
Estimated Maximum Reclaimable Volume (ML)	245.9	203.3
Natural Ground Level (RL m)	341.0	341.5
Height to Natural Ground (m)	10.5	10.5
Surface Area (ha)	4.5	4.4

1.4 TRP Proposal

The Tick Hill development proposal, forming the basis of this CCA, is to recover tailings from the TSF for the purpose of reprocessing. It is understood that the tailings will be processed on site to form a concentrate that will be exported off site for further processing to recover the gold.

The reclamation procedure involves sorting and gravity separation and carbon filter to generate a gold concentrate. The process will separate the metalliferous fraction including gold and other heavy minerals, including cyanide compounds, leaving a low metalliferous lighter silicate minerals fraction. The silicate minerals fraction (naturally occurring silicate minerals) will represent approximately 90% of the tailings mass. The non- silicate fraction (0.4% of the tailings mass) will be transported offsite to a toll treat processing facility or smelter as a concentrate for process to extract the gold.

The process will commence by feeding tailings recovered from the TSF through a trommel at a rate of approximately 70tph, where water will be added to make a high-density pulp of 70% solids (wt/wt) and for dust mitigation. The pulp will then be continuously put through 3 gravity separators in two series of three units (around 1m^3 in size each).

The light fraction (silicates) making up about 99.6% of the total tailings stream will report back to the TSF, while the heavy (non-silicate) fraction of the stream (up to 0.4% of the feed), will be placed as a concentrated into containers for transport offsite for processing and gold recovery. The entire sorting process takes around 25 minutes for each load. The operation sorting plant will be serviced by loader or excavator. The entire operation will be undertaken within the confines of the TSF.

No process chemicals will be used in the process.

Process water will initially come from the Tick Hill pit. The Tick Hill pit water is low in metals as identified in the Tick Hill tailings geochemistry report provided as part of the supporting documentation. All water (small in quantity) that collects in the TSF as the light material returns to the TSF will be recycled continuously, passing through carbon filters, in order to significantly reduce (up to 99.6%) of the historic soluble stable CN complexes in the tailings. It should be noted that the TSF does not contain free cyanide, or WAD cyanide. The carbon used in filtration will be changed over regularly, with loaded carbon bagged and sent off-site for processing in a carbon processing elution circuit. Water addition from the pit will be limited to replenishment of water lost to evaporation.

The operation will be undertaken in a bunded and lined area of the TSF to minimise release of water used in the process.

The TRP will recover tailings in relation to the zones as shown in **Diagram 1**, comprising seven (7) zones in the eastern portion of the TSF (Zones E1 to E7) and three (3) zones in the western portion (Zones W1 to W3). The general arrangement will be to recover tailings from specific zones with non-reclaimed materials and tailings from on-site reprocessing placed in previously processed zones.

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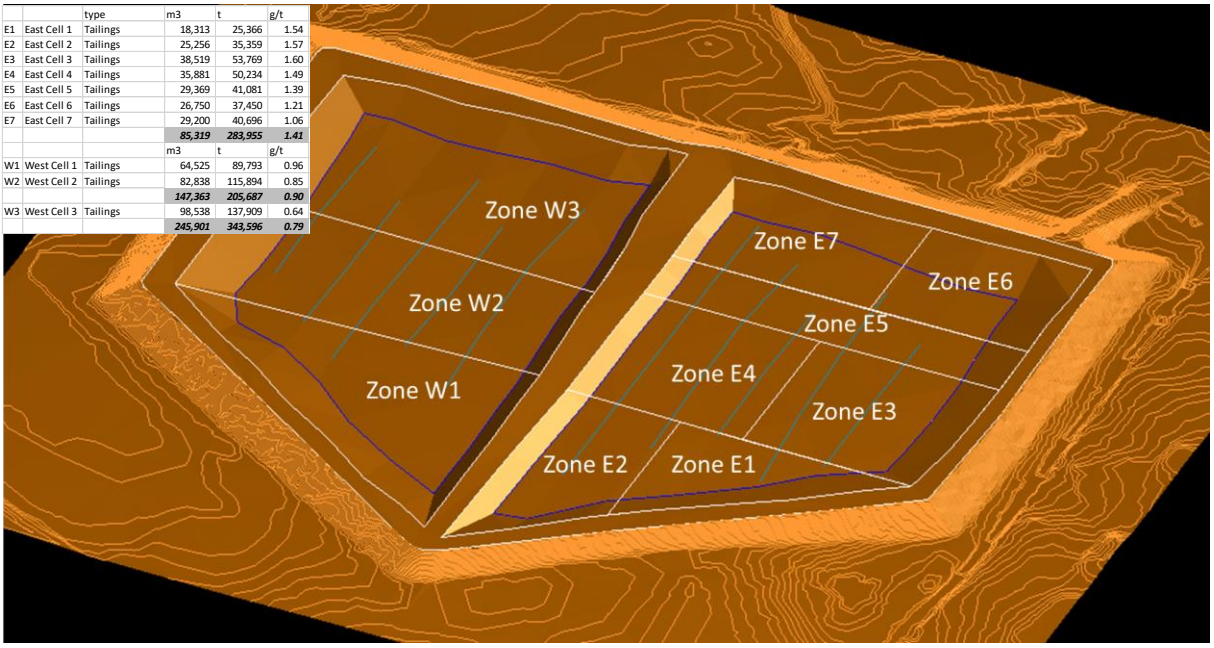
It is proposed to reclaim tailings in the following stages **[3]** noting that Zone E1 and Zone E2 and part of Zone E3, E4 and E5 have already been reclaimed to an extent:

- Stage 1 – Remainder of Zone E3 and Zone E4 mined for onsite re-processing – non reclaimed materials placed in the Zone E1 and Zone E2 void.
- Stage 2 – Zone E5, Zone E6 and Zone E7 mined for onsite re-processing – non reclaimed materials placed in the Zone E3 and Zone E4 void.
- Stage 3- Zone W1 mined for onsite re-processing – non reclaimed materials placed in the Zone E5, Zone E6 and Zone E7 void.
- Stage 4- Zone W2 mined for onsite re-processing – non reclaimed materials placed in the Zone W1 void.
- Zone W3 is not to be re-processed.

Each of these zones are located on **DIAGRAM 1**.

It is proposed to retain the existing TSF spillway for operational purposes.

DIAGRAM 1: TSF ZONE VOLUMES



		type	m3	t	g/t
E1	East Cell 1	Tailings	18,313	25,366	1.54
E2	East Cell 2	Tailings	25,256	35,359	1.57
E3	East Cell 3	Tailings	38,519	53,769	1.60
E4	East Cell 4	Tailings	35,881	50,234	1.49
E5	East Cell 5	Tailings	29,369	41,081	1.39
E6	East Cell 6	Tailings	26,750	37,450	1.21
E7	East Cell 7	Tailings	29,200	40,696	1.06
			85,319	***283,955***	***1.41***
			m3	t	g/t
W1	West Cell 1	Tailings	64,525	89,793	0.96
W2	West Cell 2	Tailings	82,838	115,894	0.85
			147,363	***205,687***	***0.90***
W3	West Cell 3	Tailings	98,538	137,909	0.64
			245,901	***343,596***	***0.79***

1.5 Available Site Data

This CCA was undertaken using the guidelines in the Manual **[2]**. The following data were available and considered in completing the CCA:

- 'Tick_Hill_TSF_reclamation_BIM-2020 v2.pptx' **[3]**,
- 'Tick Hill Gold Mine – Geotechnical and Hydrological Assessment of Tailings Recovery', Ref: PSM4146-002R, dated 14 August 2020 **[4]**.
- 'Tick Hill Tailings Reclamation Project – EA Amendment Application Supporting Information', Ref: CR0002v2, dated 10 August 2020 **[5]**
- 'Tick Hill Gold Project – Tailings Environmental Geochemistry Review', dated 29 July 2020 **[6]**
- Groundwater Sampling Results **[7] [8] [9]**

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- Queensland Globe Map Resource, retrieved 18 March 2022 **[10]**.
- SILO Data Drill for Cell -21.65 (latitude), 139.90 (longitude) of patched rainfall and potential Evapo-transpiration for the period 01/01/1889 to 17/03/2022 [11].
- 'EPBC Act Protected Matters Report', 18 March 2022, Department of Agriculture. Water and the Environment and Energy **[12]**.
- 'Environmental Reports – Matters of State Environmental Significance', 18 March 2022, Department of Environment and Science **[13]**.
- 'Environmental Reports – Biodiversity and Conservation Values – Biodiversity Planning Assessments and Aquatic Conservation Assessments', 18 March 2022, Department of Environment and Science **[14]**.
- 'Environmental Reports – Regional Ecosystems – Biodiversity Status', 18 March 2022, Department of Environment and Science **[15]**.

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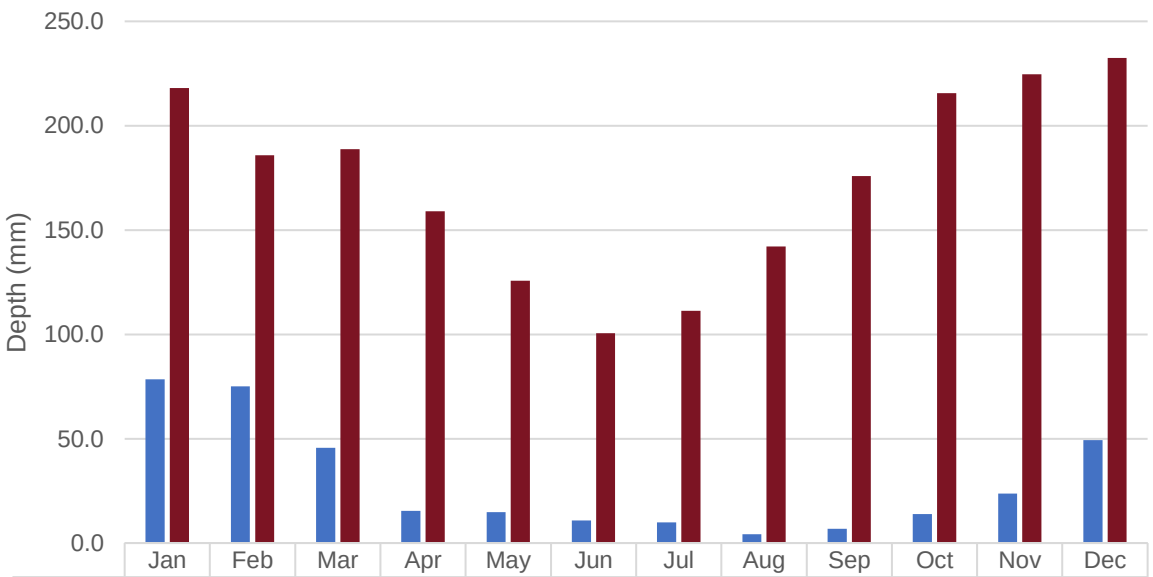
2 SITE CONDITIONS

2.1 Climatic Conditions

The Köppen Climate classification of the region is a hot arid/desert climate (BWh). Highly variable rainfall occurs in the summer/wet season, which is typically hot and humid. The data obtained from the SILO Data Drill (The Long Paddock, 2022) **[11]** indicates that the mean annual rainfall for the region is 348 mm. The highest monthly rainfall occurs mostly in December through to March, as illustrated in **Chart 1**. The lowest monthly rainfall occurs in the winter months from April to October. **Chart 1** indicates that monthly potential evapo-transpiration (PET) evaporation rates exceed rainfall year-round at the Tick Hill Mine site.

CHART 1: AVERAGE ANNUAL RAINFALL AND PET ON A MONTHLY SCALE



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall	78.5	75.0	45.7	15.4	14.8	10.9	9.9	4.3	6.9	13.9	23.7	49.3
PET	218.0	185.8	188.8	158.9	125.7	100.6	111.3	142.1	175.9	215.5	224.7	232.4

2.2 Site Topography and Hydrology

Regionally, the Tick Hill Mine is located across several unnamed tributaries of Petticoat Creek. The dominant unnamed tributary to the immediate east of the TSF travels approximately 1.8 km to the northwest where it outlets to Petticoat Creek. Approximately 5.6 km to the northeast of the site, Petticoat Creek crosses the Duchess-Phosphate Hill Road and the Mount Isa Rail Line.

More broadly, Petticoat Creek travels approximately 18 km to the east where it outlets to the Burke River. The Burke River flows in a southerly direction for approximately 193 km where it outlets to the Georgina River. The Georgina continues to flow south towards Lake Eyre.

The location of watercourses proximate to the Tick Hill Mine site, with drainage through Petticoat Creek and the Burke River are depicted on **Map 3**.

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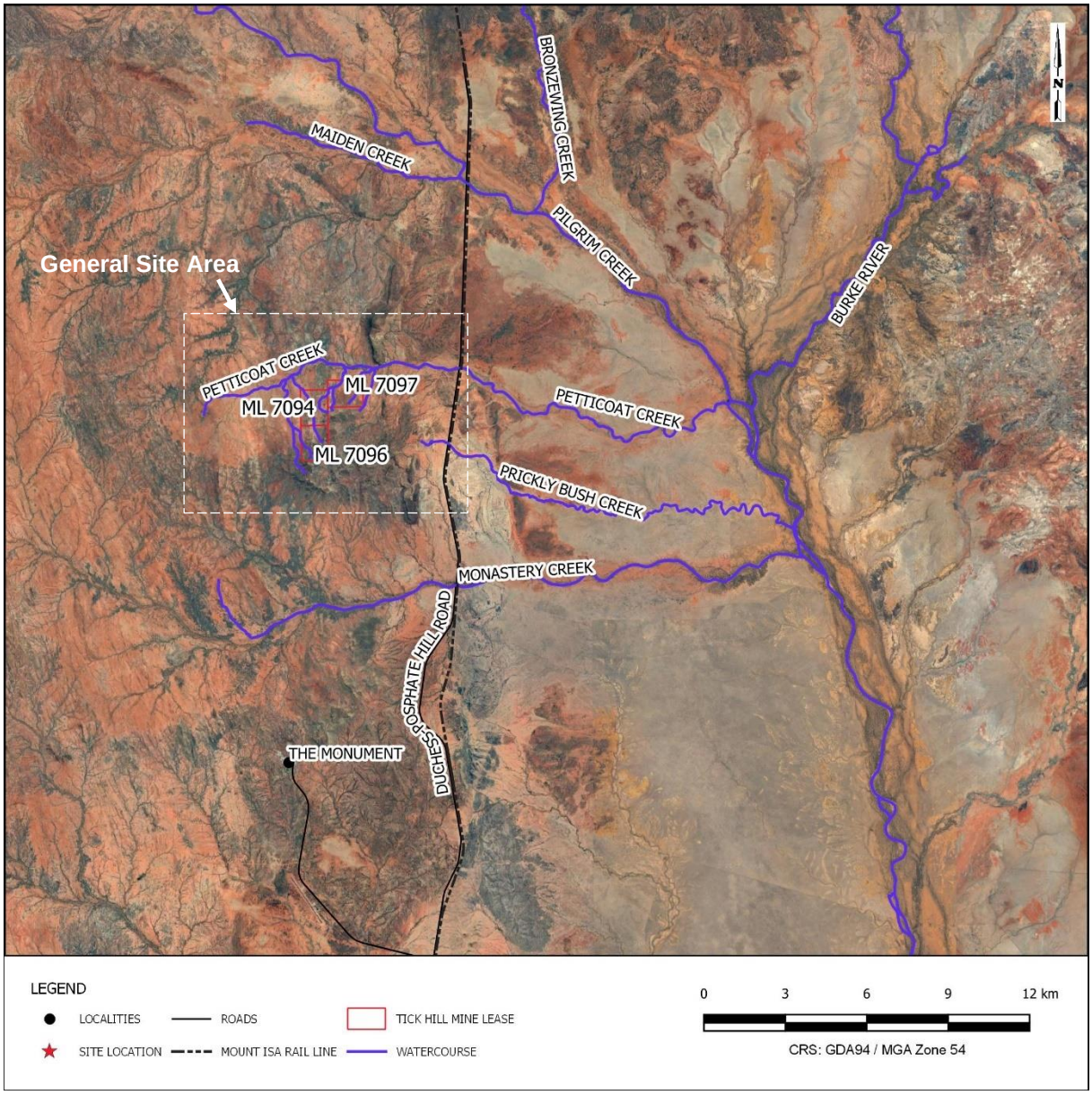
MAP 3: DRAINAGE SYSTEM ADJACENT TO THE TICK HILL MINE SITE



2.3 General Surrounds

The Tick Hill mine site is remotely located, with no towns, villages or residences/homesteads located nearby (generally within 5 km). The only "sensitive receptor" from the mining operation's perspective is incidental motorists along the Duchess – Phosphate Hill Road located to the east (and topographically downstream) from the site.

Generally, the land use of the region is low density cattle grazing, with the inability to support any cropping or intense grazing. The presence of the general public or landowners near to the site is therefore remote/infrequent.

2.4 Subsurface Conditions (Geology and Hydrogeology)

Investigation of available surface geology data from 'Queensland Globe' **[10]** determined that the Tick Hill Mine site is located within the Corella Formation (PLkc), with mixed siliciclastic/carbonate rocks being typical.

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Due to the installed clay liner in the TSF, the potential for seepage from the storage is understood to be very low, with any seepage being directed to the open cut. This condition is supported by PSM **[4],** which determined:

- Rainfall over the structure will be available for evapotranspiration,
- The Open Cut Pit is linked to an upper unconfined valley aquifer beneath the Tick Hill site,
- The Open Cut Pit receives groundwater flows from the area to the north at a rate of approximately 0.35 L/s
- Any seepage from the TSF will drain in a north easterly direction, reporting to the Open Cut Pit.

2.5 Groundwater Setting and Quality

The TSF is located above an upper unconfined valley aquifer which is intercepted by the Pit. The Pit receives inflows from the upper unconfined valley aquifer and a deeper valley confined (regolith) aquifer **[5]** with average inflow rates of 0.36 L/s. Approximately 0.01 to 0.1 L/s of this inflow is from the TSF **[5]**. The Pit forms the local groundwater sink.

Water quality from the regolith aquifer is reported in BCM **[7] [8] [9]**, with sampling carried out from groundwater monitoring sites located as depicted on **Map 4**. THGW001, THGW003 and TWGW004 monitor mine affected aquifer areas, and THGW002, THGW005 and THGW006 monitor background or reference areas aquifer.

Groundwater sampling was last undertaken in June 2020, January 2021 and June 2021, with results summarised in **Table A1**, **Table A2** and **Table A3** in **Appendix A**. Where sampled analytes exceed the EA release limits, these values are highlighted in red.

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MAP 4: GROUNDWATER SAMPLING LOCATIONS

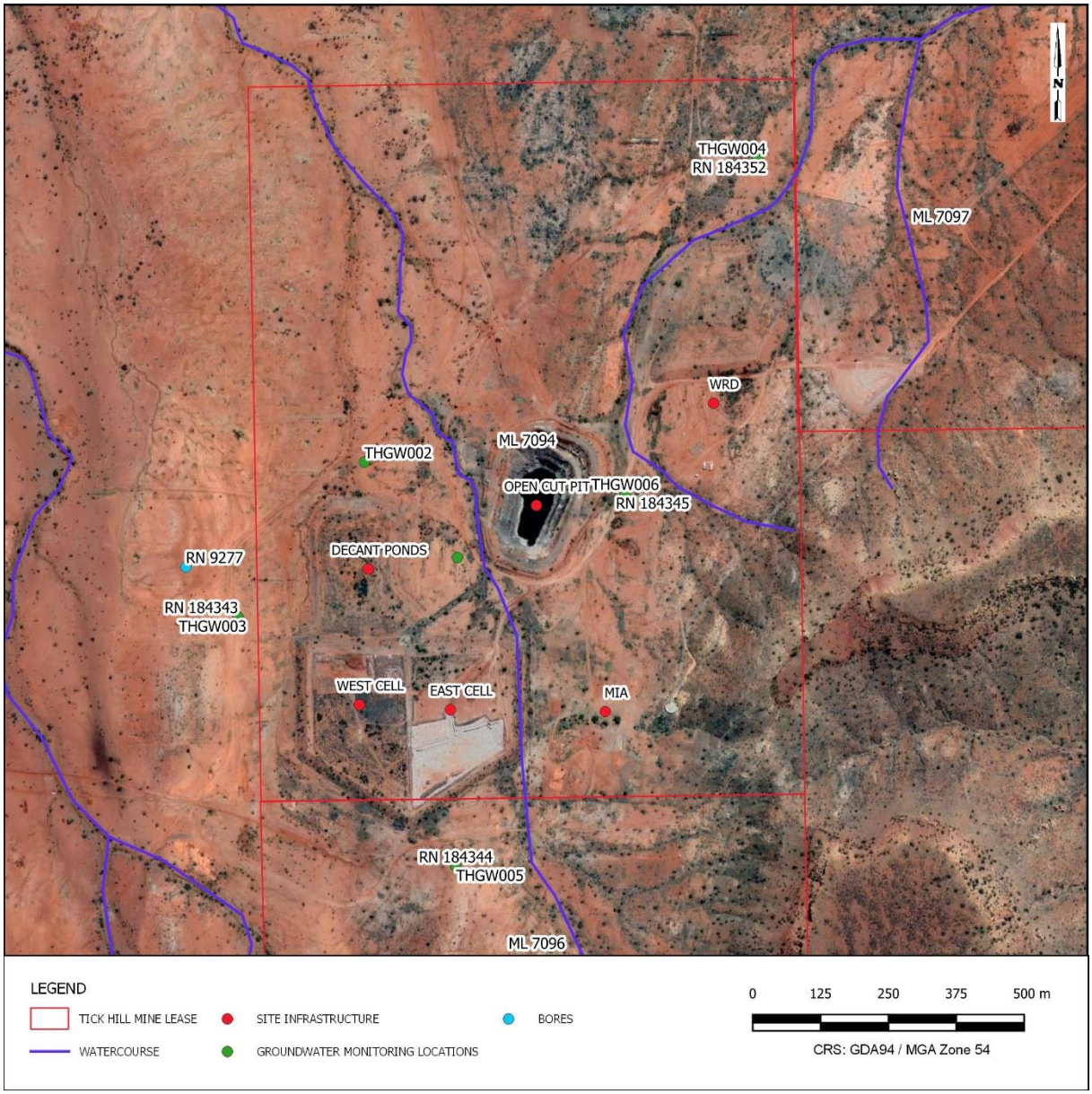

TABLE 2: REGISTERED LOCAL BOREHOLES ON ML7094, ML7096, ML 7097 AND SURROUNDS

EA Monitoring Point	Registered Bore Reference
THGW001	N/A
THGW002	N/A
THGW003	RN184343
THGW004	RN184352
THGW005	RN184344
THGW006	RN184345

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The results from recent groundwater sampling (refer **Appendix A**) indicate that groundwater from within the limits of the site and near surrounds can be characterised as being slightly alkaline (pH between 8.0 and 8.4) and slightly saline (EC between 1,200 µs/cm and 2,900 µs/cm) and against ANZECC water quality guidelines, would be generally suitable for use as stockwater. Access to groundwater for water resource purposes (stockwater or potable water for humans), beyond the boundary of the mine site, is unlikely to be feasible due to the considerable depth to groundwater and the limited yield/sustainability of the aquifer.

2.6 Groundwater Supply and Monitoring

Table 3 provides a summary of the local registered private boreholes within ML7094 (which extends 1.0 km to the north of the TSF) and Lot 13 on SP223510, which extends 55 km to the east of the TSF. The location of the borehole's relatives to the TSF are shown on **MAP 5**. The majority of bores identified are associated with monitoring at the Tick Hill mine site. There are two additional bores for which details were not publicly available. As such the impacts to those bores could not be assessed. Bore RN5179 is located almost 3.5 km to the west of the site and is outside the expected zone of impact in the event of a failure. RN9277 is located is close proximity to RN184343.

TABLE 3: REGISTERED LOCAL BOREHOLES ON ML7094, ML7096, ML 7097 AND 0137 AND LOT 13 ON SP223510

Local Bore Locations and Details					
Bore*	Coordinates (GDA94, Zone 54)		Location on Site	Date Drilled	Type/Role
	Easting	Northing			
RN5179	384981 E	7605806 S	3400 m west of TSF	N/A	N/A
RN9277	388181 E	7605791 S	270 m northwest of TSF	N/A	N/A
RN184343	388277 E	7605699 S	140 m northwest of TSF	14/01/2020	Mine Monitoring
RN184344	388678 E	7605240 S	120 m south of TSF	11/01/2020	Mine Monitoring
RN184345	388990 E	7605925 S	70 m east of Pit	14/01/2020	Mine Monitoring
RN184352	389233 E	7606543 S	590 m northeast of Pit	14/01/2020	Mine Monitoring

*Details provided by Queensland Globe **[10]** and Business Queensland **[16]**. Accessed 4 March 2022.

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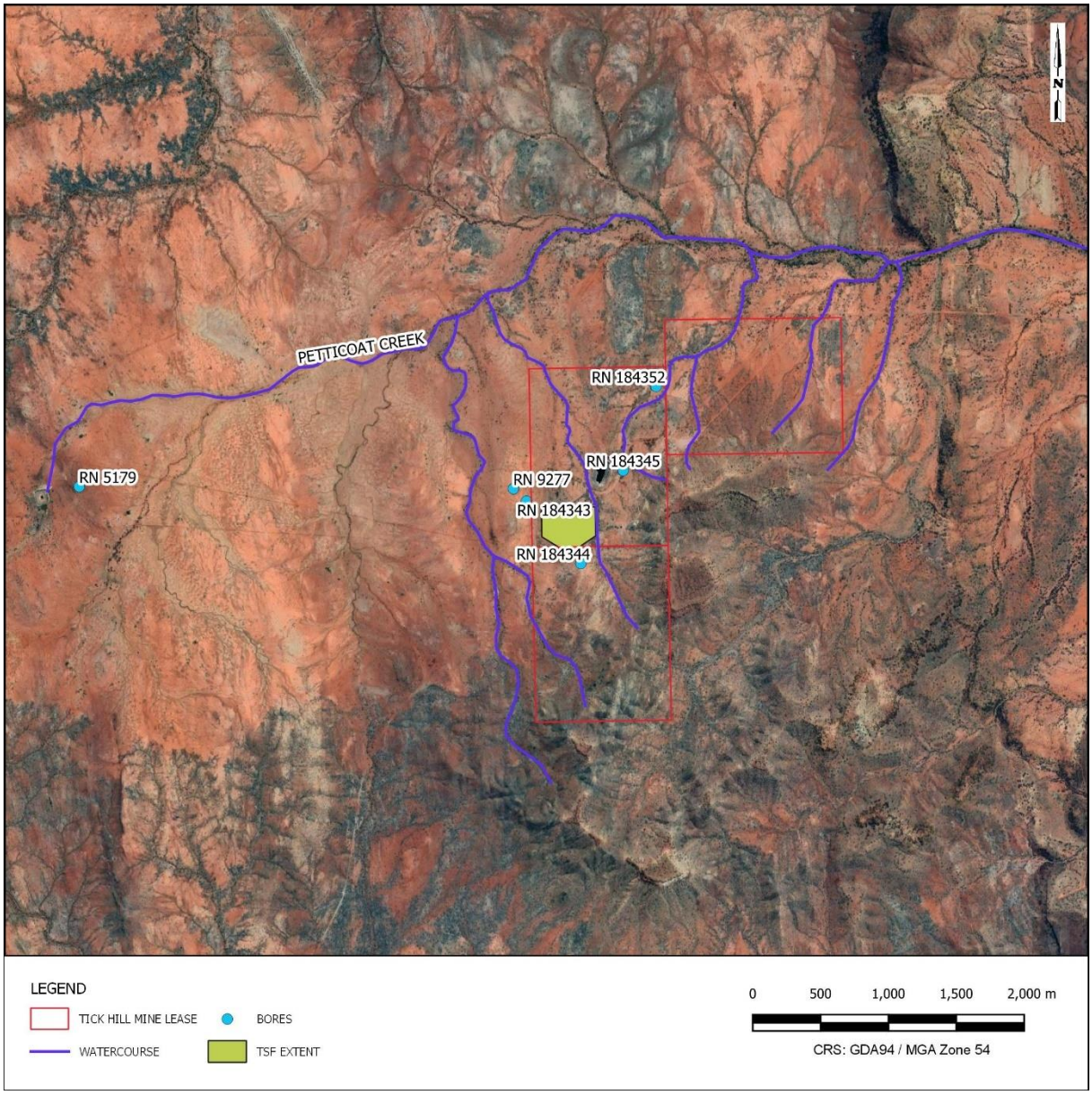
MAP 5: BORES ADJACENT TO SITE LOCATION



Exposure to, and interaction with the upper level unconfined valley aquifer is limited by depth and permeability. There are no identified beneficial groundwater uses within the 5km of the site. Any seepage that does express from the TSF reports to the pit via the upper level unconfined valley aquifer. Degradation of groundwater quality is expected to be minimal , with any degraded groundwater reporting to the Pit where it forms a local groundwater sink.

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3 GENERAL ENVIRONMENTAL HARM ASSESSMENT

3.1 General

In assessing the consequence category for the TSF in accordance with the Manual **[2]**, the CCA is undertaken against the following 'potential harm' scenarios:

- harm to humans,
- general environment harm, and;
- general economic loss or property damage.

Context in relation to these aspects based on the setting of the site as described in **Section 2** is provided as follows. In summary, given this setting, the key impact of consideration is General Environmental Harm.

3.1.1 Harm to Humans

Potential harm to humans can occur through a failure to contain (e.g. spillway discharge, foundation or embankment seepage) or dam break scenario, whereby humans are within the zone of the discharge.

Subject to the Manual **[2]**, exposure to humans is to those people other than site personnel or people engaged in on-site work. Subject to a failure to contain event, exposure to humans would occur if present within the spillway discharge pathway or if accessing water (either surface water or groundwater) that is impacted by the release. Subject to a dam break,

In general terms, the risk of exposure to humans resulting from a failure to contain or dam break event would be low to very low given the setting of the site.

3.1.2 General Environmental Harm

When considering general environmental harm, the receiving environment for the failure of the TSF has been taken to include, but not limited to, ephemeral waterways, creeks and rivers within a 20 km flow path from the TSF. The receiving environment for the TSF to the north and east therefore includes:

- The unnamed tributary of Petticoat Creek traversed by the existing site development; and
- Petticoat Creek.

The Burke River is located outside this 20km limit.

In accordance with the Manual, general environment harm considers effects to areas with 'Significant Values' and 'Moderate Values' within the receiving environment. Such values are defined as follows.

- Significant Values
  - Matters of National Environmental Significance (MNES)
  - Matters of State Environmental Significance (MSES)
  - High Ecological Value (HEV) waters as per the Queensland Environmental Protection (Water) Policy 2009 (EPP Water).
- Moderate Values
  - Slightly or moderately disturbed waters as per the EPP Water
  - Wetland of general ecological significance (GES) as mapped on the Queensland Government referable wetland mapping
  - Riverine areas, springs or lakes and associated flora and fauna.

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The characteristics and exposure of these receiving environments, are identified in the environmental assessment reports in **Appendix B – EPBC Act Protected Matter Report** , **Appendix C – Environmental Reports - Matters of State Environmental Significance**, **Appendix D – Environmental Reports – Biodiversity and Conservation Values – Biodiversity Planning Assessments and Aquatic Conservation Assessments** and **Appendix E – Environmental Reports – Regional Ecosystems – Biodiversity Status**. Further assessment of potential environmental harm related to a failure to contain or dam break scenario is provided in **Section 4**.

3.1.3 General Economic Loss or Property Damage

Economic loss or property damage relates to the operation as well as any businesses, property or asset located beyond the site extent, which includes clean-up of any release.

Regardless of the site setting, clean-up of a large release is a major consideration subject to a TSF release. The impact on the business of the operation, through financial impact as part of clean up and restoration as well as on business reputation is also a critical aspect.

Within the expected failure path or impact area, there are no identified third party property or assets (including residential structures) that would require, repair, remediation or rehabilitation. Duchess Phosphate Hill Road is located approximately 5.6 km to the east of the site but is not expected to be impacted by a failure to contain (seepage or overtopping) or failure to contain (dam break) (**Section 4.3**) scenarios.

3.2 Potential Environment Impacts

The relevant characteristics of the unnamed tributary of Petticoat Creek and Petticoat Creek in the context of environmental values, were assessed from the following sources:

- Matters of National Environmental Significance
- Matters of State Environmental Significance
- High Ecological Value Wetlands and Waterways
- Aquatic Conservation Significance
- Registered Private Bores

The relevant information from each of these data sources are discussed in the following sub-sections, with reference to data provided in **Appendices B** to **E**. The unnamed tributary of Petticoat Creek and Petticoat Creek are ephemeral watercourses, and as such only flow during and after periods of significant rainfall.

3.2.1 Matters of National Environmental Significance

The Protected Matter Report (PMR) **[10]** for the Tick Hill Mine site, is provided in **Appendix B.** This report lists the MNES that may occur within a 5 km buffer of ML7094, ML7096 and ML7097. It includes locations upstream and downstream of the project area, as well as locations in adjacent catchments.

There are no World Heritage Properties, National Heritage Places, Wetlands of International Importance, Great Barrier Reef Marine Park, Commonwealth Marine Area or Listed Threatened Ecological Communities listed for the receiving environment in the PMR **[10]**.

The PMR **[10]** contains 9 Listed Threatened Species and 10 Migratory Species listed for the receiving environment. The critically endangered and endangered animals listed in the PMR **[10]** report is summarised in **Table 4**. The PMR lists the potential for species or species habitat to occur within the search areas. Detailed flora and fauna survey can be undertaken to quantify the actual occurrence of species and species habitat.

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TABLE 4: MNES LISTED CRITICALLY ENDANGERED AND ENDANGERED ANIMALS

Name	Scientific Name	Status	Comments
Curlew Sandpiper	Calidris Ferruginea	Critically Endangered	Species or species habitat may occur within area (Bird)
Night Parrot	Pezoporus occidentalis	Endangered	Species or species habitat likely to occur within area (Bird)
Australian Painted Snipe	Rostratula australis	Endangered	Species or species habitat may occur within area (Bird)

3.2.2 Matters of State Environmental Significance

There are several areas of Matters of State Environmental Significance (MSES) **[13]** within ML7094 (which extends 1.0 km to the north of the TSF) and Lot 13 on SP223510, which extends 55 km to the east of the TSF pertaining to:

- Wildlife habitat (special least concern)
- Wildlife habitat (endangered or vulnerable)
- Regulated vegetation (intersecting a watercourse) along the unnamed tributary of Petticoat Creek; and,
- Regulated vegetation (essential habitat) to the east and upstream of the TSF extents .

These areas are shown in the MSES documentation in **Appendix C – Map 3a** and **Map 4**.

3.2.3 High Ecological Value Wetlands and Waterways

Assessment of the available data MSES data **[13]** (**Appendix D**) shows that no High Ecological Value (HEV) wetlands or waterways have been identified in the receiving environment within ML7094 (which extends 1.0 km to the north of the TSF) and Lot 13 on SP223510, which extends 55 km to the east of the TSF.

3.2.4 Aquatic Conservation Significance

Petticoat Creek (and its unnamed tributary) is located in the Mitchell Grass Downs and Northwest Highlands bioregions, the Southwestern Downs and Mount Isa Inlier subregions, which are all within the Georgina River catchment. The unnamed tributary of Petticoat Creek and Petticoat Creek were assessed against the characteristics for riverine areas, lakes and springs, as per the Queensland Government Wetland Maps **[13].**

Review of the available wetland mapping, MNES **[10]**, MSES **[13]**, Biodiversity and Conservation Values **[14]** and Regional Ecosystems **[15]** did not identify any riverine waterbodies in the unnamed tributary of Petticoat Creek and Petticoat Creek.

The unnamed tributary of Petticoat Creek and Petticoat Creek were identified as areas of 'Low' riverine subcatchment significance as depicted in **Appendix E – Map 5**.

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4 SIMPLIFIED DAM BREAK ASSESSMENT

4.1 General

The initial operations at Tick Hill reclaimed in situ tailings and were transported off site for processing, therefore residual capacity has been formed within the TSF. The permitted tailings reclamation involves establishing the processing plant within the tailings precinct, reclaiming in situ tailings, processing the reclaimed tailings and backfilling the treated tailings in available void space within the TSF, followed in time by progressive placement of a low risk cap and topsoil consistent with the previously constructed capping profile.

Beyond that time, once on site processing facilities have been established, while tailings will continue, capacity will be used for placement of residual tailings. Either way, it has been assumed that in the event of a dam break failure, mine impacted waters will be potentially available for release, with no significant quantity of residual tailings solids being mobilised. This assumption is conservative to the extent that the inundation reach under a release of water will be further than of tailings solids.

The TSF was originally constructed in the early 1990's. There is no evidence of failure subsequent to its closure and remediation.

The reclamation of tailings involves the construction of a decant pond within the TSF of approximately 24.3 ML (at maximum volume) with an active operational volume of approximately 6 ML. the location of the decant within the TSF will move throughout the reclamation process.

4.2 Failure Scenario and Credibility

4.2.1 Hydrologic Scenarios

In undertaking an empirical dam break assessment, the following two (2) hydrologic scenarios were considered:

- Sunny Day Failure
- Flood Day Failure

The Sunny Day Failure (SDF) represents a scenario whereby a sudden failure occurs during normal operating conditions with no rainfall present, such as failure modes induced by static (load-induced) liquefaction, dynamic (earthquake-induced) liquefaction, slope instability (foundation failure, differential settlement), and internal erosion (piping) leading to an impoundment failure. Although such a failure mechanism is typically non-flood producing, failure to contain events may involve the release of contaminants, which could endanger environmental values or human life/wellbeing.

The Flood Day Failure (FDF) represents a scenario whereby the dam is subjected to a flood event equivalent to the capacity of the emergency spillway and routed through the storage at Full Supply Level (FSL). Dam break would then be triggered with a Probable Maximum Precipitation (PMP) event occurring concurrently and leading to overtopping and the partial or complete collapse of the structure. The PMP is defined as 'the greatest depth of precipitation for a given duration meteorologically possible for a given size storm area at a particular location at a particular time of year' (WMO, 2009) **[22]**.

Of these two possible hydrologic scenarios, only the SDF was considered for impacts due to the high level assessment of this CCA.

4.2.2 Storage Scenario

A dam break under the conditions as described in **Section 4.2.1** (for the SDF) is assumed to occur along the northern embankment, exposing the adjacent tributary of Petticoat Creek, and therefore anticipating the greatest impact. This is deemed to coincide with Stage 3 development, refer **Section 1.4,** at the time that a maximum storage volume will exist against the northern embankment. The maximum stored water at this time is expected to be 24.3 ML.

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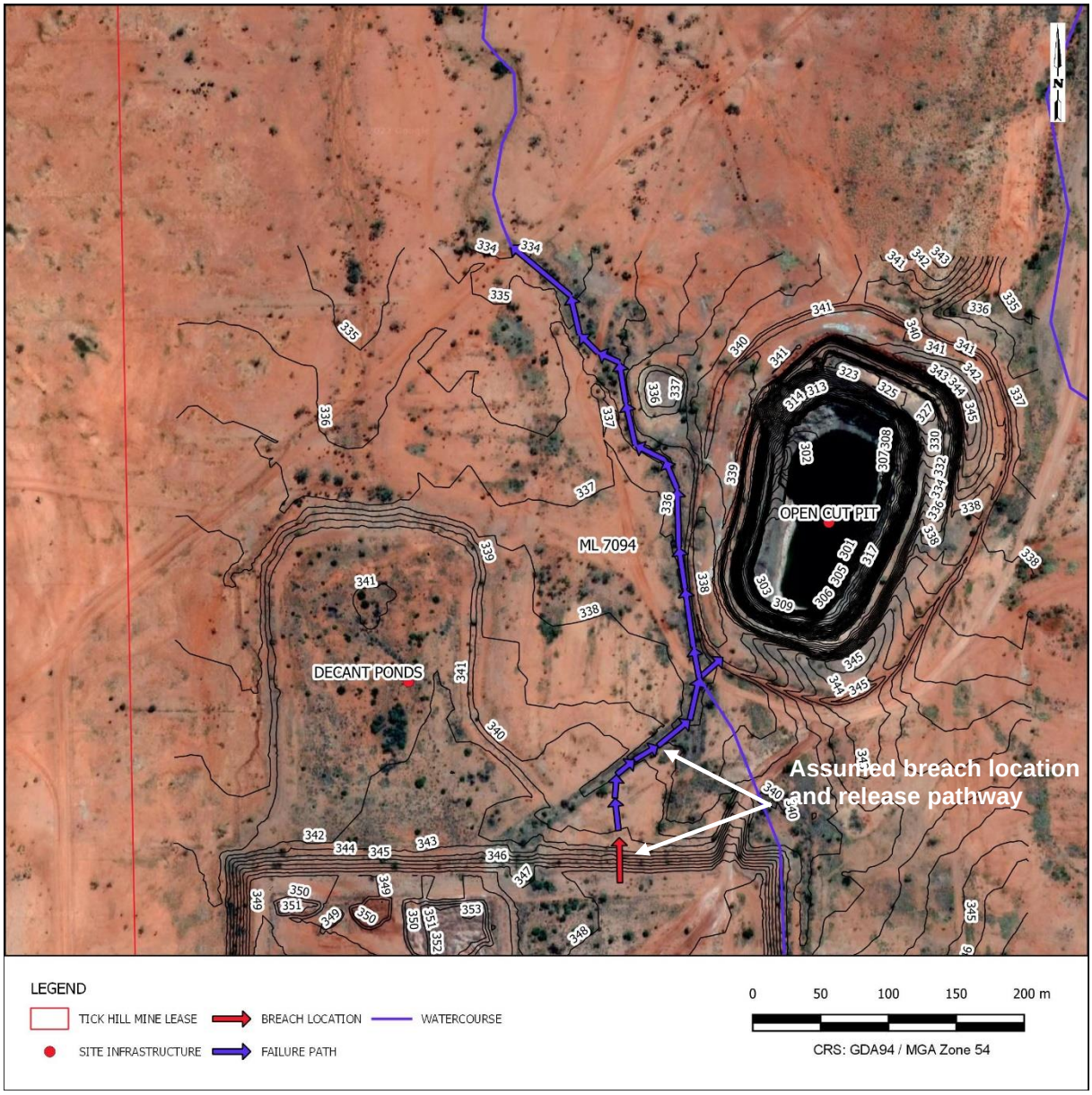
It is noted that a failure from the West Cell was not considered, given that Zone W3 located against the northern embankment will not be mined, therefore a significant separation between the pond area and the northern embankment will exist.

The assessed breach location in Zone E6/Zone E7 and failure path is shown on **Map 6**. The primary failure path is expected to be towards the open cut pit, with some minor flows bypassing into the unnamed tributary of Petticoat Creek.

MAP 6: BREACH LOCATION



4.3 Runout Volume and Distance

The potential runout distance from the dam break scenario described in **Section 4.2.2** can be estimated based on

EQUATION 1 from Rico et al **[18]**, and is detailed in **Table 5**. .

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EQUATION 1: D_{MAX}

$$D_{MAX} = 1.61\ (H\ V_F)^{0.66}\ \text{km}$$

Where: V_F = Total volume of water and tailings released (GL)

H = Failure Height (m)

TABLE 5: SUMMARY OF SIMPLIFIED DAM BREAK SCENARIO

Parameter	SDF
Volume of Water – V_w (ML)	24.3
Volume of Failure – V_F (ML)	24.3
Failure Height – H (m)	10.5
Runout Distance (km)	0.65

As can be seen from **Table 5**, the estimated runout distance is 0.65 km. This represents a failure form the Eastern Cell. A failure of the Western Cell was not considered credible, as described in **Section 4.2.2**.

A comparison was made against the Department of Natural Resources, Mines and Energy's (DNRME) 'Guideline for failure impact assessment of water dams' **[23]** indicative failure impact zones for initial assessments. As dam break assessment assumed a full release of impounded waters from the East Cell, this comparison was considered suitable.

Table 5 of DNRME **[23]**, indicates that a failure volume of up to 200 ML has a total downstream failure impact of 5 km. As the failure volume of 24.3 ML has a runout distance of 0.65 km, this was considered to be an appropriate estimate for the high level nature of this assessment.

4.4 Population at Risk

Population at Risk (PAR) is a key indicator in characterising off property impacts associated with a dam break scenario. PAR is defined as people other than site personnel or people engaged in on-site work, therefore limited to the general public located in the failure impact zone at the time of failure. Based on this definition, the most likely locations of impact to non-site personnel are the general public travelling on Duchess-Phosphate Hill Road.

Traffic data for the Duchess-Phosphate Hill Road was not publicly available. As such, the nearest state controlled Road (Cloncurry-Dajarra Road) was utilised. Traffic data was available from the intersection with Duchess-Phosphate Hill Road, extracted from the 'Traffic census of the Queensland state-declared road network – 2019' **[21]**. The Annual Average Daily Traffic (AADT) was stated as 69 at this location. The PAR can be calculated based on AADT by **Equation 2 [23].** The parameters used to calculate the PAR on the Duchess-Phosphate Hill Road are detailed in **Table 6**.

EQUATION 2: POPULATION AT RISK FROM AADT

$$PAR = \frac{(AADT\ x\ Nv)}{24\ x\ (\frac{60}{Thaz})}$$

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TABLE 6: POPULATION AT RISK

Parameter	Value
AADT	69
Nv (Number of persons per vehicle)	1.5
Length of Road Impacted (m)	730*
Gazetted Speed Limit (km/hr)	100*
T_{haz} (Hazard Exposure Time) (minute)	0.63 (38 sec)
Population at Risk	0.03

*Based on assessment via Google Earth

As can be seen in **Table 6**, the estimated PAR is 0.03. This value has been rounded down to 0 as Duchess-Phosphate Hill Road is located approximately 7.4 km downstream of the site, which exceeds the estimated runout distance of 1.50 km. It can be concluded therefore that there is no PAR in the event of a dam break.

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5 CONSEQUENCE CATEGORY ASSESSMENT

5.1 Basis of the Consequence Category Assessment

The TSF was assessed against the requirements of the Manual **[2]** subject to operational site conditions. This involved a desktop review of site setting and details of receiving environments, and assessment of potential harm associated with failure-to-contain and dam break scenarios. Background to this assessment is summarised in **Sections 2, 3** and **4**.

5.2 Consequence Category Assessment Regulatory Requirements

The Manual sets out the requirements of the administering authority for a CCA and certification of the design of regulated structures, constructed as part of environmentally relevant activities under the Environmental Protection Act (1994) **[20]**.

The purpose of the Manual is to:

- *Guide the assessment of the Consequence Category of all structures constructed as part of activities that require an EA or development approval;*
- *Guide the determination of the structure(s) that require formal documentation; and*
- *Provide approved methods for specifying the design performance and monitoring requirements for those structures.*

Assessment criteria for CCA is based on the following failure event scenarios.

- Failure to Contain – Seepage

  Spills or release to ground/groundwater via seepage from the floor and/or sides of the structure. This is only relevant to a new structure and does not apply to structures approved prior to development of the current version of the Manual. As such, a seepage failure has not been completed.

- Failure to Contain – Overtopping

  Spills or releases from the structure that result from loss of containment due to overtopping of the structure.

- Failure to Contain – Dam Break

  Collapse of the structure due to any possible cause.

Under these scenarios, several modes of failure are possible as described below:

- A failure to contain scenario means a release from the structure that results from loss of containment due to overtopping of the structure and/or other deficiencies in water management aspects of the storage. Although such a failure mechanism is typically non-flood producing, failure to contain events may involve the release of contaminants, which could endanger environmental values or human life/wellbeing.
- A dam break scenario involves the partial or complete collapse of a structure due to any possible cause. For the purposes of CCA, a simplified empirical dam break assessment was undertaken for the proposed Zone E5, Zone E6 and Zone E7 north towards the open cut pit, assuming the following:
  - The void made by the TRP associated with the Stage 3 works of Zone E5, E6 and E7 was full to the embankment crest level; and,
  - Full failure of above ground embankment to natural ground level allowing the release of 24.3 ML

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The criteria adopted for the assessment of Consequence Category reproduced from the Manual is reproduced in **Table 7**. Assessments against the failure scenarios following the Manual for the TSF were undertaken. This assessment is contained in **Table 8**.

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TABLE 7: CONSEQUENCE CATEGORY ASSESSMENT CRITERIA (DES 2016) [2]

Environmental Harm	Consequence Category		
	High	**Significant**	**Low**
Harm to Humans	Location such that people are routinely present in the failure path and if present loss of life to greater than 10 people is expected[8]. Note: The requirement to consider the location of people in the failure path is only relevant to the 'dam break' scenario.	Location such that people are routinely present in the failure path and if present loss of life to 1 person or greater but less than 10 people is expected[7]. Note: The requirement to consider the location of people in the failure path is only relevant to the 'dam break' scenario.	Location such that people are not routinely present in the failure path and loss of life is not expected[7]. Note: The requirement to consider the location of people in the failure path is only relevant to the 'dam break' scenario.
	Location such that contamination of waters (surface and/or groundwater[9]) used for human consumption could result in the health of 20 or more people being affected[10].	Location such that contamination of waters (surface and/or groundwater[8]) used for human consumption could result in the health of 10 or more people but less than 20 people being affected[9].	Location such that contamination of waters (surface and/or groundwater[8]) used for human consumption could result in the health of less than 10 people being affected[9].
General environmental harm	Location such that: a) Contaminants may be released to areas of MNES, MSES or HEV waters that are not already authorised to be disturbed to at least the same extent under other conditions of this authority subject to any applicable offset commitment (Significant Values); and b) Adverse effects[11] on Significant Values are likely; and c) The adverse effects[10] are likely to cause at least one of the following: i) loss or damage or remedial costs greater than $50,000,000; or ii) remediation of damage is likely to take 3 years or more; or iii) permanent alteration to existing ecosystems; or iv) the area of damage (including downstream effects) is likely to be at least 5 km².	Location such that contaminants may be released so that adverse effects[10] (that are not already authorised to be disturbed to at least the same extent under other conditions of the authority subject to any applicable offset commitment) either: a) Would be likely to be caused to Significant Values but those adverse effects[10] would not be likely to meet the thresholds for the High Consequence Category and instead would be likely to cause at least one of the following: i) loss or damage or remedial costs greater than $10,000,000 but less than $50,000,000; or ii) remediation of damage is likely to take more than 6 months but less than 3 years; or iii) significant alteration to existing ecosystems; or iv) the area of damage (including downstream effects) is likely to be at least 1km2 but less than 5 km². or b) Would be likely to be caused to environmental values classed as slightly or moderately disturbed waters[12], wetland of general ecological significance[13], riverine areas, springs or lakes and associated flora and fauna (Moderate Values), and the adverse effects[10] are likely to cause at least one of the following: i) loss or damage or remedial costs greater than $20,000,000; or ii) remediation of damage is likely to take more than 1 year; or iii) significant alteration to existing ecosystems; or the area of damage (including downstream effects) is likely to be at least 2 km².	Location such that either: a) Contaminants are unlikely to be released to areas of Significant Values or Moderate Values; or b) Contaminants are likely to be released to those areas, but would be unlikely to meet any of the minimum thresholds specified for the Significant Consequence Category for adverse effects[10]
General economic loss or property damage	Location such that harm (other than a different category of harm as specified above) to third party assets in the failure path would be expected to require $10 million or greater in rehabilitation, compensation, repair or rectification costs[14].	Location such that harm (other than a different category of harm as specified above) to third party assets in the failure path would be expected to require $1 million and greater but less than $10 million in rehabilitation, compensation, repair or rectification costs[13].	Location such that harm (other than a different category of harm as specified above) to third party assets in the failure path would be expected to require less than $1 million in rehabilitation, compensation, repair or rectification costs[13] .

7 To be used for all failure event scenarios

8.'People routinely present in the failure path' could be considered to be people who occupy buildings or other places of occupation that lie within the failure impact zone. For the purposes of this Manual, this should refer to people other than site personnel engaged by the resource operation and located on the tenements and tenure associated with the resource operation; for other ERAs, it would be the 'premises referred to in the authority'. It should be noted that while this is appropriate for the assessment of consequence categories in accordance with this Manual, adherence to the requirements of this Manual does not limit, amend or change in any way, any other requirements to be complied with under relevant health and safety acts or legislation that requires the safety of site personnel to be considered.

9 When considering potential impacts on groundwater, it is not envisaged that a full hydrogeological assessment will be required in all cases. Any consideration of potential impacts on groundwater systems should consider the water quality of the potential receiving aquifer as well as the quality of fluid stored in the regulated dam. Existing groundwater drawdown in areas surrounding resource operations (e.g. drawdown as a result of mine pit or underground mine dewatering) can also be considered when assessing the consequence of dam seepage on groundwater systems.

10 'An adverse effect on human health means a physiological effect on human health and does not include an impact on the quality of downstream water that merely negatively affects taste and which is unlikely to cause persons to become physically ill.

11 Adverse effects includes chronic and acute effects where an acute effect is on living organism/s which results in severe symptoms that develop rapidly, and a chronic effect is an adverse effect on a living organism/s which develops slowly. In some instances, it may be necessary to carry out or reference existing ecological/toxicological studies to assess the impacts of contaminants on living organisms.

12 See Water EPP for definitions

13 Wetland of general ecological significance' means a wetland shown on a map of referable wetland as a 'general ecologically significant wetland' or 'wetland of other environmental value'.

14 This does not include the holder's own mine or gas production, on-site industrial or commercial assets, the holder's workers' accommodation, agricultural facilities on the holder's land such as a farm shed or farm dam or infrastructure solely for servicing the holder.

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TABLE 8: CONSEQUENCE CATEGORY ASSESSMENT

Environmental Harm	Consequence Category		
	Failure to Contain – Seepage	**Failure to Contain – Overtopping**	**Failure to Contain – Dam Break**
Harm to Humans	Under Section 2.1.2.1.a of the Manual **[2],** the assessment against the 'Failure to contain – seepage' scenario is applicable for new structures and does not apply to structures approved prior to development of Version 5.02 of the Manual. As the TSF is an existing structure, an assessment of 'Failure to contain – seepage' has not been undertaken.	In the event of an overtopping event, release of mine impacted water will occur through the TSF spillway and flow north along the unnamed tributary of Petticoat Creek. Overtopping flows may report to the Pit. An overtopping failure would typically result from the following: • Mismanagement of impounded surface waters • Prolonged extended rainfall exceeding containment criteria Overtopping flows is not expected to impact public roads, with no other areas where non-site personnel would be expected to be routinely present. There are no potable water sources (either surface water or groundwater) used for human consumption in the potential impact area. **Consequence Category is assessed as Low.**	In the event of a dam break failure of the TSF, it has been assumed that the release of mine impacted water resulting from impoundment failure will flow north along the unnamed tributary of Petticoat Creek. Flows may report to the Pit. The Duchess-Phosphate Hill Road is located approximately 7.3 km downstream of the TSF and will likely be affected by a dam break event. However, for this scenario, the Population at Risk (PAR) was assessed to be < 1. **Consequence Category is assessed as Low**
General environmental harm		In the event of an overtopping failure, release of mine impacted water will flow north along the unnamed tributary of Petticoat Creek. Overtopping flows may report to the Pit. Overtopping flows may impact the following areas of MNES and MSES: • Wildlife habitat (special least concern), • Wildlife habitat (endangered or vulnerable), • Regulated vegetation (intersecting a watercourse), and; • Regulated vegetation – essential habitat). Impact is expected to downstream areas of significant environmental value, but not meet the thresholds for a 'High' consequence. Impacts and likely consequences would likely include: 6) remediation of damage is likely to take more than 6 months but less than 3 years; or ii) the area of damage (including downstream effects) is likely to be at least 1 km^2 but less than 5 km^2. **Consequence Category is assessed as Significant.**	In the event of a dam break failure of the TSF, the release of mine impacted water will flow north along the unnamed tributary of Petticoat Creek. Flows may report to the Pit. Flows from a Dam Break event may impact the following areas of MNES and MSES: • Wildlife habitat (special least concern), • Wildlife habitat (endangered or vulnerable), • Regulated vegetation (intersecting a watercourse), and; • Regulated vegetation – essential habitat). Impact is expected to downstream areas of significant environmental value, but not meet the thresholds for a 'High' consequence. Impacts and likely consequences would likely include: 6) remediation of damage is likely to take more than 6 months but less than 3 years; or ii) the area of damage (including downstream effects) is likely to be at least 1 km^2 but less than 5 km^2. **Consequence Category is assessed as Significant.**
General economic loss or property damage	**Consequence Category is assessed as N/A.**	In the event of an overtopping failure, release of mine impacted water will flow north along the unnamed tributary of Petticoat Creek. Overtopping flows may report to the Pit. There are no third party assets in the potential failure area. However, a clean up liability along the length of impacted creek line would be required. Rehabilitation, repair or compensation would be expected to be less than $1 million. **Consequence Category assessed as Low.**	In the event of a dam break failure of the TSF, the release of mine impacted water will flow north along the unnamed tributary of Petticoat Creek. Flows may report to the Pit. There are no third party assets in the potential failure area. However, a clean up liability along the length of impacted creek line would be required, which would be reasonable extensive given the predicted impact area from the dam break assessment. Rehabilitation, repair or compensation would be expected to be more than $1 million, however less than $10 million. **Consequence Category is assessed as Significant.**
Overall Consequence Category	**N/A**	**SIGNIFICANT**	**SIGNIFICANT**

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6 SUMMARY AND DESIGN

A CCA has been undertaken in relation to the existing Tick Hill TSF, associated with a tailings reprocessing proposal (TRP). The CCA was completed in accordance with DES **[2]** with results summarised in **Table 9**.

TABLE 9: DES CONSEQUENCE CATEGORY ASSESSMENT SUMMARY

Failure Scenario	TSF
Failure to Contain – Seepage	N/A.
Failure to Contain – Overtopping	Significant
Failure to Contain – Dam Break	Significant
Overall	Significant
Regulated Structure, as defined in the Manual (Y/N)	Y

As shown in **Table 9**, the TSF has an overall consequence category of "**Significant**" and is therefore considered to be regulated structure.

Based on the above assessment, the preliminary hydraulic performance criteria to be applied to design and operation of the TSF are as detailed in **Table 10**.

TABLE 10: HYDRAULIC PERFORMANCE CRITERIA (DES 2016) [2]

Consequence Category	Spillway Capacity Criteria	Design Storage Allowance (DSA)	Extreme Storm Storage (ESS)
Significant	1:100 AEP to 1:1,000 AEP + wave runup for 1:10 AEP wind	1:20 AEP 3-month wet season	1:10 AEP 72 hr duration

A preliminary analysis to quantify DSA and ESS based on the criteria listed in **Table 10** has been undertaken in accordance with the Manual [2] and are detailed in **Table 11** and **Table 12** respectively.

TABLE 11: DESIGN STORAGE ALLOWANCE (DSA)

Parameter	West Cell	East Cell
Hazard Category	Significant	Significant
Design Risk	1:20 AEP, 3 month wet season	1:20 AEP, 3 month wet season
Rainfall Total	510 mm*	510 mm*
Catchment area (includes storage extents)	4.6 ha	4.6 ha
Runoff Coefficient	1.0	1.0
Calculated Runoff Volume	23.5 ML	23.5 ML
Process Inputs	6.0 ML	6.0. ML
DSA Volume	**29.5 ML**	**29.5 ML**

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*The Longpaddock SILO data drill for location -21.65S and 139.90E **[11]**.

It is noted that the DSA volume of 29.5 ML is greater than the volume of the decant pond of 24.3 ML. Ordinarily, this would result in a loss of containment, however, there is additional volume above the decant pond provided by the area of reprocessing. As such, sufficient storage will be available to contain the DSA.

TABLE 12: MANDATORY REPORTING LEVEL ASSESSMENT

Parameter	West Cell	East Cell
Hazard Category	Low	Significant
Design Risk	-	1:10 AEP, 72 hr duration
Rainfall Total	-	181 mm
Catchment area (includes storage extents)	-	4.6 ha
Runoff Coefficient	-	1.0
Extreme Storm Storage (ESS)	**-**	**8.3 ML**
Depth below Spillway Level to achieve Volume	-	Varies based upon staging
MRL	**-**	**TBD prior to 1 November based upon staging**

As noted in **Table 12**, the MRL in the East Cell will vary based upon the staging of works current as at 1 November. As such, the MRL will vary during the duration of the project. The MRL is to be re-applied to the decant pond at each stage of reclamation as the decant pond moves. An MRL for the Western Cell is not required.

Upon closure, it is understood a residual 60 ML void will remain within the Western Cell of the TSF.

These design and operating aspects should be confirmed based on criteria listed in **Table 10** as part of final development planning.

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REFERENCES

[1] Department of Environment and Science (2021), Environmental Authority EPML00773613 (Effective Date 20 April 2021), Queensland Government.

[2] Department of Environment and Science (2016), 'Manual for Assessing Consequence Categories and Hydraulic Performance of Structures', ESR/2016/1933, March 2016, version 5.01, Queensland Government.

[3] 'Tick_hill_TSF_reclamation_BIM-2020 v2.pptx',

[4] PSM (2020), 'Tick Hill Gold Mine – Geotechnical and Hydrological Assessment of Tailings Recovery', Ref: PSM4146-002R, dated 14 August 2020.

[5] Envirofin (2020), 'Tick Hill Tailings Reclamation Project – EA Amendment Application Supporting Information', Ref: CR0002v2, dated 10 August 2020.

[6] PA Scott Consulting (2020), 'Tick Hill Gold Project – Tailings Environmental Geochemistry Review', dated 29 July 2020.

[7] Groundwater Sampling Results, 'ET2002584_0_COA.pdf', 20 June 2020

[8] Groundwater Sampling Results, 'ET2102774_0_COA.pdf', 23 January 2021

[9] Groundwater Sampling Results, 'ET2102774_0_COA.pdf', 09 June 2021

[10] Queensland Government, 'Queensland Globe', accessed 4 March 2022, https://qldglobe.information.qld.gov.au/help-info/, Queensland Government.

[11] The Long Paddock (2021), SILO Data Drill for Cell -21.65, 139.90, accessed 17 March 2022, https://www.longpaddock.qld.gov.au/silo/gridded-data/, Queensland Government

[12] Department of Agriculture, Water and the Environment (20221), 'EPBC Act Protected Matter Report', accessed 4 March 2022 for coordinates -20.33105, 145.77554, http://www.environment.gov.au/epbc/pmst/, Australian Government.

[13] Department of Environment and Science (2022a), 'Environmental Reports - Matters of State Environmental Significance', accessed 4 March 2022 for ML10137, https://apps.des.qld.gov.au/report-request/environment/, Queensland Government.

[14] Department of Environment and Science (2022b), 'Environmental Reports - Biodiversity and Conservation Values – Biodiversity Planning Assessments and Aquatic Conservation Assessments', accessed 4 March 2022 for ML10137, https://apps.des.qld.gov.au/report-request/environment/, Queensland Government.

[15] Department of Environment and Science (2022c), 'Environmental Reports - Regional Ecosystems – Biodiversity Status', accessed 4 March 2022 for ML10137, https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/descriptions, Queensland Government.

[16] Business Queensland (2022), 'Bore Reports' accessed 4 March 2022, https://www.business.qld.gov.au/industries/mining-energy-water/water/bores-and-groundwater/bore-reports, Queensland Government.

[17] Beck, H.E., N.E. Zimmermann, T.R. McVicar, N. Vergopolan, A. Berg, E.F. Wood (2018), 'Present and future Köppen-Geiger climate classification maps at 1-km resolution', *Scientific Data* 5:180214, doi:10.1038/sdata.2018.214 (2018)

[18] Rico, M.; Benito, G.; Diez-Herrero, A. Floods from tailings dam failures. J. Hazard. Mater. (2008)

[19] ANCOLD (2019), 'Guidelines on Tailings Dams – Planning, Design, Construction, Operation and Closure – Revision 1'. July 2019. Australian National Committee on Large Dams.

[20] Queensland Parliament (2018), *Environmental Protection Act 1994*, 1 January 2018 Reprint, Queensland Government.

[21] Queensland Government (2019), 'Traffic census of the Queensland state-declared road network – 2019', Accessed 22 December 2021.

[22] World Meteorological Organization (WMO), Manual on estimation of Probable Maximum Precipitation (PMP), 2009

[23] Department of Natural Resources, Mines and Energy (2018), 'Guideline for failure impact assessment of water dams', November 2018.

CONDITIONS OF REPORT

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APPENDICES

APPENDIX A – GROUNDWATER QUALITY SAMPLING RESULTS

TABLE A1: GROUNDWATER SAMPLES – 22 JUNE 2020 [7]

Quality Parameter (Total)	Unit	Sampling Location						ANZECC Release Limit for Stockwater
		THGW001	THGW002	THGW003	THGW004	THGW005	THGW006	
pH Value	pH Unit	8.08	8.17	8.17	8.23	8.33	8.16	-
Electrical Conductivity	µS/cm	2600	1240	2070	2850	1750	1820	5970
Total Dissolved Solids	mg/L	1690	806	1340	1850	1140	1180	-
Total Hardness as CaCO3	mg/L	604	282	479	89	314	326	-
Hydroxide Alkalinity as CaCO3	mg/L	<1	<1	<1	<1	<1	<1	-
Carbonate Alkalinity as CaCO3	mg/L	<1	<1	<1	<1	<1	<1	-
Bicarbonate Alkalinity as CaCO3	mg/L	743	445	669	1230	828	931	-
Total Alkalinity as CaCO3	mg/L	743	445	669	1230	828	931	-
Sulfate as SO4 - Turbidimetric	mg/L	97	16	53	91	25	27	1000
Chloride	mg/L	391	142	300	125	90	77	-
Dissolved Major Cations								
Calcium	mg/L	44	32	45	6	25	20	-
Magnesium	mg/L	120	49	89	18	61	67	-
Sodium	mg/L	376	177	291	686	321	326	-
Potassium	mg/L	7	7	9	6	6	4	-
Dissolved Metals by ICP-MS								
Aluminium	mg/L	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	5
Antimony	mg/L	0.003	<0.001	0.002	0.001	0.003	<0.001	
Arsenic	mg/L	0.002	<0.001	<0.001	0.004	<0.001	<0.001	0.5

Quality Parameter (Total)	Unit	Sampling Location						ANZECC Release Limit for Stockwater
		THGW001	THGW002	THGW003	THGW004	THGW005	THGW006	
Cadmium	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.01
Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	1.0
Cobalt	mg/L	0.249	0.004	0.013	<0.001	0.004	0.001	1.0
Copper	mg/L	0.002	0.002	0.002	0.003	0.002	<0.001	1.0
Lead	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.1
Manganese	mg/L	0.005	0.008	0.003	0.011	<0.001	0.007	
Molybdenum	mg/L	0.002	<0.001	0.002	0.007	0.003	0.002	0.15
Nickel	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Selenium	mg/L	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	0.02
Zinc	mg/L	0.018	0.005	0.05	0.054	0.024	0.008	20
Tungsten	mg/L	<0.001	<0.001	0.002	0.001	0.008	0.001	

TABLE A2: GROUNDWATER SAMPLES – 23 JANUARY 2021 [8]

Quality Parameter (Total)	Unit	Sampling Location						ANZECC Release Limit for Stockwater
		THGW001	THGW002	THGW003	THGW004	THGW005	THGW006	
pH Value	pH Unit	8.00	8.07	8.09	8.35	8.38	8.06	
Electrical Conductivity	µS/cm	2560	1340	2090	2810	1800	1780	5970
Total Dissolved Solids	mg/L	1660	871	1360	1830	1170	1160	
Total Hardness as CaCO3	mg/L	595	291	490	91	323	337	
Hydroxide Alkalinity as CaCO3	mg/L	<1	<1	<1	<1	<1	<1	
Carbonate Alkalinity as CaCO3	mg/L	<1	<1	<1	8	13	<1	
Bicarbonate Alkalinity as CaCO3	mg/L	752	490	657	1200	861	894	
Total Alkalinity as CaCO3	mg/L	752	490	657	1210	874	894	-
Sulfate as SO4 - Turbidimetric	mg/L	88	2	51	82	25	25	1000
Chloride	mg/L	402	160	314	117	99	65	-
Dissolved Major Cations								
Calcium	mg/L	47	34	48	5	27	23	-
Magnesium	mg/L	116	50	90	19	62	68	-
Sodium	mg/L	387	191	310	724	345	329	-
Potassium	mg/L	7	7	8	5	7	4	-
Dissolved Metals by ICP-MS								
Aluminium	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	5
Antimony	mg/L	<0.001	<0.001	0.004	<0.001	0.006	<0.001	-
Arsenic	mg/L	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	0.5
Cadmium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.01

Quality Parameter (Total)	Unit	Sampling Location						ANZECC Release Limit for Stockwater
		THGW001	THGW002	THGW003	THGW004	THGW005	THGW006	
Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	1.0
Cobalt	mg/L	0.199	0.004	0.013	0.002	0.003	0.001	1.0
Copper	mg/L	<0.001	0.002	0.005	<0.001	0.004	<0.001	1.0
Lead	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.1
Manganese	mg/L	0.002	0.015	<0.001	<0.001	0.012	0.001	-
Molybdenum	mg/L	0.002	<0.001	0.002	0.006	0.003	0.001	0.15
Nickel	mg/L	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.001
Selenium	mg/L	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	0.02
Zinc	mg/L	<0.005	0.005	0.037	<0.005	0.024	0.006	20
Tungsten	mg/L	<0.001	<0.001	0.002	0.001	0.007	<0.001	-

TABLE A3: GROUNDWATER SAMPLES – 9 JUNE 2021 [9]

Quality Parameter (Total)	Unit	Sampling Location						ANZECC Release Limit for Stockwater
		THGW001	THGW002	THGW003	THGW004	THGW005	THGW006	
pH Value	pH Unit	8.00	8.07	8.09	8.35	8.38	8.06	-
Electrical Conductivity	µS/cm	2560	1340	2090	2810	1800	1780	5970
Total Dissolved Solids	mg/L	1660	871	1360	1830	1170	1160	-
Total Hardness as CaCO3	mg/L	595	291	490	91	323	337	-
Hydroxide Alkalinity as CaCO3	mg/L	<1	<1	<1	<1	<1	<1	-
Carbonate Alkalinity as CaCO3	mg/L	<1	<1	<1	8	13	<1	-
Bicarbonate Alkalinity as CaCO3	mg/L	752	490	657	1200	861	894	-
Total Alkalinity as CaCO3	mg/L	752	490	657	1210	874	894	-
Sulfate as SO4 - Turbidimetric	mg/L	88	2	51	82	25	25	1000
Chloride	mg/L	402	160	314	117	95	65	-
Dissolved Major Cations								
Calcium	mg/L	47	34	48	5	27	23	-
Magnesium	mg/L	116	50	90	19	62	68	-
Sodium	mg/L	387	191	310	724	345	329	-
Potassium	mg/L	7	7	8	5	7	4	-
Dissolved Metals by ICP-MS								
Aluminium	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	5
Antimony	mg/L	<0.001	<0.001	0.004	<0.001	0.006	<0.001	-
Arsenic	mg/L	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	0.5
Cadmium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.01

Quality Parameter (Total)	Unit	Sampling Location						ANZECC Release Limit for Stockwater
		THGW001	THGW002	THGW003	THGW004	THGW005	THGW006	
Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	1.0
Cobalt	mg/L	0.199	0.004	0.0013	0.002	0.003	0.001	1.0
Copper	mg/L	<0.001	<0.001	0.005	<0.001	0.004	<0.001	1.0
Lead	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.1
Manganese	mg/L	0.002	0.015	0.002	0.006	0.012	0.001	-
Molybdenum	mg/L	0.002	<0.001	0.001	0.002	0.003	0.001	0.15
Nickel	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Selenium	mg/L	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	0.02
Zinc	mg/L	<0.005	<0.005	0.037	<0.005	0.024	0.006	20
Tungsten	mg/L	<0.001	<0.001	0.002	0.001	0.007	<0.001	-

APPENDIX B – EPBC ACT PROTECTED MATTER REPORT

Australian Government
Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 18-Mar-2022

- Summary
- Details
  - Matters of NES
  - Other Matters Protected by the EPBC Act
  - Extra Information
- Caveat
- Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	9
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	15
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	2
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Species			[Resource Information]
Status of Conservation Dependent and Extinct are not MNES under the EPBC Act. Number is the current name ID.			
Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat may occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area	In feature area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat likely to occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area	In feature area
MAMMAL			
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat may occur within area	In feature area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
REPTILE			
Acanthophis hawkei			
Plains Death Adder [83821]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Listed Migratory Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Motacilla cinerea			
Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
Motacilla flava			
Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos			
Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Charadrius veredus			
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area	In feature area
Gallinago hardwickii			
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Glareola maldivarum			
Oriental Pratincole [840]		Species or species habitat may occur within area	In feature area

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis			
Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Calidris melanotos			
Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Chalcites osculans as Chrysococcyx osculans			
Black-eared Cuckoo [83425]		Species or species habitat may occur within area overfly marine area	In feature area
Charadrius veredus			
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine area	In feature area
Gallinago hardwickii			
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area overfly marine area	In feature area
Glareola maldivarum			
Oriental Pratincole [840]		Species or species habitat may occur within area overfly marine area	In feature area
Haliaeetus leucogaster			
White-bellied Sea-Eagle [943]		Species or species habitat may occur within area	In feature area
Merops ornatus			
Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla cinerea			
Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla flava			
Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato)			
Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area

Extra Information

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
CopperString Project	2010/5581	Controlled Action	Completed	In feature area
Not controlled action				
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX C – ENVIRONMENTAL REPORTS – MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE

Queensland Government

Department of Environment and Science

Environmental Reports

Matters of State Environmental Significance

For the selected area of interest
ml: 7094

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Please direct queries about these reports to: Planning.Support@des.qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.

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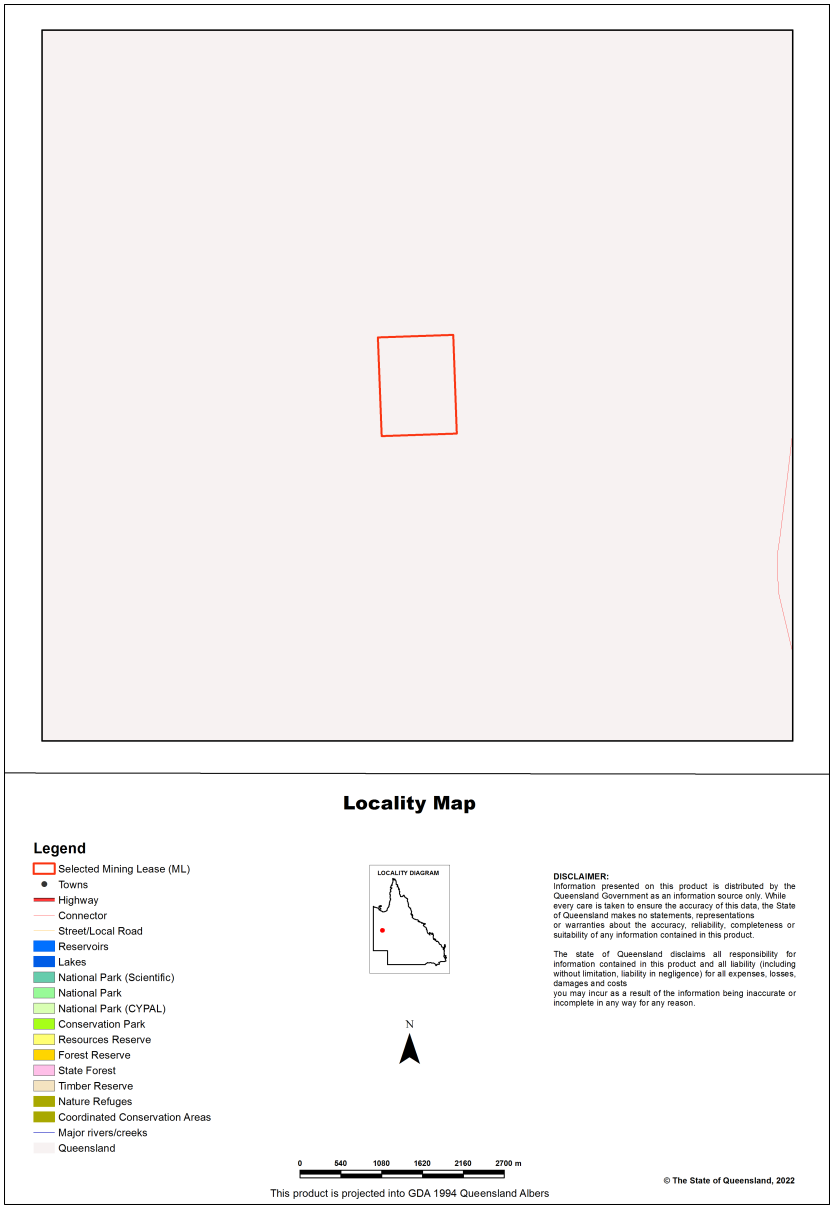
Assessment Area Details

The following table provides an overview of the area of interest (AOI) with respect to selected topographic and environmental values.

Table 1: Summary table, details for AOI ml: 7094

Size (ha)	129.99
Local Government(s)	Cloncurry Shire
Bioregion(s)	Mitchell Grass Downs, Northwest Highlands
Subregion(s)	Southwestern Downs, Mount Isa Inlier
Catchment(s)	Georgina



Matters of State Environmental Significance (MSES)

MSES Categories

Queensland's State Planning Policy (SPP) includes a biodiversity State interest that states:

'The sustainable, long-term conservation of biodiversity is supported. Significant impacts on matters of national or state environmental significance are avoided, or where this cannot be reasonably achieved; impacts are minimised and residual impacts offset.'

The MSES mapping product is a guide to assist planning and development assessment decision-making. Its primary purpose is to support implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations. Similarly, the SPP biodiversity policy does not override or replace specific requirements of other Acts or regulations.

The SPP defines matters of state environmental significance as:

- Protected areas (including all classes of protected area except coordinated conservation areas) under the *Nature Conservation Act 1992* ;

- Marine parks and land within a 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zone under the *Marine Parks Act 2004* ;

- Areas within declared fish habitat areas that are management A areas or management B areas under the Fisheries Regulation 2008;

- Threatened wildlife under the *Nature Conservation Act 1992* and special least concern animals under the Nature Conservation (Wildlife) Regulation 2006;

- Regulated vegetation under the *Vegetation Management Act 1999* that is:

  • Category B areas on the regulated vegetation management map, that are 'endangered' or 'of concern' regional ecosystems;

  • Category C areas on the regulated vegetation management map that are 'endangered' or 'of concern' regional ecosystems;

  • Category R areas on the regulated vegetation management map;

  • Regional ecosystems that intersect with watercourses identified on the vegetation management watercourse and drainage feature map;

  • Regional ecosystems that intersect with wetlands identified on the vegetation management wetlands map;

- Strategic Environmental Areas under the *Regional Planning Interests Act 2014* ;

- Wetlands in a wetland protection area of wetlands of high ecological significance shown on the Map of Queensland Wetland Environmental Values under the Environment Protection Regulation 2019;

- Wetlands and watercourses in high ecological value waters defined in the Environmental Protection (Water) Policy 2009, schedule 2;

- Legally secured offset areas.

MSES Values Present

The MSES values that are present in the area of interest are summarised in the table below:

Table 2: Summary of MSES present within the AOI

1a Protected Areas- estates	0.0 ha	0.0 %
1b Protected Areas- nature refuges	0.0 ha	0.0 %
1c Protected Areas- special wildlife reserves	0.0 ha	0.0 %
2 State Marine Parks- highly protected zones	0.0 ha	0.0 %
3 Fish habitat areas (A and B areas)	0.0 ha	0.0 %
4 Strategic Environmental Areas (SEA)	0.0 ha	0.0 %
5 High Ecological Significance wetlands on the map of Referable Wetlands	0.0 ha	0.0 %
6a High Ecological Value (HEV) wetlands	0.0 ha	0.0 %
6b High Ecological Value (HEV) waterways **	0.0 km	Not applicable
7a Threatened (endangered or vulnerable) wildlife	79.53 ha	61.2%
7b Special least concern animals	129.99 ha	100.0%
7c i Koala habitat area - core (SEQ)	0.0 ha	0.0 %
7c ii Koala habitat area - locally refined (SEQ)	0.0 ha	0.0 %
8a Regulated Vegetation - Endangered/Of concern in Category B (remnant)	0.0 ha	0.0 %
8b Regulated Vegetation - Endangered/Of concern in Category C (regrowth)	0.0 ha	0.0 %
8c Regulated Vegetation - Category R (GBR riverine regrowth)	0.0 ha	0.0 %
8d Regulated Vegetation - Essential habitat	26.36 ha	20.3%
8e Regulated Vegetation - intersecting a watercourse **	3.8 km	Not applicable
8f Regulated Vegetation - within 100m of a Vegetation Management Wetland	0.0 ha	0.0 %
9a Legally secured offset areas- offset register areas	0.0 ha	0.0 %
9b Legally secured offset areas- vegetation offsets through a Property Map of Assessable Vegetation	0.0 ha	0.0 %

Additional Information with Respect to MSES Values Present

MSES - State Conservation Areas

1a. Protected Areas - estates

(no results)

1b. Protected Areas - nature refuges

(no results)

1c. Protected Areas - special wildlife reserves

(no results)

2. State Marine Parks - highly protected zones

(no results)

3. Fish habitat areas (A and B areas)

(no results)

Refer to **Map 1 - MSES - State Conservation Areas** for an overview of the relevant MSES.

MSES - Wetlands and Waterways

4. Strategic Environmental Areas (SEA)

(no results)

5. High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values

(no results)

6a. Wetlands in High Ecological Value (HEV) waters

(no results)

6b. Waterways in High Ecological Value (HEV) waters

(no results)

Refer to **Map 2 - MSES - Wetlands and Waterways** for an overview of the relevant MSES.

MSES - Species

7a. Threatened (endangered or vulnerable) wildlife

Values are present

7b. Special least concern animals

Values are present

7c i. Koala habitat area - core (SEQ)

Not applicable

7c ii. Koala habitat area - locally refined (SEQ)

Not applicable

Threatened (endangered or vulnerable) wildlife habitat suitability models

Species	Common name	NCA status	Presence
Boronia keysii		V	None
Calyptorhynchus lathami	Glossy black cockatoo	V	None
Casuarius casuarius johnsonii	Sthn population cassowary	E	None
Crinia tinnula	Wallum froglet	V	None
Denisonia maculata	Ornamental snake	V	None
Litoria freycineti	Wallum rocketfrog	V	None
Litoria olongburensis	Wallum sedgefrog	V	None
Melaleuca irbyana		E	None
Petaurus gracilis	Mahogany Glider	E	None
Petrogale persephone	Proserpine rock-wallaby	E	None
Phascolarctos cinereus	Koala - outside SEQ*	V	None
Pezoporus wallicus wallicus	Eastern ground parrot	V	None
Taudactylus pleione	Kroombit tinkerfrog	E	None
Xeromys myoides	Water Mouse	V	None

**For koala model, this includes areas outside SEQ. Check 7c SEQ koala habitat for presence/absence.*

Threatened (endangered or vulnerable) wildlife species records

Scientific name	Common name	NCA status	EPBC status	Migratory status
Petrogale purpureicollis	purple-necked rock-wallaby	V		
Acanthophis hawkei	plains death adder	V	V	

Special least concern animal species records

Scientific name	Common name	Migratory status
Tachyglossus aculeatus	short-beaked echidna	

**Nature Conservation Act 1992 (NCA) Status- Endangered (E), Vulnerable (V) or Special Least Concern Animal (SL). Environment Protection and Biodiversity Conservation Act 1999 (EPBC) status: Critically Endangered (CE) Endangered (E), Vulnerable (V)*

Migratory status (M) - China and Australia Migratory Bird Agreement (C), Japan and Australia Migratory Bird Agreement (J), Republic of Korea and Australia Migratory Bird Agreement (R), Bonn Migratory Convention (B), Eastern Flyway (E)

To request a species list for an area, or search for a species profile, access Wildlife Online at:
https://www.qld.gov.au/environment/plants-animals/species-list/

Refer to **Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals** and **Map 3b - MSES - Species - Koala habitat area (SEQ)** for an overview of the relevant MSES.

MSES - Regulated Vegetation

For further information relating to regional ecosystems in general, go to:
https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/
For a more detailed description of a particular regional ecosystem, access the regional ecosystem search page at:
https://environment.ehp.qld.gov.au/regional-ecosystems/

8a. Regulated Vegetation - Endangered/Of concern in Category B (remnant)

Not applicable

8b. Regulated Vegetation - Endangered/Of concern in Category C (regrowth)

Not applicable

8c. Regulated Vegetation - Category R (GBR riverine regrowth)

Not applicable

8d. Regulated Vegetation - Essential habitat

Values are present

8e. Regulated Vegetation - intersecting a watercourse**

A vegetation management watercourse is mapped as present

8f. Regulated Vegetation - within 100m of a Vegetation Management wetland

Not applicable

Refer to **Map 4 - MSES - Regulated Vegetation** for an overview of the relevant MSES.

MSES - Offsets

9a. Legally secured offset areas - offset register areas

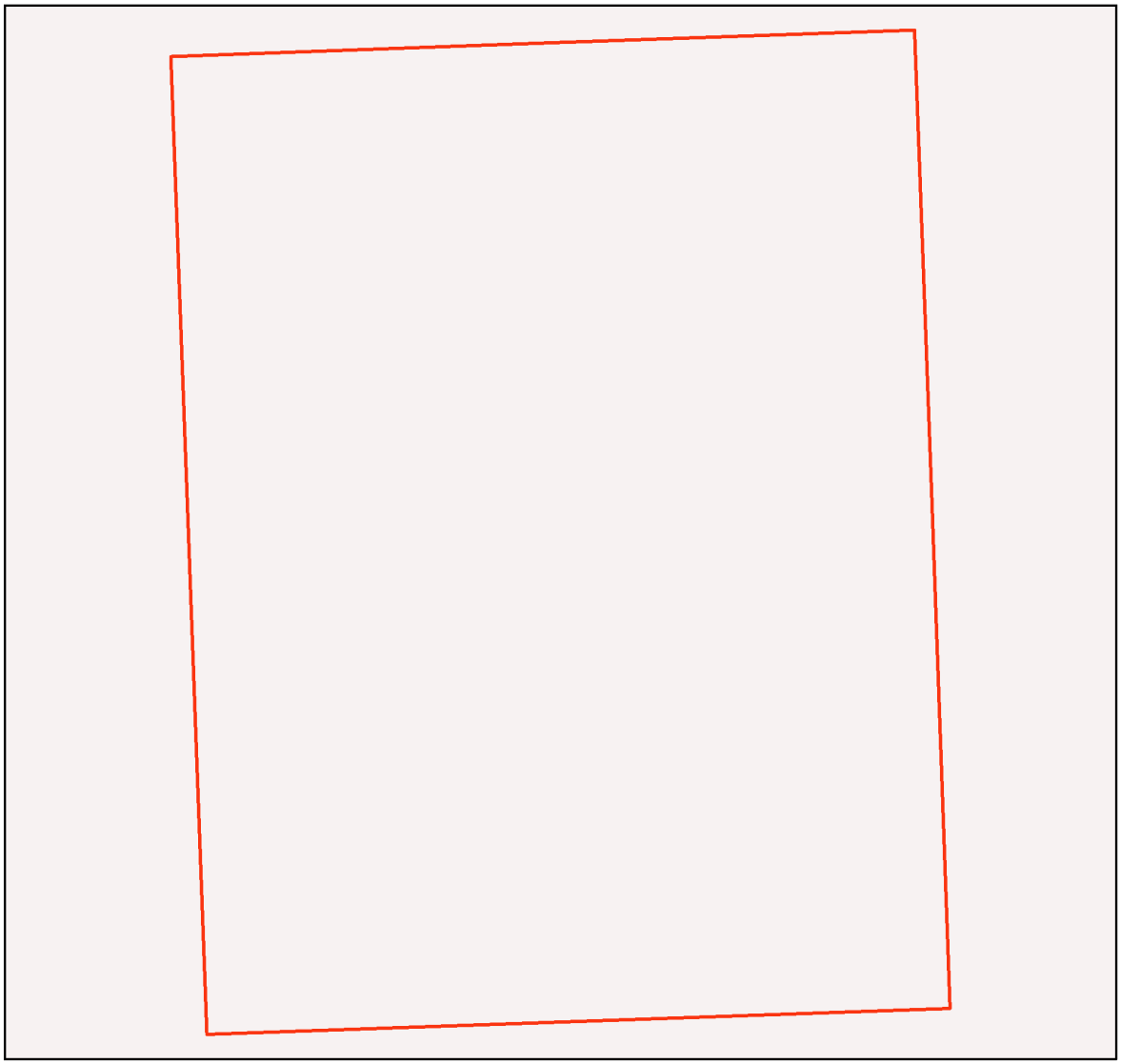
(no results)

9b. Legally secured offset areas - vegetation offsets through a Property Map of Assessable Vegetation

(no results)

Refer to **Map 5 - MSES - Offset Areas** for an overview of the relevant MSES.

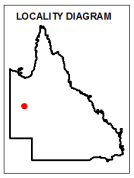
Map 1 - MSES - State Conservation Areas



MSES - State Conservation Areas

Area of Interest

- Selected Mining Lease (ML)
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Protected area (estates, nature refuges, special wildlife reserves)
- Declared fish habitat area (A and B areas)
- Marine park (highly protected)



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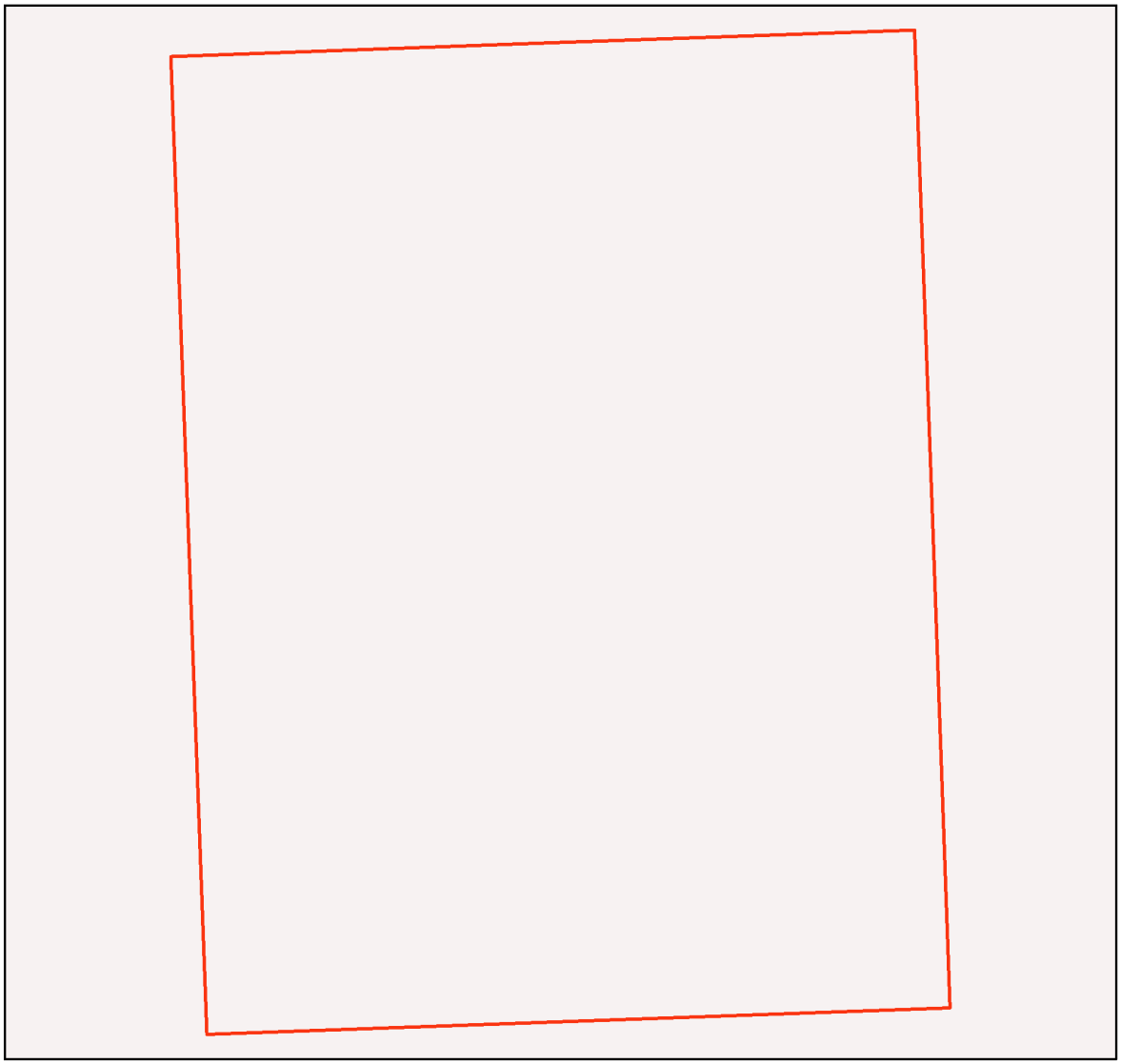
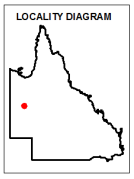
Map 2 - MSES - Wetlands and Waterways



MSES - Wetlands and Waterways

Area of Interest

- Selected Mining Lease (ML)
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Declared high ecological value waters (watercourse)
- Strategic environmental area (designated precinct)
- Declared high ecological value waters (wetland)
- High ecological significance wetlands



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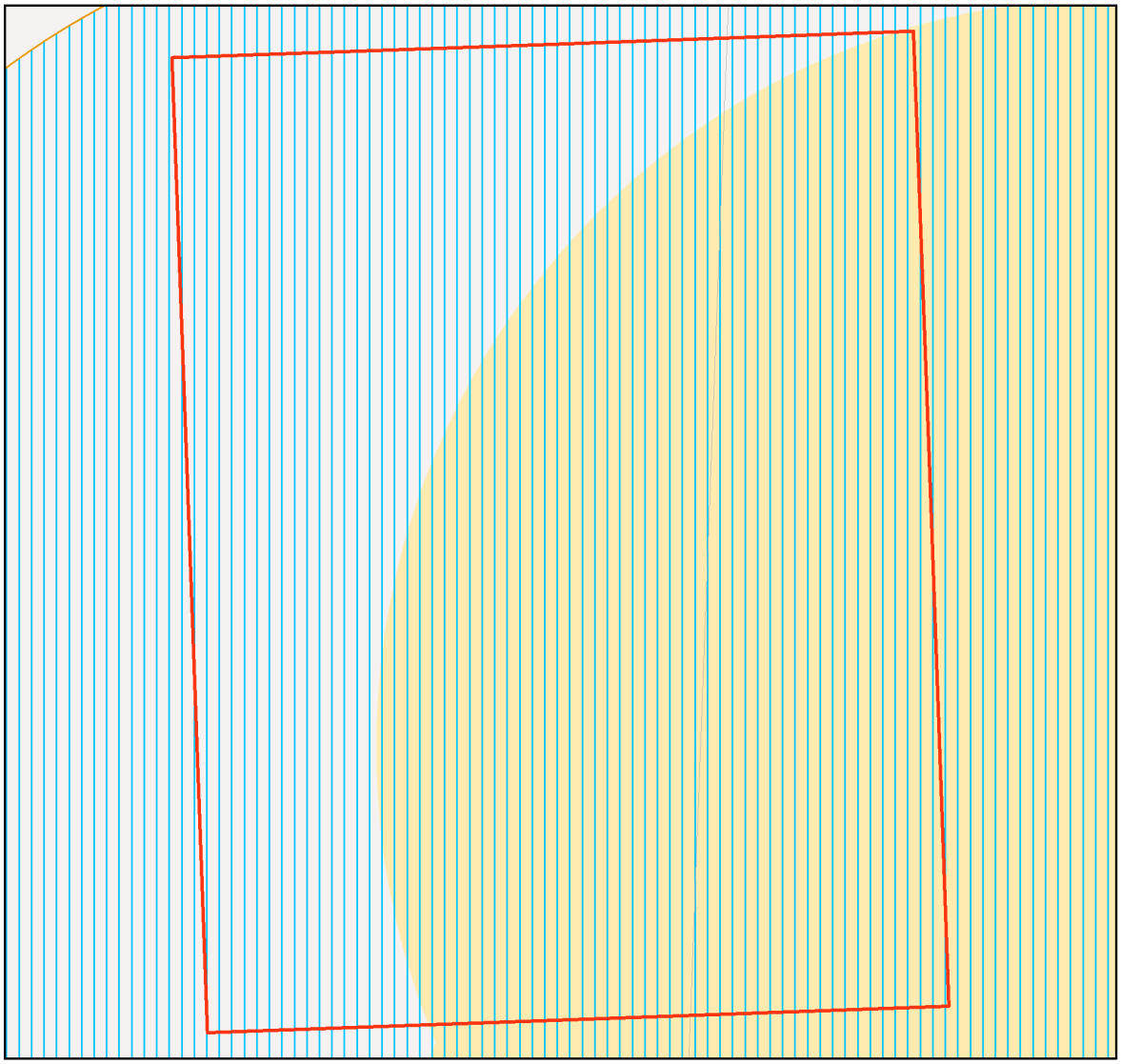
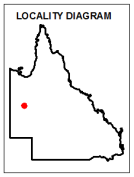
Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals



MSES - Species
Threatened (endangered or vulnerable) wildlife and special least concern animals

Area of Interest

- Selected Mining Lease (ML)
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Wildlife habitat (special least concern)
- Wildlife habitat (endangered or vulnerable)



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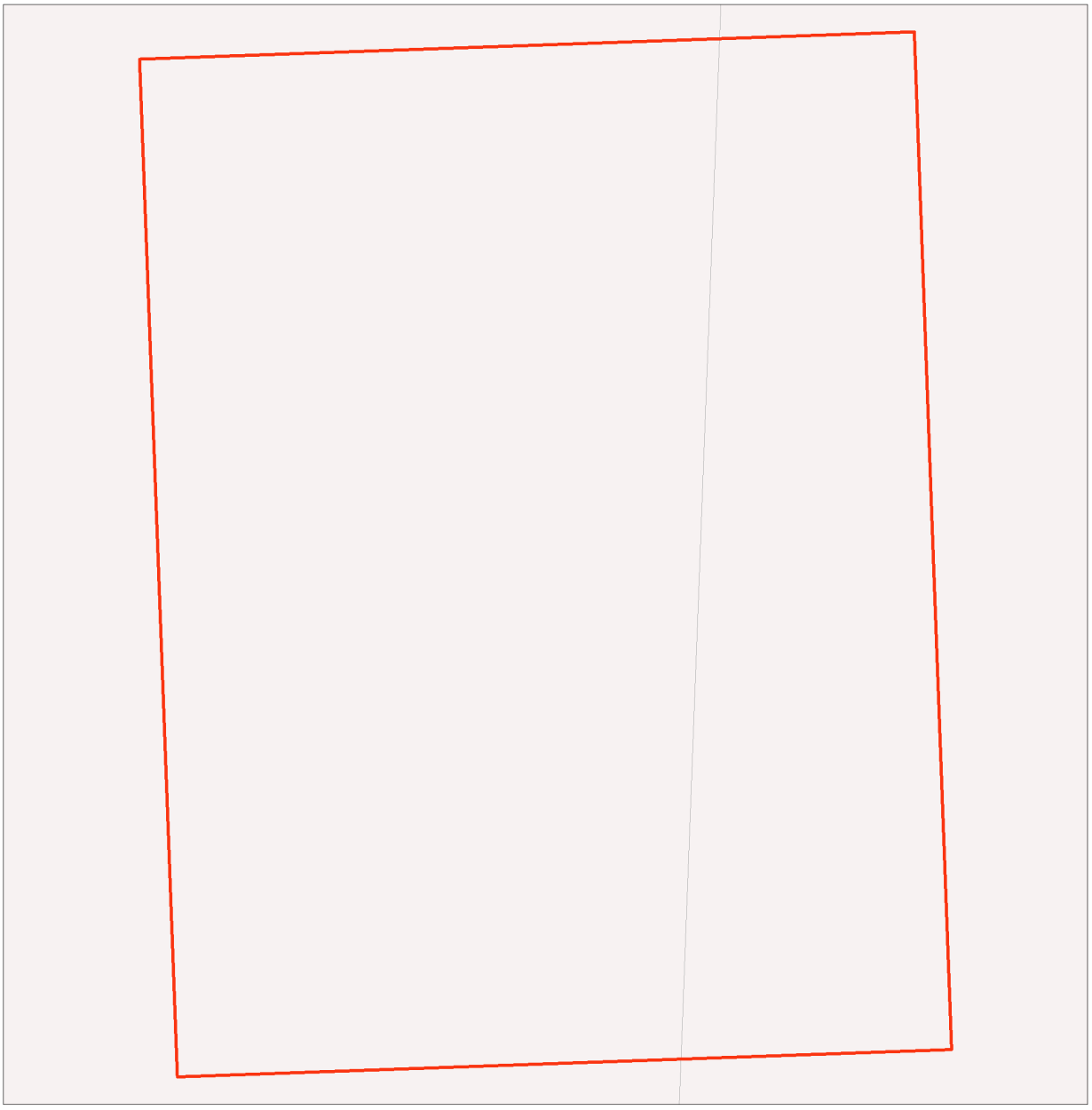
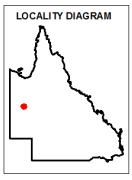
Map 3b - MSES - Species - Koala habitat area (SEQ)



MSES - Species
Koala habitat area (SEQ)

Area of Interest

- Selected Mining Lease (ML)
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Koala habitat area (core)
- Koala habitat area (locally refined)



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The represented layers for SEQ 'koala habitat area-core' and 'koala habitat area- locally refined' in MSES are sourced directly from the regulatory mapping under the Nature Conservation (Koala) Conservation Plan 2017. Whilst every effort is made to ensure the information remains current, there may be delays between updating versions. Please refer to the original mapping for the most recent version. See https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping

The koala habitat mapping within South East Queensland uses regional ecosystem linework compiled at a scale varying from 1:25,000 to 1:100,000. Linework should be used as a guide only. The positional accuracy of regional ecosystem data mapped at a scale of 1:100,000 is +/- 100 metres.

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0 70 140 210 280 350 m

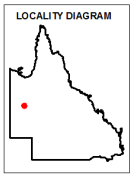
This product is projected into GDA 1994 Queensland Albers

Map 4 - MSES - Regulated Vegetation

MSES - Regulated Vegetation

Area of Interest

- Selected Mining Lease (ML)
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Regulated vegetation (intersecting a watercourse)
- Regulated vegetation (100m from wetland)
- Regulated vegetation (category B - endangered or of concern)
- Regulated vegetation (category C - endangered or of concern)
- Regulated vegetation (category R - GBR riverine)
- Regulated vegetation (essential habitat)



N

0 80 160 240 320 400 m

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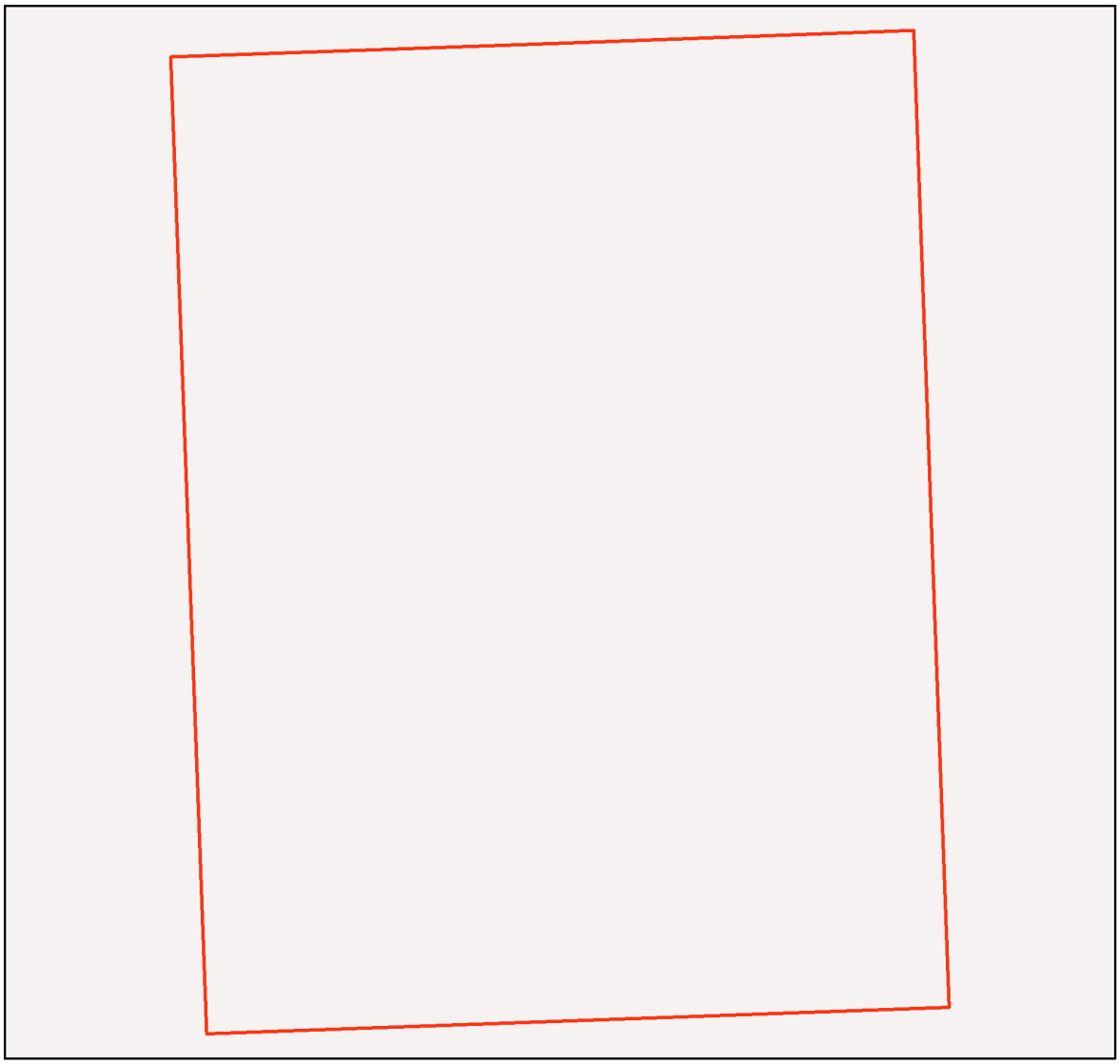
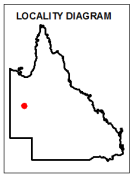
Map 5 - MSES - Offset Areas



MSES - Offsets

Area of Interest

- Selected Mining Lease (ML)
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Legally secured offset area (offset register)
- Legally secured offset area (vegetation offsets)



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Appendices

Appendix 1 - Matters of State Environmental Significance (MSES) methodology

MSES mapping is a regional-scale representation of the definition for MSES under the State Planning Policy (SPP). The compiled MSES mapping product is a guide to assist planning and development assessment decision-making. Its primary purpose is to support implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations. Similarly, the SPP biodiversity policy does not override or replace specific requirements of other Acts or regulations.

The Queensland Government's "Method for mapping - matters of state environmental significance for use in land use planning and development assessment" can be downloaded from:

http://www.ehp.qld.gov.au/land/natural-resource/method-mapping-mses.html .

Appendix 2 - Source Data

The datasets listed below are available on request from:

http://qldspatial.information.qld.gov.au/catalogue/custom/index.page

- Matters of State environmental significance

Note: MSES mapping is not based on new or unique data. The primary mapping product draws data from a number of underlying environment databases and geo-referenced information sources. MSES mapping is a versioned product that is updated generally on a twice-yearly basis to incorporate the changes to underlying data sources. Several components of MSES mapping made for the current version may differ from the current underlying data sources. To ensure accuracy, or proper representation of MSES values, it is strongly recommended that users refer to the underlying data sources and review the current definition of MSES in the State Planning Policy, before applying the MSES mapping.

Individual MSES layers can be attributed to the following source data available at QSpatial:

MSES layers	**current QSpatial data (http://qspatial.information.qld.gov.au)**
Protected Areas-Estates, Nature Refuges, Special Wildlife Reserves	- Protected areas of Queensland - Nature Refuges - Queensland - Special Wildlife Reserves- Queensland
Marine Park-Highly Protected Zones	Moreton Bay marine park zoning 2008
Fish Habitat Areas	Queensland fish habitat areas
Strategic Environmental Areas-designated	Regional Planning Interests Act - Strategic Environmental Areas
HES wetlands	Map of Queensland Wetland Environmental Values
Wetlands in HEV waters	HEV waters: - EPP Water intent for waters Source Wetlands: - Queensland Wetland Mapping (Current version 5) Source Watercourses: - Vegetation management watercourse and drainage feature map (1:100000 and 1:250000)
Wildlife habitat (threatened and special least concern)	-WildNet database species records - habitat suitability models (various) - SEQ koala habitat areas under the Koala Conservation Plan 2019
VMA regulated regional ecosystems	Vegetation management regional ecosystem and remnant map
VMA Essential Habitat	Vegetation management - essential habitat map
VMA Wetlands	Vegetation management wetlands map
Legally secured offsets	Vegetation Management Act property maps of assessable vegetation. For offset register data-contact DES
Regulated Vegetation Map	Vegetation management - regulated vegetation management map

Appendix 3 - Acronyms and Abbreviations

AOI	- Area of Interest
DES	- Department of Environment and Science
EP Act	- *Environmental Protection Act 1994*
EPP	- Environmental Protection Policy
GDA94	- Geocentric Datum of Australia 1994
GEM	- General Environmental Matters
GIS	- Geographic Information System
MSES	- Matters of State Environmental Significance
NCA	- *Nature Conservation Act 1992*
RE	- Regional Ecosystem
SPP	- State Planning Policy
VMA	- *Vegetation Management Act 1999*

APPENDIX D – ENVIRONMENTAL REPORTS – BIODIVERSITY AND CONSERVATION VALUES – BIODIVERSITY PLANNING ASSESSMENTS AND AQUATIC CONSERVATION ASSESSMENTS

TAILINGS.WATER.WASTE.

Queensland Government

Department of Environment and Science

Environmental Reports

Biodiversity and Conservation Values

Biodiversity Planning Assessments and Aquatic Conservation Assessments

For the selected area of interest
ml: 7094

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or Area of Interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "Central co-ordinates" option, the resulting assessment area encompasses an area extending from 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Please direct queries about these reports to: biodiversity.planning@des.qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.

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Summary Information

Tables 1 to 8 provide an overview of the AOI with respect to selected topographic and environmental values.

Table 1: Area of interest details: ml: 7094

Size (ha)	129.99
Local Government(s)	Cloncurry Shire
Bioregion(s)	Mitchell Grass Downs, Northwest Highlands
Subregion(s)	Southwestern Downs, Mount Isa Inlier
Catchment(s)	Georgina

The following table identifies available Biodiversity Planning Assessments (BPAs) and Aquatic Conservation Assessments (ACAs) with respect to the AOI.

Table 2: Available Biodiversity Planning and Aquatic Conservation Assessments

Assessment Type	Assessment Area and Version
Biodiversity Planning Assessment(s)	Mitchell Grass Downs v1.1, Northwest Highlands v1.1
Aquatic Conservation Assessment(s) (riverine)	Lake Eyre and Bulloo Basins v1.1
Aquatic Conservation Assessment(s) (non-riverine)	Lake Eyre and Bulloo Basins v1.1

Table 3: Remnant regional ecosystems within the AOI as per the Qld Herbarium's 'biodiversity status'

Biodiversity Status	Area (Ha)	% of AOI
Endangered	0.0	0.0
Of concern	0.0	0.0
No concern at present	129.99	100.0

The following table identifies the extent and proportion of the user specified area of interest (AOI) which is mapped as being of "State", "Regional" or "Local" significance via application of the Queensland Department of Environment and Science's *Biodiversity Assessment and Mapping Methodology* (BAMM).

Table 4: Summary table, biodiversity significance

Biodiversity significance	Area (Ha)	% of AOI
State Habitat for EVNT taxa	0.0	0.0
State	0.0	0.0
Regional	129.99	100.0
Local or Other Values	0.0	0.0

Table 5: Non-riverine wetlands intersecting the AOI

Non-riverine wetland types intersecting the area of interest	#
(No Records)	

NB. The figures presented in the table above are derived from the relevant non-riverine Aquatic Conservation Assessment(s). Later releases of wetland mapping produced via the Queensland Wetland Mapping Program may provide more recent

information in regards to wetland extent.

Table 6: Named waterways intersecting the AOI

(no results)

Refer to **Map 1** for general locality information.

The following two tables identify the extent and proportion of the user specified AOI which is mapped as being of "Very High", "High", "Medium", "Low", or "Very Low" aquatic conservation value for riverine and non-riverine wetlands via application of the Queensland Department of Environment and Science's *Aquatic Biodiversity Assessment and Mapping Method* (AquaBAMM).

Table 7: Summary table, aquatic conservation significance (riverine)

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
Very High	0.0	0.0
High	0.0	0.0
Medium	0.0	0.0
Low	129.99	100.0
Very Low	0.0	0.0

Table 8: Summary table, aquatic conservation significance (non-riverine)

Aquatic conservation significance (non-riverine wetlands)	Area (Ha)	% of AOI
(No Records)		

Biodiversity Planning Assessments

Introduction

The Department of Environment and Science (DES) attributes biodiversity significance on a bioregional scale through a Biodiversity Planning Assessment (BPA). A BPA involves the integration of ecological criteria using the *Biodiversity assessment and Mapping Methodology* (BAMM) and is developed in two stages: 1) **diagnostic criteria**, and 2) **expert panel criteria**. The diagnostic criteria are based on existing data which is reliable and uniformly available across a bioregion, while the expert panel criteria allows for the refinement of the mapped information from the diagnostic output by incorporating local knowledge and expert opinion.

The BAMM methodology has application for identifying areas with various levels of significance solely for biodiversity reasons. These include threatened ecosystems or taxa, large tracts of habitat in good condition, ecosystem diversity, landscape context and connection, and buffers to wetlands or other types of habitat important for the maintenance of biodiversity or ecological processes. While natural resource values such as dryland salinity, soil erosion potential or land capability are not dealt with explicitly, they are included to some extent within the biodiversity status of regional ecosystems recognised by the DES.

Biodiversity Planning Assessments (BPAs) assign three levels of overall biodiversity significance.

- **State significance** - areas assessed as being significant for biodiversity at the bioregional or state scales. They also include areas assessed by other studies/processes as being significant at national or international scales. In addition, areas flagged as being of State significance due to the presence of endangered, vulnerable and/or near threatened taxa, are identified as "State Habitat for EVNT taxa".
- **Regional significance** - areas assessed as being significant for biodiversity at the subregional scale. These areas have lower significance for biodiversity than areas assessed as being of State significance.
- **Local significance and/or other values** - areas assessed as not being significant for biodiversity at state or regional scales. Local values are of significance at the local government scale.

For further information on released BPAs and a copy of the underlying methodology, go to:

http://www.qld.gov.au/environment/plants-animals/biodiversity/planning/

The GIS results can be downloaded from the Queensland Spatial Catalogue at:

http://qspatial.information.qld.gov.au/geoportal/

The following table identifies the extent and proportion of the user specified AOI which is mapped as being of "State", "Regional" or "Local" significance via application of the BAMM.

Table 9: Summary table, biodiversity significance

Biodiversity significance	Area (Ha)	% of AOI
State Habitat for EVNT taxa	0.0	0.0
State	0.0	0.0
Regional	129.99	100.0
Local or Other Values	0.0	0.0

Refer to **Map 2** for further information.

Diagnostic Criteria

Diagnostic criteria are based on existing data which is reliable and uniformly available across a bioregion. These criteria are diagnostic in that they are used to filter the available data and provide a "first-cut" or initial determination of biodiversity significance. This initial assessment is then combined through a second group of other essential criteria.

A description of the individual diagnostic criteria is provided in the following sections.

Criteria A. Habitat for EVNT taxa: Classifies areas according to their significance based on the presence of endangered, vulnerable and/or rare (EVNT) taxa. EVNT taxa are those scheduled under the *Nature Conservation Act 1992* and/or the

Environment Protection and Biodiversity Conservation Act 1999. It excludes highly mobile fauna taxa which are instead considered in Criterion H and brings together information on EVNT taxa using buffering of recorded sites or habitat suitability models (HSM) where available.

Criteria B. Ecosystem value: Classifies on the basis of biodiversity status of regional ecosystems, their extent in protected areas (presence of poorly conserved regional ecosystems), the presence of significant wetlands; and areas of national importance such as the presence of Threatened Ecological Communities, World Heritage areas and Ramsar sites. Ecosystem value is applied at a bioregional (**B1**) and regional (**B2**) scale.

Criteria C. Tract size: Measures the relative size of tracts of vegetation in the landscape. The size of any tract is a major indicator of ecological significance, and is also strongly correlated with the long-term viability of biodiversity values. Larger tracts are less susceptible to ecological edge effects and are more likely to sustain viable populations of native flora and fauna than smaller tracts.

Criteria D. Relative size of regional ecosystems: Classifies the relative size of each regional ecosystem unit within its bioregion (**D1**) and its subregion (**D2**). Remnant units are compared with all other occurrences with the same regional ecosystem. Large examples of a regional ecosystem are more significant than smaller examples of the same regional ecosystem because they are more representative of the biodiversity values particular to the regional ecosystem, are more resilient to the effects of disturbance, and constitute a significant proportion of the total area of the regional ecosystem.

Criteria F. Ecosystem diversity: Is an indicator of the number of regional ecosystems occurring within an area. An area with high ecosystem diversity will have many regional ecosystems and ecotones relative to other areas within the bioregion.

Criteria G. Context and connection: Represents the extent to which a remnant unit incorporates, borders or buffers areas such as significant wetlands, endangered ecosystems; and the degree to which it is connected to other vegetation.

A summary of the biodiversity status based upon the diagnostic criteria is provided in the following table.

Table 10: Summary of biodiversity significance based upon diagnostic criteria with respect to the AOI

Biodiversity significance	Description	Area (Ha)	% of AOI
Regional	Remnant contains at least 1 RE with <10 pc extent remaining or rare in subregion (B2)	7.6	5.85
Regional	Remnant contains at least 1 Vulnerable or Near Threatened species (A)	20.34	15.65
Local or Other Values	Refer to diagnostic data for additional information	102.05	78.51

Assessment of diagnostic criteria with respect to the AOI

The following table reflects an assessment of the individual diagnostic criteria noted above in regards to the AOI.

Table 11: Assessment of individual diagnostic criteria with respect to the AOI

Diagnostic Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
A: Habitat for EVNT Taxa			20.34	15.6	109.64	84.3		
B1: Ecosystem Value (Bioregion)					129.98	100.0		
B2: Ecosystem Value (Subregion)	7.6	5.8			122.38	94.1		
C: Tract Size			129.98	100.0				
D1: Relative RE Size (Bioregion)					22.78	17.5	107.2	82.5
D2: Relative RE Size (Subregion)					22.78	17.5	107.2	82.5
F: Ecosystem Diversity	129.98	100.0						
G: Context and Connection	129.98	100.0						

Other Essential Criteria

Other essential criteria (also known as expert panel criteria) are based on non-uniform information sources and which may rely more upon expert opinion than on quantitative data. These criteria are used to provide a "second-cut" determination of biodiversity significance, which is then combined with the diagnostic criteria for an overall assessment of relative biodiversity significance. A summary of the biodiversity status based upon the other essential criteria is provided in the following table.

Table 12: Summary of biodiversity significance based upon other essential criteria with respect to the AOI

Biodiversity significance	Description	Area (Ha)	% of AOI
Regional	Remnant contains Core Habitat for Priority Taxa (H)	129.99	100.0

A description of each of the other essential criteria and associated assessment in regards to the AOI is provided in the following sections.

Criteria H. Essential and general habitat for priority taxa: Priority taxa are those which are at risk or of management concern, taxa of scientific interest as relictual (ancient or primitive), endemic taxa or locally significant populations (such as a flying fox camp or heronry), highly specialised taxa whose habitat requirements are complex and distributions are not well correlated with any particular regional ecosystem, taxa important for maintaining genetic diversity (such as complex spatial patterns of genetic variation, geographic range limits, highly disjunct populations), taxa critical for management or monitoring of biodiversity (functionally important or ecological indicators), or economic and culturally important taxa.

Criteria I. Special biodiversity values: areas with special biodiversity values are important because they contain multiple taxa in a unique ecological and often highly biodiverse environment. Areas with special biodiversity values can include the following:

- Ia - centres of endemism - areas where concentrations of taxa are endemic to a bioregion or subregion are found.
- Ib - wildlife refugia (Morton *et al*. 1995), for example, islands, mound springs, caves, wetlands, gorges, mountain ranges and topographic isolates, ecological refuges, refuges from exotic animals, and refuges from clearing. The latter may include large areas that are not suitable for clearing because of land suitability/capability.
- Ic - areas with concentrations of disjunct populations.
- Id - areas with concentrations of taxa at the limits of their geographic ranges.
- Ie - areas with high species richness.
- If - areas with concentrations of relictual populations (ancient and primitive taxa).
- Ig - areas containing REs with distinct variation in species composition associated with geomorphology and other environmental variables.
- Ih - an artificial waterbody or managed/manipulated wetland considered by the panel/s to be of ecological significance.
- Ii - areas with a high density of hollow-bearing trees that provide habitat for animals.
- Ij - breeding or roosting sites used by a significant number of individuals.
- Ik - climate change refuge.

The following table identifies the value and extent area of the Other Essential Criteria H and I within the AOI.

Table 13: Relative importance of expert panel criteria (H and I) used to access overall biodiversity significance with respect to the AOI

Expert Panel	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
H: Core Habitat Priority Taxa			129.98	100.0				
Ia: Centres of Endemism								
Ib: Wildlife Refugia								
Ic: Disjunct Populations								
Id: Limits of Geographic Ranges								
Ie: High Species Richness								
If: Relictual Populations								

Expert Panel	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
Ig: Variation in Species Composition								
Ih: Artificial Wetland								
Ii: Hollow Bearing Trees								
Ij: Breeding or Roosting Site								
Ik: Climate Refugia								

NB. Whilst biodiversity values associated with Criteria I may be present within the site (refer to tables 12 and 15), for the New England Tableland and Central Queensland Coast BPAs, area and % area figures associated with Criteria Ia through to Ij cannot be listed in the table above (due to slight variations in data formats between BPAs).

Criteria J. Corridors: areas identified under this criterion qualify either because they are existing vegetated corridors important for contiguity, or cleared areas that could serve this purpose if revegetated. Some examples of corridors include riparian habitats, transport corridors and "stepping stones".

Bioregional and subregional conservation corridors have been identified in the more developed bioregions of Queensland through the BPAs, using an intensive process involving expert panels. Map 3 displays the location of corridors as identified under the Statewide Corridor network. The Statewide Corridor network incorporates BPA derived corridors and for bioregions where no BPA has been assessed yet, corridors derived under other planning processes. *Note: as a result of updating and developing a statewide network, the alignment of corridors may differ slightly in some instances when compared to those used in individual BPAs.*

The functions of these corridors are:

- **Terrestrial** Bioregional corridors, in conjunction with large tracts of remnant vegetation, maintain ecological and evolutionary processes at a landscape scale, by:

  • Maintaining long term evolutionary/genetic processes that allow the natural change in distributions of species and connectivity between populations of species over long periods of time;

  • Maintaining landscape/ecosystems processes associated with geological, altitudinal and climatic gradients, to allow for ecological responses to climate change;

  • Maintaining large scale seasonal/migratory species processes and movement of fauna;

  • Maximising connectivity between large tracts/patches of remnant vegetation;

  • Identifying key areas for rehabilitation and offsets; and

- **Riparian** Bioregional Corridors also maintain and encourage connectivity of riparian and associated ecosystems.

The location of the corridors is determined by the following principles:

- Terrestrial

  • Complement riparian landscape corridors (i.e. minimise overlap and maximise connectivity);

  • Follow major watershed/catchment and/or coastal boundaries;

  • Incorporate major altitudinal/geological/climatic gradients;

  • Include and maximise connectivity between large tracts/patches of remnant vegetation;

  • Include and maximise connectivity between remnant vegetation in good condition; and

- Riparian

  • Located on the major river or creek systems within the bioregion in question.

The total extent of remnant vegetation triggered as being of "State", "Regional" or "Local" significance due to the presence of an overlying BPA derived terrestrial or riparian corridor within the AOI, is provided in the following table. For further information on how remnant vegetation is triggered due to the presence of an overlying BPA derived corridor, refer to the relevant landscape BPA expert panel report(s).

Table 14: Extent of triggered remnant vegetation due to the presence of BPA derived corridors with respect to the AOI

Biodiversity Significance	Area (Ha)	% of AOI
State	0.0	0.0
Regional	0.0	0.0
Local	0.0	0.0

NB: area figures associated with the extent of corridor triggered remnant vegetation are only available for those bioregions where a BPA has been undertaken.

Refer to **Map 3** for further information.

Threatening process/condition (Criteria K) - areas identified by experts under this criterion may be used to amend (upgrade or downgrade) biodiversity significance arising from the "first-cut" analysis. The condition of remnant vegetation is affected by threatening processes such as weeds, ferals, grazing and burning regime, selective timber harvesting/removal, salinity, soil erosion, and climate change.

Assessment of Criteria K with respect to the AOI is not currently included in the "Biodiversity and Conservation Values" report, as it has not been applied to the majority of Queensland due to data/information limitations and availability.

Special Area Decisions

Expert panel derived "Special Area Decisions" are used to assign values to Other Essential Criteria. The specific decisions which relate to the AOI in question are listed in the table below.

Table 15: Expert panel decisions for assigning levels of biodiversity significance with respect to the AOI

(No Records)

Expert panel decision descriptions:

(No Records)

Aquatic Conservation Assessments

Introduction

The Aquatic Biodiversity Assessment and Mapping Method or AquaBAMM (Clayton *et al.* 2006), was developed to assess conservation values of wetlands in queensland, and may also have application in broader geographical contexts. It is a comprehensive method that uses available data, including data resulting from expert opinion, to identify relative wetland conservation/ecological values within a specified study area (usually a catchment). The product of applying this method is an Aquatic Conservation Assessment (ACA) for the study area.

An ACA using AquaBAMM is non-social, non-economic and identifies the conservation/ecological values of wetlands at a user-defined scale. It provides a robust and objective conservation assessment using criteria, indicators and measures that are founded upon a large body of national and international literature. The criteria, each of which may have variable numbers of indicators and measures, are naturalness (aquatic), naturalness (catchment), diversity and richness, threatened species and ecosystems, priority species and ecosystems, special features, connectivity and representativeness. An ACA using AquaBAMM is a powerful decision support tool that is easily updated and simply interrogated through a geographic information system (GIS).

Where they have been conducted, ACAs can provide a source of baseline wetland conservation/ecological information to support natural resource management and planning processes. They are useful as an independent product or as an important foundation upon which a variety of additional environmental and socio-economic elements can be added and considered (i.e. an early input to broader 'triple-bottom-line' decision-making processes). An ACA can have application in:

- determining priorities for protection, regulation or rehabilitation of wetlands and other aquatic ecosystems
- on-ground investment in wetlands and other aquatic ecosystems
- contributing to impact assessment of large-scale development (e.g. dams)
- water resource and strategic regional planning prcesses

For a detailed explanation of the methodology please refer to the summary and expert panel reports relevant to the ACA utilised in this assessment. These reports can be accessed at Wetland *Info*:

http://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca

The GIS results can be downloaded from the Queensland Spatial Catalogue at:

http://qspatial.information.qld.gov.au/geoportal/

Explanation of Criteria

Under the AquaBAMM, eight criteria are assessed to derive an overall conservation value. Similar to the Biodiversity Assessment and Mapping Methodology, the criteria may be primarily diagnostic (quantitative) or primarily expert opinion (qualitative) in nature. The following sections provide a brief description of each of the 8 criteria.

Criteria 1. Naturalness - Aquatic: This attribute reflects the extent to which a wetland's (riverine, non-riverine, estuarine) aquatic state of naturalness is affected through relevant influencing indicators which include: presence of exotic flora and fauna; presence of aquatic communities; degree of habitat modification and degree of hydrological modification.

Criteria 2. Naturalness - Catchment: The naturalness of the terrestrial systems of a catchment can have an influence on many wetland characteristics including: natural ecological processes e.g. nutrient cycling, riparian vegetation, water chemistry, and flow. The indicators utilised to assess this criterion include: presence of exotic flora and/or fauna; riparian, catchment and flow modification.

Criteria 3. Naturalness - Diversity and Richness: This criterion is common to many ecological assessment methods and can include both physical and biological features. It includes such indicators as species richness, riparian ecosystem richness and geomorphological diversity.

Criteria 4. Threatened Species and Ecosystems: This criterion evaluates ecological rarity characteristics of a wetland. This includes both species rarity and rarity of communities / assemblages. The communities and assemblages are best represented by regional ecosystems. Species rarity is determined by NCA and EPBC status with Endangered, Vulnerable or Near-threatened species being included in the evaluation. Ecosystem rarity is determined by regional ecosystem biodiversity status i.e. Endangered, Of Concern, or Not of Concern.

Criteria 5. Priority Species and Ecosystems: Priority flora and fauna species lists are expert panel derived. These are aquatic, semi-aquatic and riparian species which exhibit at least 1 particular trait in order to be eligible for consideration. For

flora species the traits included:

- It forms significant macrophyte beds (in shallow or deep water).
- It is an important food source.
- It is important/critical habitat.
- It is implicated in spawning or reproduction for other fauna and/or flora species.
- It is at its distributional limit or is a disjunct population.
- It provides stream bank or bed stabilisation or has soil binding properties.
- It is a small population and subject to threatening processes.

Fauna species are included if they meet at least one of the following traits:

- It is endemic to the study area (>75 per cent of its distribution is in the study area/catchment).
- It has experienced, or is suspected of experiencing, a serious population decline.
- It has experienced a significant reduction in its distribution and has a naturally restricted distribution in the study area/catchment.
- It is currently a small population and threatened by loss of habitat.
- It is a significant disjunct population.
- It is a migratory species (other than birds).
- A significant proportion of the breeding population (>one per cent for waterbirds, >75 per cent other species) occurs in the waterbody (see Ramsar criterion 6 for waterbirds).
- Limit of species range.

See the individual expert panel reports for the priority species traits specific to an ACA.

Criteria 6. Special Features: Special features are areas identified by flora, fauna and ecology expert panels which exhibit characteristics beyond those identified in other criteria and which the expert panels consider to be of the highest ecological importance. Special feature traits can relate to, but are not solely restricted to geomorphic features, unique ecological processes, presence of unique or distinct habitat, presence of unique or special hydrological regimes e.g. spring-fed streams. Special features are rated on a 1 - 4 scale (4 being the highest).

Criteria 7. Connectivity: This criterion is based on the concept that appropriately connected aquatic ecosystems are healthy and resilient, with maximum potential biodiversity and delivery of ecosystem services.

Criteria 8. Representativeness: This criterion applies primarily to non-riverine assessments, evaluates the rarity and uniqueness of a wetland type in relation to specific geographic areas. Rarity is determined by the degree of wetland protection within "protected Areas" estate or within an area subject to the *Fisheries Act 1994*, *Coastal Protection and Management Act 1995*, or *Marine Parks Act 2004*. Wetland uniqueness evaluates the relative abundance and size of a wetland or wetland management group within geographic areas such as catchment and subcatchment.

Riverine Wetlands

Riverine wetlands are all wetlands and deepwater habitats within a channel. The channels are naturally or artificially created, periodically or continuously contain moving water, or connecting two bodies of standing water. AquaBAMM, when applied to riverine wetlands uses a discrete spatial unit termed subsections. A subsection can be considered as an area which encompasses discrete homogeneous stream sections in terms of their natural attributes (i.e. physical, chemical, biological and utilitarian values) and natural resources. Thus in an ACA, an aquatic conservation significance score is calculated for each subsection and applies to all streams within a subsection, rather than individual streams as such.

Please note, the area figures provided in Tables 16 and 17, are derived using the extent of riverine subsections within the AOI. Refer to **Map 5** for further information. A summary of the conservation significance of riverine wetlands within the AOI is provided in the following table.

Table 16: Overall level/s of riverine aquatic conservation significance

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
Very High	0.0	0.0

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
High	0.0	0.0
Medium	0.0	0.0
Low	129.99	100.0
Very Low	0.0	0.0

The individual aquatic conservation criteria ratings for riverine wetlands within the AOI are listed below.

Table 17: Level/s of riverine aquatic conservation significance based on selected criteria

Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
1. Naturalness aquatic			129.99	100.0				
2. Naturalness catchment	129.99	100.0						
3. Diversity and richness					129.99	100.0		
4. Threatened species and ecosystems					129.99	100.0		
5. Priority species and ecosystems								
6. Special features								
7. Connectivity							129.99	100.0
8. Representative-ness								

The table below lists and describes the relevant expert panel decisions used to assign conservation significance values to riverine wetlands within the AOI.

Table 18: Expert panel decisions for assigning overall levels of riverine aquatic conservation significance

Decision number	Special feature	Catchment	Criteria/Indicator/Measure	Conservation rating (1-4)
(No Records)				

4 is the highest rating/value

Expert panel decision descriptions:

(No Records)

Non-riverine Wetlands

Non-riverine wetlands include both lacustrine and palustrine wetlands, however, do not currently incorporate estuarine, marine or subterranean wetland types. A summary of the conservation significance of non-riverine wetlands within the AOI is provided in the following table. Refer to **Map 6** for further information.

Table 19: Overall level/s of non-riverine aquatic conservation significance

Aquatic conservation significance (non-riverine wetlands)	Area (Ha)	% of AOI
(No Records)		

The following table provides an assessment of non-riverine wetlands within the AOI and associated aquatic conservation criteria values.

Table 20: Level/s of non-riverine aquatic conservation significance based on selected criteria

Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
(No Records)								

The table below lists and describes the relevant expert panel decisions used to assign conservation significance values to non-riverine wetlands within the AOI.

Table 21: Expert panel decisions for assigning overall levels of non-riverine aquatic conservation significance.

Decision number	Special feature	Catchment	Criteria/Indicator/Measure	Conservation rating (1-4)
(No Records)				

4 is the highest rating/value

Expert panel decision descriptions:

(No Records)

Threatened and Priority Species

Introduction

This chapter contains a list of threatened and priority flora and/or fauna species that have been recorded on, or within 4km of the Assessment Area.

The information presented in this chapter with respect to species presence is derived from compiled databases developed primarily for the purpose of BPAs and ACAs. Data is collated from a number of sources and is updated periodically.

It is important to note that the list of species provided in this report, may differ when compared to other reports generated from other sources such as the State government's WildNet, Herbrecs or the federal government's EPBC database for a number of reasons.

Records for threatened and priority species are filtered and checked based on a number of rules including:

- Taxonomic nomenclature - current scientific names and status,
- Location - cross-check co-ordinates with location description,
- Taxon by location - requires good knowledge of the taxon and history of the record,
- Duplicate records - identify and remove,
- Expert panels - check records and provide new records,
- Flora cultivated records excluded,
- Use precise records less than or equal to 2000m,
- Use recent records greater than or equal to 1975 animals, greater than or equal to 1950 plants.

Threatened Species

Threatened species are those species classified as "Endangered" or "Vulnerable" under the *Environment Protection and Biodiversity Conservation Act 1999* or "Endangered", "Vulnerable" or "Near threatened" under the *Nature Conservation Act 1992*.

The following threatened species have been recorded on, or within approximately 4km of the AOI.

Table 22: Threatened species recorded on, or within 4km of the AOI

Species	Common name	NCA status	EPBC status	Back on Track rank	Migratory species*	Wetland species**	Identified flora/fauna
Acanthophis hawkei	plains death adder	V	V	Data deficient			FA
Petrogale purpureicollis	purple-necked rock-wallaby	V		Low			FA

NB. Please note that the threatened species listed in this section are based upon the most recently compiled DES internal state-wide threatened species dataset. This dataset may contain additional records that were not originally available for inclusion in the relevant individual BPAs and ACAs.

**JAMBA - Japan-Australia Migratory Bird Agreement; CAMBA - China-Australia Migratory Bird Agreement; ROKAMBA - Republic of Korea-Australia Migratory Bird Agreement; CMS - Convention on the Conservation of Migratory Species*.

***I - wetland indicator species; D - wetland dependent species*.

BPA Priority Species

A list of BPA priority species that have been recorded on, or within approximately 4km of the AOI is contained in the following table.

Table 23: Priority species recorded on, or within 4km of the AOI

Species	Common name	Back on Track rank	Identified flora/fauna
Amytornis ballarae	Kalkadoon grasswren	H	FA

Species	Common name	Back on Track rank	Identified flora/fauna
Barnardius zonarius macgillivrayi	Cloncurry parrot	L	FA
Egernia hosmeri	Hosmer's skink	DD	FA
Gehyra robusta	robust dtella	L	FA
Oedura bella	Gulf marbled velvet gecko	None	FA
Planigale ingrami	long-tailed planigale	L	FA
Planigale tenuirostris	Narrow-nosed Planigale	L	FA
Planigale tenuirostris	narrow-nosed planigale	L	FA
Sminthopsis macroura	Stripe-faced Dunnart	L	FA

NB. Please note that the list of priority species is based on those species identified in the BPAs, however records for these species may be more recent than the originals used. furthermore, the BPA priority species databases are updated from time to time. At each update, the taxonomic details for all species are amended as necessary to reflect current taxonomic name and/or status changes.

ACA Priority Species

A list of ACA priority species used in riverine and non-riverine ACAs that have been recorded on, or within approximately 4km of the AOI are contained in the following tables.

Table 24: Priority species recorded on, or within 4 km of the AOI - riverine

(no results)

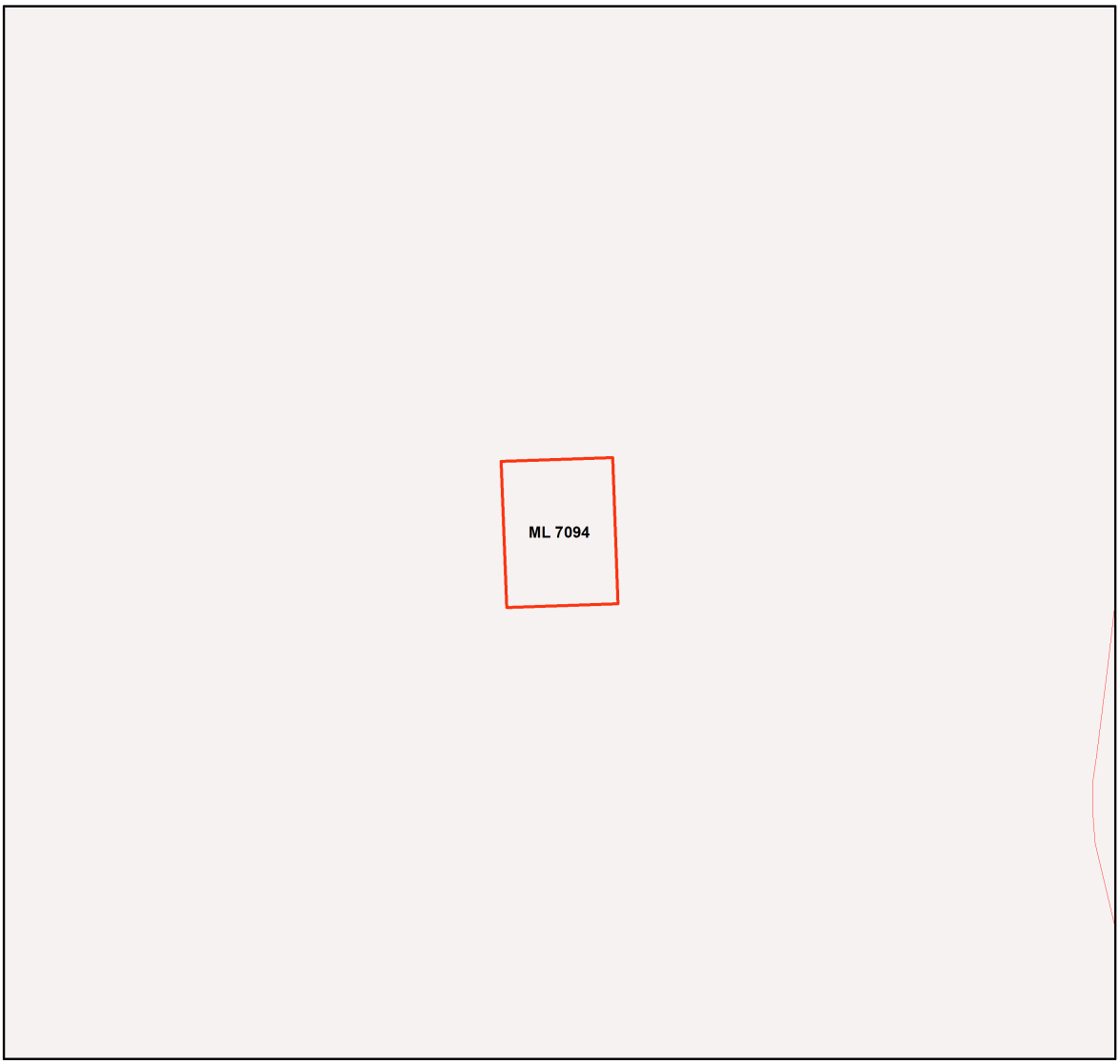
Table 25: Priority species recorded on, or within 4 km of the AOI - non-riverine

(no results)

NB. Please note that the priority species records used in the above two tables are comprised of those adopted for the released individual ACAs. The ACA riverine and non-riverine priority species databases are updated from time to time to reflect new release of ACAs. At each update, the taxonomic details for all ACAs records are amended as necessary to reflect current taxonomic name and/or status changes.

Maps

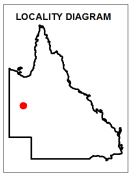
Map 1 - Locality Map



Locality Map

Legend

- Selected Mining Lease (ML)
- Towns
- Highway
- Connector
- Street/Local Road
- Reservoirs
- Lakes
- National Park (Scientific)
- National Park
- National Park (CYPAL)
- Conservation Park
- Resources Reserve
- Forest Reserve
- State Forest
- Timber Reserve
- Nature Refuges
- Coordinated Conservation Areas
- Major rivers/creeks
- Queensland



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0 540 1080 1620 2160 2700 m

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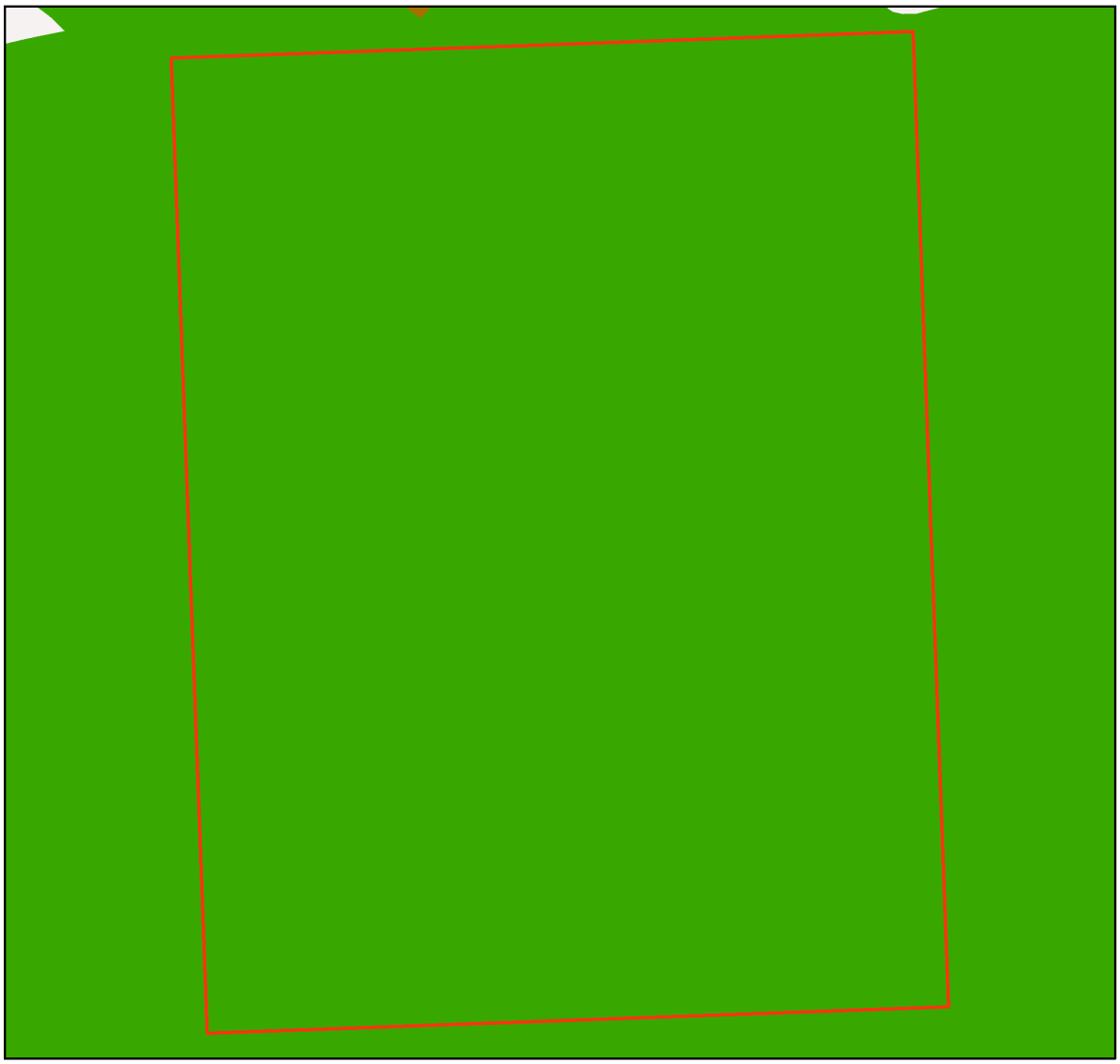
Map 2 - Biodiversity Planning Assessment (BPA)



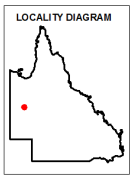
Biodiversity Planning Assessments

Legend

- Selected Mining Lease (ML)
- Towns
- Roads
- Major rivers/creeks
- Queensland

Biodiversity Planning Assessment

- State Habitat for EVNT taxa
- State
- Regional
- Local or Other Values
- Non Bioregion Ecosystem



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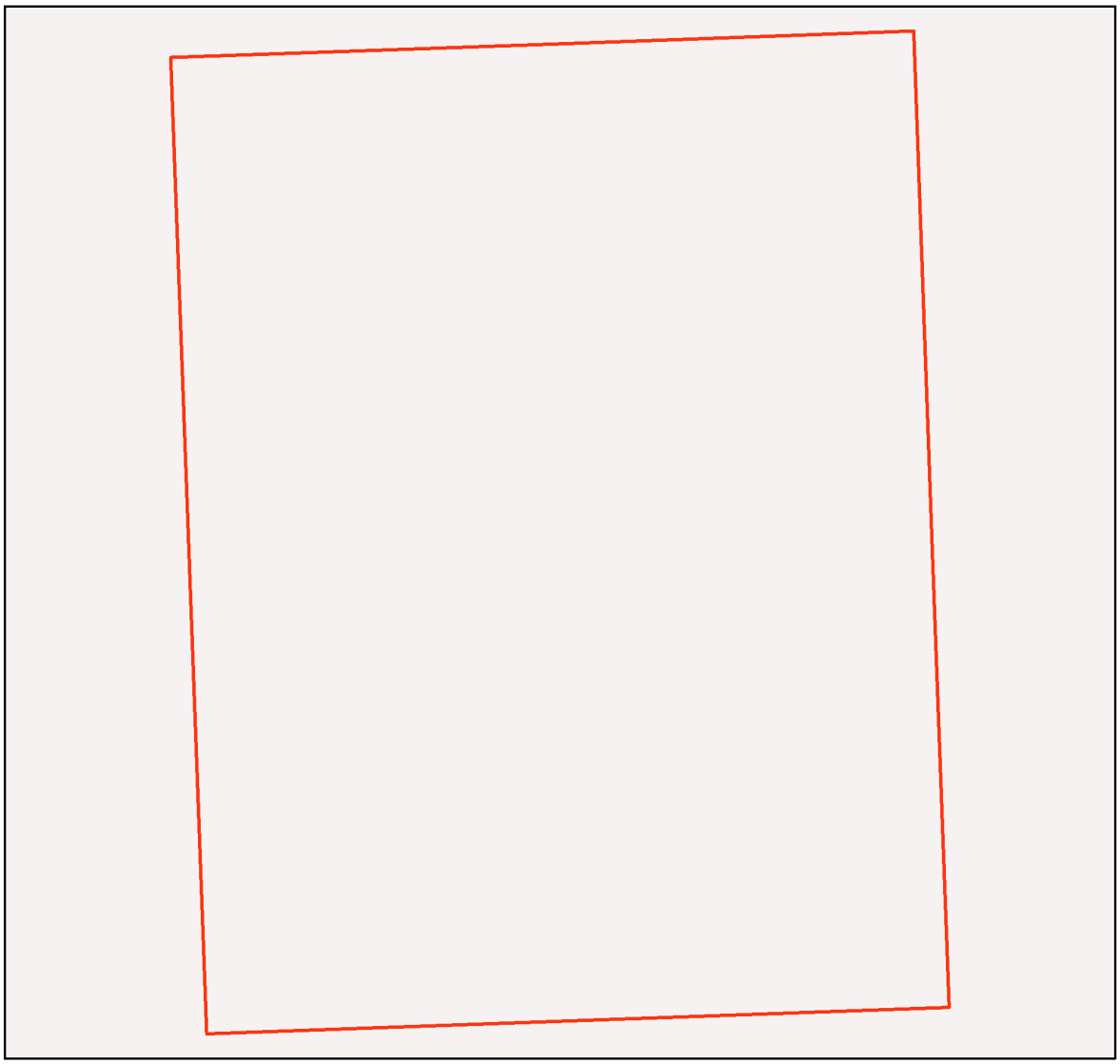
Map 3 - Corridors



Corridors

Legend

- Selected Mining Lease (ML)
- Towns
- Roads
- Major rivers/creeks
- Queensland

Corridors

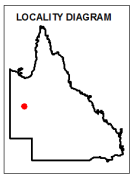
- State
- Regional

Corridor Triggered Vegetation

- State
- Regional
- Local

Core Area Vegetation

- Brigalow Belt only



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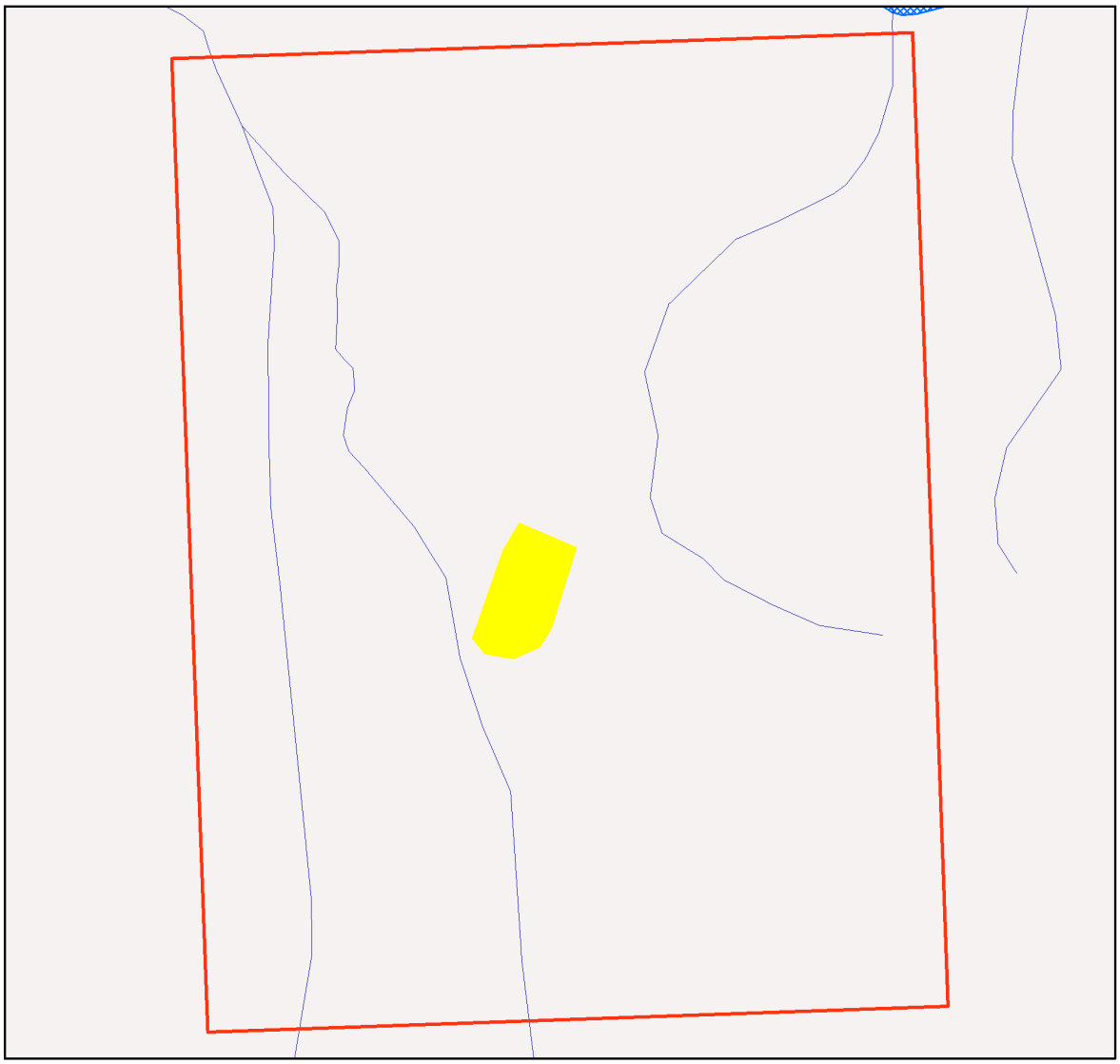
Map 4 - Wetlands and waterways



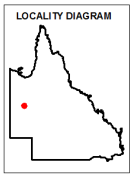
Wetlands and Waterways

Legend

- Selected Mining Lease (ML)
- Towns
- Roads
- Springs
- Rivers/Creeks
- Directory of Important Wetlands
- Ramsar Sites - QLD
- Queensland

Wetland Type

- Marine Waterbodies
- Estuarine Waterbodies
- Riverine Waterbodies
- Lacustrine Waterbodies
- Palustrine Waterbodies
- Marine RE
- Estuarine RE
- Riverine RE
- Lacustrine RE
- Palustrine RE
- RE 51-80% wetland (mosaic units)
- RE 1-50% wetland (mosaic units)



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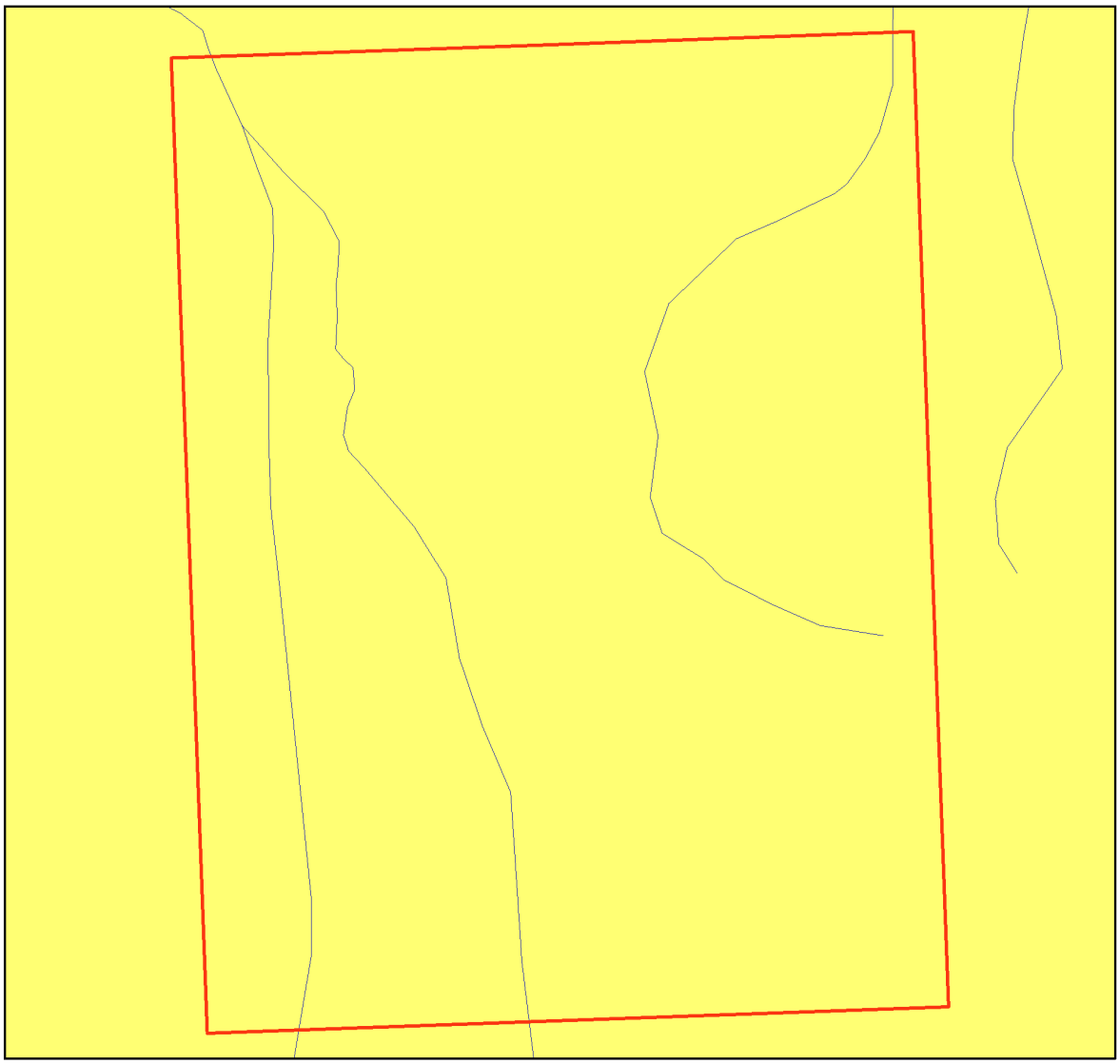
Map 5 - Aquatic Conservation Assessment (ACA) - riverine



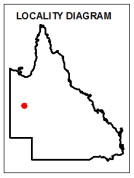
Aquatic Conservation Assessment (ACA) - riverine

Legend

- Selected Mining Lease (ML)
- Towns
- Roads
- Rivers/Creeks
- Queensland

ACA Riverine - Subcatchment Significance

- Very High
- High
- Medium
- Low
- Very Low



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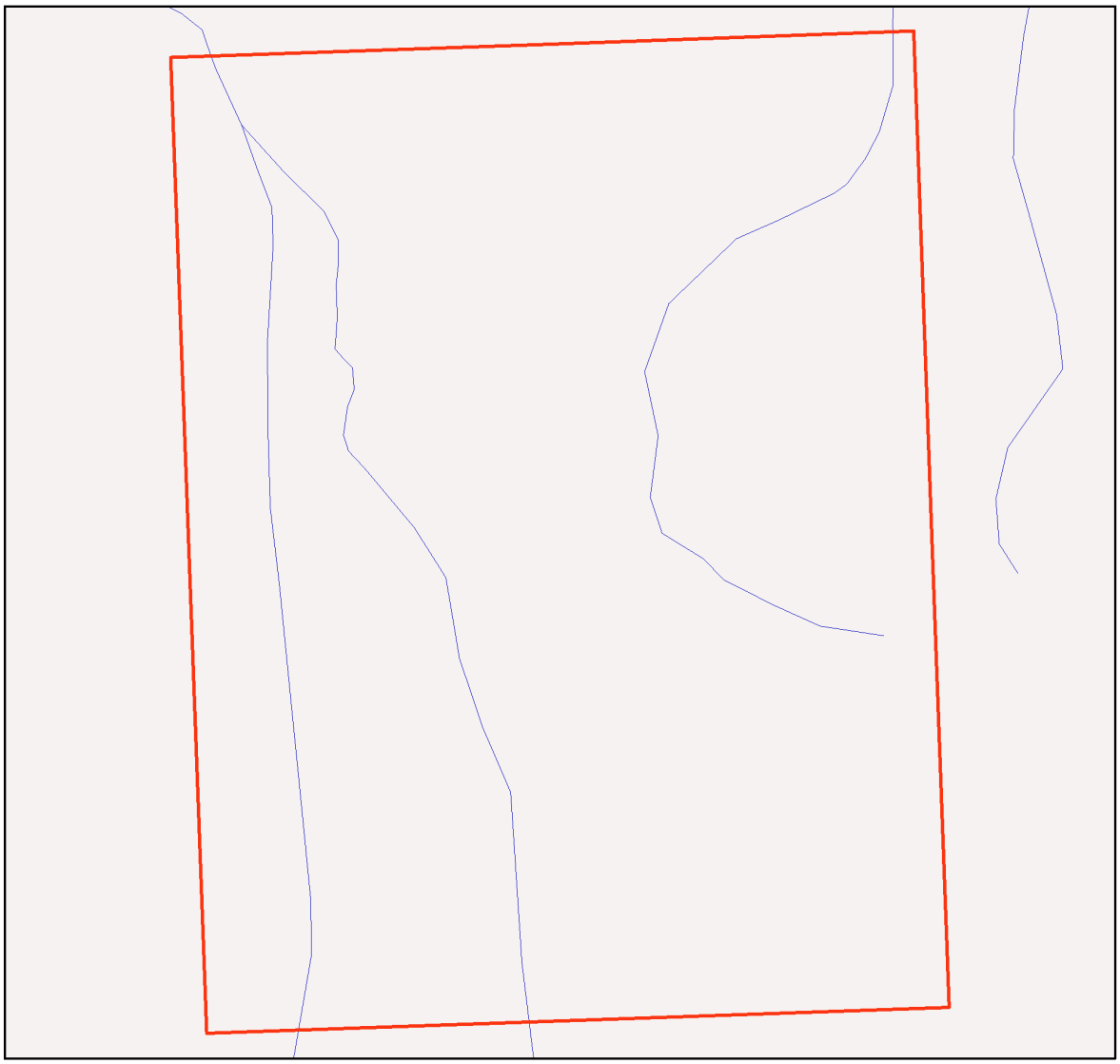
Map 6 - Aquatic Conservation Assessment (ACA) - non-riverine



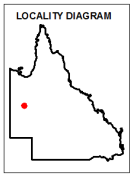
Aquatic Conservation Assessment (ACA) - nonriverine

Legend

- Selected Mining Lease (ML)
- Towns
- Roads
- Rivers/Creeks
- Queensland

ACA Non-riverine

- Very High
- High
- Medium
- Low
- Very Low



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References

Clayton, P.D., Fielder, D.F., Howell, S. and Hill, C.J. (2006) *Aquatic biodiversity assessment and mapping method (AquaBAMM): a conservation values assessment tool for wetlands with trial application in the Burnett River catchment.* Published by the Environmental Protection Agency, Brisbane. ISBN 1-90928-07-3. Available at

http://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca/

Environmental Protection Agency (2002) *Biodiversity Assessment and Mapping Methodology. Version 2.1, July 2002.* (Environmental Protection Agency, Brisbane).

Morton, S. R., Short, J. and Barker, R. D. with an Appendix by G.F. Griffin and G. Pearce (1995). *Refugia for Biological Diversity in Arid and Semi-arid Australia. Biodiversity Series* , Paper No. 4, Biodiversity Unit, Environment Australia.

Sattler, P.S. and Williams, R.D. (eds) (1999). *The Conservation Status of Queensland's Bioregional Ecosystems*. Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

Theme	Datasets
Aquatic Conservation Assessments Non-riverine*	Combination of the following datasets: Cape York Peninsula Non-riverine v1.1 Eastern Gulf of Carpentaria v1.1 Great Barrier Reef Catchment Non-riverine v1.3 Lake Eyre and Bulloo Basins v1.1 QMDB Non-riverine ACA v1.4 Southeast Queensland ACA v1.1 WBB Non-riverine ACA v1.1 Southern Gulf Catchments Non-riverine ACA v1.1
Aquatic Conservation Assessments Riverine*	Combination of the following datasets: Cape York Peninsula Riverine v1.1 Eastern Gulf of Carpentaria v1.1 Great Barrier Reef Catchment Riverine v1.1 Lake Eyre and Bulloo Basins v1.1 QMDB Riverine ACA v1.4 Southeast Queensland ACA v1.1 WBB Riverine ACA v1.1 Southern Gulf Catchments Riverine ACA v1.1
Biodiversity Planning Assessments*	Combination of the following datasets: Brigalow Belt BPA v2.1 Cape York Peninsula BPA v1.1 Central Queensland Coast BPA v1.3 Channel Country BPA v1.1 Desert Uplands BPA v1.3 Einasleigh Uplands BPA v1.1 Gulf Plains BPA v1.1 Mitchell Grass Downs BPA v1.1 Mulga Lands BPA v1.4 New England Tableland v2.3 Northwest Highlands v1.1 Southeast Queensland v4.1 Wet Tropics v1.1
Statewide BPA Corridors*	Statewide corridors v1.6
Threatened Species	An internal DES database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.
BPA Priority Species	An internal DES database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.
ACA Priority Species	An internal DES database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.

***These datasets are available at:**

http://dds.information.qld.gov.au/DDS

Appendix 2 - Acronyms and Abbreviations

AOI	- Area of Interest
ACA	- Aquatic Conservation Assessment
AQUABAMM	- Aquatic Biodiversity Assessment and Mapping Methodology
BAMM	- Biodiversity Assessment and Mapping Methodology
BoT	- Back on Track
BPA	- Biodiversity Planning Assessment
CAMBA	- China-Australia Migratory Bird Agreement
DES	- Department of Environment and Science
EPBC	- *Environment Protection and Biodiversity Conservation Act 1999*
EVNT	- Endangered, Vulnerable, Near Threatened
GDA94	- Geocentric Datum of Australia 1994
GIS	- Geographic Information System
JAMBA	- Japan-Australia Migratory Bird Agreement
NCA	- *Nature Conservation Act 1992*
RE	- Regional Ecosystem
REDD	- Regional Ecosystem Description Database
ROKAMBA	- Republic of Korea-Australia Migratory Bird Agreement

APPENDIX E – ENVIRONMENTAL REPORTS – REGIONAL ECOSYSTEMS – BIODIVERSITY STATUS

Queensland Government

Department of Environment and Science

Environmental Reports

Regional Ecosystems

Biodiversity Status

For the selected area of interest
ml: 7094

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the input coordinates.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no matters of interest have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Important Note to User

Information presented in this report is based upon the Queensland Herbarium's Regional Ecosystem framework. The Biodiversity Status has been used to depict the extent of "Endangered", "Of Concern" and "No Concern at Present" regional ecosystems in all cases, rather than the classes used for the purposes of the *Vegetation Management Act 1999* (VMA). Mapping and figures presented in this document reflect the Queensland Herbarium's Remnant and Pre-clearing Regional Ecosystem Datasets, and not the certified mapping used for the purpose of the VMA.

For matters relevant to vegetation management under the VMA, please refer to the Department of Resources website

https://www.dnrme.qld.gov.au/

Please direct queries about these reports to: Queensland.Herbarium@qld.gov.au

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Summary Information

The following table provides an overview of the AOI with respect to selected topographic and environmental themes. Refer to **Map 1** for locality information.

Table 1: Area of interest details: ml: 7094

Size (ha)	129.99
Local Government(s)	Cloncurry Shire
Bioregion(s)	Mitchell Grass Downs, Northwest Highlands
Subregion(s)	Southwestern Downs, Mount Isa Inlier
Catchment(s)	Georgina

The table below summarizes the extent of remnant vegetation classed as "Endangered", "Of concern" and "No concern at present" regional ecosystems classified by Biodiversity Status within the area of interest (AOI).

Table 2: Summary table, biodiversity status of regional ecosystems within the AOI

Biodiversity Status	Area (Ha)	% of AOI
Endangered	0.0	0.0
Of concern	0.0	0.0
No concern at present	129.99	100.0
Total remnant vegetation	129.99	100.0

Refer to **Map 2** for further information.

Regional Ecosystems

1. Introduction

Regional ecosystems are vegetation communities in a bioregion that are consistently associated with particular combinations of geology, landform and soil (Sattler and Williams 1999). Descriptions of Queensland's Regional ecosystems are available online from the Regional Ecosystem Description Database (REDD). Descriptions are compiled from a broad range of information sources including vegetation, land system and geology survey and mapping and detailed vegetation site data. The regional ecosystem classification and descriptions are reviewed as new information becomes available. A number of vegetation communities may form a single regional ecosystem and are usually distinguished by differences in dominant species, frequently in the shrub or ground layers and are denoted by a letter following the regional ecosystem code (e.g. a, b, c). Vegetation communities and regional ecosystems are amalgamated into a higher level classification of broad vegetation groups (BVGs).

A published methodology for survey and mapping of regional ecosystems across Queensland (Neldner et al 2020) provides further details on regional ecosystem concepts and terminology.

This report provides information on the type, status, and extent of vegetation communities, regional ecosystems and broad vegetation groups present within a user specified area of interest. Please note, for the purpose of this report, the Biodiversity Status is used. This report has not been developed for application of the *Vegetation Management Act 1999* (VMA). Additionally, information generated in this report has been derived from the Queensland Herbarium's Regional Ecosystem Mapping, and not the regulated mapping certified for the purposes of the VMA. If your interest/matter relates to regional ecosystems and the VMA, users should refer to the Department of Resources website.

https://www.dnrme.qld.gov.au/

With respect to the Queensland Biodiversity Status,

"Endangered" regional ecosystems are described as those where:

- remnant vegetation is less than 10 per cent of its pre-clearing extent across the bioregion; or 10-30% of its pre-clearing extent remains and the remnant vegetation is less than 10,000 hectares, or
- less than 10 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss*, or
- 10-30 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss and the remnant vegetation is less than 10,000 hectares; or
- it is a rare** regional ecosystem subject to a threatening process.***

"Of concern" regional ecosystems are described as those where:

- the degradation criteria listed above for 'Endangered' regional ecosystems are not met and,
- remnant vegetation is 10-30 per cent of its pre-clearing extent across the bioregion; or more than 20 per cent of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares, or
- 10-30 percent of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss.****

and "No concern at present" regional ecosystems are described as those where:

- remnant vegetation is over 30 per cent of its pre-clearing extent across the bioregion, and the remnant area is greater than 10,000 hectares, and
- the degradation criteria listed above for 'Endangered' or 'Of concern' regional ecosystems are not met.

**Severe degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 50 years even with the removal of threatening processes; or soil surface is severely degraded, for example, by loss of A horizon, surface expression of salinity; surface compaction, loss of organic matter or sheet erosion.*

***Rare regional ecosystem: pre-clearing extent (1000 ha); or patch size (100 ha and of limited total extent across its range).*

****Threatening processes are those that are reducing or will reduce the biodiversity and ecological integrity of a regional ecosystem. For example, clearing, weed invasion, fragmentation, inappropriate fire regime or grazing pressure, or infrastructure development.*

*****Moderate degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 20 years even with the removal of threatening processes; or soil surface is moderately degraded.*

2. Remnant Regional Ecosystems

The following table identifies the remnant regional ecosystems and vegetation communities mapped within the AOI and provides their short descriptions, Biodiversity Status, and remnant extent within the selected AOI. Please note, where heterogeneous vegetated patches (mixed patches of remnant vegetation mapped as containing multiple regional ecosystems) occur within the AOI, they have been split and listed as individual regional ecosystems (or vegetation communities where present) for the purposes of the table below. In such instances, associated area figures have been generated based upon the estimated proportion of each regional ecosystem (or vegetation community) predicted to be present within the larger mixed patch.

Table 3: Remnant regional ecosystems, description and status within the AOI

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
1.11.10b	Mixed low open woodland on metamorphic plains	No concern at present	33.73	25.95
1.11.2a	Eucalyptus leucophloia low open woodland	No concern at present	5.28	4.06
1.12.3b	Eucalyptus leucophylla and/or Corymbia terminalis +/- C. aparrerinja low open woodland on igneous rocks	No concern at present	5.99	4.61
1.5.3	Eucalyptus leucophloia low open woodland to woodland on sandy and gravelly red soils	No concern at present	3.84	2.96
1.5.4d	Eucalyptus leucophylla and/or Corymbia terminalis low open woodland on red earths	No concern at present	34.47	26.52
1.5.6c	Atalaya hemiglauca, Ventilago viminalis, Grevillea striata low open woodland on red earth plains	No concern at present	33.92	26.1
1.7.1a	Eucalyptus leucophloia low open woodland on silcrete and lateritic surfaces	No concern at present	4.39	3.38
4.4.1d	Astrebla pectinata +/- Aristida latifolia +/- Eulalia aurea grassland on Tertiary clays overlying limestone	No concern at present	7.6	5.85
4.9.12x4a	Corymbia terminalis low open woodland with Astrebla pectinata +/- Eulalia aurea on plains of fine grained sediments	No concern at present	0.77	0.6

Refer to **Map 2** for further information. **Map 3** also provides a visual estimate of the distribution of regional ecosystems present before clearing.

Table 4 provides further information in regards to the remnant regional ecosystems present within the AOI. Specifically, the extent of remnant vegetation remaining within the bioregion, the 1:1,000,000 broad vegetation group (BVG) classification, whether the regional ecosystem is identified as a wetland, and extent of representation in Queensland's Protected Area Estate. For a description of the vegetation communities within the AOI and classified according to the 1:1,000,000 BVG, refer to **Table 6**.

Table 4: Remnant regional ecosystems within the AOI, additional information

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
1.11.10b	Pre-clearing 170000 ha; Remnant 2019 169000 ha	19b	Not a Wetland	No representation

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
1.11.2a	Pre-clearing 1245000 ha; Remnant 2019 1239000 ha	19a	Not a Wetland	Low
1.12.3b	Pre-clearing 307000 ha; Remnant 2019 307000 ha	19b	Not a Wetland	Low
1.5.3	Pre-clearing 290000 ha; Remnant 2019 289000 ha	19a	Not a Wetland	Low
1.5.4d	Pre-clearing 356000 ha; Remnant 2019 352000 ha	19b	Not a Wetland	Low
1.5.6c	Pre-clearing 313000 ha; Remnant 2019 313000 ha	27a	Not a Wetland	Low
1.7.1a	Pre-clearing 421000 ha; Remnant 2019 420000 ha	19a	Not a Wetland	High
4.4.1d	Pre-clearing 3338000 ha; Remnant 2019 3332000 ha	30b	Not a Wetland	Medium
4.9.12x4a	Pre-clearing 235000 ha; Remnant 2019 234000 ha	19b	Not a Wetland	Low

Representation in Protected Area Estate: High greater than 10% of pre-clearing extent is represented; Medium 4 - 10% is represented; Low less than 4% is represented, No representation.

The distribution of mapped wetland systems within the area of interest is displayed in **Map 6**.

The following table lists known special values associated with a regional ecosystem type.

Table 5: Remnant regional ecosystems within the AOI, special values

Regional Ecosystem	Special Values
1.11.10b	Potential habitat for NCA listed species: Eucalyptus nudicaulis
1.11.2a	Potential habitat for NCA listed species: Eucalyptus nudicaulis, Ipomoea antonschmidii, Solanum carduiforme, Trachymene glandulosa
1.12.3b	None
1.5.3	None
1.5.4d	Potential habitat for NCA listed species: Ipomoea antonschmidii
1.5.6c	None
1.7.1a	Potential habitat for NCA listed species: Solanum carduiforme, Trachymene glandulosa
4.4.1d	None
4.9.12x4a	None

3. Remnant Regional Ecosystems by Broad Vegetation Group

BVGs are a higher-level grouping of vegetation communities. Queensland encompasses a wide variety of landscapes across temperate, wet and dry tropics and semi-arid climatic zones. BVGs provide an overview of vegetation communities across the state or a bioregion and allow comparison with other states. There are three levels of BVGs which reflect the approximate scale at which they are designed to be used: the 1:5,000,000 (national), 1:2,000,000 (state) and 1:1,000,000 (regional) scales.

A comprehensive description of BVGs is available at:

https://publications.qld.gov.au/dataset/redd/resource/

The following table provides a description of the 1:1,000,000 BVGs present and their associated extent within the AOI.

Table 6: Broad vegetation groups (1 million) within the AOI

BVG (1 Million)	Description	Area (Ha)	% of AOI
19a	Low open woodlands dominated by Eucalyptus leucophloia (snappy gum) with Triodia spp. dominated ground layer, mainly on hills and ranges. (land zones 11, 7, 5, 12, 9, 10) (NWH, GUP, MGD)	13.51	10.39
19b	Low open woodlands dominated by Eucalyptus leucophylla (Cloncurry box) or less extensively Corymbia terminalis (long-fruited bloodwood) low open woodlands and related associations, mainly lower slopes and valleys. (land zones 5, 11, 9, 7, 12, 3) (NWH, MGD, GUP, CHC)	74.96	57.67
27a	Low open woodlands dominated by a variety of species including Acacia tephrina (boree), Atalaya hemiglauca (whitewood), Ventilago viminalis (supplejack) and Lysiphyllum spp. (land zones 9, 3, 4, [5]) (MGD, GUP, BRB, NWH, DEU, [CYP, EIU])	33.92	26.1
30b	Tussock grasslands dominated by Astrebla spp. (mitchell grass) or Dichanthium spp. (bluegrass) often with Iseilema spp. on undulating downs or clay plains. (land zones 9, 3, 4, 8, [5]) (MGD, CHC, GUP, BRB, [EIU, DEU, NWH])	7.6	5.85

Refer to **Map 4** for further information. **Map 5** also provides a representation of the distribution of vegetation communities as per the 1:5,000,000 BVG believed to be present prior to European settlement.

4. Technical and BioCondition Benchmark Descriptions

Technical descriptions provide a detailed description of the full range in structure and floristic composition of regional ecosystems (e.g. 11.3.1) and their component vegetation communities (e.g. 11.3.1a, 11.3.1b). See:

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

The descriptions are compiled using site survey data from the Queensland Herbarium's CORVEG database. Distribution maps, representative images (if available) and the pre-clearing and remnant extent (hectares) of each vegetation community derived from the regional ecosystem mapping data are included. The technical descriptions should be used in conjunction with the fields from the regional ecosystem description database (REDD) for a full description of the regional ecosystem.

Technical descriptions include data on canopy height, canopy cover and native plant species composition of the predominant layer, which are attributes relevant to assessment of the remnant status of vegetation under the *Vegetation Management Act 1999*. However, as technical descriptions reflect the full range in structure and floristic composition across the climatic, natural disturbance and geographic range of the regional ecosystem, local reference sites should be used for remnant assessment where possible (Neldner et al. 2020 (PDF)* section 3.3 of:

https://publications.qld.gov.au/dataset/redd/resource/

The technical descriptions are subject to review and are updated as additional data becomes available.

When conducting a BioCondition assessment, these technical descriptions should be used in conjunction with BioCondition benchmarks for the specific regional ecosystem, or component vegetation community.

http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

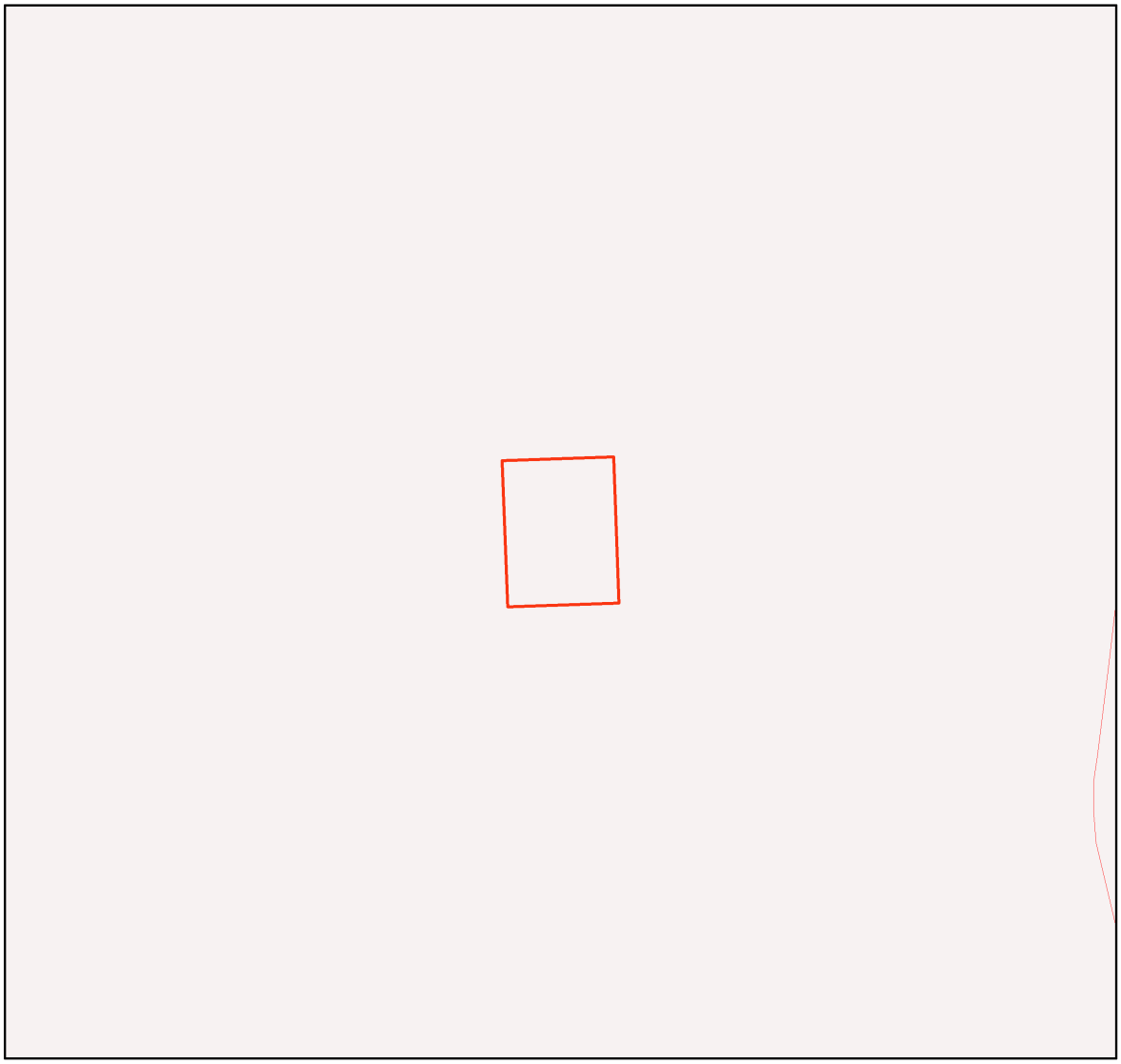
Benchmarks are based on a combination of quantitative and qualitative information and should be used as a guide only. Benchmarks are specific to one regional ecosystem vegetation community, however, the natural variability in structure and floristic composition under a range of climatic and natural disturbance regimes has been considered throughout the geographic extent of the regional ecosystem. Local reference sites should be used for this spatial and temporal (seasonal and annual) variability.

Table 7: List of remnant regional ecosystems within the AOI for which technical and biocondition benchmark descriptions are available

Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
1.11.10b	Available	Not currently available
1.11.2a	Available	Not currently available
1.12.3b	Available	Not currently available
1.5.3	Available	Not currently available
1.5.4d	Available	Not currently available
1.5.6c	Available	Not currently available
1.7.1a	Available	Not currently available
4.4.1d	Not currently available	Not currently available
4.9.12x4a	Not currently available	Not currently available

Maps

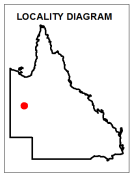
Map 1 - Location



Locality Map

Legend

- Selected Mining Lease (ML)
- Towns
- Highway
- Connector
- Street/Local Road
- Reservoirs
- Lakes
- National Park (Scientific)
- National Park
- National Park (CYPAL)
- Conservation Park
- Resources Reserve
- Forest Reserve
- State Forest
- Timber Reserve
- Nature Refuges
- Coordinated Conservation Areas
- Major rivers/creeks
- Queensland



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0 540 1080 1620 2160 2700 m

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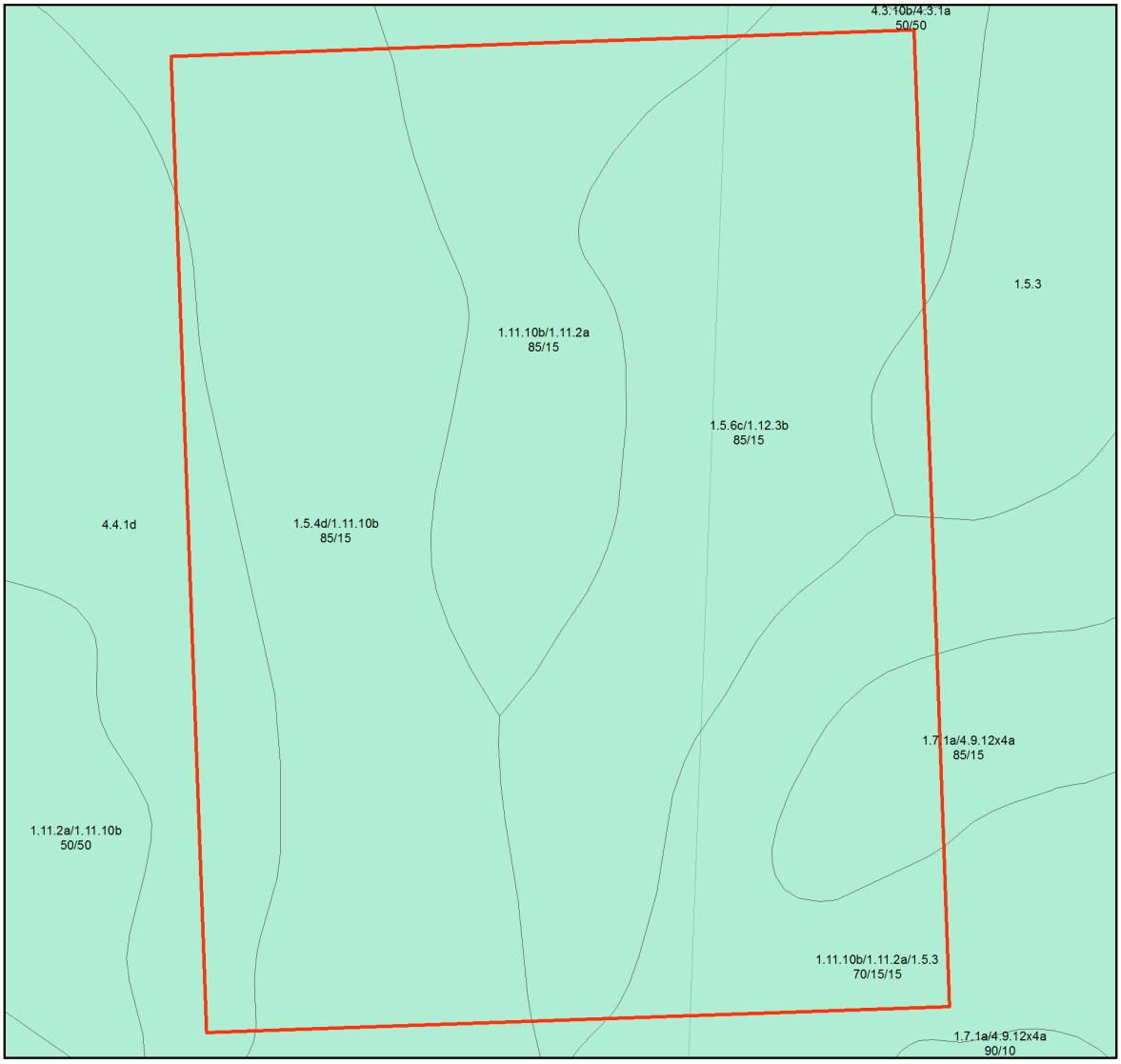
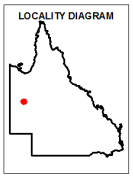
Map 2 - Remnant 2019 regional ecosystems



Remnant 2019 Regional Ecosystems

Biodiversity Status

- Selected Mining Lease (ML)
- Endangered - Dominant vegetation
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- No concern at present
- Non-remnant vegetation, cultivated or built environment
- Plantation
- Water
- Cadastral Boundaries



N

0 0.085 0.17 0.255 0.34 km

This product is projected into GDA 1994 Queensland Albers

Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil.
The polygons are labelled by regional ecosystem (RE); where more than one RE occurs, the percentage of each is labelled. The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.
Remnant woody vegetation is defined as vegetation that has not been cleared or vegetation that has been cleared but where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.
Non-remnant vegetation includes regrowth and disturbed native vegetation.

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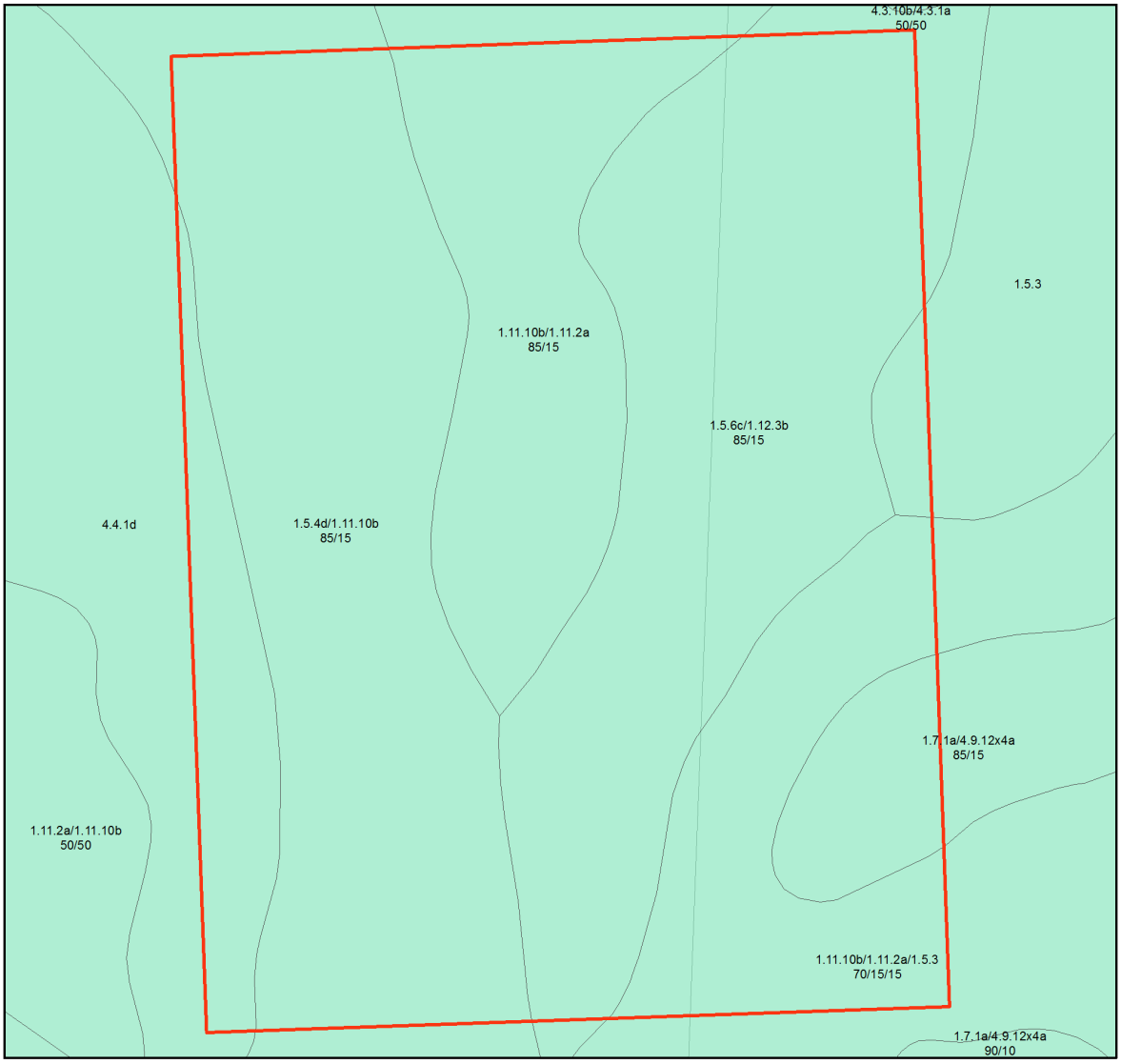
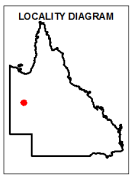
Map 3 - Pre-clearing regional ecosystems



Pre-clearing Regional Ecosystems

Biodiversity Status

- Selected Mining Lease (ML)
- Endangered - Dominant vegetation
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- No concern at present
- Water
- Cadastral Boundaries



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Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

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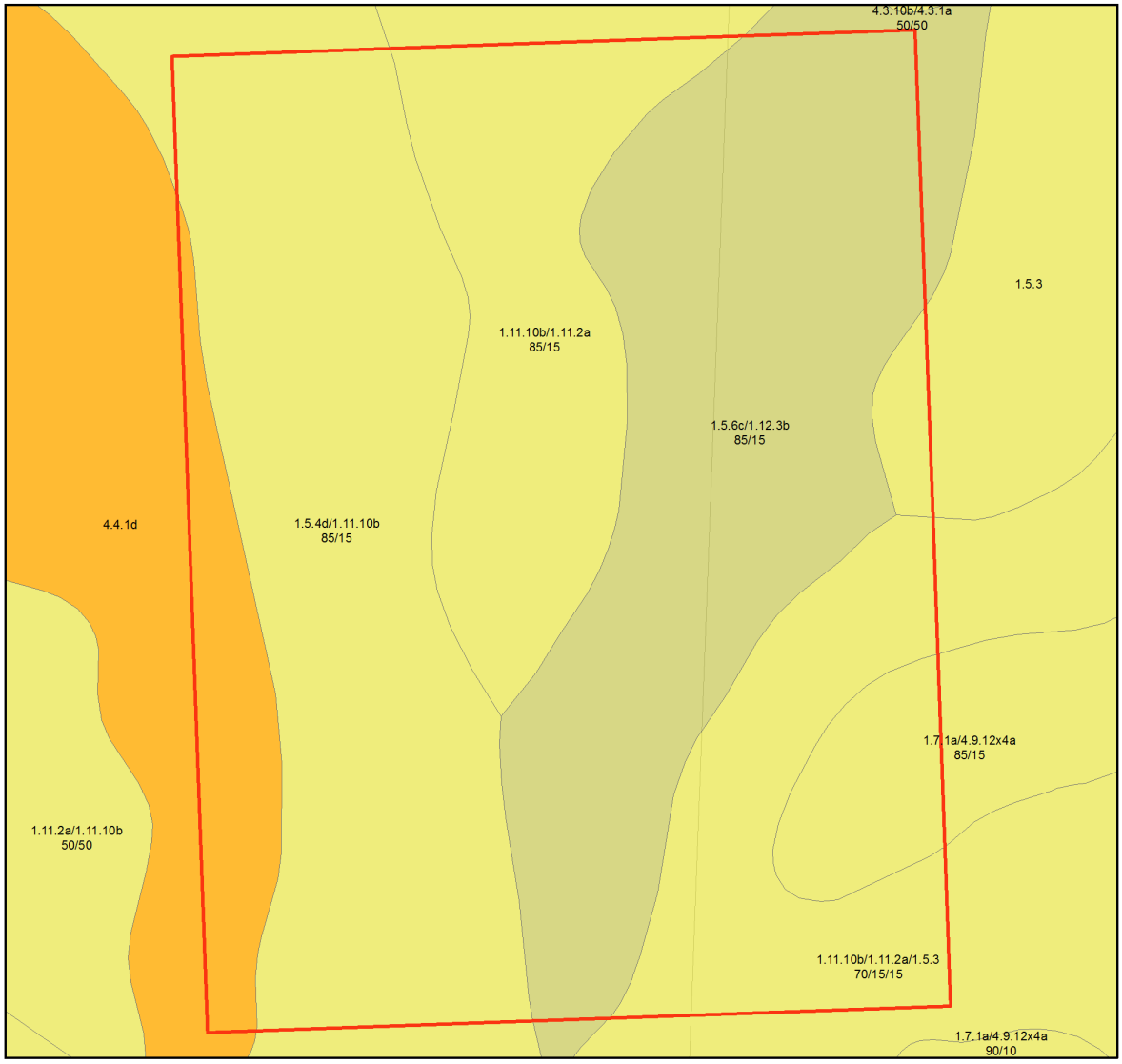
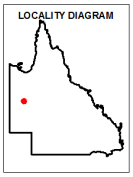
Map 4 - Remnant 2019 regional ecosystems by BVG (5M)



Remnant 2019 Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups
BVG5M Description (BVG1M codes)

- Selected Mining Lease (ML)
- 1. Rainforests and scrubs (1-7b)
- 2. Wet eucalypt open forests (8-8b)
- 3. Eucalypt woodlands to open forests (mainly eastern Qld) (9-15b)
- 4. Eucalypt open forests to woodlands on floodplains (16-16d)
- 5. Eucalypt dry woodlands on inland depositional plains (17-18d)
- 6. Eucalypt low open woodlands usually with spinifex understorey (19-19d)
- 7. Callitris woodland - open forests (20a)
- 8. Melaleuca open woodlands on depositional plains (21-22c)
- 9. Acacia aneura (mulga) dominated open forests, woodlands and shrublands (23-23b)
- 10. Other acacia dominated open forests, woodlands and shrublands (24-26a)
- 11. Mixed species woodlands, open woodland - (inland bioregions) includes wooded downs (27-27c)
- 12. Other coastal communities or heaths (28-29b)
- 13. Tussock grasslands, forblands (30-32b)
- 14. Hummock grasslands (33-33b)
- 15. Wetlands (swamps and lakes) (34-34g)
- 16. Mangroves and saltmarshes (35-35b)
- Non-remnant vegetation, cultivated or built environment
- Water
- Cadastral Boundaries



N

0 0.085 0.17 0.255 0.34 km

This product is projected into GDA 1994 Queensland Albers

Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled.
Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil.
The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.
Remnant woody vegetation is defined as vegetation that has not been cleared or vegetation that has been cleared but where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.
Non-remnant vegetation includes regrowth and disturbed native vegetation.

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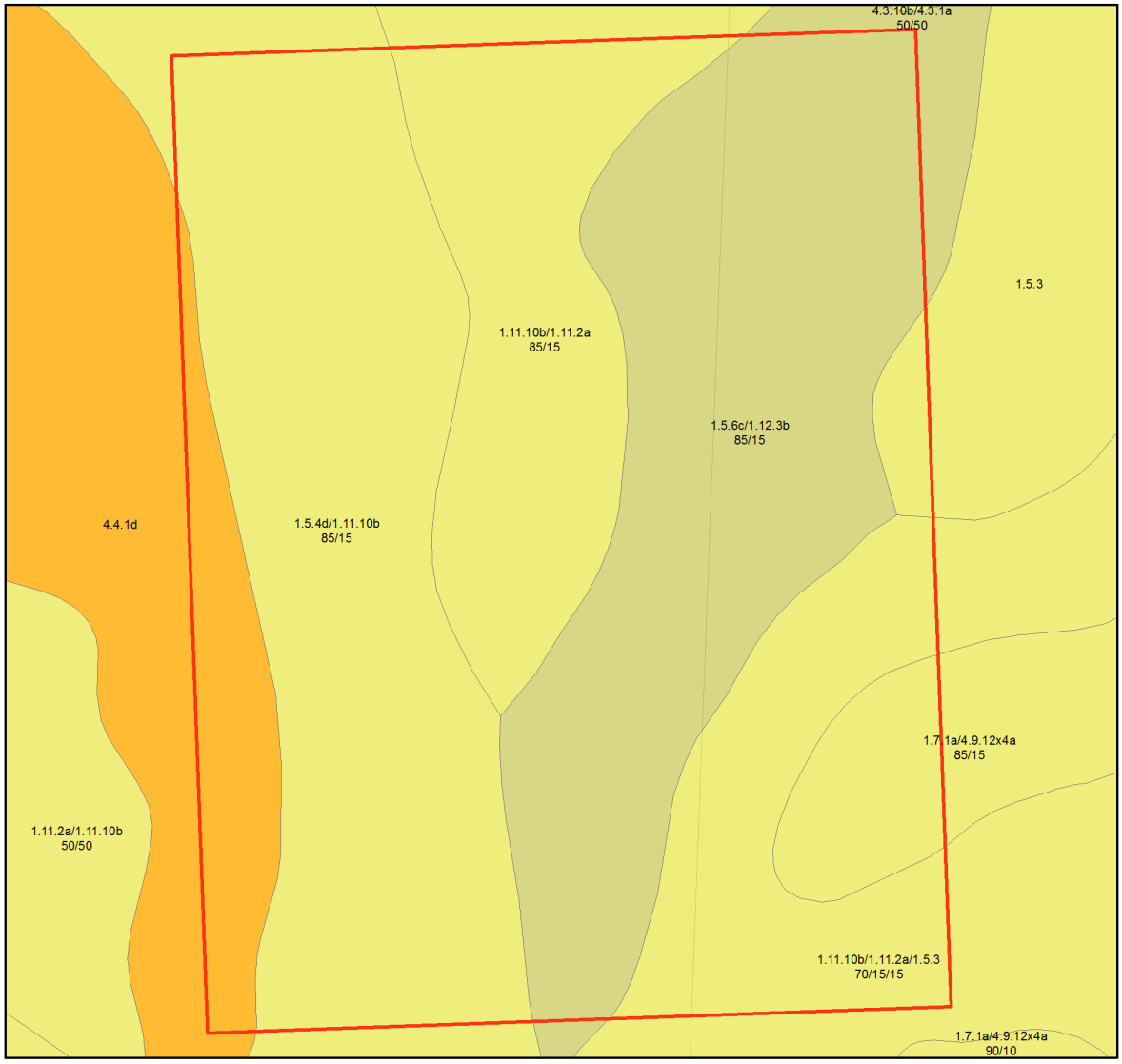
Map 5 - Pre-clearing regional ecosystems by BVG (5M)



Pre-clearing Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups
BVG5M Description (BVG1M codes)

- Selected Mining Lease (ML)
- 1. Rainforests and scrubs (1-7b)
- 2. Wet eucalypt open forests (8-8b)
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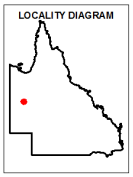
- 4. Eucalypt open forests to woodlands on floodplains (16-16d)
- 5. Eucalypt dry woodlands on inland depositional plains (17-18d)
- 6. Eucalypt low open woodlands usually with spinifex understorey (19-19d)
- 7. Callitris woodland - open forests (20a)
- 8. Melaleuca open woodlands on depositional plains (21-22c)
- 9. Acacia aneura (mulga) dominated open forests, woodlands and shrublands (23-23b)
- 10. Other acacia dominated open forests, woodlands and shrublands (24-26a)
- 11. Mixed species woodlands, open woodland - (inland bioregions) includes wooded downs (27-27c)
- 12. Other coastal communities or heaths (28-29b)
- 13. Tussock grasslands, forblands (30-32b)
- 14. Hummock grasslands (33-33b)
- 15. Wetlands (swamps and lakes) (34-34g)
- 16. Mangroves and saltmarshes (35-35b)
- Water
- Cadastral Boundaries



N

0 0.085 0.17 0.255 0.34 km

This product is projected into GDA 1994 Queensland Albers

Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled.
Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil.
The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

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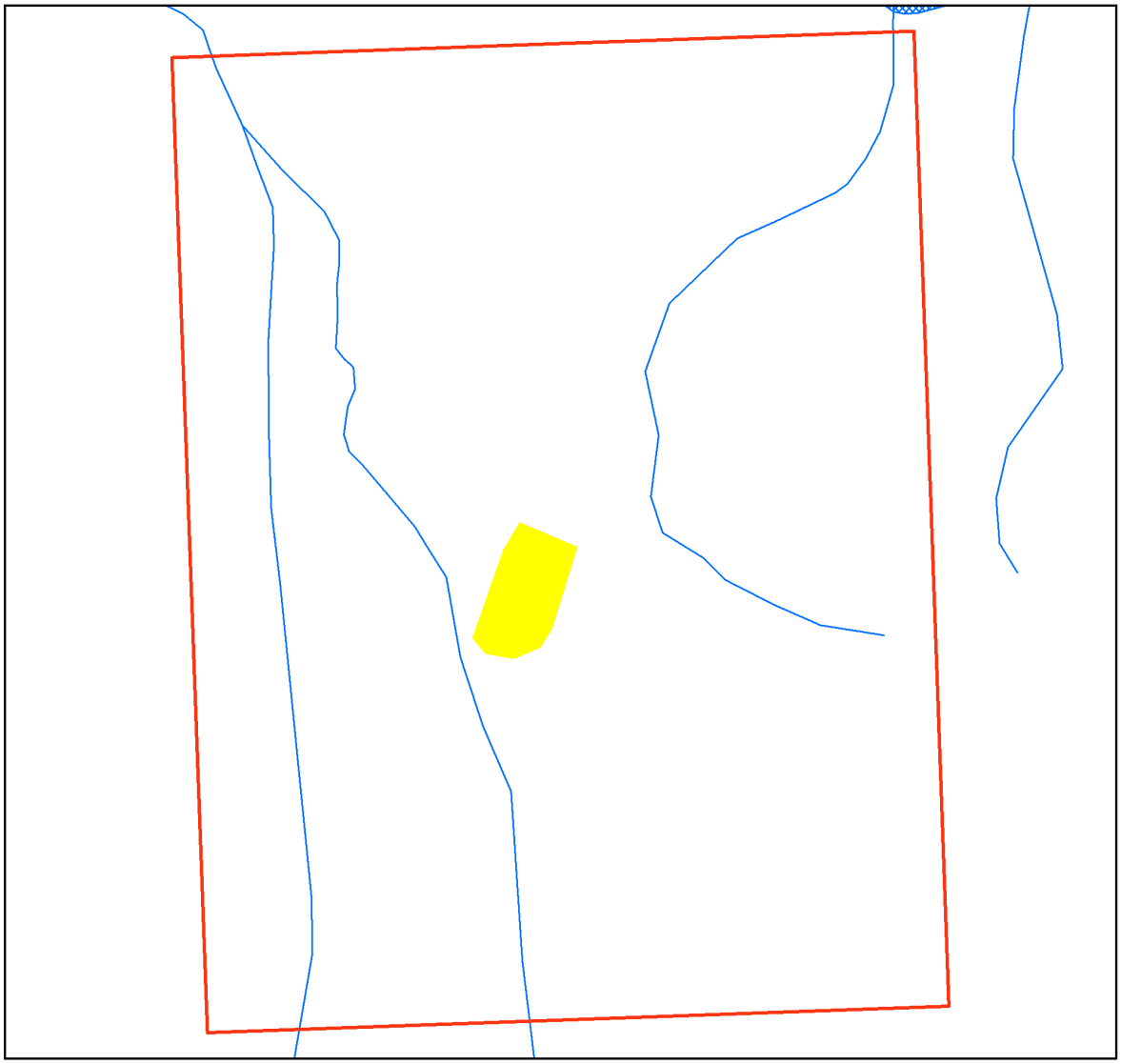
Map 6 - Wetlands and waterways



Queensland Wetland Data

Legend

- Selected Mining Lease (ML)
- Towns

Queensland Wetland Data

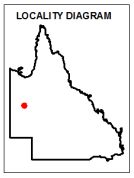
- Riverine Drainage Lines
- Springs

Wetland System - Water Bodies

- Marine Waterbodies
- Estuarine Waterbodies
- Riverine Waterbodies
- Lacustrine Waterbodies
- Palustrine Waterbodies

Wetland System - Regional Ecosystems

- Marine RE
- Estuarine RE
- Riverine RE
- Lacustrine RE
- Palustrine RE
- RE 51-80% wetland (mosaic units)
- RE 1-50% wetland (mosaic units)



N

0 80 160 240 320 400 m

This product is projected into GDA 1994 Queensland Albers

Accuracy information: The positional accuracy of wetland data mapped at a scale of 1:100,000 is +/-100m with a minimum polygon size of 5ha or 75m wide for linear features, except for areas along the east coa st which are mapped at the 1:50,000 scale with a positional accuracy of +/-50m, with a minimum polygon size of 1ha or 35m wide for linear features. Wetlands smaller than 1ha are not delineated on the wetland data. Consideration of the effects of mapped scale is necessary when interpret ing data at a larger scale, e.g. 1:25,000. For property assessment, digital linework should be used as a guide only. The extent of wetlands depicted on this map is based on rectified 2013 Landsat ETM+ imagery supplied by Statewide Landcover and Trees Study (SLATS), Department of Environment and Science. The extent of water bodies is based on the maximum extent of inundation derived from available Landsat imagery up to and including the 2013 imagery.

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Links and Other Information Sources

The Department of Environment and Science's Website -

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/

provides further information on the regional ecosystem framework, including access to links to the Regional Ecosystem Database, Broad Vegetation Group Definitions, Regional Ecosystem and Land zone descriptions.

Descriptions of the broad vegetation groups of Queensland can be downloaded from:

https://publications.qld.gov.au/dataset/redd/resource/

The methodology for mapping regional ecosystems can be downloaded from:

https://publications.qld.gov.au/dataset/redd/resource/

Technical descriptions for regional ecosystems can be obtained from:

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

Benchmarks can be obtained from:

http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

For further information associated with the remnant regional ecosystem dataset used by this report, refer to the metadata associated with the Biodiversity status of pre-clearing and Remnant Regional Ecosystems of Queensland dataset (version listed in **Appendix 1**) which is available through the Queensland Government Information System portal,

http://dds.information.qld.gov.au/dds/

The Queensland Globe is a mapping and data application. As an interactive online tool, Queensland Globe allows you to view and explore Queensland maps, imagery (including up-to-date satellite images) and other spatial data, including regional ecosystem mapping. To further view and explore regional ecosystems over an area of interest, access the Biota Globe (a component of the Queensland Globe). The Queensland Globe can be accessed via the following link:

http://www.dnrm.qld.gov.au/mapping-data/queensland-globe

References

Neldner, V.J., Niehus, R.E., Wilson, B.A., McDonald, W.J.F., Ford, A.J. and Accad, A. (2019). The Vegetation of Queensland. Descriptions of Broad Vegetation Groups. Version 4.0. Queensland Herbarium, Department of Environment and Science.

(https://publications.qld.gov.au/dataset/redd/resource/78209e74-c7f2-4589-90c1-c33188359086)

Neldner, V.J., Wilson, B.A., Dillewaard, H.A., Ryan, T.S., Butler, D.W., McDonald, W.J.F, Addicott, E.P. and Appelman, C.N. (2020). Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 5.1. Updated March 2020. Queensland Herbarium, Queensland Department of Environment and Science, Brisbane.

(https://publications.qld.gov.au/dataset/redd/resource/6dee78ab-c12c-4692-9842-b7257c2511e4)

Sattler, P.S. and Williams, R.D. (eds) (1999). *The Conservation Status of Queensland's Bioregional Ecosystems*. Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

The dataset listed below is available for download from:

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/download/

- Regional Ecosystem Description Database

The datasets listed below are available for download from:

http://dds.information.qld.gov.au/dds/

- Biodiversity status of pre-clearing and 2019 remnant regional ecosystems of Queensland
- Pre-clearing Vegetation Communities and Regional Ecosystems of Queensland
- Queensland Wetland Data Version - Wetland lines
- Queensland Wetland Data Version - Wetland points
- Queensland Wetland Data Version - Wetland areas

Appendix 2 - Acronyms and Abbreviations

AOI	- Area of Interest
GDA94	- Geocentric Datum of Australia 1994
GIS	- Geographic Information System
RE	- Regional Ecosystem
REDD	- Regional Ecosystem Description Database
VMA	- *Vegetation Management Act 1999*

APPENDIX F – FORM OF CERTIFICATION

Form of certification (Annual Dams Inspection)

Name of Registered Professional Engineer providing certification:

Allan Watson

Address of Registered Professional Engineer providing certification:

ATC Williams Pty Ltd
Ground Level, 16-20 Edmondstone Street
Newwmarket QLD 4051

Statement of relevant experience

I hereby state that I am a Registered Professional Engineer of Queensland (Number 5721) and meet the requirements of the definition of a 'suitably qualified and experienced person'.

Statement of certification

All relevant material relied upon by me is provided and/or referenced in the attached report "Tick Hill Mine – Tailings Reclamation Project – Consequence Category Assessment"; Reference 120100.02.R01-1, dated 13 June 2022.

I hereby certify that the consequence assessment "Tick Hill Mine – Tailings Reclamation Project – Consequence Category Assessment"; Reference 120100.02. R01-1, dated 13 June 2022 provides an assessment of the Tailings Storage Facility at the Tick Hill Mine in accordance with the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures published as ESR/2016/1933 Version 5, 29 March 2016.

This consequence assessment has concluded that the Tailings Storage facility has a 'Significant' consequence category and is therefore considered to be a regulated structure.

I, Allan Watson, declare that the information provided as part of this certification is true to the best of my knowledge. I acknowledge that it is an offence under section 480 of the Environmental Protection Act 1994 to give the administering authority a document containing information that I know is false, misleading or incomplete in a material particular.

Signed:

Allan Watson RPEQ 5721
Date: 13 June 2022

APPENDIX G TICK HILL GOLD MINE – INTERIM REHABILITATION REPORT (2013)

Xstrata Tick Hill Gold Project

INTERIM REHABILITATION REPORT (REV 1)

QE06640 | April 2013

SINCLAIR KNIGHT MERZ

Xstrata Tick Hill Gold Project

Document title:	Interim Rehabilitation Report
Version:	Rev 1
Date:	11 April 2013
Prepared by:	Jeremy Durbin
Approved by:	Ed Ebert
File name:	I:\QENV2\Projects\QE06640\3 - Deliverables\3.10 - PRR\Draft\QE6640 Tick Hill Interim Rehab Report_Rev1_11Apr2013.docx

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Executive Summary

Sinclair Knight Merz (SKM) was commissioned by Xstrata Copper (Xstrata) in August 2012, to undertake a data review of the available decommissioning and rehabilitation information on the Tick Hill gold mine (THGM) and to prepare a Progressive Rehabilitation Report (PRR) and supporting Audit Statement (AS).

Due to insufficient rehabilitation investigation and documentation available to reliably inform a PRR and obtain approval by the Department of Environment and Heritage Protection (DEHP), it was agreed by Xstrata and SKM that an Interim Rehabilitation Report (IRR) and supporting AS would be produced. The IRR is intended to provide a snapshot of current rehabilitation performance achieved at the THGM and guide further or additional studies, primarily in contaminated lands, hydrogeology, hydrology and geochemistry, that will be required for progressive closure and eventual relinquishment.

The accompanying Audit Statement also provides recommendations on the further studies that will be needed to develop an understanding of the residual environmental risks of the site, as part of the process towards successful mine closure.

This document is the result of a data review in September 2012 and site visits undertaken in October 2012 and February 2013 (flora only). The main findings of the data review and field observations include:

Terrestrial Flora

- A 1999 terrestrial ecology survey report concluded that the rehabilitation sites generally supported an acceptably high level of vertebrate and invertebrate diversity, but that a greater proportion of perennial vegetation on the rehabilitation sites would help to stabilise seasonal variation in the community composition over time.
- Vegetation condition at each survey site was also assessed using DEHP's BioCondition monitoring methodology
- Site observations displayed rehabilitation sites (tailings dam, rock dump, MIA) dominated by buffel grass with fewer habitat features apart from dense ground cover patches in a mosaic with bare ground.
- Results following 2012 and 2013 surveys indicate the rehabilitation in terms of establishing a self-sustaining vegetation cover suitable for soil stabilisation and grazing has been successful.

Soils

- There are three major soil groups likely to be encountered at the THGM site. Kandosol and Dermosol units (A horizon, B horizon or AB blended horizons) are suitable for reuse in rehabilitation subject to limitations. Both soil units generally exhibit suitable fertility and generally have a low potential for erosion.
- Rudosols may be encountered in small quantities at the Tick Hill Mine are unsuitable for reuse for rehabilitation they have low overall fertility and generally have a high to very-high potential for erosion.

Geotechnical

- Site observations by the EPA and XMIM between March 2000 and March 2008 state that the tailings dam, decant pond and waste rock emplacement are stable and that scouring of the western batter of the decant pond, and northern batter of the waste rock emplacement were to be addressed. The borrow pit areas, south-west and north-east of the tailings dam (Hollingsworth, Dames & Moore, 1999), have been rehabilitated.
- 2012 site observations
    - Tailings Dam - there were no visible signs of scouring, slumping or bulging of any of the batters or the toe of the embankments. There were also no signs of sink holes or slumping on the top surface. The spillway showed no signs of erosion and the wire rock protection was intact and in good condition.

- Decant Pond and waste rock emplacement - there were no visible signs of slumping or bulging of any of the batters or the toe of the embankments. There were also no signs of sink holes or slumping on the top surface. However, scour channels did exist on both structures and it is recommended that the scour lines be remediated to prevent deterioration of the localised area in the long term.
- Borrow Pit - Stability of the borrow pits is not considered to be an issue.

Groundwater

- The spatial distribution of groundwater monitoring points is restricted to two bores: one in-between the pit and the decant pond and another to the north of the decant pond.
- The depth to groundwater at Bore 1 ranges from 24.7 m (April 1997) to 26.5 m (November 1998). The depth to groundwater at Bore 2 ranges from 30.66 m (April 1997) to 20.5 m (October 1997).
- The number of groundwater monitoring bores is insufficient to define the spatial distribution and temporal variations of groundwater levels and to collect additional data within the structural features, therefore recommendation to expand the current monitoring bore network to include at least 3 new bores.

Contaminated Land

- No information exists on the former locations of activities that had the potential to cause land contamination, and there is insufficient documentation available to assess the current contaminated land status of the site.
- A contaminated land assessment (Preliminary Site Investigation) should be undertaken as defined in the Guidance for Contaminated Land Professionals (2012).

Environmental Audit

XMIM has demonstrated conformance with 46 of the 52 conditions assessed in total. Conformance with the remainder of the conditions was not able to be reliably determined due to the information gaps that currently exist on aspects such as hydrogeology and contaminated lands.

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1. Introduction

Sinclair Knight Merz (SKM) was commissioned by Xstrata Copper (Xstrata) in August 2012, to undertake a data review of the available decommissioning and rehabilitation information on the Tick Hill Gold Mine (THGM) and to prepare a Progressive Rehabilitation Report (PRR) and supporting Audit Statement (AS).

Following the data review, it was evident that significant information was not available or had not been recorded. Therefore, it was agreed between Xstrata and SKM to submit an Interim Rehabilitation Report (IRR) and supporting AS.

Due, in part to this lack of information, cost estimations for the rehabilitation of THGM have not been provided. Further studies and monitoring will be required before reasonable and accurate cost estimations can be made.

A gap analysis was undertaken and recommendations towards PRR requirements have been included here. To inform this IRR, the following tasks were undertaken by SKM between August 2012 and March 2013:

- Review of historical environmental data and reports prepared by Xstrata and other parties;
- Review of statutory approval conditions and Environmental Management Plan (EM Plan);
- Preparation of an audit framework;
- Site inspection that incorporated surveys of terrestrial flora and fauna, geotechnics and soils/landform;
- Identification of information gaps that may prevent an acceptable level of scientific certainty in relation to the state of rehabilitation achieved; and
- Preparation of an IRR and an AS.

This document provides information gathered from data and information reviews, field observations, and correspondence with Xstrata personnel in the following discipline fields:

Aspect	SKM Personnel
Project Manager	Jeremy Durbin
Terrestrial flora and fauna	Julia Olsen
Geotechnical engineering	Tony Matacin
Soils and landform	Tim Rohde
Hydrogeology	Andrew Wilson
Contaminated land	Matthew Pomeroy
Audit Statement	John Moraitis

1.1 Timing

The desktop review commenced in August 2012, with site visits conducted on 10-12 October, 2012 and 19-20 March, 2013 to provide wet and dry season terrestrial flora and fauna coverage.

1.2 Exclusions and Assumptions

The site visits were restricted to surface observations only, SKM staff specialising in groundwater and contaminated land were not required to attend. However, information from the site visits was delivered to the relevant staff for interpretation into the overall findings.

1.3 Environmental Approvals History

The THGM was officially opened in January 1992 and was originally operated by Carpentaria Gold Pty Ltd., a Mount Isa Mines (MIM) Holdings Ltd subsidiary. Active mining occurred up until 1995, at which time the mine was decommissioned.

In 1999, a Plan of Operations (PoO) was submitted and approved by the (then) Department of Mines and Energy for a period of five years. In December 1999, SKM undertook a flora and fauna survey of the site that was designed to meet the requirements of a PRR in line with the *Environmental Protection Act 1994* (EP Act). The SKM survey stated that the THGM had been successfully rehabilitated from a flora and fauna perspective. The report was submitted to the (then) Queensland Environmental Protection Agency (EPA) and it was understood by MIM at the time, that 47ha of the THGM had been successfully rehabilitated, and 3ha (final void) remained unapproved, existing as disturbed land.

In 2002, Carpentaria Gold Pty Ltd was granted an application for a conversion of a level 1 mining project to a level 2 mining project. Xstrata Copper took control of MIM in June 2003 and this ownership is referred to as XMIM throughout this document. In 2004, the mining leases were transferred from Carpentaria Gold Pty Ltd to XMIM, and a Standard Environmental Authority (EA) was issued by the (then) EPA on 27 July, 2004.

Since 2004, the THGM has been deemed to be in a 'care and maintenance phase' by the DEHP (the current administering authority). Despite the granting of the Standard EA (MIM400266004) in 2004 as a level 2 mining activity, the DEHP advised in 2012 that the THGM area (50ha in total) was not formally approved as rehabilitated land. Without this formal approval, the THGM is understood to have greater than 10 ha of disturbed land and DEHP's level of assessment criteria requires a level 1 assessment for any disturbance over 10 ha.

In 2012, XMIM submitted a revised PoO (2012-2017) and EM Plan for care, maintenance and exploration purposes only, to support a Level 1 mining project assessment. A revised EA was approved on 5 April, 2013.

XMIM determined that to facilitate potential mining lease sale or relinquishment, a level 2 mining project assessment was required. To enable an application to change the level of assessment from a level 1 to a level 2 mining project, DEHP would require a PRR and supporting AS. These documents must demonstrate that 47ha of land have been successfully rehabilitated and confirm that less than 10 ha of disturbed land awaits rehabilitation.

Following the DEHPs approval of the EM Plan and the level 1 mining project application in February 2013, XMIM will be in a better position to submit a completed PRR and supporting AS following completion of outstanding actions as outlined in this document.

This IRR document has been produced to provide guidance towards achieving successful rehabilitation outcomes that will inform a future PRR and AS at a suitable time in the future.

1.4 Environmental Audit

In parallel to the data review and site visit, an environmental audit was conducted which involved a desktop review of historical information relating to the THGM and a site inspection to ground truth the findings of the review work.

The purpose of the audit was to determine XMIMs conformance with the EA (MIM400266004) issued for the THGM in 2004, and the Code of Environmental Compliance for Mining Lease Projects (January 2001 – Version 0). SKM was able to determine that XMIM has demonstrated conformance with 46 of the 52 conditions assessed in total. Conformance with the remainder of the conditions was not able to be reliably determined due to the information gaps that currently exist on aspects such as hydrogeology and contaminated lands.

2. Context

2.1 Mine Location

The THGM is approximately 110km south-southeast of Mount Isa, located predominately within mining lease (ML)7094 and the adjoining ML7096 and ML7097. There are no major waterways located near the project area, although there are two minor ephemeral drainage lines either side of the open-cut pit drain off the lease in a northerly direction to join Petticoat Creek (**Figure 2-1**).

2.2 Mine History

XMIM has reported that active mining operations occurred from 1992 to 1995 producing 513,333 ounces of gold from 705,000 tonnes of ore at a recovered average grade of 22.6 grams/tonne gold. For the first five months of the operation, ore was transported by truck to a loading facility at a siding on the Phosphate Hill rail line, and then by rail to Mingela, north of Ravenswood. The ore was processed by Carpentaria Gold at Ravenswood. In December 1991, a processing plant utilising carbon-in-leach methods was commissioned to enable all processing to be carried out onsite. During the first quarter of 1992, underground mining operations commenced to allow complete extraction of the ore body to a final depth of 250m. Access to the underground operations was via a portal located within the open cut at a depth of 25m. The portal was sealed off in April 1995 when active mining ceased.

The Tick Hill Decommissioning Plan was used to guide mine closure in 1995, however this document could not be located following searches within Xstrata, MIM archives, DEHP, and URS (formally Hollingsworth Dames and Moore – the original authors of the Decommissioning Plan document).

2.3 Environmental Aspects – Background

2.3.1 Government Guidelines

The DEHP state the following four general rehabilitation goals for areas previously disturbed by mining. The land must be:

- safe to humans and wildlife;
- non-polluting;
- stable; and
- able to sustain an agreed post-mining land use.

In addition to these general points, DEHP may also identify site specific goals which could include requirements under other legislation. As such DEHP have provided a list of additional requirements that may include:

- establish vegetation communities that are demonstrably similar to a pre-existing ecosystem (especially where native vegetation is the proposed land use);
- establish or enhance the habitat of an endangered species (especially where the mining has affected such habitat);
- restore stream patterns where there has been a temporary stream diversion;
- achieve water quality that meets some specific beneficial use;
- maintain or restore some specific aesthetic values;
- preserve specific European and indigenous heritage that has been registered for the site (note that these values are managed under other legislation); and
- achieve specific socio-economic outcomes (e.g. restore high value agricultural land necessary to maintain a viable rural industry).

Further detail on DEHP general rehabilitation requirements for mining projects is provided in Guideline EM1122 Mining – Rehabilitation requirements for mining projects (**Appendix A**). Further to this current Guideline, there are also at least 13 additional rehabilitation guidelines, drafted in 1995 that are still referred to by DEHP (refer DEHP website: http://www.ehp.qld.gov.au/land/mining/technical_guidelines.html).

2.3.2 Terrestrial Flora Aspect

As THGM exists on current MLs, the ecological aspects are managed under the EP Act and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), with specific compliance conditions within the current THGM EA (MIM400266004).

In 1999, SKM undertook a terrestrial flora and fauna survey that used reference sites adjacent to the mine site to enable comparison between existing vegetation and THGM rehabilitation success. The 1999 report was used to inform the terrestrial flora and fauna habitat survey locations, including reference sites, and enable good temporal coverage – unusual for such a remote, closed mine site.

The area around and including Tick Hill is not covered by current DEHP regional ecosystem (RE) mapping, so knowledge of REs and other habitat data is not currently available.

There are no known EPBC Act threatened ecological communities or threatened flora species listed within a 10km radius from the centre of Tick Hill mine, according to the EPBC Act Protected Matters Search tool (accessed, 5 December, 2012).

2.3.3 Geotechnical Engineering Aspect

There is limited data available on the geotechnical aspects of the THGM while it was operational, however there have been several site audits undertaken by the (then) EPA in March 2000, May 2005 and March 2008. XMIM performed their own audits in August 2004 and June 2012. The observations and recommendations from those audits relating to the tailings dam, decant pond, waste rock emplacement and borrow pit are summarised in **Section 3.3.2**.

2.3.4 Soils/Landform Aspect

Although limited post-mine soil survey data was available, a data review and site visit provided adequate information to confirm land suitability assessments and strategic cropping land potential.

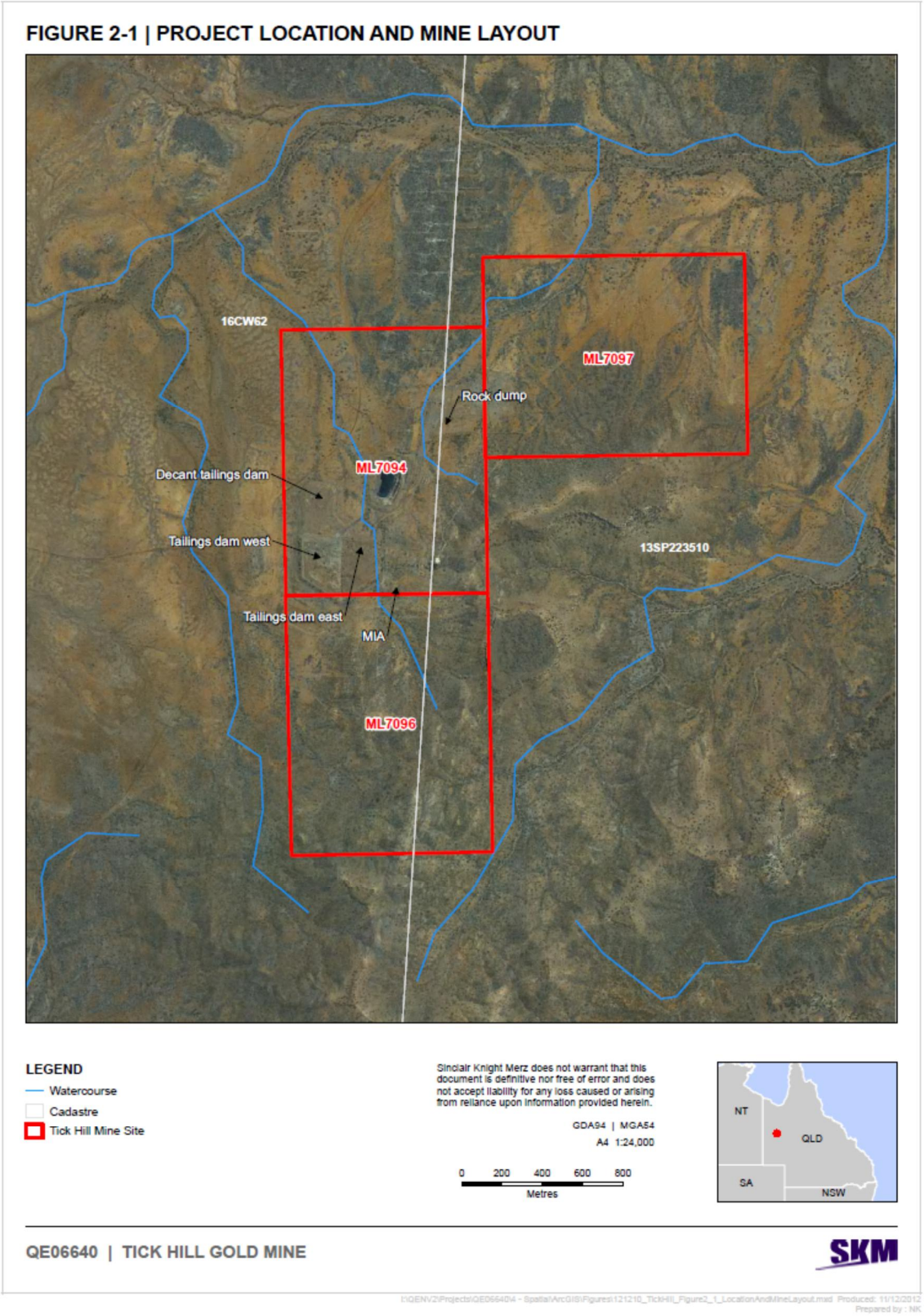

Figure 2-1: Tick Hill Mine Location

2.3.5 Groundwater Aspect

The purpose of the *Environmental Protection (Water) Policy 2009* is to achieve the object of the EP Act in relation to Queensland waters, including groundwater.

The object of EP Act is to protect Queensland's environment while allowing for development. The EP Act states that an environmental protection policy must identify the environmental values to be enhanced or protected under the policy, and that an environmental protection policy may state the water quality objectives to be achieved and maintained.

The environmental values and water quality objectives for waters must be considered when complying with a regulatory requirement under the EP Act. The environmental values also inform whether environmental harm under the EP Act has occurred.

For the THGM site, the environmental values of groundwater must be identified and the water quality objectives to be achieved and maintained must be defined, to enable the PRR to occur.

Geological reports indicate the ore body is contained within metaquartzites, laminate pegmatites and lodestone of the Proterozoic aged Corella Formation. These lithologies are likely to have low primary permeability, with secondary permeability features including joints and fractures having potential to transmit groundwater flow.

The spatial distribution of groundwater monitoring points is restricted to two bores: one in-between the pit and the tailings dam and another to the east, as shown on **Figure 2-2**. Lithological logs and bore construction details for these bores have not been provided to SKM to date, therefore the exact aquifer material, characteristics, thickness and screened intervals at the locations are not known.

A search of the Queensland Department of Natural Resources and Mines (NRM) groundwater database was performed for a 5 km radius of the Tick Hill. A total of two registered groundwater bores were identified, with their locations also shown on **Figure 2-2**. No geological or hydrogeological data are available for these bores, and no information about their status or use is available.

The closest surface water drainage is located north of the site, forming an upper tributary of the Georgina River. The Groundwater Dependant Ecosystem (GDE) Atlas (Bureau of Meteorology, 2012) has mapped this drainage as having low potential for groundwater interaction. No other potential GDE features were identified in the GDE Atlas in close proximity to the site.

The sole environmental receptor for groundwater is considered to be watering of stock through pumping from aquifer (based on current land use).

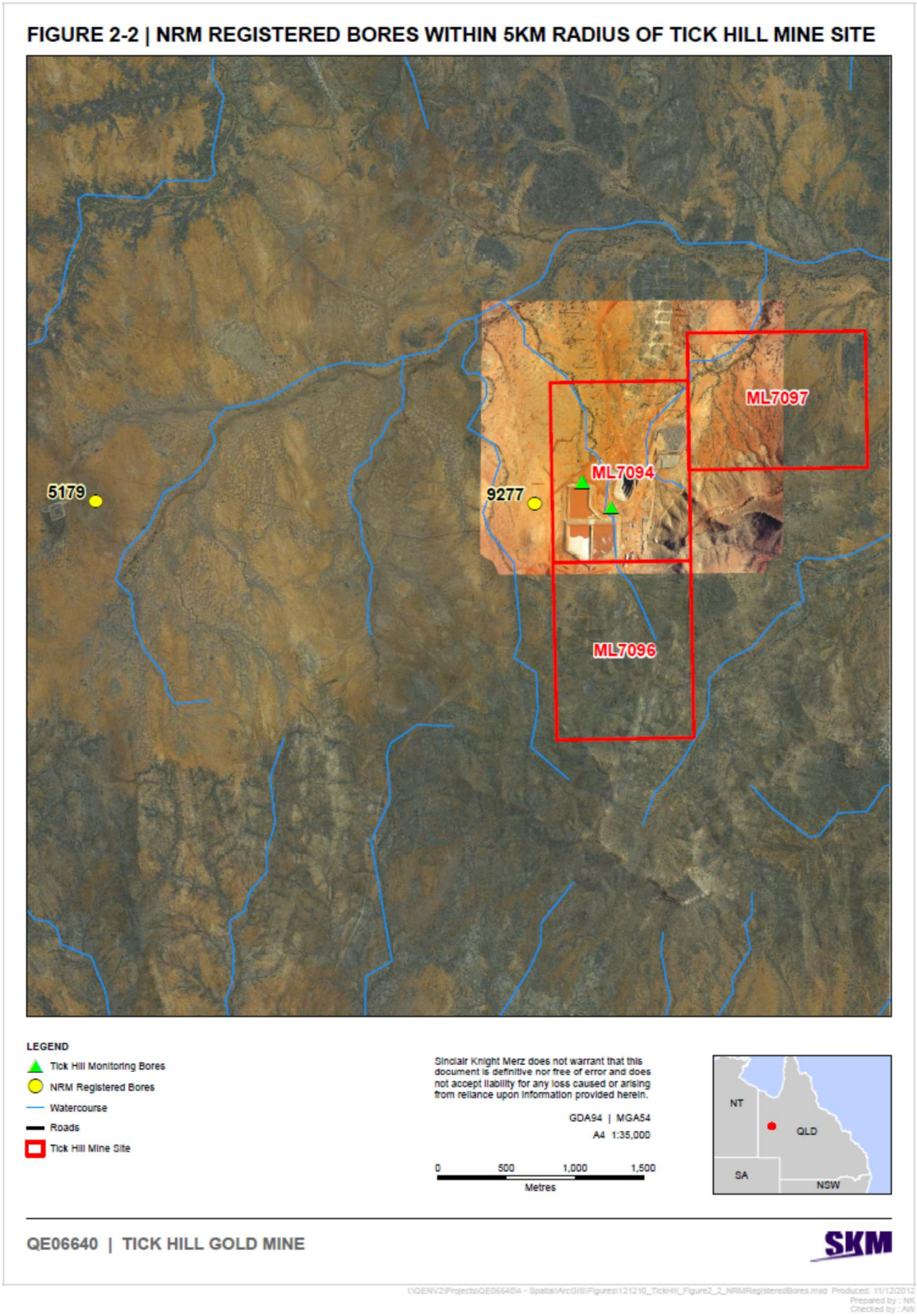

Figure 2-2: Tick Hill Monitoring Bores and NRM Registered Bores within 5km

2.3.6 Contaminated Lands Aspect

Contaminated land is managed under the EP Act. Further guidance on contaminated land matters are noted under the *Guidance for Contaminated Land Professionals (2012)*. A mine-site is considered a notifiable activity under Schedule 3 of the EP Act.

Subsequently, mine sites are listed on the DEHP Environment Management Register (EMR). Potentially contaminating activities on a mine site can include (but are not necessarily limited to) the following notifiable activities:

- Mine Wastes;
- Mineral Processing;
- Petroleum Product or Oil Storage;
- Chemical Storage;
- Workshop;
- Abrasive Blasting;
- Landfill; and
- Explosives Storage.

Additionally, secondary processes can also occur, i.e. Acid Rock Drainage (ARD) mobilisation of heavy metals and break down of complex cyanides to more available (and toxic) forms.

Contamination is considered in terms of a source of contaminants (i.e. soil contamination from past spillage, leakage from tailings dam, surface contamination), a pathway (i.e. migration of contaminants in leachate to groundwater and travel through groundwater, consumption of contaminated soils by grazing livestock) and a receptor (i.e. discharge of contaminated groundwater to surface water, extraction of groundwater for potable or domestic supply).

Contamination can often take many years to result in impacts as the contaminants migrate to a receptor via a pathway.

Note on additional Guideline: The *Greentape Reduction and Other Legislation Amendment Act (2012)* came into effect on 31 March 2013. This legislation includes further details on requirements for mine closure. Where applicable, these requirements have been discussed within this document.

3. Data Review

XMIM provided the majority of THGM data, documents and reports including previous internal and external audits, monitoring data, regulatory licences, management plans and approvals. Several documents were also provided by URS, who now represent Dames, Hollingsworth and Moore.

Tick Hill was closed 17 years ago, and following changes in mine personnel, mine ownership, and office locations, some potentially useful data has not been located, including:

- Decommissioning Plan (Hollingsworth, Dames and Moore, circa 1995);
- Continuous monitoring data for groundwater, surface water, and soil chemistry;
- Any data targeting contaminated lands;
- Terrestrial fauna data; and
- Geotechnical data.

Cognisant of the above omissions, SKM conducted this data review on all documents received, as listed in **Appendix B**.

3.1 Gap Analysis

A preliminary gap analysis, (**Appendix C**) was sent to XMIM during the data review process providing some transparency to the findings of this report in advance of this document.

The main findings of this included:

- no information exists on the former locations of activities that had the potential to cause land contamination;
- the Decommissioning Plan prepared by Hollingsworth, Dames and Moore (1993-1995) could not be located;
- there are no agreements of the remediation targets for contaminated land on record;
- there are no statutory declarations from a suitably qualified person on record for contaminated land issues;
- there is no evidence to suggest that an independent auditor was used for any contaminated land investigations;
- the number of groundwater monitoring bores is insufficient to define the spatial distribution and temporal variations of groundwater levels and to collect additional data within the structural features;
- there is no evidence to suggest that a review of sampling protocols has occurred, nor that a suitable groundwater sampling guideline such as Geoscience Australia 2009 has been followed;
- the groundwater quality data requires reviewing to establish lower and upper background limits for relevant parameters, to enable future exceedances to be identified as potential groundwater impacts;
- an absence of slug or pumping tests in bores to determine the aquifer properties hydraulic conductivity and storativity;
- a requirement to collate and synthesise all hydrogeological data to develop a conceptual hydrogeological model, enabling the interactions between the void and groundwater to be determined;
- incorporate rainfall, runoff and groundwater data to prepare a site water balance through numerical groundwater modelling, based on the conceptual model;
- assess changes to groundwater hydrochemistry through analytical modelling, based on conceptual and numerical models; and
- a lack of operational process knowledge and infrastructure location to inform future studies.

The preliminary gap analysis results, drafted following the October 2012 site visit are provided in **Appendix C**.

3.2 Terrestrial Flora

3.2.1 Vegetation mapping

The DEHP RE, high value regrowth and essential habitat mapping do not cover the project area. For areas where regional ecosystem mapping has not yet been prepared, the remnant vegetation map indicates areas of remnant and non-remnant vegetation. According to DEHP's remnant vegetation map, the project area contains remnant vegetation.

3.2.2 1999 Survey Report

The previous survey report concluded that the rehabilitation sites generally supported an acceptably high level of vertebrate and invertebrate diversity, but that a greater proportion of perennial vegetation on the rehabilitation sites would help to stabilise seasonal variation in the community composition over time.

Comparisons between the 1999 and 2012 survey results are described and discussed in **Sections 4.1.2** and **5.1**.

3.3 Geotechnical

3.3.1 Site geology

The mine lease is within the Corella Formation which is a Proterozoic sequence of thin-banded calc-silicate granofels and amphibolites. Quartz feldspar porphyries occur within the sequence as do ridge forming schistose quartzite, which may represent lenses of metamorphosed quartz arenite.

The Corella Formation sequence dips at 55° to 60° to the west and has a regional strike of 0° to 18°. The ore horizon is generally conformable with this sequence and is broadly defined as a highly strained zone within two quartzite units of variable thickness.

The unaltered rock types in the hanging wall and footwall sequences are schist and granofels with varying proportions of quartz, hornblende, biotite, plagioclase and microcline with minor magnetite and titanite. Rocks in the ore zone include similar lithologies as well as plagioclase-rich rocks.

Previous geotechnical investigations showed that the subsurface profile comprises up to 1.7 m of silty and clayey gravel residual soil overlying a weathered schist bedrock.

Mine closure compliance for the tailings dam and decant pond, waste rock dump and borrow area as per Xstrata Closure Guidelines, which conform to the DEHP Code, are shown in **Table 3-1**.

Table 3-1: Mine closure compliance criteria for various domains

Domain	Compliance Criteria
Tailings surface facilities	No erosion of batters, no batter slumping and stability issues, adequate drainage off facility, adequate freeboard, re-vegetation acceptable, no dust sourced from dam.
Waste rock piles	No erosion on slopes, acceptable water draining from slopes, re-vegetation acceptable.
Borrow pits	Re-contouring and revegetation acceptable.

In general, the tailings dam, decant pond and waste rock dump are required to have batters that are stable over the long term and will not scour. Re-vegetation is to be similar to surrounding undisturbed areas in terms of

species and density. The borrow pit areas are required to be rehabilitated to a stable landform, similar to that of the surrounding undisturbed areas.

3.3.2 Previous audits

Site audits were performed by the (then) EPA in March 2000, May 2005 and March 2008. XMIM performed their own audits in August 2004 and June 2012. The observations and recommendations from those audits relating to the tailings dam, decant pond, waste rock emplacement and borrow pit are summarised in **Table 3-2**.

Table 3-2: Previous Geotechnic Audit Results

Date	Observations	Recommendations / Actions
March 2000 (EPA)	Gully erosion present to the west of the tailings dam. Rock filled wire mattress at tailings dam spillway shows signs of some displacement. Some downstream erosion below the overflow structure (the spillway). Gully erosion on northern waste rock dump batter (towards the eastern end). Rilling on northern batter of waste rock dump. Some settling on top of waste dump and tailings dam allowing ponding (not necessarily detrimental).	Inspect surface drainage of waste structures following heavy rain.
August 2004 (XMIM)	Tailings dam, decant pond and waste rock structures appear stable. Gully erosion present on the western part of the decant pond batter. Rill erosion present on the northern part of the waste rock emplacement batter. Ground level gully erosion to the west of the tailings dam. Borrow pits have been rehabilitated. All rehabilitated areas blend well into the landscape, with similar vegetation densities within natural variation. Ground cover is dominated by buffel grass which is consistent with surrounding grazing areas.	Investigate cause of erosion to the west of tailings storage facility followed by remediation if required. Potential requirement for repair of erosion on south-western batter of decant pond. Spread seeds or plant species on tailings dam, decant pond, waste rock dump consistent with that found in surrounding areas.
May 2005 (EPA)	Rehabilitation on tailings dam and waste rock dump well established. No tailings dam, decant pond or waste rock dump stability issues noted.	None relating to tailings dam, decant pond or waste rock dump.
March 2008 (EPA)	Tailings dam was well vegetated with no visual evidence of erosion. Tailings dam spillway has been rock armoured and secured with no erosion evident. Decant pond has been capped and vegetated. Waste rock dump batters appear stable with some ground cover. Very limited amounts of erosion with no evident instability. Waste rock dump cap was vegetated and there was no evidence of oxidisation or salts on the surface. Low grade ore stockpile adjacent to the eastern side of the waste rock dump was removed in 1995 and the site	Submit PRR / Final Rehabilitation Report to have rehabilitation signed off. Will need to include Land Contamination Assessment to have the PRR signed off with a reduced Financial Assurance.

Date	Observations	Recommendations / Actions
	has been vegetated with no obvious indication of contamination or erosion.	
June 2012 (XMIM)	Rehabilitation completed.	

Site observations by the EPA and XMIM between March 2000 and March 2008 state that the tailings dam, decant pond and waste rock emplacement are stable and that scouring of the western batter of the decant pond, and northern batter of the waste rock emplacement were to be addressed. The borrow pit areas, south-west and north-east of the tailings dam (Hollingsworth, Dames & Moore, 1999), have been rehabilitated.

3.4 Soils

A soils and landform desktop review was undertaken, followed by a visual assessment of the THGM site and surrounding area. The major objectives of the visual assessment were to:

- **Objective 1. Classify and determine the soil types within the project site.** To satisfy Objective 1, the soil taxonomic classification system used was the Australia Soil Classification (ASC) system. The system is routinely used as the soil classification system in Australia.
- **Objective 2. Assess the pre-mining Land Suitability classes within the project site.** To satisfy Objective 2, the Guideline for Agricultural Land Evaluation in Queensland (DPI, 1990 and DME, 1995) was reviewed. This includes a standard list of limitations for assessing agricultural land suitability in Queensland.
- **Objective 3. Assess the pre-mining Good Quality Agricultural Land (GQAL) classes within the project site.** To satisfy Objective 3, the Planning Guidelines: Identification of Good Quality Agricultural Land (DPI/DHLGP, 1993) was used. The guideline sets conditions for land in terms of limitations, rating and ability of the land to maintain a sustainable level of agricultural productivity.
- **Objective 4. Assess the pre-mining Strategic Cropping Land (SCL)** within the project site and provide soil management recommendations for management. To satisfy Objective 4, the relevant guideline applied was the Protecting Queensland's strategic cropping land; Proposed criteria for identifying strategic cropping land (DERM, 2011)
- **Objective 5. Assess the potential erosion rates for various scenarios post-closure.**

3.4.1 Soil Classification (Objective 1)

There are three major soil groups likely to be encountered at the THGM site. Kandosol and Dermosol units (A horizon, B horizon or AB blended horizons) are suitable for reuse in rehabilitation subject to limitations. Both soil units generally exhibit suitable fertility and generally have a low potential for erosion.

Rudosols that may be encountered in small quantities at the Tick Hill Mine are unsuitable for reuse for rehabilitation as they have low overall fertility and generally have a high to very-high potential for erosion.

- The site review did identify some erosion ranging from minor to moderate. Where moderate erosion was identified it appears to have undergone self-armouring and does not show fresh signs of erosion
- Topsoil has been spread as a thin veneer across all domains is unlikely to have any potential to reduce / restrict infiltration. This may be an issue if a review of the sites geology identifies a risk of acid rock drainage.

Based on the available data gathered during the desktop assessment it can be summarised that all soil units (either undisturbed or reused as a growth medium during rehabilitation) are unlikely to have significant agricultural value (either prior to or post-mining) and are likely classified as either:

- Suitable land with moderate limitations – land which is moderately suited to a proposed use but which requires significant inputs to ensure sustainable use; or
- Marginal land with severe limitations on land use requiring major inputs to ensure sustainability. Such inputs may outweigh the returns from the land.

This assessment is based on the assumption that plant available water capacity (PAWC) will be the highest ranking limiting factor and further land suitability information is provided in **Section 3.4.2**.

- The current rehabilitated site consists of soil profiles that might have been encountered prior to mining in term of topsoil thickness and placement in the landscape.

It is unlikely that the site will have any future economic value for agricultural development (cropping) and should be relinquished as agreed with the landowner to grazing, or to natural habitat if this option exists. A review of the ASRIS database has been presented in **Figure 3-1** for THGM and the surrounding area. Available mapping indicates that the site is likely dominated by:

- Kandosol Soil (High Probability of Occurrence).
- Dermosol Soil (Medium Probability of Occurrence).
- Rudosol Soil (Medium Probability of Occurrence).

There are three major soil groups likely to be encountered at the Tick Hill Mine site. Kandosol and Dermosol units (A horizon, B horizon or AB blended horizons) are suitable for reuse in rehabilitation – subject to limitations. Both soil units generally exhibit suitable fertility and generally have a low potential for erosion.

Rudosols may be encountered in small quantities at the Tick Hill Mine are unsuitable for reuse for rehabilitation they have low overall fertility and generally have a high to very-high potential for erosion.

3.4.2 Land Suitability (Objective 2)

Land suitability mapping for the Tick Hill Mine and the surrounding area (project area) was not available at the time of preparing field notes. However a number of general comments can be made based on the soil units that are likely to be encountered at site.

The majority of the Tick Hill Mine and the surrounding area are used for broad acre cattle grazing on native grasses which were in good condition at the time of field observation.

The project area has low mean annual rainfall of between 200-400mm/year (BOM 2007) and rainfall can be unreliable and long droughts are common. Such unreliable and insufficient rainfall presents a significant limitation to sustained cropping in this area. No cropping was observed during the survey.

Land suitability classification is based on specific land uses assessed using the classes shown in **Table 4-3** (DME, 1995).

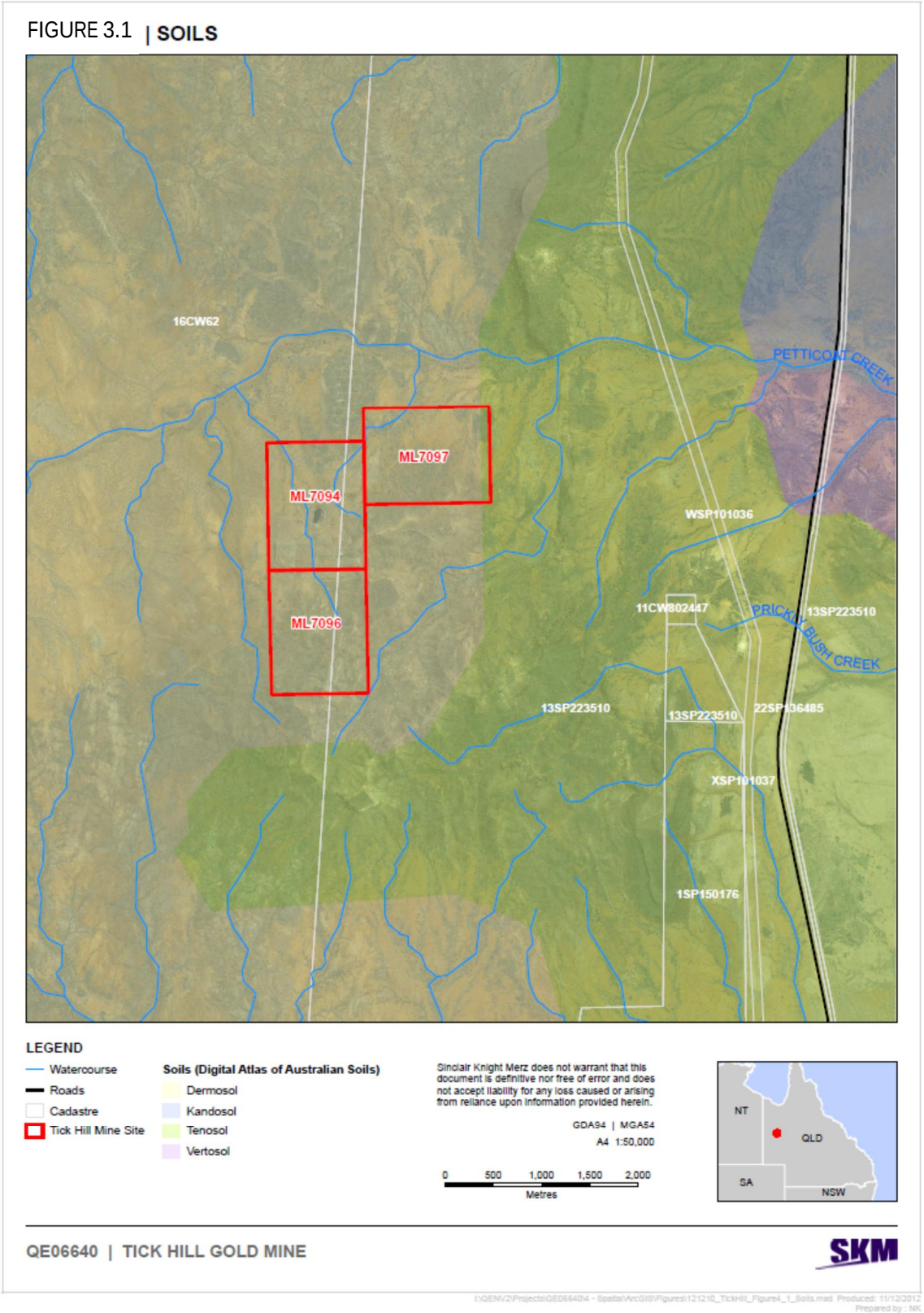

Figure 3-1: ASRIS Soil Mapping of Tick Hill and Surrounding Area

Table 3-3: Land Suitability Classes

Class	Suitability Description
Class 1	Suitable land with negligible limitations and is highly productive requiring only simple management practices.
Class 2	Suitable land with minor limitations which either reduce production or require more than simple management practices to sustain the use.
Class 3	Suitable land with moderate limitations – Land which is moderately suited to a proposed use but which requires significant inputs to ensure sustainable use.
Class 4	Marginal land with severe limitations on land use requiring major inputs to ensure sustainability. Such inputs may outweigh the returns from the land.
Class 5	Unsuitable land with extreme limitations that precludes its use.

Land suitability class is determined by the *highest ranking limiting factor* or a combination of a number of factors. The soils have been assessed against the following limiting factors defined by DME (1995) which determine crop and grazing suitability class:

- **Plant available water capacity (PAWC):** PAWC is likely the *highest ranking limiting factor* in an arid environment. Further discussion is provided below.
- **Nutrient deficiency:** This was not assessed as part of the visual assessment however a review of the ASRIS database has provided general information.
- **Salinity:** This has not been assessed in the current program.
- **Soil physical factors:** This has not been assessed in the current program.
- **Erosion:** This was not assessed as part of the visual assessment however a review of the ASRIS database has provided general information.
- **Workability:** This has not been assessed in the current program.
- **Microrelief:** This has not been assessed in the current program.
- Flooding - This has not been assessed in the current program. The site is located at the head of a catchment and the likelihood of flooding is very low.
- **Wetness:** This has not been assessed in the current program.
- **Topography:** This has not been assessed in the current program.
- **Rockiness:** This has not been assessed in the current program.

3.4.2.1 Plant Available Water Capacity (PAWC)

Plant available water capacity (PAWC) is a significant soil property in this locality as cropping is based on fallow storage of moisture in the soil profile. PAWC is the moisture stored in the soil profile that is available to the plant and is classically defined as the moisture present between field capacity and permanent wilting point (15 bar). **Table 3-4** shows the criteria which DME (1995) proposed for assessment of the moisture availability limitation for crops in this region.

Table 3-4: PAWC: Land Suitability for Cropping / Grazing (DME, 1995)

Limiting Factor	1	2	3	4	5
Moisture	PAWC >125 mm	PAWC 100-125 mm	PAWC 75-100 mm	PAWC 50-75 mm	PAWC <50 mm

Soil water storage assessment for Land Suitability Assessment was based on estimated PAWC derived from the following surrogate values (**Table 3-5**) (DERM, 2011).

Table 3-5: Estimated average PAWC per 100 mm soil depth increment for soil texture grades (DERM, 2011)

Field Texture	Estimate PAWC per 100 mm depth of soil
sand; clayey sand; loamy sand	4 mm
sandy loam	5 mm
loam; silty loam; sandy clay loam	6 mm
clay loam; clay loam, sandy; silty clay loam	8 mm
light clay; light medium clay	10 mm
medium clay; medium heavy clay; heavy clay	12 mm

PAWC suitability range estimates for observed soil orders in this survey area are shown in **Table 3-6**.

Table 3-6: Estimated Plant Rooting Depth, PAWC and Land Suitability Class

Soil Order	Concept	Estimated Effective Rooting Depth (mm)	PAWC (mm)	Limitation Level
Dermosol	Texture contrast soils with moderately to strongly structured usually clayey B2 horizons.	700->1000	100-> 125	3
Kandosol	Very deep (>1 m) and clay-rich	700 - >1000	100-> 125	3
Rudosol	Shallow apedal soil	<100 mm	>100	3-4

3.4.2.2 Land Suitability Assessment Summary

Based on the available data gathered during the desktop assessment it can be summarised that all soil units (either undisturbed or reused as a growth medium during rehabilitation) are unlikely to have significant agricultural value (either prior to or post-mining) and are likely classified as either:

- Suitable land with moderate limitations – land which is moderately suited to a proposed use but which requires significant inputs to ensure sustainable use; or
- Marginal land with severe limitations on land use requiring major inputs to ensure sustainability. Such inputs may outweigh the returns from the land.

This assessment is based on the assumption that PAWC will be the highest ranking limiting factor.

3.4.3 Good Quality Agricultural Land (GQAL) (Objective 3)

GQAL assessment is derived from the land Suitability Assessment (previous section). Based on the previous sections discussion, which is solely derived from a desk top review the Tick Hill Mine and Surrounding area are likely to be classified as either:

- **C_3 -** Land suitable for limited grazing of native pastures; or
- **D -** Land not suitable for agricultural uses due to extreme limitations. This may be undisturbed land with significant habitat, conservation and / or catchment values or land that may be unsuitable because of very steep slopes, shallow soils, rocky outcrops or poor drainage.

3.4.4 Strategic Cropping Land (SCL) (Objective 4)

Queensland SCL trigger mapping does not include the Tick Hill Mine or the surrounding area. The region, based solely on the desktop assessment, is described as arid with limited to very limited agricultural value for agriculture. The region has value for broad acre cattle grazing at very low stocking rates.

3.4.5 Erosion (Objective 5)

General erosion potential has been discussed in **Section 3.4.1**. In general Kandsol and Dermosol soil units have a lower potential for erosion, while Rudosols have a high potential for erosion.

3.5 Groundwater

The spatial distribution of groundwater monitoring points is restricted to two bores: one in-between the pit and the decant pond and another to the north of the decant pond. Monitoring of these two bores has occurred sporadically - April 1997, October 1997, November 1998, May 1999, August 2001, January 2004, July 2004, and April 2012.

The depth to groundwater at Bore 1 ranges from 24.7 m (April 1997) to 26.5 m (November 1998), indicating some seasonal variation with lower water levels recorded at the end of the dry season. The depth to groundwater at Bore 2 ranges from 30.66 m (April 1997) to 20.5 m (October 1997), which displays the opposite variation to that observed at Bore 1. Such a large variation in groundwater level at Bore 2 is considered unlikely, when compared to the smaller variation at Bore 1, and may be due to human error or inaccurate measuring equipment. No survey data for these bores has been provided to SKM to date.

The groundwater is near neutral, with the exception of a sampling round conducted in July 2004 where values pH of 13 and 12.9 were recorded at Bore 1 and Bore 2 respectively. These elevated pH values are not consistent with previous monitoring rounds and are considered anomalous and likely the result of an improperly calibrated or broken electronic meter. The groundwater is slightly brackish with EC ranging from 2400 to 5330 µS/cm at Bore 1, and 1980 to 2020 µS/cm at Bore 2. An EC value of 442 µS/cm was measured at Bore 2 in July 2004 but a corresponding reading was reported for Bore 1 at the same time, and so the reading is considered potentially anomalous.

To date, SKM has been provided with only one set of analytical results for the pit void water from a sample collected in March 2012. The pH was determined to be 8.34 and the EC was determined to be 4720 µS/cm.

For the groundwater sampling round undertaken in April 2012, the volume of groundwater purged from the bores does not tally with the pumping rate and pumping time. Xstrata have informed SKM that this discrepancy is due to the bores being pumped dry, and the samples were collected once the bores had recharged. No bore purging records have been provided to SKM to date for comparison with the previous groundwater sampling events.

For the majority of the monitoring events, groundwater samples were analysed for the following:

- major cations: Na, K, Ca Mg.
- major anions: Cl, SO 4 HCO_3.
- nutrients: NO_2 and NO_3.
- metals: Al, As, Cd, Cu, Fe, Mn, Mo, Ni, Pb, Sr, Zn, Cn.

In April 1997, samples were also analysed for the following additional metals: B, Ba, Be, Bi, Br, Ce, Co, Cr, Cs, Dy, Er, Eu, Ga, Gd, Ge, Hp. Hg. Ho, I, In, La, Li, Lu, Nb, Nd, P, Pr, Rb, Re, Sb, Sc, Se, Sm, Sn, Ta, Tb, Te, Th, Ti, Tl, Tm, U, V, W.

The groundwater sampled from Bore 1 and Bore 2 in April 2012 is Na, Mg-HCO 3, Cl type. The water sampled from the pit void in March 2012 is Na, Mg-Cl type. A Piper diagram of the major ions for these April 2012 data is presented in **Figure 3-2**. As shown, the groundwater from Bore 1 and Bore 2 plots to the lower left of the pit

void water, due to the greater proportion of HCO 3 in the groundwater. The pit void water could be affected by evaporative concentration and precipitation of some ions to change its chemical type.

It should be noted that it is difficult to assess the degree of connection between groundwater and the pit void water based on only one sample for the pit void. The degree of connection is also complicated by the absence of the following:

- water elevation data (to determine groundwater flow direction); and
- bore completion data (to determine if both of the bores are completed in the same aquifer, and if the pit is intercepting the same aquifers as either of the bores).

The DEHP recognises the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 (ANZECC 2000) as the appropriate guideline to assess the agricultural use environmental value. Groundwater samples collected from Bore 1 and Bore 2 are below the ANZECC 2000 guidelines for stock water for all major ions and metals sampled and analysed, where guidelines have been established for these analytes.

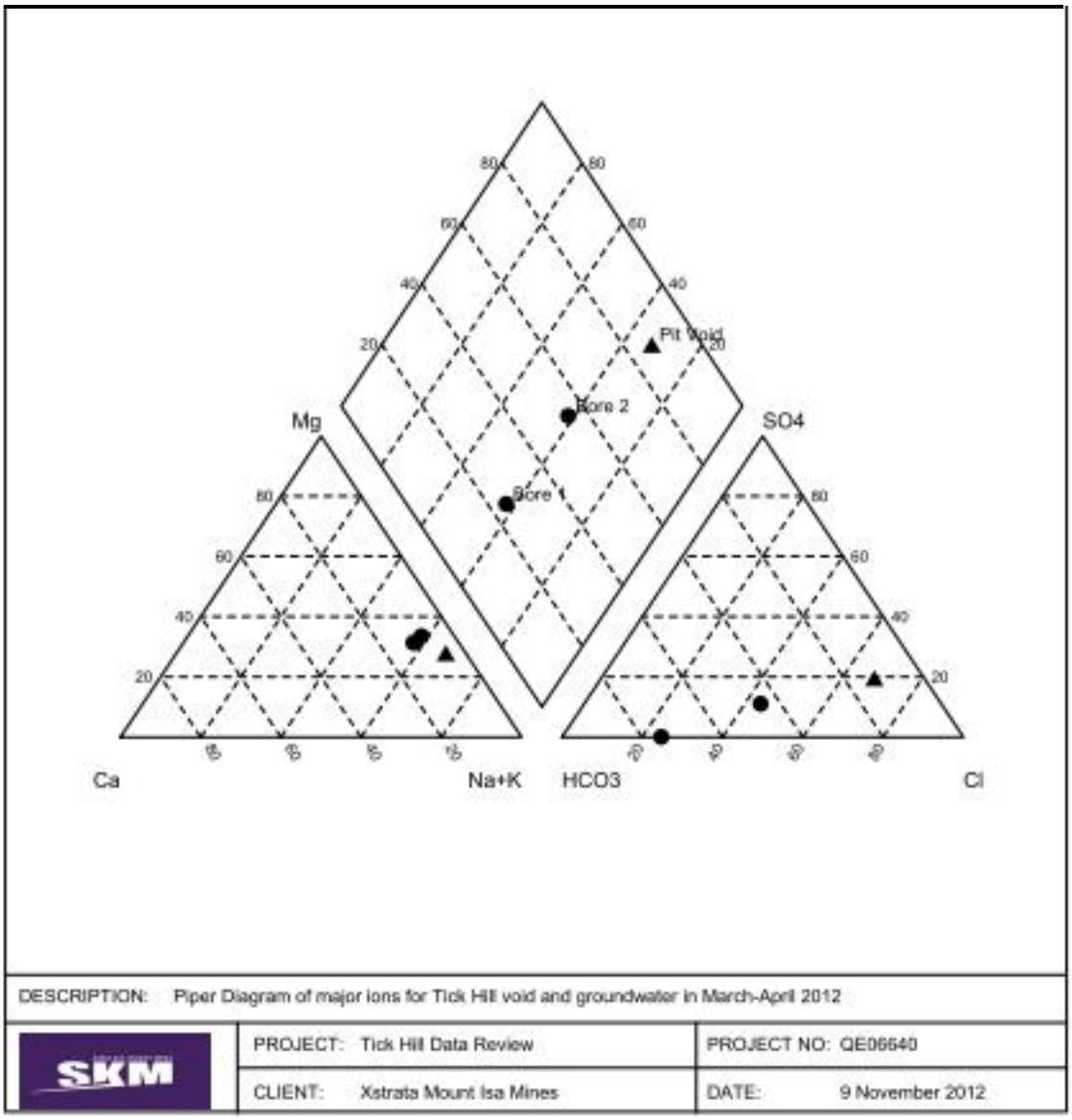

Figure 3-2: Piper Diagram of major ions for Tick Hill pit void and groundwater in March-April 2012.

3.6 Contaminated Land

Data was provided by the client to assist with this work. Although the mine site was closed prior to the introduction of the EP Act in Queensland it is considered that closure will require the current requirements and standards to be met. To assist with the review and assessment of data gaps, a checklist (**Appendix H**) was created identifying the steps required to close out a mine from a contaminated land perspective to today's standards and the respective reports expected to be required to support the closure. Approximately 20 years have passed between the decommissioning of the mine and the present. Therefore the review assessed whether documents produced relating to decommissioning of the mine prepared previously provide information which can be used to support relinquishment of the mine.

A summary of the review is as follows:

- There is insufficient documentation in regard to land contamination.
- There are no land contamination assessment reports available.
- Regulatory approval of the tailings dam capping was noted.
- Although a decommissioning report was prepared, this document is unable to be located (either by the client or the consultant).
- No rehabilitation report was available.
- No DEHP-approved management plans exist for contaminated sites not fully remediated i.e. Tailings dams.
- No statutory declaration(s) by a Suitably Qualified Person (as required under Section 381 of the EP Act) for lodgement of reports to the regulator are available.

4. Field Survey

4.1 Flora

4.1.1 Methods

The discrete point sampling method used in SKM's 1999 flora survey was replicated in this survey of the project area. The field surveys were undertaken between 10-12 October, 2012 and 19-20 March, 2013. The discrete point sampling method of measuring fractional ground cover is similar to the standardised method described in Muir et. al. (2011).

The discrete point sampling method was considered suitable as it is quantitative, time-efficient and relatively objective, ensuring repeatability between different operators (Booth et al. 2006). Three transects with 100 observations each were sampled at each of the previously surveyed sites: rock dump, tailings dam, colluvial slope (reference site) and plains (reference site) site. An additional survey site was established within the former mine infrastructure area (MIA). Ground cover (live or dead plant material, or bare ground) was recorded at one metre intervals along a 100m tape, and during the first survey (October 2012) the species frequency counted in each of ten one square metre quadrats (placed at 10m intervals along each transect). This was not replicated in the March 2013 survey as there was very little change in conditions identifiable.

Species from these quadrats were identified where sufficient plant material made identification possible.

Vegetation condition at each survey site was also assessed using DEHP's BioCondition monitoring methodology (Eyre et. al, 2011). The use of the BioCondition method was to enable comparison with DEHP's regional ecosystem (RE) benchmark documents and thus give an indication of the condition of the vegetation within the project area in relation to undisturbed vegetation.

4.1.2 Observations

4.1.2.1 Vegetation description

Vegetation within the project area consisted of a low open woodland dominated by western bloodwood (*Corymbia terminalis*) and Cloncurry box (*Eucalyptus leucophylla*), with occasional beefwood (*Grevillea striata*) and whitewood (*Atalaya hemiglauca*). On the relatively undisturbed colluvial slope (**Plate 4-1** and **Plate 4-2**) there was a shrub layer of Chisholm's wattle (*Acacia chisholmii*), sandhill wattle (*Acacia ligulata*) and native cotton (*Gossypium australe*) and ground cover was dominated by Spinifex (*Triodia* spp.). Within the rehabilitated areas (**Plate 4-3** and **Plate 4-4**) such as the tailings dams, rock dump and MIA the shrub layer was mostly absent and the ground cover was dominated by buffel grass (*Pennisetum ciliare*).

4.1.2.2 Regional ecosystems

The regional ecosystem description database (DEHP, 2012) lists remnant ecosystem (RE) descriptions and status. Vegetation observed within the project area was found to be consistent with the RE description for 1.11.3:

> "Low open-woodland of *Corymbia terminalis* usually with *Eucalyptus leucophylla* or *E. leucophloia* with *Acacia* spp. dominated shrub layer and ground layer of *Triodia* spp. and/or tussock grasses. Includes areas of *Acacia* spp. shrubland and *Triodia* spp. grassland. Occurs on metabasalts and dolerites; skeletal soils, some shallow loams."

RE 1.11.3 has a vegetation management status of 'least concern' and a biodiversity status of 'no concern at present'.

Plate 4-1: Colluvial slope October 2012

Plate 4-2: Colluvial slope March 2013

Plate 4-3: Mine infrastructure area October 2012

Plate 4-4: Mine infrastructure area March 2013

4.1.2.3 Ground cover, species richness and plant frequency data

Table 4-1: shows the averaged fractional ground cover and species richness data for the 1999 and 2012 surveys. Initial interpretation of the results indicates that the plant abundance and species richness was considerably lower in 2012 than in 1999. This may be due to a higher amount of dead plant material at the time of the 2012 flora survey. Results of the 2012 and 2013 surveys were analysed to determine if observed changes are statistically significant from 1999 results. **Appendix D** presents the averaged data for each survey location.

Due to low rainfall, site conditions during the 2012 and 2013 surveys were very similar and both were characterised by conditions typical of a dry season. As such it was not considered valid to compare the March 2013 survey data with the January 1999 (wet season) data.

A statistical comparison of August 1999 data with 2012 data was undertaken using T-tests. No significant differences were detected apart from a decrease in cover abundance at the plains (reference) location. This is not within an area disturbed by previous mining activity.

Survey locations are shown on **Figure 4-1**. Photos at each survey location and summarised field data are contained in **Appendix D**.

Table 4-1: Averaged survey results

Site		Mean plant frequency/10m^2			Mean species richness (#)			% Cover (live + dead plant material)			% Bare		
		August 1999	January 1999	October 2012	August 1999	January 1999	October 2012	August 1999	January 1999	October 2012	March 2013	August 1999	January 1999	October 2012	March 2013
Tailings dam (rehabilitated site)		69.0	638.3	25.0	3.3	11.7	2.0	69.0	40.9	76.3	76	31.0	59.1	23.3	24
Rock dump (rehabilitated site)		82.0	54.3	26.3	4.0	5.3	2	43.3	30.4	47.7	42	56.7	70.0	52.3	58
Colluvial slope (reference site)		89.3	142.0	64.3	9.3	9.0	8	58.7	50.2	63.3	54	41.3	49.8	36.7	46
Plains (reference site)		238.7	n/a	105.3	11.3	n/a	6.7	74.3	n/a	28.0	24.7	25.7	n/a	72.0	75.3
MIA		n/a	n/a	44.0	n/a	n/a	2.3	n/a	n/a	51.0	48.3	n/a	n/a	49.0	51.7

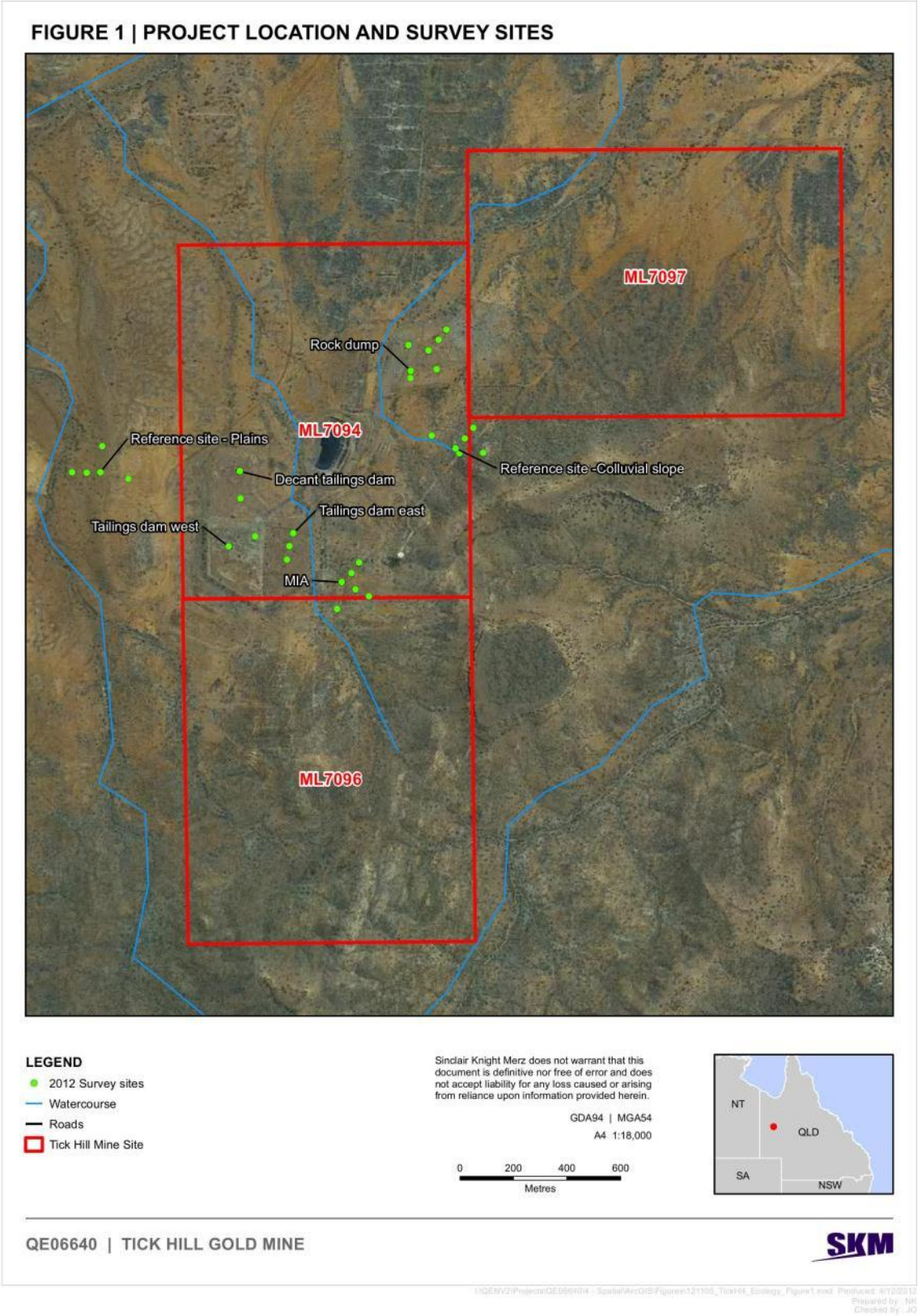

Figure 4-1: Tick Hill Flora Survey Locations

Benchmark data

DEHP publishes benchmark documents that list typical characteristics of undisturbed forms for each RE. The benchmark data draw on survey data from the Queensland Herbarium's CORVEG database and reference sites. These data are summarized to provide information specific to each regional ecosystem. In rangeland ecosystems, seasonal conditions can account for wide variation in the values obtained for some attributes assessed in BioCondition. Therefore, the benchmark data for the rangeland ecosystems is expressed as range, rather than as a single benchmark value. When using rangeland regional ecosystem benchmarks to assess vegetation condition, the lower value of the benchmark range can be used as the benchmark, or if assessing a site under good seasonal conditions then use of the average value as the benchmark (Queensland Herbarium, 2012a).

The benchmark document for RE 1.11.3 is contained in **Appendix E** and a comparison of the survey data with the benchmark attributes are shown in **Table 4-2**:.

Table 4-2: BioCondition data for RE 1.11.3 compared with survey data

Benchmark attributes for RE 1.11.3	Benchmark Data	Tailings dam	Rock dump	MIA	Colluvial slope	Plains
Recruitment of dominant canopy species (%)	100	0	100	100	0	50
Native tree species richness	0-9	3	1	1	1	2
Native shrub species richness	1-14	5	5	4	9	3
Native grass species richness	2-11	0	0	1	1	3
Native forbs and other species richness	4-20	1	2	2	1	1
Tree canopy median height (m)	3-10	7	3	7	7	8
Tree canopy cover (%)	2-29	7	0	2	0	3
Tree sub-canopy median height (m)	N/A	N/A	N/A	N/A	N/A	N/A
Tree sub-canopy cover (%)	N/A	N/A	N/A	N/A	N/A	N/A
Number of large eucalypt trees per hectare (threshold = 30cm)	no data	0	0	0	0	0
Number of large non-eucalypt trees per hectare (threshold = 20cm)	no data	0	0	0	0	0
Native shrub cover (%)	0-85	1	12	1	21.9	1
Native perennial grass cover (%)	10-91	0	0	4	55	14
Organic litter cover (%)	0	11	4	14	14	7
Coarse woody debris	0	0	0	1.5	0	2
Non-native plant cover (%)	None listed	54	53	49	0	0

4.2 Fauna

Informal observations of the habitat values at survey sites indicated that the colluvial slope site provided the most complexity of habitat, including rock crevices, dense clumps of Spinifex and a dense shrub layer. These habitat features provide suitable habitat for a range of reptiles, small birds and mammals.The rehabilitation sites (tailings dam, rock dump, MIA) were dominated by buffel grass and had fewer habitat features apart from a mosaic of dense ground cover patches.

4.3 Geotechnics

Field observations comprised a walkover of the tailings dam, decant pond, and waste rock emplacement on 11 October 2012. Conditions were windy and overcast on the day of inspection with two short (up to 5 minutes in duration), very light scattered showers between 8 am and 12 pm. The ground appeared dry. There was approximately 5 mm of rainfall during the previous night. A visual inspection was made of the rehabilitated surfaces with a particular emphasis on:

- whether there were any depressions or sink holes in re-profiled surfaces;
- whether any slumping or bulging was evident on the batters;
- whether there was any bulging at the toe; and
- whether there was any scouring on batters.

No ground investigations were performed as part of this exercise. Photographs are included in **Appendix F**.

4.3.1 Tailings dam

The tailings dam is a "turkey's nest" construction in which a perimeter embankment with a clay core retains tailings. Its height varies between approximately 6m and 10.5m and the outside batter angle is at 1V:3H. Since the time of decommissioning in 1995, the surface was capped and the surface and batters were seeded. Surface water is directed to flow towards the spillway due to the perimeter embankment being approximately 0.3m higher than the retained capped tailings.

Vegetation has covered the surface of the tailings dam and the batters. At the time of inspection, there were no visible signs of scouring, slumping or bulging of any of the batters or the toe of the embankments. There were also no signs of sink holes or slumping on the top surface.

The spillway showed no signs of erosion and the wire rock protection was intact and in good condition. Vegetation has covered the area relatively evenly, as shown in **Plate 4-5** and in the photographs in **Appendix F**.

Plate 4-5: Downstream of the spillway viewed from the spillway crest

The rehabilitated tailings dam is fulfilling the DEHP rehabilitation requirements that are summarised in **Appendix A**. It has a very low residual risk associated with instability and scouring. Based on the performance in the last 17 years, it is reasonable to expect that stability will be maintained in the future and scour will not become an issue.

Surface gully erosion to the west of the tailings dam was noted in XMIM's 2004 audit. The erosion was noted in this inspection and is shown in **Plate 4-6**. Surface runoff during heavy rainfall is the likely cause.

Plate 4-6: Surface gully erosion to the west of the tailings dam

The surface erosion poses very little risk to the tailings dam and decant pond stability. Treatment of erosion could include the periodic placement; say every 25 m, of rock check dams to reduce the water velocity. This could be performed whilst remediating scour to the western face of the decant pond (see below). Given the depth of the "gullies" (up to approximately 0.3 m deep) and the length (approximately 200 m), it is not likely to add significantly to the estimated cost of remediating the decant pond scour.

4.3.2 Decant pond

The decant pond is a "turkey's nest" construction in which a perimeter embankment with a clay core retains tailings. Its height varies between approximately 2 m and 6 m and the outside batter angle is at 1V:3H. Since the time of decommissioning in 1995, the surface was capped and the surface and batters were seeded.

Vegetation has covered the surface of the decant pond and the batters, as shown in **Plate 4-7** and the photographs in **Appendix F**. At the time of inspection, there were no visible signs of slumping or bulging of any

of the batters or the toe of the embankments. There were also no signs of sink holes or slumping on the top surface. However, there was a localised depression of approximately 1 m with a diameter of around 20 m. It is likely that this was the final profile when the decant pond was decommissioned. This location is approximately the furthest away point from the spillway. The approximate location of the depression is circled and labelled in **Plate 4-7**.

Two adjacent scour channels were observed half way along the western batter and their locations are circled in **Plate 4-7**. This was also noted in XMIM's 2004 audit. Their profile is approximately 0.5 m deep x 1 m wide x 6 m long. There were no other signs of scour or erosion.

It is recommended that the scour lines be remediated to prevent deterioration of the localised area in the long term. Two remediation alternatives could be to:

1. Allow the drainage path to continue as is and line the scoured sections with rock to prevent further scour. The rock lining would effectively turn the channels into water drop structures; or
2. Fill the scoured sections with rock and construct a low localised bund (approximately 0.3 m high and 0.4 m wide) along the western crest of the embankment in order to redirect the flow.

The first option is likely the best solution both in terms of expense and long term performance since rock could be sourced from higher "mounds" found on the top of the waste rock emplacement and the direction of the water flow will be maintained. This would present a very low residual risk. It is estimated that this work should be able to be complete for a maximum of $9,000. The second option would cost about the same amount but the residual risk would be slightly higher than the first option since there would not be certainty that the issue would not be inadvertently transferred to another location.

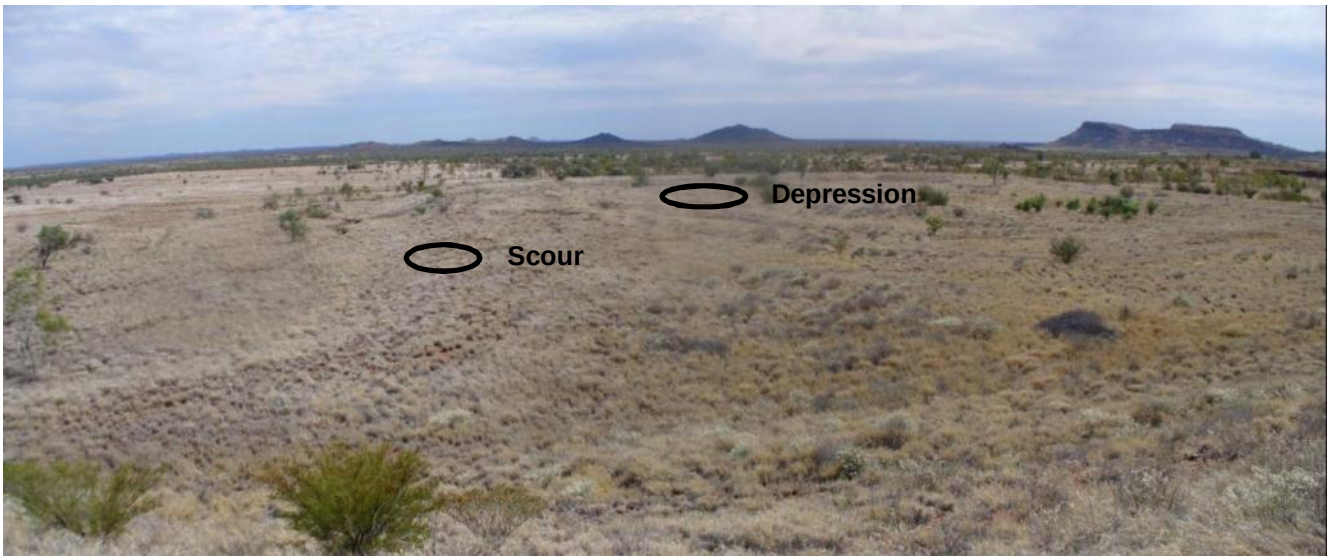

Plate 4-7: Decant pond batter scour and surface depression (viewed from NW corner of tailings dam)

4.3.3 Waste rock emplacement

The waste rock emplacement is a homogeneous construction of waste rock material. The construction sequence comprised a homogeneous waste rock perimeter embankment which was progressively filled. Its height varies between approximately 6m and 14m and the outside batter angle is at 1V:3H. Water generally flows towards a drain, which is 4m wide with 1V:3H batters, that exits at the south-west corner. Since the time of decommissioning in 1995, the surface was capped and the surface and batters were seeded. The final height was lower than the planned 20m height because the final pit floor was 80 m rather than approximately 100m below ground level as originally intended.

Vegetation has covered the surface of the waste rock emplacement and the batters, as shown in **Plate 4-8** and the photographs in **Appendix F**. At the time of inspection, there were no visible signs of slumping or bulging of

any of the batters or the toe of the embankment. There were also no signs of sink holes or slumping on the top surface.

Plate 4-8: Waste rock emplacement surface and batters (looking NW from the NE corner)

There were three eroded/scoured gullies up to 0.5 m deep approximately midway along the northern batter, as shown in **Plate 4-9**. This was identified in 2000. No other batter erosion or scouring was observed.

Plate 4-9: (a) Scouring at protrusion midway along the N batter (b) Scouring midway along N batter

It is recommended that the scour lines be remediated to prevent deterioration and destabilisation of the localised area in the long term. The successful remediation works implemented in the SE corner in 1998 should be adopted in this instance. It will involve filling the erosion/scour with rockfill and constructing a rockfill bund at the crest to ensure that water flows to the drain and not over the crest of the batter. Material could be sourced from mounds on top of the waste rock emplacement (one shown circled in **Plate 4-10**).

If there is not enough material in the mounds then excavation into the surface of the waste rock emplacement is feasible. A wide and shallow excavation (up to 0.5 m deep) leaving a surface profile with 1V:6H batters could be implemented. Seeding of the disturbed area would then be required. It is estimated that this remediation method would cost approximately $10,000 and would present a very low residual risk of further scour.

Plate 4-10: Top of waste rock emplacement looking E with drain in foreground (viewed from midway along W batter)

Approximately 10 m west of the western batter toe lies a drainage path. Some scouring of the drainage path, approximately 0.5 m deep, has occurred over time (shown in **Plate 4-11**). The resulting face is subvertical. The face on the western side of the drainage path is stable and follows the weathered rock foliation at approximately 1V:1.5H.

Past geotechnical investigations at the site indicate that the subsurface profile comprises approximately 1.7 m of highly weathered (HW) rock (schist) below which lies moderately weathered (MW) rock. The excavated HW rock remoulded to clayey gravel (GC). Test pits refused with a backhoe at the moderately weathered rock level. Given the indicated subsurface profile, further scouring at the eastern side of the drainage path is possible down to the MW rock. From visual interpretation of the geometry of the natural surface, the drainage path and the toe of the waste rock emplacement, it is estimated that MW rock is approximately up to 1 m to 1.5 m below the current level of scouring. The proximity of the toe to the drainage path can be seen in **Plate 4-12**.

It is not likely that possible further scouring of the drainage path will negatively impact the stability of the toe of the waste rock emplacement since the scouring depth would need to be approximately a further 3 m in order to do so. Therefore, no remediation is anticipated, however; regular monitoring should confirm if scouring occurs, it does not negatively impact the stability of the toe of the waste rock emplacement.

Plate 4-11: Drainage line down from the W batter with scour on the eastern side (looking S)

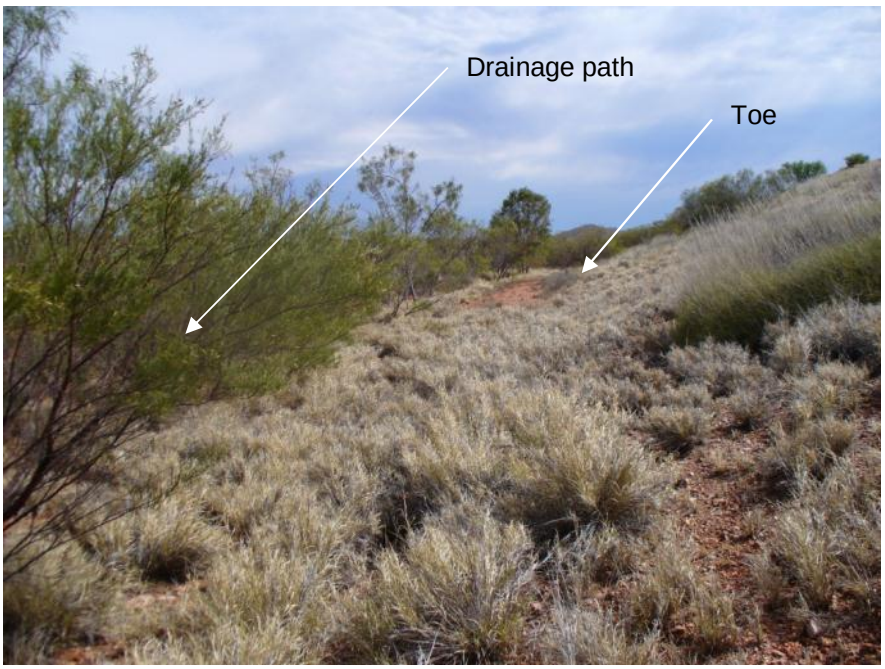

Plate 4-12: Western toe of waste rock emplacement (viewed from SW corner)

4.3.4 Borrow pits

The borrow pits were reported to be to the south-west of the mine pit and west of the tailings dam and up to 0.3 m deep. XMIM's 2004 audit noted that the borrow pits were rehabilitated. The location of the borrow pits could not be readily identified in this site inspection as the profile and vegetation type and density in these areas is similar to the surrounding undisturbed areas. Refer to **Plate 4-13** and **Plate 4-14** for the possible locations of the borrow pits to the south-west of the mine pit and west of the tailings dam.

Plate 4-13: Inferred approximate location of the borrow pit SW of the mine pit

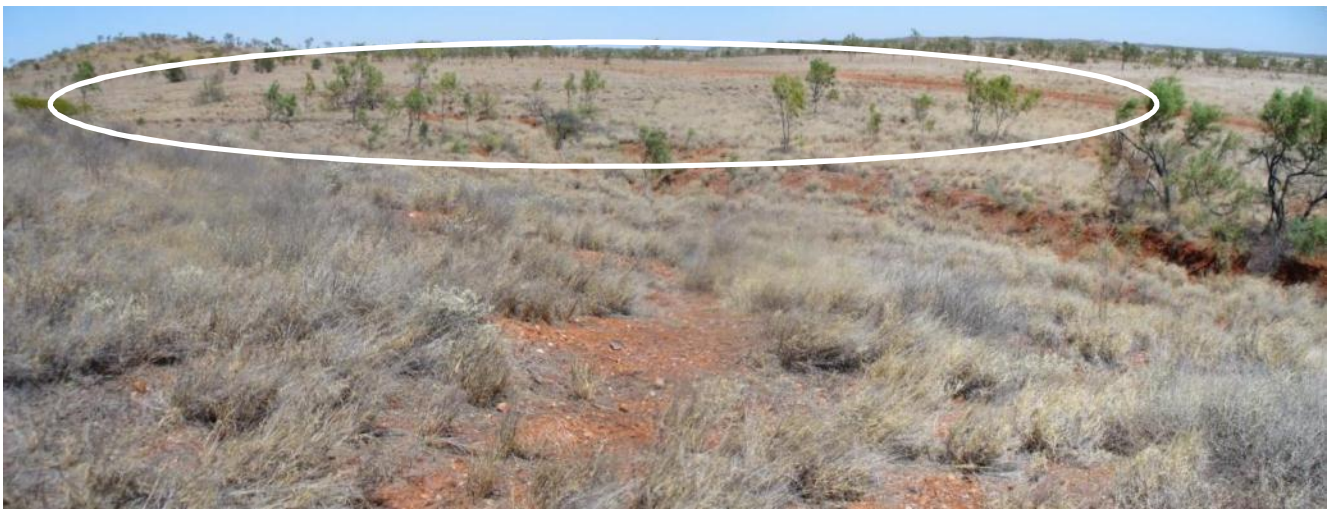

Plate 4-14: Inferred approximate location of the borrow pit W of the tailings dam

Stability of the borrow pits is not considered to be an issue.

4.4 Soils

The following notes are presented in mine domain areas and summarise observations made of the site during the October 2012 field inspection. Observations were made at the points presented in **Table 4-3**.

Table 4-3: Observation Point co-ordinates

Mine Domain	S	E
Waste Rock Dump		
1	21°38.646	139°55.776
2	21°38.612	139°55.790
3	21°38.583	139°55.807
4	21°38.580	139°55.773
5	21°38.569	139°55.784
6	21°38.547	139°55.772
7	21°38.637	139°55.669
8	21°38.639	139°55.716
Tailings Storage Facility		
1B	21°38.939	139°55.486
2B	21°38.932	139°55.410
3B	21°38.937	139°55.299
Decant Pond		
1B	21°38.847	139°55.342
2B	21°38.843	139°55.294

4.4.1 Waste Rock Dump (WRD)

4.4.1.1 Flat-Top Area

The following observations related to **Plate 4-15** and **Plate 4-16.**

- The flat-top area of the WRD is sparsely vegetated with grasses and trees.
- Soil profile is likely derived from a mixture of Kandosol and Rudosol soils. Soil horizon (A) is thin (<100 mm) and contains appreciable quantities of gravel and boulder sized particles.
- The flat-top surface has been constructed in a hummocky fashion and consists of peaks and depressions. Depressions are have accumulated fines during ponding of water, however they are generally poorly vegetated.
- The flat-top surface is not graded towards the spill-way and a number of erosion sites are evident on slopes (discussed below).
- The surface of the WRD is showing evidence of termite activity. This will likely reduce the effectiveness of the covers ability to reduce water infiltration.
- Termite activity and cover thickness indicate that the soil cover on the flat-top surface of the WRD are not sufficiently designed to reduce / restrict water infiltration. If pyrite is present in waste rock then there is likely sufficient infiltration to allow transport of oxidation products (termed acid rock drainage) from the waste rock dump.

Plate 4-15: Panoramic view of the flat-top area of the WRD

(a) (b)

(c) (d)

Plate 4-16: Flat-top surface condition (a-c) accumulations of fines in low point depressions (d) termite mounds

4.4.1.2 Slopes (1V:3H)

The following observations relate to **Plate 4-17** and **Plate 4-18.**

- The flat-top surface is not graded towards the spill-way and a number of erosion sites are evident on slopes around the perimeter of the WRD.
- Slopes are generally vegetated to greater than 50% surface cover. Most sites of erosion appear to be stable and exhibit hard-panning and concreting of particles long the edges of eroded gullies.

4.4.1.3 Spill-way

The WRD spill-way is in generally good condition with minor erosion present (**Plate 4-19**).

4.4.1.4 Other

There is an ephemeral creek (**Plate 4-18**) running adjacent to the WRD along one side. Visual inspection did not indicate undercutting of the WRD toe.

(a) (b) (c)

Plate 4-17: Gully erosion formed on outer slopes of the WRD

Plate 4-18: Ephemeral Creek adjacent to WRD

Plate 4-19: Spillway

4.4.2 Tailings Storage facility (TSF)

The following observations related to **Plate 4-20**:

- The flat-top area of the TSF is sparsely vegetated with grasses and trees.

- Soil profile is likely derived from a mixture of Kandosol and Rudosol soils. Soil horizon (A) is thin (<100 mm) and contains appreciable quantities of gravel and boulder sized particles.
- Cover thickness indicates that the soil cover on the flat-top surface of the TSF may not be sufficiently designed to reduce / restrict water infiltration. If pyrite is present in tailings then there is likely sufficient infiltration to allow transport of oxidation products (termed acid rock drainage) from the TSF.
- Outer batter slopes of the TSF have been regraded to low slope angles (approx 1V:6H), with little evidence of erosion. Where erosion was noted in was classified as minor gullying and surface sheet erosion.

(a) (b)

(c)

Plate 4-20: Tailings Storage facility (a-b) Flat-top surface (c) Batter slopes

4.4.3 TSF Spillway and Sediment Dam

The following observations related to **Plate 4-21**.

- The TSF Spillway is an engineered structure designed as gabion baskets. There is no visual evidence of erosion, or deterioration of the structure.
- The decant pond at the base of the spillway structure did not show significant signs of erosion. Erosion is present in the batter slopes of the decant pond.

(a) (b)

Plate 4-21: Spillway

4.4.4 Mine Industrial Area (MIA)

The mine industrial area is clear of debris. Vegetation establishment in this area appears appreciably lower then surrounding areas and may warrant further investigation.

4.5 Groundwater

A site visit was conducted by SKM staff on 11th October 2012 in which the presence of Bore 1 and Bore 2 was confirmed. Groundwater levels were not measured and no groundwater samples were collected. No other bores were identified on site or in the vicinity of the site.

4.6 Contaminated Land

Contaminated Land specialised staff were not present during the October 2012 site visit due to the non-invasive intent of the visit. Photographs and anecdotal information was provided by those SKM personnel involved in the site visit.

5. Discussion

5.1 Flora

5.1.1 Ground cover

Reduction in ground cover between 1999 and 2012 is significant at the plains (reference site), however no significant changes were detected at the other survey locations.

Ground cover percentage is considered to be the most important character to monitor, as the aim of the rehabilitation is to return the land to its previous use as grazing land and maintain soil stability. Monitoring ground cover gives an indication of soil erosion hazard, biodiversity potential and grazing productivity.

The percentage of bare ground appears to have no significant change between the 1999 and 2012 surveys, indicating the amount of plant material (live plus dead) has remained reasonably constant. However it should be noted that the sample size at each survey location (3) is very small and as such the confidence in the result is not high.

Visual observation of the previously disturbed mine areas indicates that the current ground cover is self-sustaining and cover levels are sufficient to prevent soil erosion.

5.1.2 BioCondition benchmark

In comparing the data collected from the project area and the benchmark data for RE1.11.3, the following points were notable:

- Native grass and other ground cover species richness was consistently lower than the benchmark at all survey locations, including the reference sites. This may have been factor of the very dry conditions resulting in a general paucity of fertile material making differentiation and detection of species difficult.
- Tree canopy cover was below the benchmark at the rock dump, and surprisingly also on the colluvial slope, as this site appeared to have been subject to very little disturbance.
- Organic litter cover was higher than the benchmark at all sites, presumably due to the abundance of dead buffel grass adding to the litter layer.

Apart from these divergences, all other indicators measured using the BioCondition methodology were within the ranges specified in the benchmark document (Queensland Herbarium, 2012a).

5.1.3 Rehabilitation performance

DEHP provides rehabilitation objectives, indicators and completion criteria in *Guideline 18: Rehabilitation requirements for mining projects*. This report is relevant to two of the suggested objectives. These are discussed in **Table 5-1**. The objectives and completion criteria have been modified to suit the intended return of the project area to grazing land.

Table 5-1: Rehabilitation objectives, indicators and completion criteria

Objective	Indicators	Completion criteria	Discussion	Compliance
Vegetation cover to minimise erosion	Vegetation type and density	Evidence that the vegetation type and density are of species suited to the spoil/waste composition, slope, aspect, climate and other factors, and that the measured erosion rates meet the limits set (only relevant to stability where root systems are a major control of erosion).	Vegetation in the project area has a higher percentage of exotic species than at the reference sites, however the dominant species, buffel grass, is known to be well suited to the soil types, climates and other factors. Very little erosion was observed within the project area, indicating the vegetation density is sufficient to minimise erosion.	Yes
	Foliage cover	Evidence that the percent cover meets the set values based on the regional assessment of cover requirements (Note: Values in excess of 70% are typically needed to protect surface soils from rain-induced erosion. In arid areas achievable values are likely to be much lower (perhaps less than 50%) and in high rainfall areas the values may be higher).	Percent cover ranges from 14% to 55% (predominately made up of native and exotic grasses). The benchmark for RE 1.11.3 lists native perennial grass cover as 10-91%. As such, the recorded range falls within an expected range for the vegetation community.	Yes
	Leaf litter, humus	Evidence that nutrient cycling is occurring and the presence of leaf litter is assisting in limiting erosion of the soil/spoil surface.	Organic litter cover recorded ranges from 4% to 14% which is well above the benchmark of zero (**Table 4-2**).	Yes
Establish specified self-sustaining natural vegetation and/or grazing land.	Presence of key species	Certification that key species are present	Species listed in the RE description are *Corymbia terminalis, Eucalyptus leucophylla, E. leucophloia, Acacia* spp. and *Triodia* spp. Species recorded during the field survey included *Corymbia terminalis*, *Eucalyptus leucophylla*, *Acacia chisholmii*, *Acacia ligulata* and *Triodia* spp.	Yes
	Species type and diversity suitable for grazing.	Certification that species mix is suitable for grazing.	The groundcover within the project area consists of buffel grass and some native perennial grasses. This is a suitable mix for grazing.	Yes
	Abundance of weeds	Certification that weed management successful	No declared weeds were recorded in the project area.	Yes

5.2 Fauna

Dedicated fauna surveys were not conducted for the purposes of this report. This is considered a reasonable approach in this situation because:

- comparing results from a current fauna survey to the 1999 results would not be statistically strong as the previous survey was conducted over only five nights. At least ten days/nights are needed to record the full suite of species present; and
- it is unlikely that the previous survey conditions could be replicated with respect to weather, soil moisture, food availability and overall land condition.

5.3 Geotechnical

5.3.1 Stability analyses

A long term stability analyses using the limit equilibrium stability with Slope/W (Version 7.18) was performed on the tailings dam, decant pond and waste rock emplacement.

5.3.1.1 Geotechnical model

Kinhill Cameron McNamara's Impact Assessment Study Report (1991) describes the subsurface profile as approximately 1.7 m of residual soil, derived from weathered schist, overlying weathered schist bedrock. The residual soil was reported to remould to the consistency of clayey gravel.

The Geotechnical Report attached in Appendix C of the Impact Assessment Study Report lists the material parameters as (KCM, 1991):

Rockfill outer zones	c' = 0 kPa, ϕ' = 37°
Clay core	c' = 20 kPa, ϕ = 34°
Foundation	c' = 0 kPa, ϕ = 40°
Dry density of tailings	13 kN/m^3

The above material parameters were adopted in the stability analyses.

5.3.1.2 Stability analysis assumptions

For the tailings dam and decant pond, it was assumed that the clay core was constructed as per the design with 1V:1.5H batters. Additionally, the maximum embankment heights used were as reported in the Final Plan of Operations (Dames & Moore, 1999) as 10.5 m for the tailings dam, 6 m for the decant pond and 14 m for the waste rock emplacement. Visual site observations and the contour profile in the Final Plan of Operations (Dames & Moore, 1999) confirm the heights. It was assumed that the tailings were saturated to one third of the embankment height. Material parameter assumptions for the coupled seepage and stability analyses included:

Rockfill outer zones	γ = 18 kN/m^3, k_{sat} = 1 x 10^{-3} m/s
Clay core	γ = 18 kN/m^3, k_{sat} = 1 x 10^{-8} m/s
Foundation	γ = 18 kN/m^3, k_{sat} = 1 x 10^{-7} m/s

The density values are conservative for the purposes of stability analysis.

For the earthquake analysis, the maximum design earthquake (MDE) was using ANCOLD guidelines and AS 1170.4 *Earthquake actions in Australia* were used with the following design parameters:

- Probability factor (k_p) = 1.3 (1/1000 annual probability of exceedence) (AS 1170.4 Table 3.1)

- Hazard factor (Z) = 0.035 (AS 1170.4 Figure 3.2(F))
- Site sub-soil class = C_e - shallow soil (AS 1170.1 Clause 4.1.1)
- MDE (k_pZ) = 0.0455 g

5.3.1.3 Stability results

A summary of the stability analysis results for the long term and earthquake conditions are as shown in **Table Table 5-2**: Stability analyses results for the tailings dam, decant pond and waste rock emplacement with the graphic representations shown in **Appendix G**.

Table 5-2: Stability analyses results for the tailings dam, decant pond and waste rock emplacement

Earth structure	**Factor of safety**			
	Long term	**Long term cutoff**	**Earthquake**	**Earthquake cutoff[1]**
Tailings dam	1.80	1.50	1.57	1.0
Decant pond	1.77	1.50	1.53	1.0
Waste rock emplacement	2.40	1.50	2.09	1.0

Note: 1. Cutoff from USACE (1970)

The results show that the tailings dam, decant pond and waste rock emplacement should be stable in the long term and under an earthquake with 1/1000 annual probability of exceedence.

5.3.1.4 DEHP compliance criteria

The tailings dam and decant pond are referable dams under the Water Resources Act 1989. The following conditions apply (DEHP, 2001):

1. The dams must be constructed as Turkeys Nest dams since they are greater than 3000m^3;
2. Seepage is to be minimised;
3. The dam should be operated to maintain a minimum freeboard of 1m;
4. The spillway should be capable of passing the design flood (1 in 100 year event); and
5. The batters shall be no steeper than 1V:2.5H (upstream batter) and 1V:2H (downstream batter) for clayey gravel (GC).

The embankments were constructed as Turkeys Nest dams with GC material with batter angles of 1V:3H. Seepage was minimised due to their clay cores with cut-off trenches down to MW rock. The tailings dam and decant pond have been decommissioned and rehabilitated (capped). All surface water on the tailings dam channels to the spillway due to the surface grade and that the perimeter embankments are approximately 0.3m to 0.5m higher than the level dam surface. The level of rehabilitation complies with the Decommissioning Criteria. In summary, the tailings dam, decant pond and waste rock emplacement are expected to be stable over the long term and comply with the decommissioning/rehabilitation criteria of the DEHP's Code of environmental compliance for Mining Lease Projects January 2001 - Version 0.

5.4 Soils

There remains some residual risk that should be considered as XMIM progresses towards relinquishment:

1. Capillary rise of sulfate salts into topsoil. If sulfate / sufide is present in waste rock and tailings then there is potential for capillary rise to bring these salts to the surface of the soil profile. Sulfate concentration near surface will result in vegetation die back.
2. Erosion will continue to degrade the rehabilitated soil profile and may result in reduced vegetation establishment.
3. The presence of acid rock drainage may require further earthwork to contain seepage and to construct covers capable of restricting infiltration into both the WRD and TSF.

6. Conclusions and Recommendations

6.1 Terrestrial Flora

Results indicate the rehabilitation in terms of establishing a self-sustaining vegetation cover suitable for soil stabilisation and grazing has been successful.

Management measures should be targeted to maintain the current conditions, including:

- limit vehicle access during times when soil is vulnerable to disturbance, i.e. wet season conditions;
- limit vehicle movement to established tracks;
- maintain fence lines to exclude stock, or if stock are introduced, adjust stocking rates to suit conditions; and
- avoid disturbance to drainage line vegetation.

6.2 Geotechnical

Visual inspection and preliminary limit equilibrium stability analyses of the tailings dam, decant pond, and waste rock emplacements indicates that the design and construction is adequate to maintain long term stability.

The batters, toes, spillway and surface of the tailings dam have performed well in the last 17 years. There appears to be adequate vegetation cover, water drains to the spillway, and the batters and toes show no signs of bulging or instability.

Scouring was observed in the western batter of the decant pond, the northern face of the waste rock emplacement, in the drainage channel approximately 10m to the west of the waste rock emplacement, and surface gully erosion west of the tailings dam. Whilst it currently does not impact on the global stability, localised stability issues are likely to occur in the long term if the scouring is not addressed.

It is recommended that the scouring on the western face of the decant pond be rock-lined to prevent further scouring. This will also maintain the existing water drainage path. Whilst lining the scouring at the decant pond, small rock check dams should be placed along the shallow gully erosion path to the west of the tailings dam in order to significantly reduce the risk of further scouring. The mounds of rock fill on top of the waste rock emplacement could be used as a source of rock. It would be prudent to seed the exposed areas following rock placement. It is estimated this work would cost approximately $9,000 and significantly reduce the residual risk of further scouring. Following the remedial works, the decant pond batter stability is not expected to be an issue.

It is recommended that the scouring in the northern batter of the waste rock emplacement be filled with rock fill and a bund placed at the crest to ensure surface water flows to the drain which exits at the SW corner. The mounds of rock fill on top of the waste rock emplacement could be used as a source of rock. Seeding of the disturbed ground should also occur. It is estimated that this work would cost approximately $10,000 and significantly reduce the residual risk of further scouring. After performing this remedial work, batter stability is not expected to be an issue.

The scouring of the drainage channel approximately 10m to the west of the toe of the waste rock emplacement does not affect its stability. The extent of further possible scouring is not expected to present a stability issue to the western batter.

6.3 Soils

It is recommended that rehabilitated sites are sampled and compared to an undisturbed analogue to determine gradients for sulfate / sulfide and fertility within the rehabilitated soil profile. This can be compared to existing government guidelines for GQAL, SCL and Land Suitability to establish the health of the rehabilitated landscape.

Erosion monitoring should be conducted post-wet season for a minimum of two seasons to ensure that the site does not have active erosion occurring.

It is recommended that the site develops and monitors groundwater quality to determine the potential for acid rock drainage.

It is also recommended that an investigation of the former MIA area be completed to determine the likely cause of poor vegetation establishment in this domain.

6.4 Groundwater

Based on the limited data available for the Tick Hill site, SKM has developed a broad range of conclusions on the THGM groundwater knowledge:

- Due to the impermeable nature of the host rock, groundwater flow is likely to be structurally controlled with flow occurring along joints and fractures.
- Depth to groundwater is at least 20 m below ground surface, therefore it is unlikely that groundwater dependant terrestrial vegetation would exist on site.
- Intra-annual variations may occur in groundwater levels, but it is difficult to attribute a seasonal cause to this observation.
- There are no data to define the baseline hydrogeological conditions existing prior to mining, and therefore the pre mining environmental values of the groundwater, however, it is likely that groundwater was no more saline than it is now, suggesting that the beneficial use (stock water) has been maintained.
- Due to the relatively higher EC of the pit void in early 2012 (4,720 µS/cm), compared to the EC of groundwater measured at Bore 1 (1,699 µS/cm) and Bore 2 (2,808 µS/cm), the pit void is likely to be acting as an evaporative sink, with groundwater flowing into the pit void and undergoing evaporative concentration within the pit void.
- Data quality of some data is questionable, particularly in regard to groundwater level data at Bore 2 in April 1997, and pH data for Bore 1 and Bore 2 in July 2004
- The limited groundwater samples collected from Bore 1 and Bore 2 are below the ANZECC 2000 guidelines for stock water for all major ions and metals, where guidelines have been established for these analytes.
- The major ionic composition of groundwater sampled in April 2012 is distinct from the pit void water sampled in March 2012.
- The spatial distribution and temporal variation of groundwater levels are unknown.
- The spatial distribution and temporal variation of groundwater quality are unknown at a regional level.
- The current groundwater monitoring network and data collected are inadequate to define water quality objectives.
- The current groundwater monitoring network and data collected are inadequate to determine potential impacts of mining on the local to regional-scale groundwater system.
- No post mining water balance model has been developed.

The likely environmental receptor at the THGM site is watering of stock from pumped groundwater. As the pit void is likely to be acting as an evaporative sink, groundwater flow would be towards the pit void, with no impact on the surrounding groundwater quality from the pit void. Some impact to groundwater level may have occurred as a result of induced groundwater flow towards the pit.

For XMIM to assess the potential impacts to groundwater quality for stock water at THGM so as to fulfil the regulatory requirements under the EP Act and enable the THGM site to be formally closed and relinquished, SKM recommends the following:

- Survey the existing bores and pit lake level (install permanent gauge board) to common height datum.
- Expand the current monitoring bore network to include at least 3 new bores, with the network to be representative of all aquifers and structural features present across the site. All bores must be drilled and constructed by a licensed water bore driller in accordance with the Minimum Construction Requirements for Water Bores in Australia, 3rd Edition (National Uniform Drillers Licensing Committee, 2012) and overseen by a qualified hydrogeologist.
- Survey the ground elevation and top of bore casing at the location of each new monitoring bore.
- Conduct a bore census of surrounding properties within 3 km of the THGM leases, to search for any registered and unregistered bores, and determine their status and groundwater use.
- Monitor groundwater levels for a period of at least 12 months, by installing an electronic data logger in each bore, to assist in defining the spatial distribution and seasonal variation of groundwater levels.
- Take quarterly groundwater samples from each bore, and quarterly pit void samples, for a period of at least 12 months, to define the spatial distribution and seasonal variation of groundwater and pit void water quality. Adequate water sampling, preservation and shipping protocols should be followed, eg. Monitoring and Sampling Manual 2009 (Queensland Department of Environment and Resource Management, 2009).
- Review collected groundwater quality data to establish lower and upper background limits for relevant parameters and refine existing water quality objectives.
- Determine the aquifer hydraulic conductivity by conducting falling or rising head tests in bores.
- Collate and interpret all data to develop a conceptual hydrogeological model of the site, which should include: geological and hydrostratigraphic framework, recharge-discharge processes, and any interactions with natural water courses (if they exist) and the pit void.
- Based on the conceptual model, prepare a site water and salt balance using an analytical spreadsheet model, to determine if the pit void is acting as an evaporative sink.

To gain an understanding of the THGM site with sufficient information for completion of a PRR, it is recommended that XMIM proceed as shown in **Figure 6-1**.

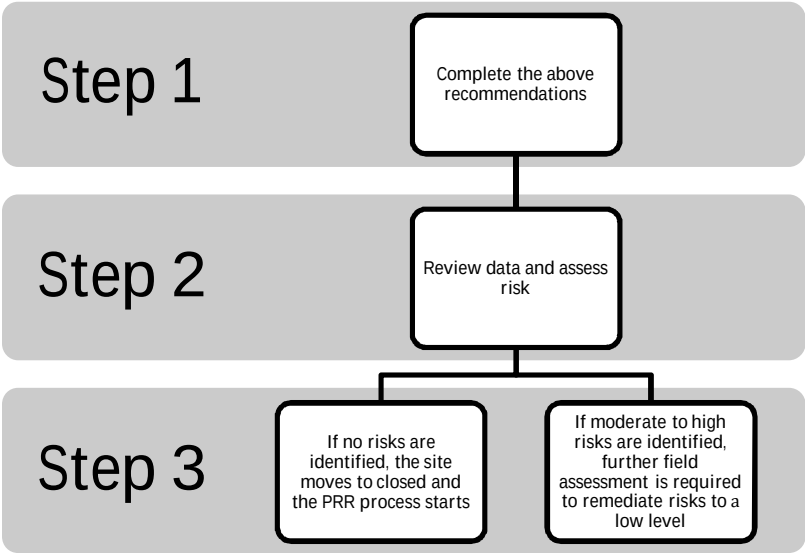

Figure 6-1: Groundwater Steps to Initiate PRR Process

Step 3 in **Figure 6-1** should be approached from a low cost and conservative assessment perspective, only becoming more complex if risks are identified as being unacceptable.

6.5 Contaminated Land

Insufficient information is available to assess the current contaminated land status of the site. Insufficient investigation and documentation is available to obtain sign off on remediation by the DEHP. Insufficient supporting information on supporting studies including hydrology and hydrogeology is available to assess whether unacceptable environmental impacts regarding land contamination, are occurring (or expected to occur) from the site in its present condition.

An investigation of the site is required to produce verifiable data to determine whether the site in its present condition satisfies the DEHP goals for mine closure, (i.e. safe to humans and wildlife, non-polluting, stable and able to sustain an agreed post-mining land use).

A contaminated land assessment (Preliminary Site Investigation) should be undertaken as defined in the Guideline for Contaminated Land Professionals (DEHP, 2012). The assessment should consider further details on site history i.e. source and location of potentially contaminating activities (e.g. former industrial areas) and an assessment of soil, groundwater and surface water across the site (targeting potentially contaminating activities).

Any contaminated land assessment undertaken should be integrated with surface water, groundwater, pit void and tailings capping studies. Environmental or Human Health Risk Assessment may be required dependent on the contaminant source, pathways and receptors identified. Risk assessment will require integration of the contaminated land assessment findings with information including:

- Groundwater: Assess this contaminant migration pathway/receptor in terms of aquifer permeability (i.e. contaminant fluxes), groundwater flow direction (i.e. receptor), and connection between the groundwater and surface water receptor.
- Surface Water: Assess this receptor in terms of surface runoff and migration of groundwater from the site.
- Water Balance: Assess the potential for groundwater flow direction to change over time (i.e. potential for water flowing to the pit void to invert based on water levels within the pit) and percentage of water reporting as runoff (i.e. potential for exposure of underlying contaminated soils) and deep drainage) i.e. potential for leakage through the base of tailings dams.

- Landform Stability: Assess the potential for gross failure of containment structure i.e. dam walls and therefore the potential for contaminated soil to be exposed at the surface. Assess the potential for erosion to expose underlying contaminated soils. Some of these stability issues have been discussed in **Sections 3.3** and **4.3**.
- Capping Assessment: Assess the potential for contamination within tailings storage facilities to be exposed through capillary rise of salts to the surface of the rehabilitated dams or from secondary processes associated with salt accumulation in the capping (or lack of water in the capping) i.e. loss of surface vegetation resulting in erosion of the cap.
- Acid Rock Drainage: assess the potential for ARD to occur and therefor the potential for mobilisation of contaminants in ARD leachate.

Based on the outcome of these studies, any remedial activities required to manage contamination should be implemented. Areas where contamination is to remain in a managed non-polluting state (i.e. tailings dams, pit void) should be managed.

6.5.1 Additional Auditor Role

Although no requirement currently exists for the appointment of an Auditor as defined in the Greentape Reduction and Other Legislation Amendment Act (2012), consideration should be given to the voluntary appointment of an Auditor (who is separate to the site investigator) due to:

- Site Complexity: Given the number of potentially contaminating activities previously operating on the site, potential for secondary processes to be contributing to contamination and the complexity of soil-groundwater-pit void-surface water interaction.
- Site Age: As the site has been previously levelled and information on the site (i.e. location of contaminating activities) may be difficult to obtain.
- Introduction of Greentape Reduction and other Legislation Act: Although no definition has currently been provided by EHP on which sites will require an Auditor. If an Auditor is required now or identified later, the Auditor may require additional assessment works to be undertaken which may delay report submission and sign off. The early voluntary appointment of an Auditor would address this matter.
- Changes to EHP: The level of technical knowledge (and therefore guidance) provided by EHP is expected to be limited following recent losses of technical personnel at EHP. In lieu of this technical guidance, EHP may mandate the use of an Auditor or may result in EHP requiring much more conservative remedial targets than may identified by the Consultant and agreed by the Auditor.
- Future Site Use: As the future site use is not certain (i.e. use for a further mining activity, grazing), the remediation targets may be different.
- Timing: Historically, the timing for review of remediation of complex sites and approval of subsequent management plans by EHP has been lengthy.

6.5.2 PRR

Following any remedial works and implementation of management plans, regular PRR should be completed in accordance with the DEHP approved Site Management Plan(s).

7. Environmental Audit Results

The environmental audit undertaken by SKM has been documented in the standalone Tick Hill Gold Project – Audit Statement report.

In summary, XMIM performed well in demonstrating conformance with the administrative requirements of the environmental authority and Code, and in avoiding impacts to air quality and noise amenity. Minor issues were noted in relation to erosion and sediment control from the perspective of localised impacts occurring, however conformance was observed due to the fact that sedimentation of watercourses has not occurred. Notwithstanding this, SKM has included recommendations in relation to erosion and sediment control to assist XMIM in avoiding the long term deterioration of selected areas.

XMIMs conformance with the remaining eight conditions was not able to be determined with an acceptable degree of certainty, due to the information gaps identified during the desktop and site reviews. SKM found that there is a general lack of historical information on the rehabilitation activities that were carried out at the site including waste disposal and acid rock drainage management. Furthermore, the historical monitoring data does not allow accurate conclusions to be made about the hydrogeological aspects of the site. These combined factors have resulted in an overall lack of scientific certainty when it comes to identifying contaminants and their pathways to receptors, meaning that the environmental risk of the site is not well understood.

As stated in the Tick Hill Gold Project – Interim Rehabilitation Report, SKM recommends that XMIM conduct further investigations at the site with the aim of developing a better understanding of the environmental risks presented by the site. This would entail:

- Developing an understanding of the source of contaminants on site. This would include conducting a contaminated land assessment (preliminary site investigation) as defined in the Guidance for Contaminated Land Professionals (DEHP, 2012).
- Developing an understanding of the likely contaminant pathways and hydrogeological aspects of the site. This would include developing a conceptual hydrogeological model of the site built from robust groundwater and surface water monitoring data.
- Addressing instances of localised erosion to safeguard the long term viability of the rehabilitation work.

The specific recommendations are described in the standalone Tick Hill Rehabilitation Audit Statement (refer to Audit Protocol [Appendix A] for detail).

8. References

8.1 Terrestrial Flora

Blake, D.H., 1987, Mt Isa Inlier and Environs 1:500,000, Bureau of Mineral Resources.

Booth, DT, Cox SE, Meikle, TW & Fitzgerald, C 2006, 'The accuracy of ground cover measurements', Rangeland Ecology & Management, vol. 59, pp. 179–88.

Eyre, T.J., Kelly, A.L, Neldner, V.J., Wilson, B.A., Ferguson, D.J., Laidlaw, M.J. and Franks, A.J. (2011). BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual. Version 2.1. Department of Environment and Resource Management (DERM), Biodiversity and Ecosystem Sciences, Brisbane.

Muir, J, Schmidt, M, Tindall, D, Trevithick, R, Scarth, P & Stewart, JB 2011, Field measurement of fractional ground cover: a technical handbook supporting ground cover monitoring for Australia, prepared by the Queensland Department of Environment and Resource Management for the Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra, November.

Queensland Herbarium (2012a) BioCondition benchmarks of Regional Ecosystems, Northwest Highlands (March, 2013) (Department of Environment and Heritage Protection: Brisbane).

Queensland Herbarium (2012) Regional Ecosystem Description Database (REDD). Version 6.0b updated, (August 2012) (DSITIA: Brisbane).

8.2 Geotechnical

Dames & Moore (1999). Tick Hill Gold Project Final Plan of Operations, Dames & Moore, Brisbane.

DEHP (2001). Code of environmental compliance for Mining Lease Projects January 2001 - Version 0, Queensland Department of Environment and Heritage Protection, Brisbane.

KCM (1991). Tick Hill Gold Project Impact Assessment Study Report, Kinhill Cameron McNamara, Brisbane.

USACE (1970). Stability of Earth and Rock-Fill Dams, US Army Corps of Engineers, Washington, DC, USA.

8.3 Soils

Department of Primary Industries, 1990. Guidelines for agricultural land evaluation in Queensland. (Queensland Government, Department of Primary Industries).

Department of Mines and Energy, 1995. Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques [online] Available from: <http://www.epa.qld.gov.au/register/p01206ae.pdf> [Accessed: 21 February 2012].

Department of Primary Industries, Department of Housing Local Government and Planning, 1993. Planning Guidelines: The Identification of Good Quality Agricultural Land, SE55-1 [online]. Available from: <http://dlgp.qld.gov.au/resources/policy/plng-guide-identif-ag-land.pdf> [Accessed: 21 February 2012].

Department of Environment and Resource Management, 2011. Protecting Queensland's strategic cropping land: A policy framework [online] Available from <http://www.derm.qld.gov.au/land/planning/pdf/strategic-cropping/strategic-cropping-policy-complete.pdf> [Accessed: 21 February 2012].

McKenzie N, Jacquier D, Isbell R, and Brown K, 2004. Australian soils and landscapes: An illustrated compendium. CSIRO Publishing: Collingwood.

Department of Environment and Resource Management, 2011. Protecting Queensland's strategic cropping land: A policy framework [online] Available from <http://www.derm.qld.gov.au/land/planning/pdf/strategic-cropping/strategic-cropping-policy-complete.pdf> [Accessed: 1 November 2012].

8.4 Contaminated Lands

Bureau of Meteorology (2012). Groundwater Dependent Ecosystems Atlas, available from <http://www.bom.gov.au/water/groundwater/gde/index.shtml> [Accessed: 19 November 2012].

DEHP. 2012. Guideline for contaminated land professionals. Brisbane: Department of Environment and Heritage Protection, Queensland Government.

Appendix A. DEHP Guideline – Mining. Rehabilitation Requirements for Mining Projects (EM1122)

Guideline

Mining

Rehabilitation requirements for mining projects

This guideline provides information on both progressive and final rehabilitation requirements for mining projects operating in Queensland under the Environmental Protection Act 1994.

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QUEENSLAND GOVERNMENT

1 Introduction

1.1 Purpose

This guideline is to assist mining companies to propose acceptable rehabilitation outcomes and strategies during the planning stages of a mine or when changes to the proposed rehabilitation outcomes and strategies become necessary during the operational stages of a mine.

The guideline also explains how the administering authority[1] will assess whether progressive or final rehabilitation for either new or established mining projects is satisfactory. Assessment will be based on the accepted rehabilitation objectives for each domain within the mine site and monitoring of indicators to demonstrate that the completion criteria have been met and are likely to be sustained for an acceptable period. Establishment of early contact with the administering authority through pre-design conferencing is recommended to ensure there are “no surprises” in the later stages of the assessment process. Similar contact during any proposal to change rehabilitation outcomes or to obtain progressive certification or final sign-off is also recommended.

1.2 Scope

This guideline applies to level 1 (larger) mining projects and to both progressive and final rehabilitation.

The guideline does not apply to level 2 mining projects, which have simplified rehabilitation requirements listed in relevant codes of environmental compliance. This guideline is not to be used to interpret the standard environmental conditions in those codes.

1.3 Structure of the guideline

Section 1 provides an introduction to the guideline. Section 2 describes the policy and legislative frameworks that provide direction for mine rehabilitation outcomes. Section 3 lists the goals that the Government expects rehabilitation to achieve. Sections 4, 5 and 6 describe how a mining company should develop site-specific rehabilitation strategies comprising:

- rehabilitation objectives for each domain in a mining project;
- indicators that can measure progress towards the objectives;
- completion criteria that are consistent with the rehabilitation goals set by Government and with the rehabilitation objectives established in the environmental authority for each domain in a mining project.

Section 7 describes the assessment process that will provide transparent and consistent decisions for progressive and final rehabilitation based on the rehabilitation goals, objectives, indicators and completion criteria for the mining project. Section 8 describes how existing mining projects with inadequate rehabilitation objectives, indicators or completion criteria will be assessed.

1.4 Other relevant guidelines

The following guidelines should also be consulted:

- Deciding the Level of Impact Assessment for the Mining Industry (EM579[2])
- Final and Progressive Rehabilitation Reports and Audit Statements for Level 1 Mining Lease Projects (EM610)
- Calculating Financial Assurance for Mining Projects (EM585).

[1] The Department of Environment and Heritage Protection is the administering authority under the *Environmental Protection Act 1994*.

[2] This is the publication number, which can be used as a search term to find the latest version of the publication at <www.ehp.qld.gov.au>.

2 Policy and legislative framework

2.1 Policy framework

Unlike most other industrial activities, each mining operation is expected to cease in the foreseeable future. This generally occurs when its finite resources are depleted. However, like other industries, a mining operation may also cease when production costs exceed returns or as a result of an unrelated management decision. The closure of a mine provides opportunities for land disturbed by mining to be rehabilitated to one or more sustainable post-mining land uses. Technological advances and changing market conditions in recent decades have facilitated the development of many new mines and increased production at existing mines. There have also been changes in community expectations about the management of the impacts of mining. These factors have focused the attention of regulatory authorities on mine rehabilitation.

National Strategy for Ecologically Sustainable Development *(COA 1992)* (NSESD) promotes economic growth that safeguards the welfare of future generations, provides equity within and between generations, protects biological diversity and maintains essential ecological processes and life support systems. The ecologically sustainable development (ESD) framework includes the "polluter pays" principle, i.e. those who generate pollution and waste should bear the cost of containment, avoidance or abatement. To ensure sound environmental practices throughout the industry, NSESD also sets several objectives for mining including development of rehabilitation policies based on:

- repairing the land so its ongoing maintenance needs are consistent with those of equivalent unmined land under equivalent land use;
- rehabilitation requirements that are open to public scrutiny;
- treating rehabilitation and mine closure as integral components of the planning and operation of mines.

The Australian and New Zealand Minerals and Energy Council (ANZMEC) and the Minerals Council of Australia (MCA) jointly published the *Strategic Framework for Mine Closure (ANZMEC 2000)*. The framework recognised that the mining industry is responsible for rehabilitation of mine disturbance in an environmentally and socially acceptable way. It considered mine planning, stakeholder involvement, financial provisioning for rehabilitation, implementation, standards and relinquishment; and developed the following key principles:

- legislation should provide a broad regulatory framework for the mine closure process;
- standards of rehabilitation should be acceptable and achievable;
- completion criteria are specific to each mine and should reflect its unique set of environmental, social and economic circumstances;
- an agreed set of indicators should be developed to demonstrate that successful rehabilitation has been achieved;
- targeted research will assist both government and industry in making better decisions about rehabilitation.

In 2003, the International Council on Mining and Metals (ICMM) adopted 10 principles for sustainable development for mining. Specific elements of Principles 4 and 6 included:

- consulting interested and affected parties[3] on all significant impacts;
- regularly updating risk management systems;
- providing safe disposal of waste and process residues;

[3] Similar consultation requirements are included in ss. 38 and 39 of the *Environmental Protection Act 1994* in regard to environmental impact statements.

- rehabilitating land in accordance with appropriate post-mining land use.

The MCA sought government input when it developed *Enduring Value (MCA 2004)*. That publication provides a framework for implementing the ICMM principles in an Australian context and indicates that effective rehabilitation planning and implementation are intimately linked to the "social licence to operate". The ICMM has stated that the mining industry's contribution to sustainable development is dependent on ensuring acceptable long-term environmental performance of mine rehabilitation (ICMM, 2005).

The mining industry has been working with Australian governments to improve the mutual understanding of how rehabilitation can minimise the future impacts of mining activities. During the 1990s, the Commonwealth Government supported the development of a series of booklets on *Best Practice Environmental Management in Mining*. The Commonwealth Department of Resources, Energy and Tourism are currently replacing this series with booklets in the series *Leading Practice Sustainable Development Program for the Mining Industry.*

2.2 Rehabilitation hierarchy

In assessing the acceptability of rehabilitation objectives, indicators and completion criteria that may be proposed for a mining project, the administering authority will have regard to a hierarchy for mine rehabilitation that is similar to the waste hierarchy. The strategies listed higher in the hierarchy should be adopted in preference to those listed lower, unless there are significant environmental, economic or social issues that override such a selection. The rehabilitation hierarchy, in order of decreasing capacity to prevent or minimise environmental harm, is:

1. avoid disturbance that will require rehabilitation
2. reinstate a "natural" ecosystem as similar as possible to the original ecosystem
3. develop an alternative outcome with a higher economic value than the previous land use
4. reinstate previous land use (e.g. grazing or cropping)
5. develop lower value land use
6. leave the site in an unusable condition or with a potential to generate future pollution or adversely affect environmental values.

In determining whether it is feasible to achieve levels in the top half of the hierarchy, the applicant and the administering authority should consider the pre-mining land use, any compensation or other agreements regarding the land, the potential uses of likely rehabilitated landforms and existing use or environmental values of surrounding land.

Developing a lower value use may be acceptable if that use is acceptable to the relevant stakeholders and all higher strategies are impractical. Leaving the site in an unstable condition or with potential to cause environmental harm will rarely be acceptable.

In general there is a higher risk of future environmental harm after the mine closes if the strategies listed lower in the hierarchy are adopted. However a "lower value" land use may be more sustainable in terms of preventing off-site impacts, especially if the post-mining land use makes an economic return that is sufficient to maintain the rehabilitation. To manage a site so that the potential for on-going environmental harm is kept to acceptable levels, future monitoring and maintenance may be required. For this reason, the acceptance of a rehabilitation strategy involving outcomes lower in the hierarchy may mean that, when progressive or final rehabilitation is assessed, the company may have to make larger payments to cover the remaining residual risk (see the guideline Calculating Financial Assurance for Mining Projects (EM585) for a discussion of residual risk and related payments).

2.3 Legislative framework

In Queensland, rehabilitation is required under the *Environmental Protection Act 1994* (EP Act)[4], which has as its object the attainment of ESD. The principles in the NSESD must be considered in decision-making under the EP Act. Section 4(6) of the EP Act requires that all reasonable and practicable measures are taken to protect environmental values from all sources of environmental harm and requires persons who cause environmental harm to pay costs and penalties for the harm. The fundamental reasons for rehabilitation are to reduce the apparent disturbance caused by authorised mining activities and to minimise the potential for future environmental harm.

Section 9 of the EP Act defines environmental values as characteristics of the environment that are conducive to environmental health or public amenity or safety, as well as qualities of the environment declared to be environmental values by an environmental protection policy (EPP) or a regulation. The environmental values listed in the EPP for water are the suitability of water for recreation, drinking, agriculture, industrial use and maintaining biological integrity; the environmental values listed in the EPP for air are qualities that are conducive to suitability for life, health and human wellbeing; and the environmental values listed in the EPP for waste management are life, health, human wellbeing, diversity of ecological processes and ecosystems, and land use capability (having regard to economic considerations).

Sections 201 to 203 of the EP Act requires all level 1 mining projects to have an environmental management plan (EM plan) which states the objectives for progressive and final rehabilitation as well as measurable indicators and standards (called completion criteria in this guideline) that are to be achieved. An EM plan is used to help the administering authority prepare the draft environmental authority for a mining project. The administering authority must be satisfied with the rehabilitation before it can certify progressive rehabilitation for part of a mining project or accept the surrender of an environmental authority for the whole or part of a project. The administering authority decision is based on an assessment of either a progressive rehabilitation report for part of the project (s.266G) or a final rehabilitation report (s.274) for the whole project or a part being surrendered. The holder of the environmental authority for mining activities must prepare a progressive / final rehabilitation report and submit it to the administering authority for assessment. The administering authority must consider the relevant completion criteria (s.266K or s.278) when deciding whether to certify progressive rehabilitation or whether to approve a surrender application. See Section 7 below and the guideline Final and Progressive Rehabilitation Reports and Audit Statements for Level 1 Mining Lease Projects (EM610).

Under the current legislation it is difficult to enforce future land use constraints for rehabilitated land after the mining tenement has been relinquished. Appropriate post-mining land use may require some form of statutory constraint to future land use in order to prevent or limit the extent of “inappropriate post-mining land use”. The options currently available include:

- specific land tenure (protected estate, reserve, etc.);
- lease conditions (e.g. term lease under *Land Act 1994*);
- covenant (freehold, perpetual lease); or
- site management plan (for contaminated land).

The various legislative / administrative steps and their associated timeframes relating to rehabilitation during the life of a mine are shown schematically in Figure 1.

[4] A small number of mines operating under Special Agreement Acts have their rehabilitation requirements set under the *Mineral Resources Act 1989* and/or the relevant Special Agreement Act.

Figure 1 - Elements of the rehabilitation process for a mine

	Regulatory elements	Company-controlled elements	Timeframe
Pre–mining		Exploration and feasibility studies – including baseline studies and planning possible rehabilitation objectives	3 to 10 years
		Pre-design conference	1 week
		Apply for environmental authority (EA)	
	EIS requirement decision (the administering authority (AA))		10 bd[5]
		Prepare EIS, if required, and/or environmental management plan (EM plan)	Up to 12 months
		Submit EM plan – including commitment to rehabilitation objectives, indicators and completion criteria	
	Assess EM plan (the AA)		30 bd
	Prepare draft EA (the AA)		10 bd
	Public notification		At least 28 days
	Objections hearing if required		3 to 6 months
	Issue final EA (the AA) – including conditions defining rehabilitation objectives, indicators and criteria		10 bd
During mining		Progressive rehabilitation and monitoring	
		Apply for progressive certification	
	Assess progressive rehabilitation report (the AA refers to progressive rehabilitation advisory committee)		30 bd
	Decide application (the AA)		10 bd
		Adjust financial assurance	
Post–mining		Apply for surrender of EA – including final rehabilitation report and residual risk calculation	
	Assess final rehabilitation report (the administering authority refers to PRAC)		30 bd
	Decide application and advise holder of decision (the AA)		10 + 10 bd
		Lodge any residual risk payment	
		Post-closure management (if required)	

[5] business days

3 General and specific rehabilitation goals

3.1 General rehabilitation goals

In this guideline, the Government's policy objectives for rehabilitation are called rehabilitation goals to distinguish them from the rehabilitation objectives selected by mining companies in their rehabilitation strategies for a particular mine. The rehabilitation goals have been developed from the ESD policy framework, especially in relation to intergenerational equity; polluter pays principle, protection of biodiversity and maintenance of essential ecological processes.

The four general rehabilitation goals require rehabilitation of areas disturbed by mining to result in sites that are:

- safe to humans and wildlife[6];
- non-polluting;
- stable;
- able to sustain an agreed post-mining land use.

3.2 Site specific goals

There may be specific additional goals that are relevant at some mine sites. These may be indirectly identified by Government through requirements under other legislation dealing with matters such as endangered species, water, registered heritage places or regional or local planning. For example, there may be requirements to:

- establish vegetation communities that are demonstrably similar to a pre-existing ecosystem (especially where native vegetation is the proposed land use);
- establish or enhance the habitat of an endangered species (especially where the mining has affected such habitat);
- restore stream patterns where there has been a temporary stream diversion;
- achieve water quality that meets some specific beneficial use;
- maintain or restore some specific aesthetic values;
- preserve specific European and indigenous heritage that has been registered for the site (note that these values are managed under other legislation); or
- achieve specific socio-economic outcomes (e.g. restore high value agricultural land necessary to maintain a viable rural industry).

4 Rehabilitation objectives for a mine

4.1 Setting rehabilitation objectives

Rehabilitation objectives must provide a clear description of proposed rehabilitation outcomes within the individual domains[7] in the mine site. One domain may contain elements that require different rehabilitation. If the elements are essential components of a single land management unit, e.g. a waste rock dump with battered slopes and a flat top, it is preferable for the elements to be included in the same domain (with different rehabilitation objectives) rather than to be treated as separate domains. The rehabilitation program for a mine

[6] Human safety at mine sites is largely managed under the *Mining and Quarrying Safety and Health Act 1999* and the *Coal Mining Safety and Health Act 1999* but fauna safety is not covered in those Acts. It will generally be appropriate to consider both human and fauna safety when designing rehabilitation under environmental legislation.

[7] Domains are defined in Appendix C.

site must address the general rehabilitation goals listed in Section 3 and any relevant site-specific goals. To ensure that the mine fulfils its environmental, economic and social responsibilities within the ESD principles, the rehabilitation objectives must:

- address potential environmental impacts;
- achieve the highest practicable level in the rehabilitation hierarchy;
- identify post-mining land uses that are acceptable to the community, local government and any other relevant stakeholders.

The first steps in identifying the potential environmental impacts for a level 1 mining project will generally be baseline environmental investigations and consultation with local residents and other interested parties to identify the environmental values in the proposed mining lease and adjoining areas. Economic or social studies may also be undertaken. The mining company is advised to seek a pre-design conference with the administering authority at this stage in the planning of the mining project. While the main purpose of a pre-design conference is to assist the applicant to identify potential environmental issues at the site, it also allows the applicant to propose a stakeholder consultation program for discussion. The administering authority may give an indication that a stakeholder consultation program proposed by the applicant is satisfactory for the development of rehabilitation conditions that will be used for assessment of progressive and final rehabilitation. Any agreements between the applicant and stakeholders should be committed to writing and, where it is relevant to the rehabilitation requirement, should be forwarded to the administering authority with the relevant application.

The second step is to develop ways to prevent or minimise the potential environmental impacts from mining and mineral processing activities that may occur on the site. Both the design of the mine and the rehabilitation strategies will be influenced by the spatial distribution of the various environmental values, the potential impacts and the costs associated with the various options for preventing or minimising the impacts. An environmental impact statement (EIS) will be required if the project exceeds the triggers in the guideline Deciding the Level of Impact Assessment for the Mining Industry (EM579). Another consideration is how to minimise the residual risk associated with the rehabilitation. If that risk is too high (i.e. issues are identified that have the potential to result in significant failure of the rehabilitation in the future, say within 30 years), the administering authority may not accept the rehabilitation. In some cases, a high risk may be accepted if the residual risk payment was sufficient to cover the expected maintenance of the rehabilitation. However, the Government is unlikely to accept the role of long-term involvement with a large number of mine sites.

Other matters that may influence decisions about selecting a rehabilitation strategy include:

- the conservation value of a proposed environmental outcome;
- the importance to the local community of the economic productivity of the proposed future land use;
- the consistency of the proposed land use with local and regional plans;
- the long-term ownership of the affected land.

Mine rehabilitation provides opportunities to restore ecosystems or create wildlife corridors which may produce major environmental benefits in all or part of the mining lease. There will also be cases where rehabilitation of a mine site may not be able to achieve future economic productivity that is comparable to the pre-mining situation. Irrespective of the rehabilitation outcome, the environmental authority holder must ensure that the rehabilitation will endure normal climatic variations and the agreed post-mining land will be sustained so that future generations are not paying maintenance costs that are higher than those normally incurred for the same land use on unmined land. To achieve this, the rehabilitated land may need to have constraints placed on its future

use (e.g. a site management plan for contaminated land or a nature refuge) making any future land owner responsible for meeting those constraints[8].

The final step in setting the objectives is to include them in the EM plan. This makes them publicly accessible and provides guidance to management and workers on the need to conduct activities on the site in a way that is consistent with the future use. They must also be stated in a way that allows the development of measurable indicators that can be audited against the completion criteria. Table 1 gives examples of strategies that contain a range of objectives for different mine domains. It does not attempt to identify all possible domains, nor does it list all possible strategies for any domain. The EA holder proposes both the domains and the strategies.

4.2 Combining the rehabilitation hierarchy with the rehabilitation goals

For each of the goals there may be many rehabilitation strategies that can be developed and applied to a mine. It is possible that the rehabilitation requirements for different domains at a mine may be significantly different. For example, a waste rock dump domain will require a different rehabilitation approach than a tailings storage facility. Rehabilitation strategies for each domain should be developed and documented in the EM plan for the mine.

Table 1 provides some examples of how the hierarchy described in Section 2.3 might be applied to establish the possible rehabilitation strategies that would achieve the main rehabilitation goals for particular mine domains. The table has not covered all the possible strategies or all potential post-mining land uses, which can be widely divergent (e.g. nature conservation, grazing, cropping, waste disposal, water supply, etc). Nor does Table 1 specify which strategy will be acceptable in a particular locality for a specific mine.

It is probable that strategies in the top row of Table 1 would be considered to produce satisfactory rehabilitation if the strategies are implemented effectively. Strategies in the middle row of the Table may be accepted in some circumstances but will generally have a higher residual risk payment associated with them. Strategies in the bottom row will rarely be acceptable.

4.3 Describing rehabilitation objectives in the EM plan

Sections 189 and 203 of the EP Act require environmental protection commitments in the EM plan for exploration or mining projects. The Act lists rehabilitation objectives as an example of these commitments. They are the basis for the conditions of the environmental authority. The conditions are initially agreed between the proponent and the administering authority (on behalf of all stakeholders) when the authority is granted. If there is no agreement, the conditions may be decided by the Land Court.

The EM plan must describe the proposed rehabilitation of the mining disturbance and how it will control future environmental harm to an acceptable level. As part of the progressive rehabilitation certification process and final surrender application, the environmental authority holder will be required to submit a risk assessment that documents the probability and consequence of future environmental harm across each of the rehabilitated domains. Where there is potential for future environmental harm, the cost to remediate this harm must be calculated in order to decide whether a residual risk payment is required, see the guideline Calculating Financial Assurance for Mining Projects (EM585).

During mine planning, the post-mining land use must be identified, as this is a controlling factor in setting rehabilitation objectives that are consistent with the goals described in Section 3.1 and in defining how rehabilitation success will be measured.

[8] The administering authority is considering extending the concept of a site management plan to ensure appropriate post-surrender land management where contamination is not an issue. The intent is to require a third party to implement a management plan prepared by the mine operator to minimise future risk. Funding (if not covered by the compensation agreement) and the third party's level of responsibility for the management plan will require further consultation.

Definition of the final land use is essential for the assessment of the long-term environmental impacts of the project by the administering authority and is typically required for the development of realistic life-of-mine costs in feasibility studies that will be assessed by the project financiers. It is also necessary for calculating financial assurance as that is based on the third party costs of rehabilitation, which cannot be calculated if the final land use is not specified. Consultation with the landowner, the local community and other stakeholders is essential when considering the future land use.

Other rehabilitation objectives may be determined through a risk assessment of the proposed mining operation and mine closure where that process identifies hazards likely to prevent the achievement of the rehabilitation goals. The objectives will focus on the end result of the rehabilitation and will not normally describe in detail how the hazards can be avoided or managed to achieve the agreed future land use. The end result must, to the maximum extent possible, be maintenance free and require no future management intervention beyond the normal land management practices for the post mining land use. The future landholder will be responsible for the management and maintenance requirements when undertaking any post mining land use at the site. A regular review of the objectives is desirable as mine plans and technology change frequently.

Achievement of short term objectives may not deliver rehabilitation outcomes that are considered sustainable in the long term i.e. centuries. Decision-making should involve stakeholders who have been provided relevant information about possible future impacts developed through a thoroughly documented risk assessment process which considers the likelihood and consequence of hazards being realised.

During the environmental impact assessment of a project, several rehabilitation options may be proposed. However, the resulting EM plan for the mining project must clearly identify the intended land use and other rehabilitation objectives for the mine at the domain level and cover the relevant rehabilitation goals listed in the previous section for each domain within the whole site. The objectives must be specified in sufficient detail to allow the administering authority to assess long-term impacts and for the community to understand the post-mining condition of the site. For a mining lease, this information is made public and objections may be lodged. Objections are considered by the Land Court and the recommendations that come from the objections hearing may result in changes to the proposed land use or other objectives before the lease is granted. The objectives must be clearly reflected in the environmental conditions for the project.

The typical details required in the EM plan for each domain within the mine site include:

- **Safety measures** – If safety hazards remain at mine closure or inevitably will develop after closure, solely as a result of the mining activities (e.g. steep slopes, exposure of hazardous materials, subsidence or potentially unstable structures), the EM plan must indicate what management controls will be implemented to reduce risks to humans or animals. These may include exclusion of access to unstable areas, waste rock characterisation and segregation or selective management of hazardous wastes. These measures complement any requirements under the *Mining and Quarrying Safety and Health Act 1999* or *Coal Mining Safety and Health Act 1999*.
- **Water management and water quality** – Details of any reconstructed water courses or proposals to contain surface water on the site must be provided. The risk of any significant environmental harm resulting from potentially contaminated water entering surface waters or groundwater must be considered. An assessment of the possible quality of water impounded in a final void or surface dam must be provided. This is likely to be based on a model and will require an ongoing monitoring program to verify the predicted water quality and hydrology so that modifications can be made to the rehabilitation plans if water quality trends or flow rates are found to vary from the predicted values in a way that is likely to cause a significant increase in the resultant environmental harm.
- **Landforms** – There must be a clear indication of the post-mining topography of the site. The final shape of waste rock heaps, tailings dams and voids must be indicated on a contoured plan at a suitable scale. The

choice of landforms must be supported by an assessment of the factors that will affect long-term stability with particular reference to hazardous materials, protective capping, geotechnical stability, and surface stability under the proposed post mining land use.

- **Land use** – The proposed post mining land use must be clearly specified using terms such as grazing (up to a particular intensity), cropping (including type of crop), forestry plantation (for a specified type of wood), habitat (for a nominated species), or return to native vegetation (see next dot point). Indicating that the land will achieve a specific land capability class (DME 1995) will generally not be sufficient description of the proposed land use. The prior land capability and use of the site, the existing uses of adjacent land and the views of landholders when selecting the future land use should be considered.
- **Vegetation** – When establishing native vegetation is one of the rehabilitation objectives for the mine site, the EM plan must specify the ecosystem(s) or habitats that are intended to be developed on the rehabilitated domains. The plan may also nominate reference / analogue sites that will be used for comparison.
- **Socio-economic objectives** – An example of when such objectives might be considered is where mining occurs on good quality agricultural land and there is an agreement that the land is to be returned to a similar productive use so that it will support a viable community similar to what was there before mining.

4.4 Changing or amending objectives

Should circumstances or knowledge change during the life of the mine, rehabilitation objectives and completion criteria may need to be reviewed. If substantial changes to the rehabilitation objectives are involved, there must be a transparent amendment process that gives the public an opportunity to comment on significant changes. The current process allows the environmental authority holder to apply for a change to the objectives through an amendment of the environmental authority. In such cases the rehabilitation goals applying at the time of the application will be taken into account. It is considered good practice for the mining company to consult community members who are likely to be affected by the changes before the amendment application is lodged.

5 Rehabilitation indicators

5.1 Defining good indicators

Rehabilitation indicators provide defensible measurements of progress towards the rehabilitation objectives. Environmental indicators may involve the measurement of a single parameter or they may involve the amalgamation of measurements of several parameters into an index or model. There could be several indicators for one objective and one indicator may have relevance to more than one objective. Some may be important over a wide area while others may have a local significance or relate to how a particular objective is to be achieved for a particular mine. Although there will be site-to-site variations in the indicators, some regional groupings are expected to emerge as knowledge improves and is shared among companies and consultants.

The properties of a good indicator (CSIRO 1998) are that it:

- has an agreed, scientifically sound meaning;
- represents an environmental aspect of importance to society;
- tells us something important and its meaning is readily understood;
- has a practical measurement process;
- helps focus information to answer important questions;
- assists decision making by being effective and cost-efficient.

Table 1 - Possible strategies to achieve rehabilitation goals for various domains[9]

PART A – Domains involving surface features including final voids, shafts, audits, subsidence

OUTCOMES	GOALS			
	SAFE	NON-POLLUTING	STABLE LANDFORM	SUSTAINS AGREED LAND USE
Generally acceptable	• Backfill to original ground level (or higher to allow for settlement. • Seal or install bat gates for shafts and audits • Structurally sound; safe to people and animals; • No hazardous materials • Treat hazardous material • Remove hazardous material	• Contains good quality water • Moderate quality but no connectivity • Low risk of groundwater contamination or overflow but monitoring and management in place	• Backfill voids and shallow shafts • Stable collar and capping or cover for shafts • Battered slopes with vegetative cover	• Natural ecosystem restored • Alternative high value use, e.g. water reservoir, good quality agricultural land, recreational use
May be acceptable	• Cover hazardous material with benign material or water • Build safety barriers	• Void acts as a sink or reservoir for contaminated water with minor risk to stock or wildlife	• Battered moderate slopes with little vegetation • Steep slopes in competent rock	• Waste disposal (if site approved under *Sustainable Planning Act 2009)* • Industrial or commercial land use • Unused void with low risk
Rarely acceptable	• Contains exposed hazardous materials (e.g. potentially acid forming or containing heavy metals)	• Poor water quality that poses a high risk to stock or wildlife	• No action but site is structurally unsound, geotechnical instable, a threat to nearby sensitive places and infrastructure	• Accumulates hazardous material

[9] Not all of these structures may be grouped in the same domain. However, similar matters will have to be considered in developing the rehabilitation outcomes for areas that have been used for these activities. There may be more than one domain of any particular type of activity within a single mine if the rehabilitation outcomes are going to be different because of variations in the topography, adjoining land use, scale of activity or other considerations.

Table 1: Continued

PART B - Domains involving solid waste disposal[10]

OUTCOMES	GOALS			
	SAFE	NON-POLLUTING	STABLE LANDFORM	SUSTAINS AGREED LAND USE
Generally acceptable	• Structurally safe, no hazardous materials • Structurally safe, treated hazardous material	• Runoff and seepage will be good quality water that is unlikely to affect known environmental values	• Place wastes below natural land surface (i.e. below grade). • Place wastes above natural surface with minimal slopes (e.g. less than 5°)	• Reinstate original ecosystem • Create a different use with enhanced environmental, economic or social values acceptable to stakeholders • Return to previous use/ condition
May be acceptable	• Structurally safe, hazardous material adequately contained	• Potential for pollution of water that is managed by: • Natural low groundwater connectivity (demonstrated by hydrological studies) • Impervious capping or lining • Store and release capping	• Place wastes above ground with moderate slopes	• Return to previous use, or a different use with reduced environmental, economic or social values (evidence that use is acceptable to stakeholders would be essential). • Managed constrained use
Rarely acceptable	• Uncontained or inadequately contained hazardous materials	• Waste disposal facility contains inadequately managed severely contaminated water or water requiring continuing treatment	• Place above ground with angle of repose slopes	• Unusable contaminated site that is not adequately managed

[10] Solid wastes include rejects, waste rock dumps, heap leach pads and general refuse disposal facilities.

Table 1: Continued

PART C - Domains involving tailings dams

OUTCOME	GOAL			
	SAFE	**NON-POLLUTING**	**STABLE LANDFORM**	**SUSTAINS AGREED LAND USE**
Generally acceptable	• Structurally safe (appropriate certification against relevant code) - no hazardous materials • Structurally safe - treated hazardous material	• Runoff and seepage will be good quality water that is unlikely to affect known environmental values	• Stored in redundant pit below natural surface level with appropriate erosion control • Outer walls designed for long term stability • Vegetation cover established and preventing erosion	• Reinstate original ecosystem • Create a different use with enhanced environmental, economic or social values acceptable to stakeholders • Return to previous use/ condition • Site management plan in place and effective
May be acceptable	• Containment of hazardous material but limited strengthening of walls or capping	• Eliminate inflow • Breach wall to prevent ponding • Armoured impervious capping with capillary break if needed • Store and release capping • Collect and treat seepage	• Appropriate maintenance program proposed	• Return to previous use, or a different use with reduced environmental, economic or social values (evidence that use is acceptable to stakeholders would be essential). • Manage constrained use
Rarely acceptable	• Unstable poorly designed structure	• Seeping contaminated water to surface or ground water	• High risk of instability and structural failure	• Unusable contaminated site that is not adequately managed

Table 1: Continued

PART D – Infrastructure

OUTCOMES	GOALS			
	SAFE	NON–POLLUTING	STABLE LANDFORM	SUSTAINS AGREED LAND USE
Generally acceptable	• No hazardous structures or chemicals used in mine • Avoid effects of hazardous materials on site by restricting use to fully contained facilities which are cleaned and removed from site • Treat hazardous materials • Remove hazardous materials	• After removal of infrastructure - runoff and seepage will be good quality water that is unlikely to affect known environmental values • Remediate contamination so that runoff and seepage will not have unacceptable effects on known environmental values	• Allow continued use of permanent infrastructure that is stable or is managed under a maintenance program • Remove infrastructure, re-shape disturbed areas to resemble surrounding landscape and establish adequate vegetation cover	• Avoid areas of remnant vegetation by locating infrastructure on previously cleared areas • Reinstate original ecosystem • Create a different use with enhanced environmental, economic or social values acceptable to stakeholders • Return to previous use/ condition
May be acceptable	• Containment of hazardous materials	• Minimise runoff or seepage tat is likely to have unacceptable effects on known environmental values e.g. by eliminating inflow through impervious capping • Collect and treat seepage	• Erosion rates higher than surrounding areas but an appropriate maintenance program proposed	• Return to previous use, or a different use with reduced environmental, economic or social values (evidence that use is acceptable to stakeholders would be essential). • Managed constrained use
Rarely acceptable	• Unsafe poorly designed structure	• Seeping contaminated water to surface or ground water	• Landform has doubtful stability	• Unusable contaminated site that is not adequately managed

5.2 EA holder to nominate indicators

The EA holder is responsible for nominating the indicators for the mining project and should consider the properties of good indicators when doing so. The EM plan submitted with the initial application for a mining tenement is required to list the indicators that are proposed to measure the success of the rehabilitation. The plan must justify why the particular chemical, physical, biological or socio-economic parameter or index has been selected (i.e. identify the implied relationship to a key element of a particular rehabilitation objective listed in the EM plan).

As rehabilitation deals with complex systems, and the relationships between indicators and objectives may not be well understood at the mine planning stage, there needs to be appropriate mechanisms for reviewing the indicators if improved information or more cost effective rehabilitation techniques become available during the life of the mine. If the proposed change to an indicator is to be accompanied by a change in the rehabilitation objectives for a particular domain, an amendment of the environmental authority will be required. If there is likely to be a significant change to the level of environmental impact, the administering authority must require the amendment to be publicly notified.

For all indicators that are selected, the environmental authority holder will:

- state what objective(s) the indicator relates to;
- justify the selection of the indicator, including how the relationship between the indicator and the objective has been established (supported by references to authoritative sources or relevant monitoring data);
- state how the indicator is to be measured;
- state how the results will be reported and interpreted.

5.3 How the administering authority will consider the indicators

A major area of concern for government is the relevance of the indicators to the specific rehabilitation objectives for the mining project, and ultimately to the long term sustainability of the rehabilitation. To ensure that the indicators are relevant, it is recommended that monitoring of the indicators start as soon as possible and continue until the application to surrender the area has been approved by the administering authority (or beyond that time if a site management plan or transitional environmental program is in place). Presentation of a long time series of monitoring data is potentially the most credible way to demonstrate that the risk of rehabilitation failure is low and/or quantifiable. The monitoring will also assist in improving the validity of the completion criteria. Despite the monitoring, there may be some remaining risk that the rehabilitation was inappropriate or will fail and serious environmental harm will occur. Quantification of the cost of this residual risk is addressed in the guideline Calculating Financial Assurance for Mining Projects (EM585).

Examples of possible indicators for a selection of rehabilitation objectives are presented in Appendix A. For land use objectives, the indicators may range from simple quantitative measures of grazing capacity or crop yields to a complex array of indicators that might be needed to establish the viability of a native species ecosystem or its similarity to some analogue / reference site or baseline study. Two recent reviews of the use of indicators show the complexity of this issue at a regional scale and the need to establish the validity of a set of indicators for each specific site (Nichols, 2004; Tongway et al 2003).

6 Completion criteria

6.1 Setting completion criteria

The completion criteria must provide a clear definition of successful rehabilitation for each domain at the mine site in the form of a set of measurable benchmarks against which the rehabilitation indicators can be compared to determine whether the objectives are being met. At least one completion criterion must be developed for each

indicator. Completion criteria should specifically relate to the environmental, social and economic context of the mine site. However, it is possible that some completion criteria may be applied uniformly across a region if supported by technical evidence.

The criteria should be developed in consultation with stakeholders (e.g. the landowner, local government, indigenous groups, community groups and various State departments). The criteria are of importance to landowners because they may set limitations on the agreed future land use and expose the landholder to risks and potential costs associated with maintaining the former mine site in a safe and productive condition.

The applicant is required to propose completion criteria in their EM plan during the application process. If these are based on relevant regional or local studies of successful mine rehabilitation, then the administering authority will include these criteria or modified versions of the proposed criteria in the environmental authority as rehabilitation conditions. The administering authority will require a risk assessment of possible failure modes for the rehabilitation, based on their consequences and probabilities of occurrence. The option to require a cash residual risk payment may defuse some potential debates about what is achievable by making the justification of rehabilitation costs a commercial decision. However, the administering authority may refuse to accept rehabilitation that is clearly not sustainable. Some examples of the type of completion criteria that might be developed are provided in Appendix A.

Note that not all of the indicators and criteria listed in the Appendix would be required for all of the goals at all mines and that specific percentages and other numbers are indicative only.

The quantitative value of a particular criterion may vary significantly from mine to mine or even between domains within a single mine depending on the nature of the disturbance, climate, topography, soil characteristics and other factors. The rehabilitation objectives will guide the selection of the indicators and the specific completion criteria. For example, stability could be reflected in criteria that do not allow erosion of materials from the disturbed areas at rates that exceed natural rates for the locality (and that may range from 1 t/ha/yr in western Queensland to more than 100 t/ha/yr in wet coastal areas). The criterion would be set at an appropriate rate, and in some cases a maintenance program may need to be developed to repair eroded areas, especially if the eroding material is contaminated or the erosion is likely to expose contaminated material.

As another example, if the outcome is to re-establish (as closely as possible) the native ecosystem that was on the mine site there may be an array of vegetation-related criteria. These may emphasise specific species, species diversity, wildlife corridors or fauna re-population. The criteria may require high levels of similarity with baseline studies or reference sites. If the vegetation is of greatest relevance as erosion control, the criteria may focus on canopy foliage cover; ground cover or the biomass developed per unit area. Comparisons with reference sites may be used as an indirect indicator of how sustainable the rehabilitated ecosystem is likely to be. If the vegetation is for aesthetic purposes, a criterion may be the abundance of a nominated species.

If the desired outcome is not related to native vegetation (e.g. the future land use is to be agriculture, grazing, urban development, waste disposal or recreation), native vegetation criteria are likely to have limited, if any, application within the site. Other criteria such as agricultural productivity, chemical and geotechnical stability, and water runoff quality/quantity may become relatively more significant. In some cases certification that a structure is meeting engineering specifications may be appropriate criteria (e.g. for tailings dam walls, waste rock dump slopes, erosion rates or void slope stability).

In areas where suitable rehabilitation information is not available, the applicant may be required to establish a research program. It may benefit the potential applicant to commence this research before an application is made for a mining lease (i.e. while the applicant holds a mineral development licence). As a fallback, this research may occur after an application is made during the preparation of an environmental impact statement. Where neither of these options is possible, the environmental authority must contain criteria based on similar mines or general research and should contain a condition requiring the commencement of on-site trials to verify

or modify these criteria within a relatively short timeframe (e.g. less than two years). The absence of field trials to verify the criteria is not justification for omitting completion criteria from the EM plan.

6.2 Monitoring and changing completion criteria

Once the criteria are established, the environmental authority holder will be expected to collect relevant information to assist the administering authority to make decisions about the adequacy and sustainability of the rehabilitation. Progressive certification of rehabilitation requires the administering authority to make the decision on whether rehabilitation is satisfactory possibly several years before the final rehabilitation application is made. In that time monitoring of the rehabilitation will continue and may disclose inadequacies in the earlier rehabilitation.

The later information does not invalidate the earlier certification unless the rehabilitation ceases to meet the original completion criteria. However, it may be used to reassess the residual risk. If the residual risk payment is likely to increase substantially or there are technical or social reasons for change, the holder may apply to amend the rehabilitation objectives and/or change the indicators or completion criteria.

A similar consultation process should be undertaken if there is a need to change the criteria because of subsequent rehabilitation research, strong community concerns or improved technology. The environmental authority must be amended and the amendment must be publicly notified if it is likely to increase the level of significant environmental harm or a significant change in the impacts on environmental values, including land use capability. If the amendment is granted, the new requirements will be taken into account at final surrender to assess the rehabilitation and to calculate the residual risk.

Monitoring of the indicators for an area of progressive rehabilitation should result in a clarification of issues, minimisation of risks and an increasing certainty in the sustainability of the rehabilitation. Where there is evidence of decreasing potential environmental harm, the monitoring of low risk matters may become unnecessary. However, unless the environmental authority is amended, evidence that the low risk matters are continuing to meet the relevant completion criteria will still be required at the time of surrender.

7 Certification or surrender

7.1 The assessment process

The certification or final sign-off of rehabilitation requires the appropriate application form to be completed and adequate information to be provided by the applicant in a rehabilitation report. This includes evidence that the rehabilitation meets the completion criteria and a risk assessment. The benefits of providing high quality information include expediting the assessment by the administering authority, improving the likelihood of a positive outcome, and minimising any necessary residual risk payment. The administering authority regards the surrender as a very significant decision as it effectively transfers future liabilities at the site from the mining company to the State and in some cases to the landowner. The administering authority will establish a Progressive Rehabilitation Advisory Committee (PRAC) consisting of senior staff members with a range of technical skills relevant to rehabilitation. The PRAC will consider any rehabilitation application for a level 1 mine, and will be available to discuss critical issues with the applicant. The PRAC will have an advisory role and provide recommendations to the decision-making delegate, based on the wide experience of its members and external advisors, if necessary.

The completion criteria are an important component of the certification process and need to be agreed before the application can proceed. The other necessary component is clear and comprehensive information on the performance of the rehabilitation from when it was undertaken until when the application for certification or surrender is made. This information is required in the progressive or final rehabilitation report that must accompany the application for certification or surrender. The guideline Final and Progressive Rehabilitation Reports and Audit Statements for Level 1 Mining Lease Projects (EM610) gives details of the type of information

and detail required. The administering authority may seek advice from landholders, other government departments or technical experts when deciding the application.

To minimise delays in the assessment process, the mining tenement holder should provide this information together with an interpretation of its significance by an appropriately qualified person. The number of measurement sites and the monitoring period will vary due to differences in the size of mines, climate and the complexity of ecosystems being established. Most mine sites are listed on the Environmental Management Register and to be removed from the register they require a site investigation and suitability report. If they remain on the register a site management plan (under s. 401 of the EP Act) must be lodged before or with the final surrender application. It must include the landowners' agreement to the proposed management arrangements for the contamination and be approved by the administering authority.

An audit statement will be required from an appropriately qualified person on behalf of the holder of the environmental authority. A risk assessment must be provided in accordance with the methodology outlined in the guideline Calculating Financial Assurance for Mining Projects (EM585). Before the administering authority issues a certificate for progressive rehabilitation, it will require any residual risk payment to be made. This can be in a bank guarantee with the financial assurance for the mining project. This may be paid in cash or bank guarantee. If the application is for the final surrender of a tenement, the administering authority will require the total residual risk payment to be made in cash, even if it includes amounts that were covered by a bank guarantee when progressive certification was granted for all or part of the area. The administering authority must decide whether the rehabilitation is satisfactory or meets other requirements such as an approved transitional environmental program or site management plan. The administering authority will consider whether the conditions of the environmental authority and any environmental protection policy (EPP) requirements have been met, the final or progressive rehabilitation report, any assessment report on the rehabilitation report, the risk assessment report, the audit statement, any site investigation conducted with regard to the contaminated land provisions of the EP Act and the standard criteria in Schedule 4 of the EP Act.

The rehabilitation will be accepted if the procedures outlined in this guideline demonstrate that it meets the specific objectives set for the mine site in its environmental authority.

7.2 Relationship between completion criteria and residual risk

The completion criteria must be met in order to obtain either certification of progressive rehabilitation or approval of a surrender application (involving final rehabilitation). Some of the criteria may require achieving a nominated value for an indicator for a specified time period. Others may require evidence that the nominated value has been achieved, or is expected to be achieved, on the basis of current trends. The latter is potentially a higher risk option and that would be reflected in the residual risk calculation described below.

Because natural processes and human activities may have adverse effects on rehabilitation, it is possible that a site that meets a criterion at one time may fail to meet the same criterion at some future time. Even if all criteria are met for several years, there is no guarantee that the rehabilitation will not fail in the future. The risk of failure is called the residual risk. The guideline Calculating Financial Assurance for Mining Projects (EM585) indicates how it is calculated through a risk assessment that considers:

- what components of the rehabilitation are most likely to fail (hazards);
- the likelihood of failure;
- the consequences of failure.

For any given set of completion criteria, the cost of rehabilitation will depend to some extent on the length of time that the rehabilitation is designed to meet the criteria. If more costly rehabilitation were undertaken, the risk of failure within a specified time period would generally decrease. This would be reflected in a requirement for a lower residual risk payment. It is a commercial decision for the mining company whether it should design its

rehabilitation to a standard that goes beyond compliance with the environmental authority and be rewarded by a lower residual risk payment.

7.3 Use of the risk assessment in decision making

Risk assessment involves measures of likelihood and consequence of a potentially hazardous event. In order to quantify the risk, both likelihood and consequence need to be estimated quantitatively. That means likelihood will be identified as the probability of rehabilitation failing to meet completion criteria within specific timeframes after certification or approval and consequence will be estimated as the cost of managing the hazardous event. More detail on this process will be included in the guideline Calculating Financial Assurance for Mining Projects (EM585).

The probability of rehabilitation failure will usually be established from estimates of the minimum time before the rehabilitation has a 50 percent probability of failure and the variance of that estimate. In some cases it will be possible to model when a particular structure may fail, or to predict when a final void is likely to overflow on the basis of empirical measurements at the mine. In other cases there may be empirical data from nearby mines or theoretical calculations based on general scientific principles. If relevant scientific data is not available, anecdotal evidence from this or nearby mines may be of some use. However, there will be cases where the only source of information will be the best estimate of people with extensive experience in particular aspects of rehabilitation. A risk assessment based on poor data will have relatively high levels of uncertainty that would be factored into the administering authority decision on whether or not to accept the application.

While estimates of probability of failure would normally assume that the proposed land use will occur, the estimates may not be relevant if the rehabilitated land is used for a purpose other than the specified/agreed use. This needs to be considered where an alternative/more intensive use may occur without constraint. As indicated in Section 2.2, there are few legislative constraints on future land use and most of these (except site management plans and nature refuges) depend on voluntary actions by the land owner.

The consequence of a hazardous event will be estimated as the cost of management if the event happened at the present time. A consequence that does not reach the threshold of material environmental harm, i.e. an actual or potential loss to property or rehabilitation costs of at least $5000 within the first year period, will not be considered in calculations. Because risk is defined as the product of likelihood and consequence, the threshold for consideration will be set at a risk-cost of $5000 per year to provide consistency with material environmental harm.

The first decision the administering authority must make is whether to accept the rehabilitation for certification or approval of surrender. Certification or approval is unlikely to occur unless the likelihood of failure of the rehabilitation to meet the required outcomes over the medium term (e.g. at least 30 years) is expected to have a low probability (e.g. less than 0.01). If there is a higher probability of failure that would exceed the risk-cost threshold in the medium term, the administering authority would generally determine that the risk of failure is unacceptable. However, in some cases the failure would be accepted because the company has proposed a financial scheme to cover ongoing costs, such as a sinking fund. This type of arrangement is only likely to be an appropriate solution if maintenance is required for a short period. See the guideline Calculating Financial Assurance for Mining Projects (EM585). An alternative rehabilitation strategy would be needed if perpetual maintenance (in excess of the maintenance that would normally be required to undertake the proposed land use on un-mined land) is considered necessary to deliver a sustainable outcome.

The second application of the risk assessment is to assist the administering authority in determining whether any residual risk payment will be required and if so, how much will be required. Because these costs are likely to occur at some future time, standard accounting procedures should be used to establish the net present value (NPV) of the consequences. Note that the NPV is not used in calculating the risk-cost of the incident.

8 Dealing with existing mines

8.1 Mines with clear rehabilitation objectives

Historic rehabilitation must be evaluated against the rehabilitation requirements that were in place for the mining project at the time the rehabilitation was completed. This could lead to a matrix of different rehabilitation outcomes within a single domain. For example, over a period of time the species mix may have been changed in response to earlier experience or changing community expectations. The following does not deal with mines operating under Special Agreement Acts (see s.614 of EP Act).

Mines operating prior to September 1990 may have had special lease conditions relating to rehabilitation. Many would have had no specific rehabilitation requirements. Otherwise they may have been subject to rehabilitation conditions applied under s.60(2) of the *Mining Act 1968* or under s.61 of the *Mining Act 1968,* which gave the Minister discretion to require the tenement holder to:

- undertake certain activities if directed by the Minister;
- level the surface and otherwise restore the land to its original condition (as nearly as may be);
- reinstate (as nearly as may be) the natural contours and channel of every watercourse.

The standard wording used typically was even more stringent and required:

- shaping the area so that it conforms as far as reasonably practicable with the surrounding topography;
- reforming all drainage lines, waterways and creek beds to stable contours and as near as reasonably practicable to the situation existing prior to mining;
- achieving a post mining land use capability across the lease area equal with that pre-existing the Lease, where this is technically feasible.

Between 1 September 1990 and 1 May 1995, all mining leases that were current under the *Mineral Resources Act 1989* (MR Act) had a condition that the holder shall undertake rehabilitation to the satisfaction of the Minister for Mines (s.7.33(1)(d)). From June 1992 until 1 January 2001 a Department of Mineral Resources policy, Environmental Management for Mining in Queensland 1992, explained how those requirements were to be defined in an Environmental Management Overview Strategy (EMOS). An amendment to s.276 of the MR Act in May 1995 made the preparation of an EMOS a statutory requirement. Every EMOS that had been accepted or approved (except for mines operating under Special Agreement Acts) were validated by s.585 of the EP Act. Also in 1995, the Minister for Mines and Energy was prevented from accepting the surrender of a mining lease, unless the Minister was satisfied that the holder had satisfactorily rehabilitated the land (s. 309(5) of MR Act).

Rehabilitation completed prior to 2001 would generally not be assessed against the current legislation or the policy position proposed in this guideline. Where rehabilitation was completed prior to the preparation of an accepted EMOS or EM plan, the rehabilitation requirements may have been in:

- the instrument of lease;
- special conditions imposed by the minister at grant, renewal or assignment;
- a direction by the Minister for Mines under s. 309(3) of the MR Act; or
- a decision of the Mining Warden.

Between 1992 and 1996, almost every mining project prepared an EMOS. Most will have identified at least one rehabilitation objective (typically low intensity grazing), but few will have established indicators that can be used to measure the success of the rehabilitation and even fewer will have any specific completion criteria.

Where there is a clear intention for the rehabilitation to achieve a specified objective, the administering authority will consider applications for surrender or progressive certification from the environmental authority holder on the basis of that objective. The application must show how the holder has rehabilitated the site to achieve the objective, and provide evidence to support the success of the rehabilitation. This success must be demonstrated for the four rehabilitation goals described in Section 3.1 above (and any other site specific goals that are appropriate). The application must also be accompanied by an environmental risk assessment consistent with s.266G(2) or s.274(2) of the EP Act.

As the overall rehabilitation objective for these mining projects is likely to be some form of agreed post-mining land use, the environmental authority holder will be expected to demonstrate that the land use has been established and is sustainable. If on-going maintenance needs are likely (above the level that would typically be required for the specified land use in that locality), an explanation of how the holder intends to fund those costs is required.

A site that is unsafe (or is likely to become unsafe because of stability issues) would not be accepted as adequately rehabilitated. Similarly a site that is causing, or likely to cause, material or serious environmental harm (e.g. water pollution) would not be accepted as being successfully rehabilitated. If an environmental risk assessment shows that the risk cost of the rehabilitation failure exceeds the threshold set by the administering authority (currently $5000), the applicant will be required to nominate an appropriate amount as the residual risk payment. A site that is likely to require on-going maintenance would not normally be accepted without a fully funded maintenance program.

8.2 Mines without clear rehabilitation objectives

The rehabilitation requirements that applied at the time the rehabilitation was completed will be considered. However, if those requirements do not clearly define rehabilitation objectives, the environmental authority holder should apply to amend the environmental authority to define rehabilitation objectives, indicators and completion criteria for the site that are consistent with the four rehabilitation goals described in Section 3.1 above. Public notice of this application will be required and public objection rights will apply to any new rehabilitation objectives and any associated amendments that are likely to cause a significant increase in environmental harm. Approval of any amendment application will be required before an application for surrender or progressive certification of rehabilitated areas can be decided. An application that provides a strategy to ensure that the proposed future land use will be adopted would reduce some of the uncertainty that may delay decision making.

An environmental risk assessment and residual risk calculations must also be included with the application. If the rehabilitation meets the rehabilitation requirements that were in place at the time the rehabilitation was completed and there is an acceptably low risk of environmental harm occurring from the site, a certification application should be accepted. Acceptance of a surrender application may require lodgement of an appropriate residual risk payment.

9 References

ANZMEC 2000. *Strategic Framework for Mine Closure*. Australian and New Zealand Minerals and Energy Council and Minerals Council of Australia. Canberra, ACT.

ANZECC 2000. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand. Canberra, ACT.

COA 1992. *National Strategy for Ecologically Sustainable Development.* AGPS, Canberra ACT.

CSIRO 1998. *A guidebook to environmental indicators*. CSIRO, Canberra, ACT.

DITR 2006. *Community Engagement and Development*. Leading Practice Sustainable Development Program for the Mining Industry, Department of Industry, Tourism and Resources, Canberra, ACT.

DME 1995. *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland*. Department of Minerals and Energy, Brisbane, Queensland.

ICMM 2005. *Financial Assurance for Mine Closure and Reclamation*. International Council on Mining and Metals, London, UK.

MCA 2004. *Enduring Value, the Australian Minerals Industry Framework for Sustainable Development*. Minerals Council of Australia, Canberra, ACT.

Nichols, O. G. 2004. *Development of rehabilitation completion criteria for native ecosystem establishment on coal mines in the Bowen Basin*. ACARP Project No. C12045, May 2004. Australian Centre for Mining Environmental Research, Kenmore, Queensland.

QMC 2001. *Guidelines for planning mine closure in Queensland.* Queensland Mining Council Brisbane.

Tongway, D., Hidley, N., Mulligan, D., Seaborn, B. and Jasper, D. 2003. *Indicators of ecosystem rehabilitation success: Stage two – Verification of EFA indicators, Final Report*. Australian Centre for Mining Environmental Research, Kenmore, Queensland.

UNEP 2002. *Berlin II. Guidelines for Mining and Sustainable Development*. United Nations,

10 Further information

The latest version of this publication can be found at <www.ehp.qld.gov.au> using the publication number EM1122 as a search term.

Disclaimer

While this document has been prepared with care it contains general information and does not profess to offer legal, professional or commercial advice. The Queensland Government accepts no liability for any external decisions or actions taken on the basis of this document. Persons external to the Department of Environment and Heritage Protection should satisfy themselves independently and by consulting their own professional advisors before embarking on any proposed course of action.

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Appendix A – Examples of possible rehabilitation objectives, indicators and completion criteria

REHABILITATION GOAL	POSSIBLE REHABILITATION OBJECTIVES	POSSIBLE INDICATORS	NATURE OF COMPLETION CRITERIA
Long-term safety	Site is safe for humans and animals now and in the foreseeable future	• Safety assessment of openings	• Certification in rehabilitation report that openings are now safe and will remain so
		• Safety assessment of slopes that are >30° and >5m in height	• Certification in rehabilitation report that slopes are safe and predictions about future safety
		• Exposure to and availability of heavy metals and other toxic materials (selected because of relevance to site)	• Certification in rehabilitation report that specified cover thickness (and/or other specific criteria) is in place and predictions about future changes • Evidence in rehabilitation report that dust monitoring results have complied, and will continue to comply, with limits (derived from EPP Air or other agreed reference source)
			• Evidence in rehabilitation report that measures required in site investigation report have been implemented • Leaching tests of exposed material meet specified guideline values (using standard protocols such as US EPA Toxic Characteristic Leaching Procedure) • Evidence that monitoring surface water quality for [X] years has complied with specified guideline values (derived from ANZECC 2000 or agreed reference source) • Site management plan to include measures for fire reduction and to control woody weeds
		• Adequacy and predicted long-term performance of safety barriers	• Evidence in rehabilitation report that adequate safety plan has been implemented
Non-polluting	Hazardous material adequately managed	• Technical design of capping	• Engineers certification of construction and maintenance to design performance stated in environmental authority or EM plan
			• Evidence that X years monitoring data demonstrates that capping is

REHABILITATION GOAL	POSSIBLE REHABILITATION OBJECTIVES	POSSIBLE INDICATORS	NATURE OF COMPLETION CRITERIA
			functioning according to environmental authority
		• Results of site investigation report	• Removed from Environmental Management Register or Adequate funds to implement approved site management plan
	Acid mine drainage will not cause serious environmental harm	• Technical design of barriers	• Engineers certification of construction and maintenance to specified design performance
	(a) by excluding water and/or air from sulphides		
	Or	• Hydrostatic head / temperature in waste rock piles	• Certification that monitoring data show no unexpected rise of water levels or temperature
	(b) by implementing a treatment system to remove acidity	• Downstream surface/groundwater monitoring	• Certification in rehabilitation report that water neutralisation system is meeting and will continue to meet design requirements
	Polluted water contained on site	• Downstream surface/groundwater monitoring	• Certification that water diversion/containment structures to minimise quantities of polluted water and containing it on site are effective • Certification that monitoring data meet specified criteria relevant to potential contaminants
Stable	Very low probability of subsidence or rock falls with serious consequences (link to environmental harm?)	• Geotechnical studies of existing structures, underground workings, high walls or voids	• Evidence in rehabilitation report that appropriate risk assessment has been undertaken and control measures are in place
		• Past record of subsidence or rock falls in this mine	• Evidence in rehabilitation report that appropriate control measures are in place to prevent recurrence
	Very low probability of slope slippage with serious consequences (link to environmental harm?)	• Geotechnical, geochemical and hydrological studies of existing structures (outer batter slopes of waste rock dumps & tailings storage facilities)	• Evidence in rehabilitation report that appropriate risk assessment has been undertaken and control measures are in place that will continue to meet agreed requirements

REHABILITATION GOAL	POSSIBLE REHABILITATION OBJECTIVES	POSSIBLE INDICATORS	NATURE OF COMPLETION CRITERIA
		• Past record of slope failure in this mine	• Evidence in rehabilitation report that appropriate control measures are in place to prevent recurrence
	Landform design achieves appropriate erosion rates	• Slope angle and length	• Slopes <12o (or other value determined for particular waste material and climate)
		• Engineered structures to control water flow	• Evidence in rehabilitation report that required contour banks, channel linings, surface armour, engineered drop structures, etc are in place and functioning
		• Rate of “soil” loss	• Evidence in rehabilitation report that measured erosion rates meet limits set from reference sites, regional studies or by agreement (e.g. derived from in situ trials or calculated from Universal Soil Loss Equation or similar agreed method)
	Vegetation cover to minimise erosion	• Vegetation type and density	• Evidence that the vegetation type and density are of species suited to the spoil/waste composition, slope, aspect, climate and other factors, and that the measured erosion rates meet the limits set (only relevant to stability where root systems are a major control of erosion).
		• Foliage cover	• Evidence that the percent cover meets the set values based on the regional assessment of cover requirements (Note: Values in excess of 70% are typically needed to protect surface soils from rain-induced erosion. In arid areas achievable values are likely to be much lower (perhaps less than 50%) and in high rainfall areas the values may be higher).
		• Leaf litter, humus, depth of growing medium	• Evidence that nutrient cycling is occurring and the presence of leaf litter is assisting in limiting erosion of the soil/spoil surface.

REHABILITATION GOAL	POSSIBLE REHABILITATION OBJECTIVES	POSSIBLE INDICATORS	NATURE OF COMPLETION CRITERIA
Sustainable land use	Soil properties that support and will continue to support desired land use (The soil indicators are less likely to be used for completion criteria than as planning tools to improve chances of other outcomes being achieved)	• Chemical properties (e.g. pH, salinity, nutrients, trace elements) of topsoil and in soil profiles that are within range of roots of proposed vegetation	• pH in range 5.0 to 8.5 (narrower range if necessary to achieve specific outcomes or broader range depending on local conditions) • Salinity < 0.2% chloride (lower levels if necessary to achieve particular outcome or broader range depending on local conditions). • Evidence that highly saline material should not be used as surface cover or potential growth medium
		• Physical properties (e.g. depth of top soil, water infiltration, crusting, slope)	Limits set from reference sites, regional studies or agreed conditions (e.g. derived from trials)
		• Biological properties (e.g. nutrient cycling, microbial biomass, invertebrates)	• (Completion criteria for such indicators may require site trials because they will be specific to the site)
	Establish specified self sustaining natural vegetation or habitat	• Presence of key species • Species type and diversity • Abundance of weeds	• Certification that key species are present • Certification that species diversity achieved • Certification that weed management successful
	Establish specified water body with low risk of environmental harm	• Hydrological studies to establish water levels and connectivity • Water quality established by monitoring or modelling validated by monitoring • Structural report on integrity of structure	• Certification that water body will not overflow in 1:100 ARI event (or less frequent event if containing hazardous material) • Monitoring specified contaminants (e.g. pH, As, cyanide) for X years • Meets specified water quality guidelines • Hydrologists report • Engineers certification of structure
	Establish land use with comparable management requirements to similarly used non-mined land.	• Crop productivity • Achieve agreed capability distribution	• Meets specified yield (e.g 90% of unmined land or 20% of unmined land)

Appendix B – Definitions

Term	Definition
Appropriately qualified person	The person or persons should have qualifications and/or experience that are relevant to aspects of the rehabilitation so they can give an authoritative assessment of the performance of that aspect of the rehabilitation, especially in relation to the completion criteria.
Completion criteria	These are the standards that are to be met by successful rehabilitation. They will generally be in the form of numerical values that can be verified by measurement of the indicators selected for the rehabilitation objectives. They may include an element based on time, e.g. the criterion has been achieved for 7 consecutive years for 95 percent of the area.
Consultation	The act of providing information or advice for, and seeking responses to, an actual or proposed event, activity or process.
Domain	Land management units within a mine site, usually with similar geophysical characteristics. Some examples of typical domains include: • Mine pit • Waste rock piles • Tailings dam • Infrastructure area Within domains, elements may be designated where different rehabilitation techniques and/or timing of work is required, e.g. an access road
EA	Environmental authority
EM plan	Environmental management plan
Environmental hazards	These are chemical, physical or biological changes that may cause environmental harm to one or more environmental values.
Goals	These are the policy objectives for rehabilitation that are set (often informally) by Government.
Indicator	An indicator is something that can be measured and audited according to an established protocol and used to evaluate changes in a system.
Land capability class	Classification of the capacity of land to achieve and sustain specified land uses. Class I land is capable of supporting most agricultural and grazing activities whilst class VIII land imposes severe limitations on agricultural or grazing uses. “Average” management inputs are assumed.
Objectives	The end points that rehabilitation aims to achieve. They may be described

Term	Definition
	in terms of future land use, biodiversity values, conservation values, health and safety outcomes, aesthetics or social outcomes or combinations of these.
Rehabilitation	Rehabilitation is the process of making a former mine site safe, stable and self-sustaining. Note: This usage is far broader than rehabilitation's literal meaning of re-establishing former condition or effectiveness. While it may be appropriate to attempt to restore the pre-mining conditions after mining has ceased for some smaller mines and mines in areas with special values, this may not be possible or an optimum result across mine sites particularly in specific domains.
Residual risk	Residual risk is defined in schedule 4 of the EP Act to include the risk that: • apparently satisfactory rehabilitation will fail in the foreseeable future and require repair, replacement or maintenance; • the area will need ongoing management; or • contaminants will be released and potentially cause environmental harm that requires monitoring or management.
Stable	Resistant to change in landform, pollution generation or land use potential to an extent that is similar to unmined land in the locality. The acceptable rates of change of specified parameters or the maximum risk of specified environmental harm may be set in an environmental authority.
Stakeholder	A person or organisation that is potentially affected by a decision, such as a resident, land owner, community group, government agency, company, traditional owner, or environmental group.
Suitably qualified person	A person whose professional training or experience is relevant to the matter being considered.

Appendix B. Documents Received & Reviewed

- Tick Hill Gold Project Impact Assessment Study Report (Kinhill Cameron McNamara, 1991)
- *Compliance program - inspection checklist* (Environmental Protection Agency Queensland, 1995)
- Tick Hill Gold Project Environmental Audit Report (XMIM, 1995)
- Tick Hill Gold Project Final Plan of Operations (Dames & Moore, 1999)
- *Field Inspection Report - Tick Hill* (Environmental Protection Agency Queensland, 2000)
- Code of environmental compliance for Mining Lease Projects January 2001 - Version 0 (Queensland Department of Environment and Heritage Protection, 2001)
- Tick Hill Gold Project Environmental Assessment (XMIM, 2004)
- Facility Closure Guideline (Xstrata Copper, 2007)
- *Compliance program - inspection checklist* (Environmental Protection Agency Queensland, 2008)
- Tick Hill Audit Statement - Plan of Operations (XMIM, 2012)
- *Rehabilitation requirements for mining projects - EM1122* (Queensland Department of Environment and Heritage Protection, 2012)

Appendix C. Preliminary Gap Analysis

Tick Hill Mine Closure Checklist: Contaminated Land

Stage	Stage Objectives	Key Documents	Key Stakeholders Discussions		Evidence of Works/Reports/Discussions
Closure Planning	· Identification of contamination source types and areas including development of a mine site contaminated sites register · Investigation of sites on contaminated sites register to assess and delineate soil (and potentially) groundwater contamination · Meet with the client and key stakeholders to identify remedial works expected to be required to achieve the post mining land use based on identified contamination. · For contamination expected to exceed guidelines post remediation, undertake a site-specific risk assessment to determine site-specific remedial targets · Agree on remedial targets with key stakeholders (including future land users and the regulator) including obtaining site-specific advice where required · Submission of a draft Remediation Plan including Remedial targets for stakeholder comment · Finalisation of Remediation Plan and inclusion into the Site Closure Plan	Stage 1 Site History Investigation Stage 2 Closure Assessment - contaminated sites Risk Assessment for derivation of remedial targets Remediation Plan/Remediation options study Independent auditor report (if used) Groundwater monitoring events Statutory declaration by SQP for relevant reports	Future land use agreement (regulator/future owner) Remediation options agreement (regulator) Remediation targets to support future land use (regulator)		No information in regards to former locations of contaminating activities (including potential contaminants on file) i.e. no site history. No closure assessments on file. A closure plan was prepared by Dames and Moore in 1993/1994. This plan has been lost. Amendments to the plan in regards to rehabilitation of some areas i.e. tailings dam are on file. Approval by DPI of D&M tailings dam closure plan on file. No agreement of remediation targets on file. No statutory declaration from a SQP on file. No evidence of use of an independent auditor.
Closure	· Implementation of Remediation Plan · On-going dialogue with key stakeholders · Revisions to remediation plan as required · Audit of remediated areas · Integration of remedial and contamination works with engineering and capping works where possible to maximise efficiencies · Summary of remedial works in a Remediation Report	Progressive closure reports Risk Assessment for further derivation of remedial targets (if required) Remediation Report Independent auditor report (if used) Statutory declaration by SQP for relevant reports	Any modifications to remedial targets/closure plan (regulator/future owner)		No evidence of works being undertaken in accordance with the closure plan i.e. No closure/decommissioning report on file. No statutory declaration from a SQP on file. Agreement from future lessee on assets to remain on file.
Post Closure	· Finalisation and implementation of Management Plans for areas requiring on-going management · Implementation of Management Plans including on-going monitoring and regular inspections. · Independent audits · Submission of key reports to stakeholders	Management Plan (on-going site use) Post closure monitoring Post closure audits Statutory declaration by SQP for relevant reports	On-going discussions with regulator Discussions with future owner (if required)		Audits undertaken by regulator on file. Audits appear to be compliance/H&S orientated - unsure what the purpose of these audits was besides compliance with current authority Monitoring/assessment undertaken in 2012 by Xstrata. Soil sampling locations unknown as well as the purpose of this monitoring/assessment. Groundwater monitoring data - unsure of relevance, spatial distribution, analytes, how the data relates to groundwater - void models No statutory declaration from a SQP on file

Tick Hill Mine Closure Checklist: Ground Water

Stage	Key Information Required	Evidence of Works	Key Gaps Identified	Works Suggested
Closure Planning	Determine the spatial distribution and temporal variations of groundwater levels across the site, including within the underground workings, to identify any impacts from the void, tailings dam and decant pond	2 monitoring bores with sporadic groundwater level data	The number of groundwater monitoring bores and data collected are insufficient Due to the impermeable nature of the host rock and the faulting across the site, groundwater flow is likely to be structurally controlled with flow occurring almost exclusively along the faults and associated fractures. To assess the potential impact of mining activities and site infrastructure, the groundwater in these structural features should be examined. The locations of any future monitoring bores must therefore target these structural features, to adequately characterise the groundwater levels across the site.	Expand the current monitoring bore network to define the spatial distribution and temporal variations of groundwater levels, and collect additional data, including within the structural features
	Determine the spatial distribution and temporal variations of groundwater quality across the site, including within the underground workings, to identify any impacts from the void, tailings dam and decant pond	2 monitoring bores with sporadic groundwater quality data	The number of groundwater monitoring bores and data collected are insufficient The higher pH values in July 2004 may be indicative of a faulty electronic meter. Bore purge sheets from 2012 have a discrepancy between the pumping rate, pumping duration and total volume purged. Due to the impermeable nature of the host rock and the faulting across the site, groundwater flow is likely to be structurally controlled with flow occurring almost exclusively along the faults and associated fractures. To assess the potential impact of mining activities and site infrastructure, the groundwater in these structural features should be examined. The locations of any future monitoring bores must therefore target these structural features, to adequately characterise the groundwater levels across the site.	Expand the current monitoring bore network to define the spatial distribution and temporal variations of groundwater quality, and collect additional data, including within the structural features Review sampling protocols and follow a suitable groundwater sampling guideline such as Geoscience Australia 2009.
	Define the lower and upper background limits for hydrochemical parameters		Lower and Upper Background limits of groundwater quality parameters	Review groundwater quality data to establish lower and upper background limits for relevant parameters, to enable future
	Determine the aquifer properties		Aquifer properties	Conduct slug or pumping tests in bores to determine the aquifer properties hydraulic conductivity and storativity
	Develop a conceptual hydrogeological model, including the influence of structural features on		Conceptual Hydrogeological Model	Collate and synthesise all hydrogeological data to develop a conceptual hydrogeological model, enabling the interactions
	Prepare a current site water balance		Numerical groundwater flow model	Based on conceptual model, incorporate rainfall, runoff and groundwater data to prepare a site water balance through
	Examine the changes to groundwater hydrochemistry		Analytical model	Based on conceptual and numerical model, assess changes to groundwater hydrochemistry through analytical modelling
Post Closure	Expanded groundwater monitoring network and ongoing monitoring program for groundwater levels and quality			

Tick Hill Mine Closure Checklist: Geotechnical

Summary

The global stability of the waste rock dump, tailings dam and decant pond seem fine. There were no signs of instability (bulging toe, slumping, tension cracks on or behind the crest). This important point can be

Waste rock dump

Scour/erosion is currently a minor issue. Technically, DEHP can instruct XMIM to rectify this issue on the waste rock dump since the 1999 Plan of Operations clearly shows a contour profile in which all water on top of the waste rock dump will drain towards the channel which exits in the SW corner (I presume that's the same as the referenced Figure 3.1 from the 1994 Plan). There are 3 erosion/scour gullies in the northern batter which means the water does not drain as per the plan. One is 0.5 m to 1.0 m deep. That is

Potential solutions are to:

- Do the same as what was done in the SE corner and southern batters (i.e. fill void with dumped rock and build up a small bund at the crest to prevent water from flowing over and scouring the batter), or
- Line the scouring and vegetate as shown in:
  - http://www.maccaferri-

The drainage path / creek near the toe of the western batter is scouring over time. The western creek bank is at 1V:1.5H and the eastern creek bank is subvertical and approximately 1 m high. Whilst it will present an issue at some stage to the stability of the eastern face of the creek bank at some point, it should not affect

Tailings dam

It appears to be performing as planned.

Decant pond

The batters are stable and the drainage path of the surface water appears to be in general accordance with the 1999 Plan of Operations Figures. Global stability is fine.

The only potential issue from DEHP is two scoured channels on the western batter. They are located approximately half way along the length of the western batter and are approximately 0.5 m deep and 1 m wide. It shows that flows tend to concentrate here.

I think the best solution would be to line these channels with Biomac (reference above) or similar and vegetate to greatly reduce / stop further scour.

Tick Hill Mine Closure Checklist: Ecology

Terrestrial ecology component is OK.

The DEHP may want data from sometime in between 2012 and 1999 but we should be able to discuss/negotiate this with 2012 dry and wet season data.

Tick Hill Mine Closure Checklist: Soils / Landform

Landform component is OK.

The DEHP may want data from sometime in between 2012 and 1999 but we should be able to discuss/negotiate this with 2012 dry and wet season data.

Soils appears OK at this point. There may be some minor works required, but generally this could be incorporated into future Contam Lands/ground Water works, so would unlikely be a stand-alone cost.

Appendix D. Field Data Summary – Flora

Plant frequency per 10m^2

	August 1999	October 2012
Survey location	Mean (Std. Dev.)	Mean (Std. Dev.)
Colluvial slope	89.3 (48.7)	64.3 (17.6)
Plains	238.7 (21.4)	105.3 (42.7)
Rock dump	82.0 (21.9)	26.3 (12.1)
Mine infrastructure area	No data	44 (7.8)
Tailings dams	69.0 (72.2)	25 (6.1)

Species richness

	August 1999	October 2012
Survey location	Mean (Std. Dev.)	Mean (Std. Dev.)
Colluvial slope	9.3 (3.5)	8 (0)
Plains	11.3 (3.1)	6.7 (2.5)
Rock dump	4 (2)	2 (1)
Mine infrastructure area	No data	2.3 (1.2)
Tailings dams	3.3 (0.6)	2 (1)

Percentage cover

	August 1999	October 2012
Survey location	Mean (Std. Dev.)	Mean (Std. Dev.)
Colluvial slope	58.6 (5.6)	54 (5.6)
Plains	74.3 (11.6)	24.7 (16.4)
Rock dump	43.3 (13.6)	42 (5.6)
Mine infrastructure area	No data	43 (10.5)
Tailings dams	69 (7)	76 (20.1)

October 2012

Location	Cover (%)		Plant frequency in 10m^2	Species richness (#)	Photo
	Bare	Cover (live + dead)			
Colluvial slope	48	52	74	8	
	34	66	44	8	
	29	71	75	8	
Plains	90	10	130	4	
	63	37	56	7	
	61	39	130	9	
Rock dump	40	60	40	2	
	58	42	17	3	
	58	42	22	1	

Location	Cover (%)		Plant frequency in 10m^2	Species richness (#)	Photo
	Bare	Cover (live + dead)			
Mine infrastructure area	50	50	40	3	
	42	58	39	1	
	58	42	53	3	
Tailings dams	33	67	29	3	
	7	93	28	2	
	30	70	18	1	

March 2013

Location	Cover (%)		Photo
	Bare	Cover (live + dead)	
Colluvial slope	51	49	
	40	69	
	47	53	
Plains	94	6	
	69	31	
	63	37	

Location	Cover (%)		Photo
	Bare	Cover (live + dead)	
Rock dump	52	48	
	63	37	
	59	41	
Mine infrastructure area	67	33	
	42	58	
	46	54	

Location	Cover (%)		Photo
	Bare	Cover (live + dead)	
Tailings dams	43	57	
	3	97	
	26	74	

Appendix E. Benchmark Data for RE1.11.3

BioCondition Benchmarks for Regional Ecosystem Condition Assessment

Benchmarks are quantitative values derived from reference sites for each condition attribute assessed in BioCondition, and are used as a reference value for comparison purposes. Benchmarks have been developed from information published by the State of Queensland (acting through the Department of Environment and Resource Management, the Department of Employment, Economic Development and Innovation and the Commonwealth Scientific and Industrial Research Organization). They have been developed primarily to be used with the condition assessment tools, BioCondition (Eyre *et al.* 2011), the Delbessie Agreement Guidelines for Determining Lease Land Condition (State of Queensland, Department of Environment and Resource Management 2009), the Queensland Biodiversity Offset policy and the Vegetation Management Offset policy. Benchmarks are subject to regular review based on additional data and expert opinion.

The benchmarks are compiled using site survey data from the Queensland Herbarium's CORVEG database and quantitative site data from reference sites and are summarized to provide information specific to each regional ecosystem vegetation community. BioCondition benchmarks aim to reflect the natural variability in structure and floristic composition under a range of climatic and natural disturbance regimes throughout the geographic extent of a RE. Local reference sites should be assessed where possible to account for this spatial and temporal (seasonal and annual) variability.When conducting BioCondition assessments, the technical descriptions, if available, should be used in conjunction with the benchmarks and the regional ecosystem description database (REDD) for the specific regional ecosystem.

In rangeland ecosystems, seasonal conditions can account for wide variation in the values obtained for some attributes assessed in BioCondition. Therefore in these ecosystems a range is expressed instead of a single benchmark value. When using rangeland regional ecosystem benchmarks to assess condition, the lower value of the benchmark range can be used as the benchmark, or if assessing a site under good seasonal conditions then use of the average value as the benchmark.

Definitions

Attribute	Brief description
Recruitment of dominant canopy species	Proportion of the dominant canopy (ecologically dominant layer) species with evidence of recruitment.
Native plant species richness	The number of species expected in four life form groups, i.e. tree, shrub, grass, forbs and other species
Tree strata: • Canopy • Sub-canopy • Large trees	• *Height* – median height in metres • *Cover* - percentage cover (assessed as opaque crowns) • *DBH (Diameter at Breast Height)* – For large trees only; dbh threshold (cm). • *Typical tree species for benchmark sites*
Shrub strata: • Native shrub cover	• *Cover* - percentage cover (assessed as opaque crowns) • *Typical shrub species*
Ground cover: • Native perennial grass cover • Litter cover	• *Cover* – percentage cover (assessed as projected foliage cover) • *Typical ground cover species*
Coarse woody debris	• Total length in metres of woody debris > 10 cm diameter and > 0.5 m per hectare
Non-native plant cover	• *Cover* – The percentage cover of non-native plants • *Typical non-native species* listed with common names and declared pest status[1]

Conditions of use

BioCondition benchmarks have been developed from information published by the State of Queensland (acting through the Department of Science, Information Technology, Innovation and the Arts) and remain the property of the State of Queensland. BioCondition benchmarks are not to be included on internet sites other than the departmental website.

Users should reference information contained in the BioCondition benchmarks as: Queensland Herbarium (year*) BioCondition benchmarks of Regional Ecosystems, (month, year*) (Department of Science, Information Technology, Innovation and the Arts: Brisbane). * Date shown in footnote of individual descriptions.

While every effort has been made to ensure the information presented is as reliable as possible, the State of Queensland accepts no liability and gives no assurance in respect of its accuracy and shall not be liable for any loss or damage arising from its use. BioCondition benchmarks are based on a combination of quantitative and qualitative information and should be used as a guide only. BioCondition benchmarks are subject to review and are updated as additional data becomes available.

For more information, contact:

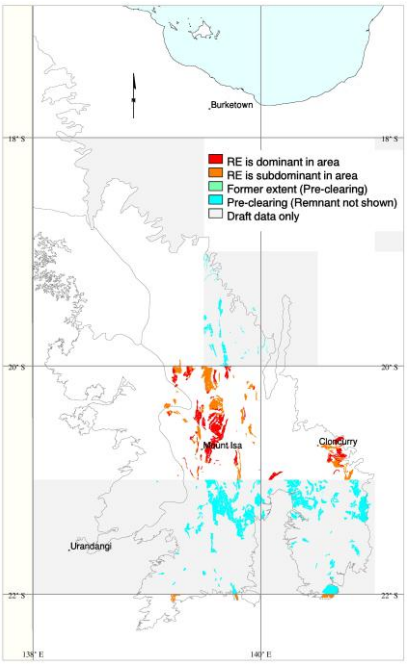
Annie Kelly, Queensland Herbarium, Science Delivery, DSITIA
Brisbane Botanic Gardens (Mt Coot-tha), Mt Coot-tha Road, Toowong QLD 4066

[1] **Declared**—either:
a) a plant or animal species listed in Schedule 2 of the Land Protection (Pest and Stock Route Management) Regulation 2003; or b) an exotic plant that is listed in a local government pest management plan.

BioCondition benchmark for regional ecosystem condition assessment

Northwest Highlands — Regional ecosystem: 1.11.3

Corymbia terminalis low open-woodland on basic metamorphics



Dan Kelman

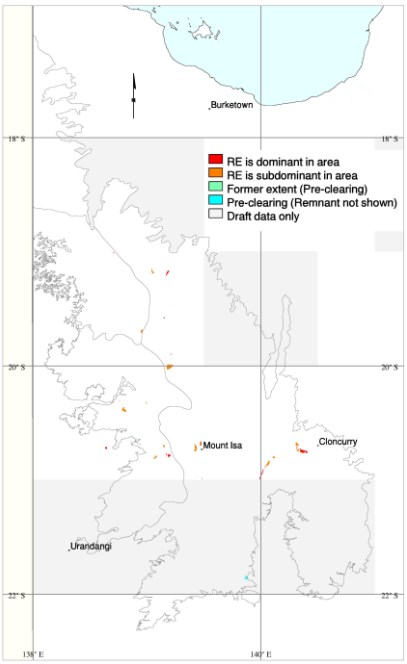
BioCondition attribute			Benchmark
Recruitment of dominant canopy species (%):			100
Native plant species richness:		Tree:	1-9
		Shrub:	1-14
		Grass:	2-11
		Forbs and other:	4-20
Trees:	Tree canopy	Tree canopy median height (m):	3-10
		Tree canopy cover (%):	2-29
	Tree sub-canopy	Tree sub-canopy median height (m):	na
		Tree sub-canopy cover (%):	na
	Large trees	Large eucalypt tree dbh threshold (cm):	30
		Number of large eucalypt trees per hectare:	no data
		Large non-eucalypt tree dbh threshold (cm):	20
		Number of large non-eucalypt trees per hectare:	no data
Shrubs:		Native shrub cover (%):	0-85
Ground cover (%):		Native perennial grass cover (%):	10-91
		Organic litter cover (%):	0-20
Coarse woody debris: Total length (m) of debris ≥ 10cm diameter and ≥0.5m in length per hectare:			no data
Non-native plant cover			0
None listed			

Selected typical species are those that characterize the ecosystem, community or stratum at reference sites. Up to five frequently occurring species for each stratum are selected. Users should refer to the regional ecosystem description database (REDD) and/or the technical description for more complete lists of characteristic species. Only the most frequently used common name is given. Other common names may be used in other regions. Declared pest species in Queensland are designated (^).

BioCondition benchmark for regional ecosystem condition assessment

Northwest Highlands — Regional ecosystem: 1.11.3x1

Eucalyptus leucophylla low open-woodland on hills



BioCondition attribute			Benchmark
Recruitment of dominant canopy species (%):			100
Native plant species richness:		Tree:	1-4
		Shrub:	6-7
		Grass:	2
		Forbs and other:	6
Trees:	Tree canopy	Tree canopy median height (m):	5-6
		Tree canopy cover (%):	2
	Tree sub-canopy	Tree sub-canopy median height (m):	na
		Tree sub-canopy cover (%):	na
	Large trees	Large eucalypt tree dbh threshold (cm):	30
		Number of large eucalypt trees per hectare:	no data
		Large non-eucalypt tree dbh threshold (cm):	20
		Number of large non-eucalypt trees per hectare:	no data
Shrubs:		Native shrub cover (%):	1.5
Ground cover (%):		Native perennial grass cover (%):	45
		Organic litter cover (%):	2
Coarse woody debris: Total length (m) of debris ≥ 10cm diameter and ≥0.5m in length per hectare:			no data
Non-native plant cover			0
None listed			

Selected typical species are those that characterize the ecosystem, community or stratum at reference sites. Up to five frequently occurring species for each stratum are selected. Users should refer to the regional ecosystem description database (REDD) and/or the technical description for more complete lists of characteristic species. Only the most frequently used common name is given. Other common names may be used in other regions. Declared pest species in Queensland are designated (^).

Appendix F. Geotech Site Photographs: Tailings Dam, Decant Pond, Waste Rock Dump

Appendix F. Site photographs - tailings dam, decant pond, waste rock dump

Tailings Dam

Tailings dam looking east from the NE corner

Tailings dam looking SW from the NE corner

Tailings dam looking W from NE corner

Tailings dam spillway crest looking E

Tailings dam looking towards the pit from W of the spillway crest

Tailings dam looking over the decant pond and towards the pit from the NW corner

Tailings dam looking W to NW from the NW corner

Tailings dam looking N to NE from the SW corner

Tailings dam looking E from the SW corner

Tailings dam looking SE from the SE corner

Tailings dam looking NW from the SE corner

Tailings dam looking E at the ex-MIA from midway along the E batter

Decant Pond

Decant pond looking NE from the NE corner

Decant pond looking SW from the NW corner

Decant pond looking NW from the NW corner

Waste Rock Emplacement

Waste rock emplacement SE corner looking W

Waste rock emplacement looking N from the NE corner

Waste rock emplacement looking E from the W batter crest

Waste rock emplacement looking S from W batter crest

Waste rock emplacement looking NE from SW corner

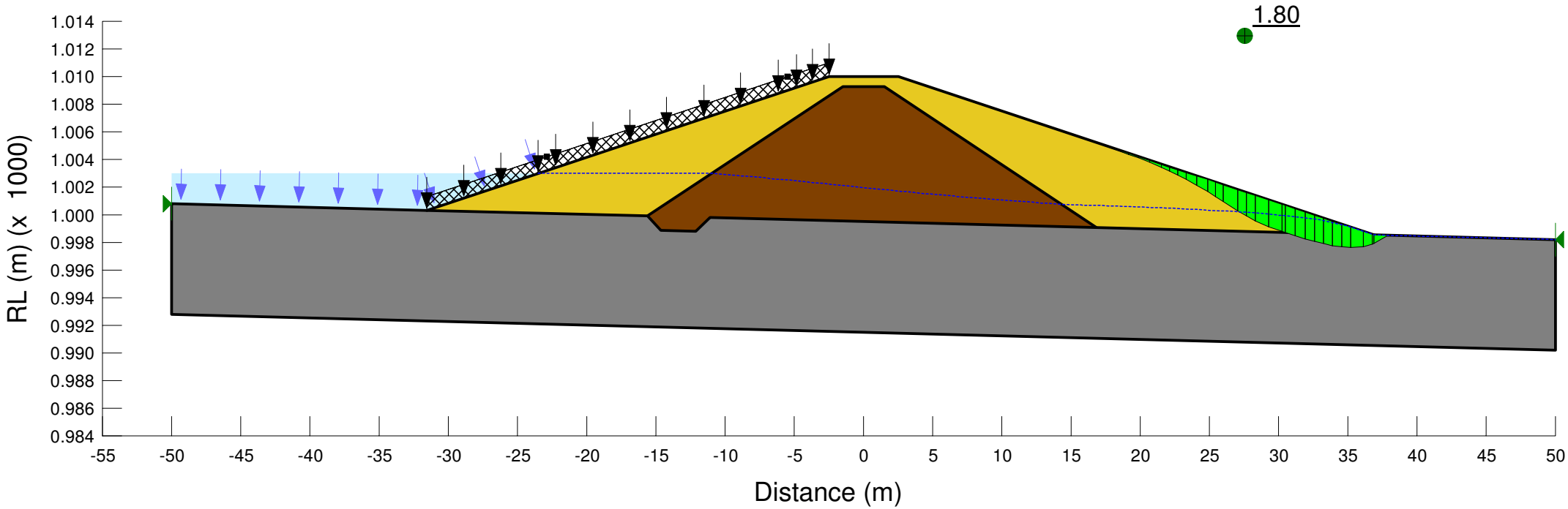
Waste rock emplacement S batter looking E

Waste rock emplacement S batter looking at rock placed in 2004 remedial works

Appendix G. Stability Analyses - Tailings Dam, Decant Pond, Waste Rock Dump

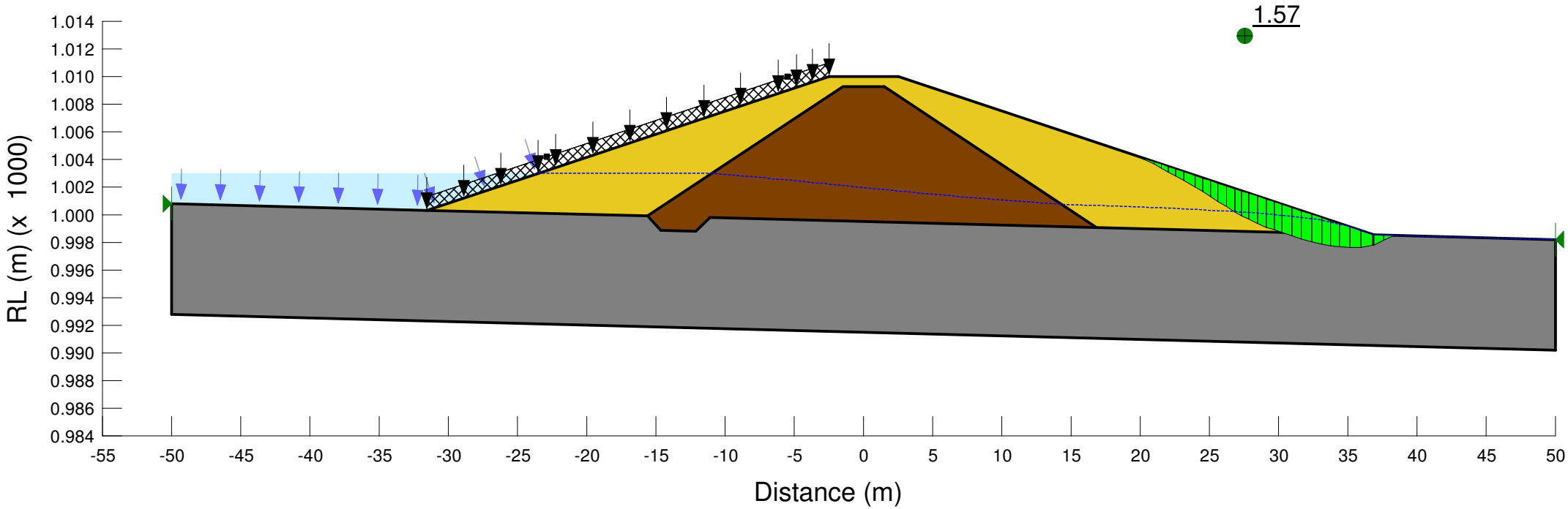
TICK HILL GOLD MINE TAILINGS DAM 10.5m HIGH 1V:3H SHOULDERS
LONG TERM STABILITY DOWNSTREAM

Name: Natural Ground (Drained) Model: Mohr-Coulomb Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 40 ° Phi-B: 0 °
Name: Shoulder (Drained) Model: Mohr-Coulomb Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 37 ° Phi-B: 0 °
Name: Clay Core (Drained) Model: Mohr-Coulomb Unit Weight: 18 kN/m³ Cohesion: 20 kPa Phi: 34 ° Phi-B: 0 °



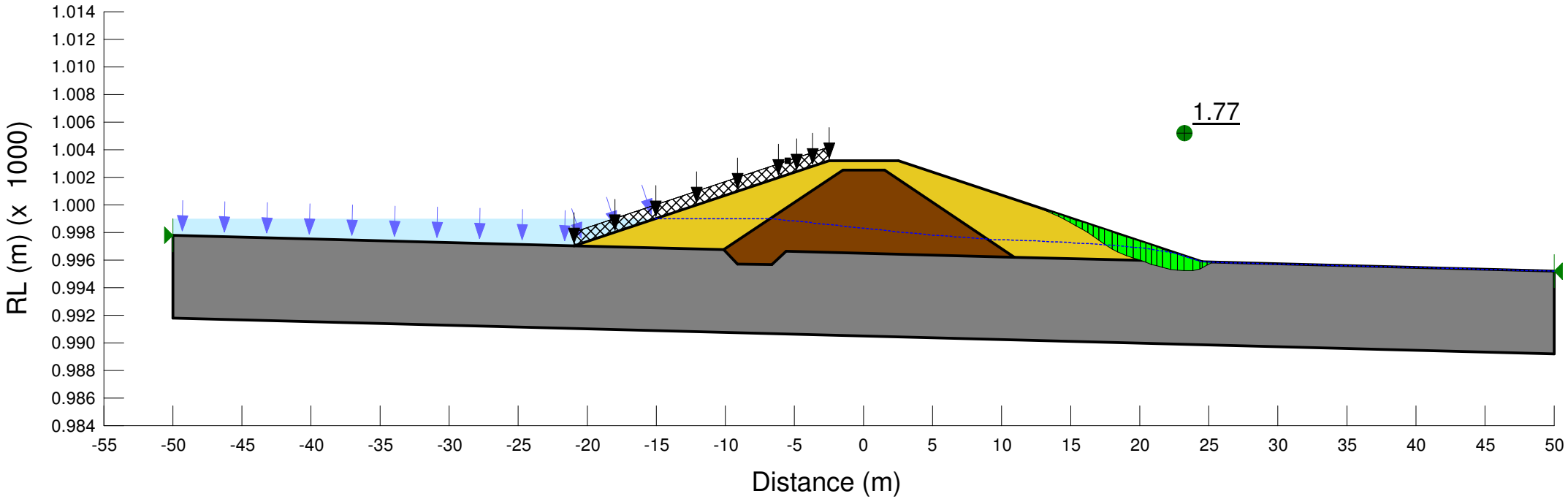
TICK HILL GOLD MINE TAILINGS DAM 10.5m HIGH 1V:3H SHOULDERS EARTHQUAKE STABILITY DOWNSTREAM

Name: Natural Ground (Drained) Model: Mohr-Coulomb Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 40 ° Phi-B: 0 °
Name: Shoulder (Drained) Model: Mohr-Coulomb Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 37 ° Phi-B: 0 °
Name: Clay Core (Drained) Model: Mohr-Coulomb Unit Weight: 18 kN/m³ Cohesion: 20 kPa Phi: 34 ° Phi-B: 0 °



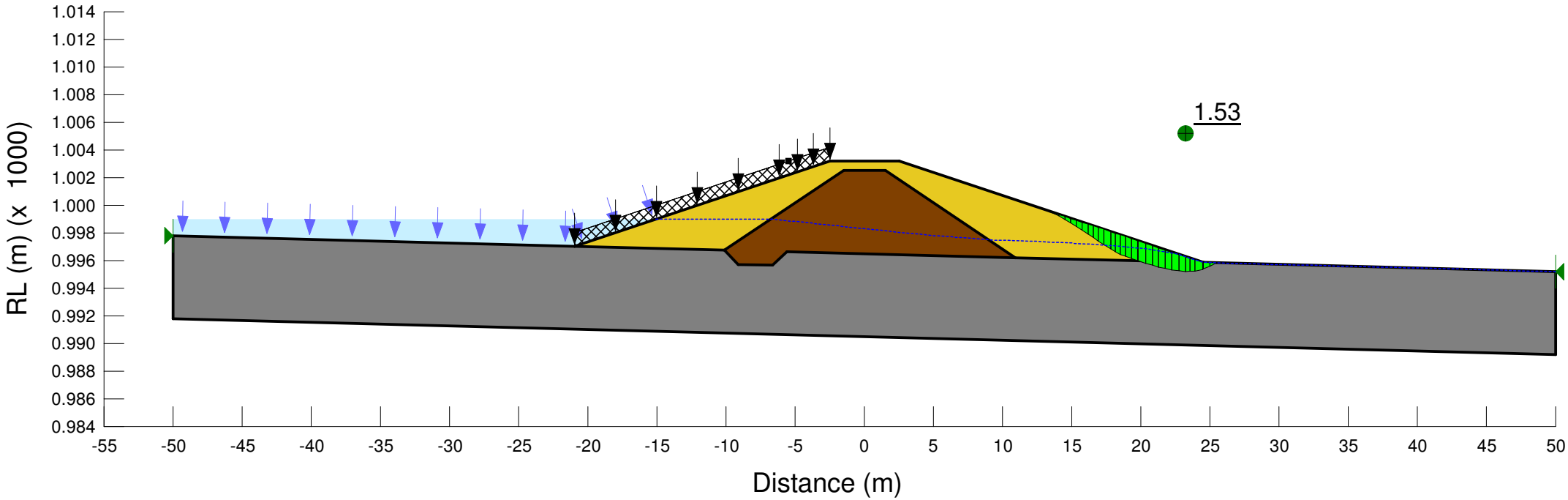
TICK HILL GOLD MINE DECANT POND 6m HIGH 1V:3H SHOULDERS
LONG TERM STABILITY DOWNSTREAM

Name: Natural Ground (Drained) Model: Mohr-Coulomb Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 40 ° Phi-B: 0 °
Name: Shoulder (Drained) Model: Mohr-Coulomb Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 37 ° Phi-B: 0 °
Name: Clay Core (Drained) Model: Mohr-Coulomb Unit Weight: 18 kN/m³ Cohesion: 20 kPa Phi: 34 ° Phi-B: 0 °



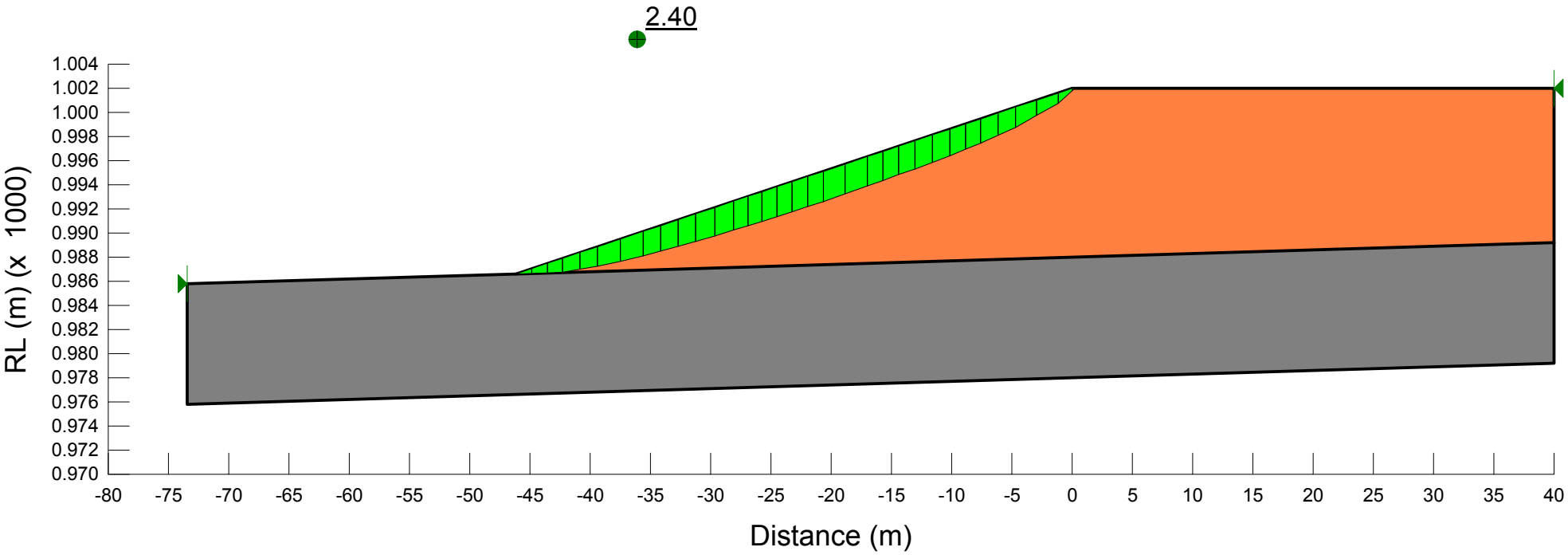
TICK HILL GOLD MINE DECANT POND 6m HIGH 1V:3H SHOULDERS EARTHQUAKE STABILITY DOWNSTREAM

Name: Natural Ground (Drained) Model: Mohr-Coulomb Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 40 ° Phi-B: 0 °
Name: Shoulder (Drained) Model: Mohr-Coulomb Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 37 ° Phi-B: 0 °
Name: Clay Core (Drained) Model: Mohr-Coulomb Unit Weight: 18 kN/m³ Cohesion: 20 kPa Phi: 34 ° Phi-B: 0 °



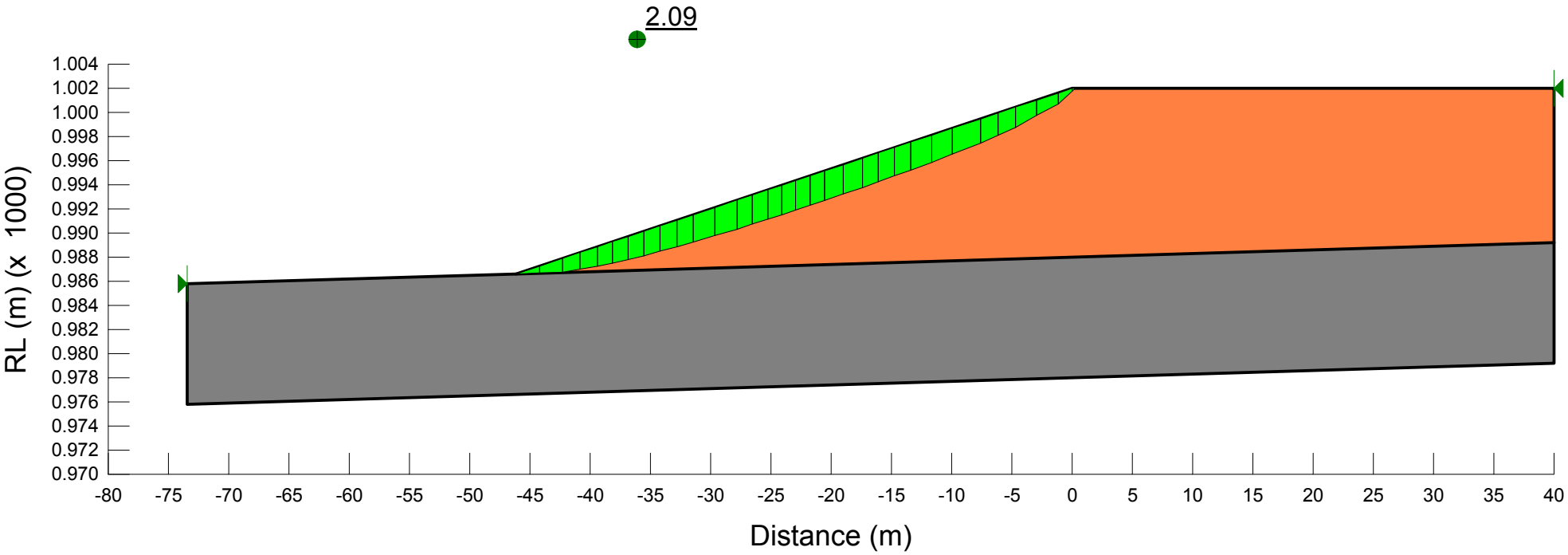
TICK HILL GOLD MINE WASTE ROCK EMPLACEMENT 14m HIGH 1V:3H BATTER LONG TERM STABILITY

Name: Natural Ground (Drained) Model: Mohr-Coulomb Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 40 ° Phi-B: 0 °
Name: Waste Rock (Drained) Model: Mohr-Coulomb Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 37 ° Phi-B: 0 °



TICK HILL GOLD MINE WASTE ROCK EMPLACEMENT 14m HIGH 1V:3H BATTER EARTHQUAKE STABILITY

Name: Natural Ground (Drained) Model: Mohr-Coulomb Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 40 ° Phi-B: 0 °
Name: Waste Rock (Drained) Model: Mohr-Coulomb Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 37 ° Phi-B: 0 °



Appendix H. Contaminated Land Checklist for Process to Closure

Tick Hill Mine Closure Checklist: Contaminated Land

Stage	Stage Objectives	Key Documents	Key Stakeholders Discussions		Evidence of Works/Reports/Discussions
Closure Planning	· Identification of contamination source types and areas including development of a minesite contaminated sites register · Investigation of sites on contaminated sites register to assess and delineate soil (and potentially) groundwater contamination · Client and key stakeholders to identify (and agree to) remedial works expected to be required to achieve the post mining land use based on identified contamination. · For contamination expected to exceed guidelines post remediation, undertake a site-specific risk assessment to determine site-specific remedial targets · Agree on remedial targets with key stakeholders (including future land users and the regulator) including obtaining site-specific advice where required · Submission of a draft Remediation Plan including remedial targets for stakeholder comment · Finalisation of Remediation Plan and inclusion into the Site Closure Plan	Stage 1 Site History Investigation Stage 2 Closure Assessment - contaminated sites Supporting investigations, hydrogeology, hydrology, limnology, water and salt balance models Risk Assessment for derivation of remedial targets Remediation Plan/Remediation options study Independent auditor report (if used) Groundwater monitoring events Statutory declaration by SQP for relevant reports	Future land use agreement (regulator/future owner) Remediation options agreement (regulator) Remediation targets to support future land use (regulator)		No information in regards to former locations of contaminating activities (including potential contaminants on file) i.e. no site history. No closure assessments on file. A closure plan was prepared by Dames and Moore in 1993/1994. This plan has been lost. Amendments to the plan in regards to rehabilitation of some areas i.e. tailings dam are on file. Approval by DPI of D&M tailings dam closure plan on file. No agreement of remediation targets on file. No statutory declaration from a SQP on file. No evidence of use of an independent auditor.
Closure	· Implementation of Remediation Plan · On-going dialogue with key stakeholders · Revisions to Remediation Plan as required · Audit of remediated areas · Integration of remedial and contamination works with engineering and capping works where posisble to maximise effeciencies · Summary of remedial works in a Remediation Report	Stage 1 Site History Investigation Stage 2 Closure Assessment - contaminated sites Risk Assessment for derivation of remedial targets Remediation Plan/Remediation options study Independent auditor report (if used) Groundwater monitoring events Statutory d	Any modifications to remedial targets/closure plan (regulator/future owner)		No evidence of works being undertaken in accordance with the closure plan i.e. No closure/decommissioning report on file. No statutory declaration from a SQP on file. Agreement from future lessee on assets to remain on file.
Post Closure	· Finalisation and implementation of Management Plans for areas requiring on-going management · Implementation of Management Plans including on-going monitoring and regular inspections. · Independent audits · Submission of key reports to stakeholders	Management Plan (on-going site use) Post closure monitoring Post closure audits Statutory declaration by SQP for relevant reports	On-going discussions with regulator Discussions with future owner (if required)		Audits undertaken by regulator on file. Audits appear to be compliance/H&S orientated - unsure what the purpose of these audits was besides compliance with current authority Monitoring/assessment undertaken in 2012 by Xstrata. Soil sampling locations unknown as well as the purpose of this monitoring/assessment. Groundwater monitoring data - unsure of relevance, spatial distribution, analytes, how the data relates to groundwater - void models No statutory declaration from a SQP on file

APPENDIX H COMMUNITY CONSULTATION REGISTER AND PLAN

Carnaby

Community Consultation

Plan and Register

2023

01 September 2023

Project No.: 0699754

Carnaby Resources Limited

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Introduction

Purpose

This Community Consultation Plan and Register has been prepared to document Carnaby Resources Limited. (CNB) strategy and process for engaging and collaborating with stakeholders on rehabilitation and closure aspects and outcomes, as well as detailing the consultation undertaken prior to and during the development of the Progressive Rehabilitation and Closure Plan (PRCP).

Scope

This document outlines the current community consultation process at Tick Hill Gold Mine (THGM) including stakeholder identification, stakeholder consultation type (details of how and when stakeholder will be engaged), engagement objectives, what information will be provided for community consultation as well as historical issues raised and will document the process by which feedback will be considered by THGM.

It applies to all landholdings under the THGM ownership or management within mining leases 7097, 7094, 7096.

Objectives for Community Consultation

Through the community consultation process, THGM will achieve the following objectives:

- Discuss Post Mining Land Uses (PMLUs) with Stakeholders, to ensure end users are satisfied with the outcome.
- Notify and engage the community regarding rehabilitation and closure of THGM;
- Provide ongoing community consultation throughout the mine life cycle to ensure progressive rehabilitation, socio-economic and environmental impacts related to mine closure are communicated and understood;
- Collaborate with the community to identify rehabilitation and closure opportunities and constraints that could influence effectiveness of final land outcomes; and
- Provide a platform for comments and feedback mechanism to ensure closure and rehabilitation goals and expectations are effectively communicated and addressed.

Context to Community

THGM is located in a remote location, 40 km south of Duchess and 140 km southeast of Mount Isa. THGM has a modest history of engaging directly with the landowners and surrounding businesses. As part of the PRCP process, THGM plans to develop a strategy by which rehabilitated land will be transitioned back into sustained grazing land for the landowners.

Community Profile

THGM is located within the Cloncurry Regional Council (hereafter referred to as "the region" unless otherwise stated), over 100km south west of Cloncurry, in North West Queensland. THGM is remotely located, with no towns, villages or residences/homesteads located nearby (within 5 km).The region is a significant contributor to the North West Queensland economy, where by mining and minerals processing is the central source of employment.

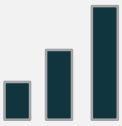
In June 2021, the estimated resident population of Cloncurry Regional Council area was 3,644 with a steady decline in population from 2021 being 4,797 (ABS, Cloncurry 2023). The median age was 34 years in 2021. In 2021 mining was the largest employer in the region, followed by agriculture (beef cattle farming) (ABS, Cloncurry 2023).

THGM is a formaly open-cut and underground operation, managed by CNB. During its operations in the early 1991 - 1995, there have been direct and indirect employment opportunities through suppliers, contractors, service providers and local business.

Stakeholder Identification and Categorisation

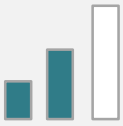
The key focus of community engagement for the PRCP is the directly affected landowners in the vicinity of the mining operation, other effected groups include traditional owners, local government, and local businesses as detailed in Table 1. Engagement on rehabilitation, closure and post-mining land use(s) has occurred to derived the PMLUs, and ongoing consultation as detailed in this plan will be undertaken to confirm suitability as the site is progressively rehabilitated and moves into closure.

For the purpose of consultation frequency, key stakeholder groups for THGM have been categorised into tiers according to their level of impact and engagement.



Key

High and/or frequent level of impact, influence or interest in site activities or decisions



Minor

Medium/semi-frequent level of impact, influence or interest in site activities

Other

Low or infrequent level of impact, influence or interest in site activities or decisions

Table 1 Stakeholder Identification and Categorisation

Category	Identification	Level of impact and engagement
Landholders M.D.H Pty Ltd	Stanbroke Station	**Key**
	Chatsworth Station	**Key**
Community	Duchess	Other
	Dajarra	Other
	The Monument	Other
	Cloncurry	Other
	Mt Isa	Other
Business operators and employees in the locality	Duchess Hotel	**Minor**
	Camps/caravan parks	Other
	Schools/daycare	Other
	Hospitality (restaurants, pubs, bars)	Other
	General stores and markets.	Other
Cultural Heritage	Yulluna People	**Minor**
	Kalkadoon Tribal Council	Other
	Kalkadunga Association in Mt Isa	Other
Government	Local including: Cloncurry Mayor – Greg Campbell	Other
	State and other including: ▪ Department of Environment and Science ▪ Department of Regional Development, Manufacturing and Water ▪ Department of Resources ▪ Department Seniors, Disability Services and Aboriginal and Torres Strait Islander Partnerships ▪ Department of Children, Youth Justice and Multicultural Affairs ▪ Department of State Development, Infrastructure, Local Government and Planning ▪ Department of Transport and Main Roads	Other

Engagement Method

Landholders M.D.H Pty Ltd

The identified key stakeholders are MDH Pty Ltd (MDH) being Stanbroke Station to the West and Chatsworth Station to the East. CNB has an agreement in place, the latest being from the 13th of October 2021. MDH is the lessee of the pastoral development holding no 13/5398 (known as Stanbroke Holding) and pastoral development holding no 13/345 (known as Chatsworth Holding) issued under the *Land Act 1962*. Prior to the mining leases being relinquished CNB must adhere to the agreement. The agreement states such items as: 'not interfere with any fences on the Lease without the company's prior consent,' and statements regarding environmental harm and having controls in place, division and access of water and the maintenance of the water pipeline. Communication between both parties has been face to face in a cooperative manner.

Community

As THGM is remotely located and has ceased mining from 1995 to 2020, communication to community members, and groups remains minor.

Business operators and employees in the locality

During mining between 1991 to 1995 employees were accommodated in the Monument township which was leased from Western Mining Corporation. During the exploration period and recent tailing reprocessing, employees have remained in small numbers and been accommodated in local hotels such as the Duchess Hotel. As employment numbers have remained low and irregular over the years, the communication to local businesses has been minor, and will be contacted when services are required for small working groups.

Cultural Heritage

The native title belongs to the Yulluna People. In March 1990, an archaeological survey was conducted on Tick Hill's mining leases by Brayshaw McDonald Pty Ltd. The sites identified during the investigation were all low archaeological/heritage significance, in that artefacts were sparsely distributed, few, non-diagnostic and in un-stratified contexts. The prepared report was forwarded to the Department of Heritage and Environment, Queensland National Parks and Wildlife Service and a copy of the survey results were sent to the Kalkadoon Tribal Council and the Kalkadunga Association in Mount Isa (Envirofin, 2020). The communication with cultural heritage groups has been minor.

Government

Government representatives were included at the Federal, State and Local level. Key agencies of relevance to the area included police, emergency services, drug and alcohol services, housing, Aboriginal, employment and social services.

Engagement with local government has been continuous through the life of the mine. The Cloncurry Regional Council plays a vital role in reviewing and providing feedback on potential project impacts on local government services.

Stakeholder Consultation Register

A Stakeholder Consultation Register is a process used to manage and document the engagement and involvement of stakeholders. It is used to record historical consultation activities and feedback and will be updated in future to document future consultation activities. Detail of past stakeholder consultation has been summarised in Table 2.

Table 2 Consultation Register

Consultation date	Community member	Consultation type	Information provided	Issues raised by community	How issues were considered	Decisions / outcomes	Commitments
18/11/2020	Andrew Davey (MDH)	Phone Message to Paul Tan	Logistics of crane hire for installation of new bore generator to supply water to Tick Hill tank.	Pilgrim Creek generator installation to supply water to Tick Hill Tank.	Paul Tan organised Carnaby staff to meet on site 17/11/2020 with MDH personnel to arrange installation of generator at Pilgrim Creek bore.	New generator installed.	Maintain contact with station owner if any issues arise with new generator.
29/03/2021	Andrew Davey (MDH)	Phone Text - Paul Tan to Andrew Davey	Discussion about grader work pipe access track from Tick Hill main tank to secondary cattle watering point.	Need pipe to supply water to secondary tank.	Paul Tan organised with BIM to use their grader to put in pipe access track.	New track and water pipe installed.	None
19/02/2022	Andrew Davey (MDH)	Phone Message to Paul Tan	Pump issues with Pilgrim Creek bore and pipe leak.	Require pipe repair and replacement bore.	Remploy engaged by MDH to carry out pump replacement and repairs.	Carnaby has paid for pump replacement and pipe repair.	Maintain communication with MHD regarding water pipe and bore.
24/01/2023	Al Macdonald (MDH)	Phone Message from Paul Tan	Advise of break in at Tick Hill containers	Theft	Station owner notified	Cloncurry Police followed	None

Consultation date	Community member	Consultation type	Information provided	Issues raised by community	How issues were considered	Decisions / outcomes	Commitments
						up with investigation.	
23/06/2023	Al Macdonald (MDH)	Phone Message from Paul Tan	Advice over proposed air geophysics flyover	Possible impact on mustering.	Station owner notified	Aircraft activity approved. No Impact.	None

Details of PRCP Consultation Process

Objectives for community consultation

The objective for THGM community consultation is to involve the key stakeholders in the decision-making processes that directly impact them. THGM aims to gather insights and feedback through conversation to understand perspectives and experiences for the final rehabilitation outcome.

How the Stakeholders will be Engaged

THGM has an established relationship with key stakeholders, discussions have been informal, however open and progressive relating to THGM operations and environmental performance.

As part of the ongoing stakeholder consultation at THGM, CNB staff will engage with key stakeholders and landholders to discuss rehabilitation and closure concerns, as required by the PRCP. Discussions will include but will not be limited to, potential post-mining land uses, rehabilitation performance, targeted vegetation and alternative water supply arrangements (AWSAs).

Consultation Plan

As part of the ongoing consultation the relevant stakeholders will be engaged to outline their concerns and views of the future of THGM see Table 3. Those methods are as follows:

- Ongoing face-to-face meetings,
- Site drives and inspections; and
- Written communication.

Face-to-face meetings

Face-to-face meetings have a proven track record of productive engagement and have been conducted by representatives of CNB with landholders and businesses e.g. the Duchess Hotel. Face-to-face meetings facilitate real-time collaboration, problem solving and immediate feedback.

Site drives and inspections

Taking site drives and inspections with stakeholders is valuable in providing stakeholders with a visual understanding of the site to be rehabilitated and to better inform their engagement with the proposed post mining land uses for the site. Stakeholders can see first-hand the proposed plans and they can help to identify potential constraints and opportunities.

Written communication

Written communication allows for clarity and precision. It will provide the stakeholders with accurate PRCP information to avoid misunderstandings. The stakeholder can then carefully formalate their thoughts, organise ideas, and articulate their options in a structural manner to formulate a response to CNB if there are any conserns or issues.

Proposed Consultation Frequency

Consultation should occur prior to any PRCP schedule amendments that are likely to impact the stakeholder, with the register updated as consultation is completed. Ongoing stakeholder consultation will continue throughout the stages of the PRCP.

Table 3 Consultation Plan

Identified stakeholder	Objective	Engagement type	Proposed consultation frequency	Released information	How feedback/comments are considered
Landholders **M.D.H Pty Ltd – representatives from Stanbroke and Chatsworth Stations**	Collaboration with key stakeholders.	Face-to-face meetings. Site drives and inspections. Written communication	Maintain effective Face-to-face as required. Site drives during rehabilitation planning, during rehabilitation works and after rehabilitation works to gain input. Written communication detailing the PRCP facts and PMLU.	PMLU and NUMA maps, rehabilitation schedule.	High - As a key stakeholder all feedback should be regarded as a valuable source of insight and suggestions should be taken aboard.
Community representatives from Duchess, Dajarra and The Monument.	Communities will experience little to no impact, the objective is to inform the community of the PRCP schedule and proposed outcomes.	Face-to-face meetings with key community members and leaders.	As required	Rehabilitation schedule.	Low - Keep the community updated of any changes or developments to maintain a positive relationship.
Community representatives from Cloncurry and Mt Isa	Communities will experience little to no impact. The objective is to inform the community of the THGM PRCP.	Written communication	As required	Awareness THGM of PRCP.	Low – provide updates only when required.

Identified stakeholder	Objective	Engagement type	Proposed consultation frequency	Released information	How feedback/comments are considered
Business operators and employees in the locality at the often used by CNB or contractors such as the Duchess Hotel	Medium impact on used businesses. The objective is to inform the cbusinessesof the PRCP schedule and proposed outcomes.	Face-to-face meetings with key businesses comminly used by CNB and contractors.Followed up with written communication.	Maintain effective face-to-face communication. Written communication will beon an as required basis.	Rehabilitation schedule. Periods of high and low required labour so businesses can plan for increased or decreased people using service.	Medium - Keep the businesses updated of any changes or developments. Take into consideration flutuation periods across other mines in the area that may impact business.
Business operators and employees in the locality that CNB or contractors do not directly use or use often Camps/caravan parks, schools/daycare, hospitality (restaurants, pubs, bars) and general stores and markets.	Businesses will experience little to no impact. The objective is to inform the businesses of the THGM PRCP.	Written communication	As required	Awareness THGM of PRCP.	Low – provide updates only when required.
The Yulluna People	Sharing information, collobrating and mobilizing support	Face-to-face meeting with key leader/s.	As required	PMLU and NUMA maps, rehabilitation schedule.	Medium - Keep the Yulluna People updated of any changes or developments.

Identified stakeholder	Objective	Engagement type	Proposed consultation frequency	Released information	How feedback/comments are considered
	during the PRCP process.	Written communication			Consider and action any cultural heritage impacts or concerns.
Kalkadoon Tribal Council and Kalkadunga Association in Mt Isa	Objective is to inform only when directed by the Yulluna people or if Yulluna representatives are not available.	Written communication	As required	PMLU and NUMA maps, rehabilitation schedule.	Low – provide updates only when required.
Local Government	Sharing information, and informing during the PRCP process.	Written communication	As required	PMLU and NUMA, maps, rehabilitation schedule	Low – provide updates only when required.
State and other Government.	Objective is to inform, collobrate and gather feedback.	Written communication	As required	Documents required by government bodies.	High – All feedback is of priority.

Summary

This document outlines the current community consultation process at THGM including stakeholder identification, stakeholder consultation type (details of how and when stakeholder will be engaged), engagement objectives, what information will be provided for community consultation as well as issues raised and will document the process by which feedback will be considered by THGM. THGM is remotely located, with no towns, villages or residences/homesteads located nearby (generally within 5 km). The region is a significant contributor to the Northwest Queensland economy, whereby mining and minerals processing is the central source of employment. The key stakeholders are:

- Landholders M.D.H Pty Ltd
- Community
- Business operators and employees in the locality
- Cultural Heritage
- Government

The objective for THGM community consultation is to involve the key stakeholders in the decision-making processes that directly impact them.

THGM has an established relationship with key stakeholders, discussions have been informal, however open, and progressive relating to THGM operations and environmental performance.

Stakeholder feedback is a valuable source of insight and suggestions that should be taken aboard from key stakeholders. As many stakeholders will have little to no impact they will be updated of any changes or developments. All feedback from government bodies is of priority.

Document Information

References used in the preparation of this document are listed below in Table 4

Table 4 References

Reference	Title
ABS (2021)	Cloncurry - 2021 Census All persons QuickStats, retrieved 08th August 2023 from https://www.abs.gov.au/census/find-census-data/quickstats/2021/LGA32450
Compensation Agreement (2023)	Compensation Agreement and Right of Way MDH and CNB (2021). The Mineral Resources Act 1989 ML's 7094, 7096, 7097 (Mount Isa Mining District)
MIM (1993)	MIM Holdings Limited: Tick Hill Gold Mine (1993). Visit by Asarco Directors
Envirofin (2020)	Envirofin: Tick Hill Tailings Reclamation Project (2020). EA Amendment Application Supporting Information

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APPENDIX I TSF COVER MODELLING REPORT

Tick Hill TSF cover modelling report

Tick Hill Mine

12 February 2025

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Document Control

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K. Adhikari	E. Denholm	P. Scott D. Rutherfurd	31/01/2025	RevA

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Executive Summary

The Tick Hill Gold Mine ceased operations in 1994 and has been undergoing re-commercialisation through tailings reprocessing. This report outlines the results of tailings storage facility (TSF) cover modelling undertaken to support the Progressive Rehabilitation and Closure Plan (PRCP), in response to regulatory requirements from the Queensland Government Department of Environment, Tourism, Science and Innovation (DETSI).

Key features of the TSF include two engineered dam structures with a combined capacity of 600,000 m³ and an existing water-shedding cover system comprising waste rock and topsoil. The study focused on assessing the performance of various cover design scenarios to reduce net percolation (NP), mitigate seepage risks, and support site rehabilitation in alignment with the region's hot desert climate and regulatory expectations.

Findings

The key findings were:

- The hot arid climate with winter droughts supports the adoption of a store-and-release cover system to manage water retention and promote vegetation growth.
- Substantial variability was observed in texture and drainage classification (at 95% MDD) of potential cover material was observed. Sensitivity analysis was not carried out as it requires great deal of time and effort and full still doesn't capture heterogeneity cover material. Hence, field trial are essential to understand the overall performance of cover.
- A threshold NP was taken as 10% based on the information and considering the current scenario, expected spoil remains at closure, and risk of seepage to the surrounding environment. It was assumed that all tailings will be reprocessed leaving NAF spoils at closure reducing the metals concentration in seepage.
- All modelled cover scenarios achieved NP below the threshold value of 10%, except for the existing cover material scenario. By replacing the cover, there is a minimum of 50% reduction in the seepage as indicated by the analysed cover scenarios.
- Borrow pit materials and waste rock exhibited superior performance in minimising NP due to their lower hydraulic conductivity compared to the current TSF cover material.
- Model outputs are subject to simplifications, requiring validation through field trials.
- Salinities in cover material including tailings were very low and may not affect vegetation growth.

Recommendations

The recommendations include:

- Upgrade the cover system to a store and release cover by incorporating borrow pit or waste rock material to enhance the reduction in seepage.
- Conduct field-scale trials to validate modelling results and optimise cover performance under real-world conditions. Refine the cover design based on trial results and evolving environmental or regulatory requirements.
- Manage the drainage on the top surface to avoid drainage concentrations that may lead to increased NP.
- Implement or upgrade to a comprehensive long-term monitoring program to track cover system performance, groundwater quality, and vegetation establishment.
- Prepare an inventory of cover materials to assess the material volumes required and to ensure that adequate volumes are available for each material type.

- Maintain transparent communication with regulators, communities, and stakeholders to address concerns and ensure compliance with closure objectives.

1. Introduction

The Tick Hill Gold Mine (THGM) is situated around 110 km south-southeast of Mount Isa. Mining operations were halted in 1994, and the site has been under care and maintenance by various owners until recent efforts to re-commercialise it through tailings reprocessing. Key features of the site include an open cut pit, a partially capped tailings storage facility (TSF), a waste rock dump (WRD), a run-of-mine (ROM) pad, topsoil stockpiles, as well as a processing area with workshops and administrative buildings.

Mine Earth was engaged by JDR Mining & Civil to update the Progressive Rehabilitation and Closure Plan (PRCP) in response to the Queensland Government Department of Environment, Science, and Innovation's (DESI) request for an information letter dated 31 October 2023. Cover modelling and design form part of PRCP.

1.1 Geochemical risk and environmental considerations

The tailings are generally characterised by a very low acid-generation potential and minimal total metals content, indicating a low risk of neutral metalliferous drainage. Comprehensive geochemical investigations were conducted to assess potential risks from elevated metals such as copper and cyanide. Analyses of the pit, surface water, and groundwater quality revealed no evidence of acid metalliferous drainage (AMD) or neutral metalliferous drainage (NMD), which would likely have manifested given the cessation of operations nearly 30 years ago (Carnaby Resources Ltd, 2023).

Concentrations of total cyanide were assessed due to the presence in tailings. Levels in groundwater varied across groundwater bores at THGM. Low concentrations were generally found in all bores, with the exception of bores THGW001 and THGW008, where levels exceeded screening criteria. The variation in concentration of cyanide in these bores was found to be consistent with the vertical gradation of cyanide concentration in groundwater sourced from infiltration from the Tailing Storage Facility (TSF) to the south. It is highly likely that cyanide concentrations will steadily decrease over time and that cyanide expressing in pit water would be degraded by sunlight, as has already been occurring (Carnaby Resources Ltd, 2023).

1.2 Challenges and Opportunities

The TSF cover was not originally designed to minimise NP, and monitoring data indicates that seepage has occurred, resulting in the migration of contaminants such as copper and cyanide into the local groundwater aquifer and residual void (Carnaby Resources Ltd, 2023).The revised operation to relocate all tailings material offsite presents an opportunity to enhance the cover system and mitigate future seepage risks.

1.3 Report structure

This report is structured as follows:

1. **Introduction:** project description, overview of information review, and report outline.
2. **Background Information:** Provides the project background information on location and climatic conditions, information review, and examples of cover design in Western Australia.
3. **Field assessment:** Information sample collection, analysis, and results.
4. **Design criteria:** Type of cover, cover selection and design criteria
5. **Vadose zone modelling:** water balance modelling and discussion on modelling results.
6. **Conclusion and recommendations**: Provides conclusions and recommendations based on the study.

2. Background information

2.1 Location and climate

The THGM site is situated in north-central Queensland, approximately 40 km south of the township of Duchess and roughly 140 km southeast of Mount Isa. The region experiences a warm and predominantly dry climate year-round. Average daily temperatures range from 7°C to 24°C during the 'dry season' (April to September) and increase to 17°C to 40°C during the 'wet season' (October to March). According to 2023 data from the Bureau of Meteorology (BoM), the wet season receives an average monthly rainfall of 47 mm, while the dry season receives significantly lower rainfall, averaging 8.8 mm per month (Carnaby Resources Ltd, 2023).

The site layout is given in Figure 1 below.

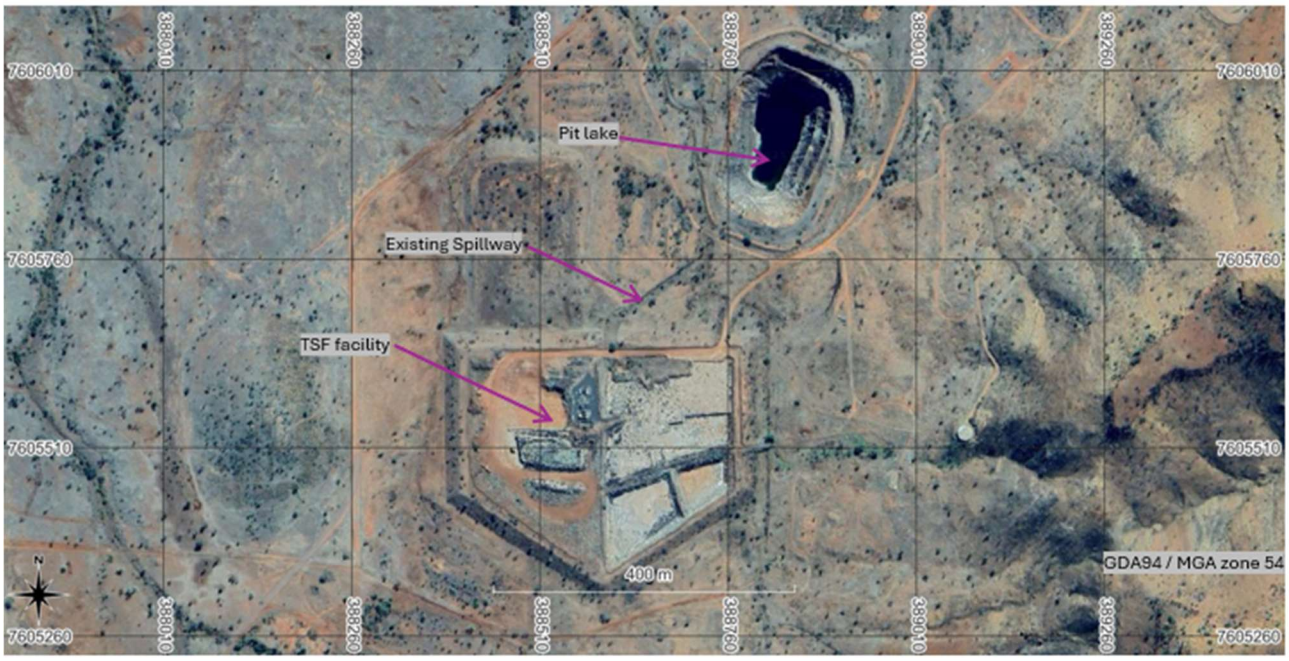

Figure 1: Site layout

2.2 Modified Koppen climate classification

The modified Koppen classification system for Australia based on standard 30-year climatology (1961 -1990) is available on Bureau of Meteorology(BoM) website. These classification maps show 6 major groups and 27 sub-groups of climate zones across Australia based on the concept that native vegetation is the best expression of climate in an area.

The project is in a hot desert zone with drought in winter (Figure 2) with annual average pan evaporation of 2,800 mm, which is about 7 times the annual average rainfall.

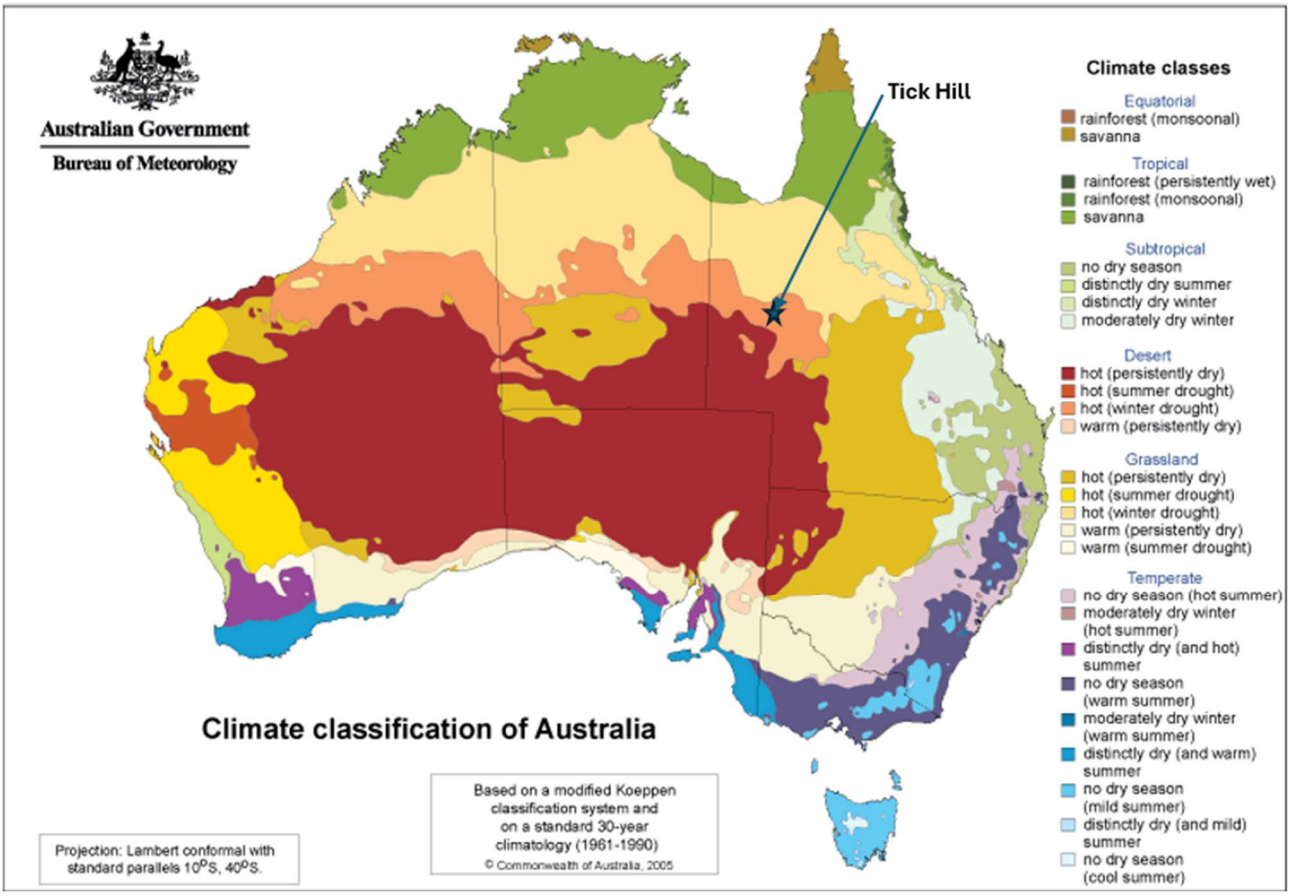

Figure 2: Climate classification of Australia with project location (BOM, 2024)

2.3 Tailings storage facility characteristics

The review of information pertaining to the tailings storage facility from the Progressive Rehabilitation and Closure Plan (Carnaby Resources Ltd, 2023) is summarised below;

- The tailing storage facility consists of two above-ground engineered dam structures with 10.5 m high embankments likely constructed at a single stage with a side slope of 1:3. The 500 mm clay liner in the base and clay core in the embankments were installed during construction.
- The surface areas of the western and eastern cells are 4.4 ha and 4.5 ha, respectively, with an overall capacity of 600,000 m3. The two cells are flat-topped and have a cell surface lower than the perimeter embankment, ranging from 6 – 10 m in depth.
- The water-shedding cover with waste rock mulch to a depth of 700-1,000 mm and topsoil of 100 mm was constructed without proper design to minimise Net Percolation (NP) and with drains and a spillway attached to the facility.
- Currently, approximately 2 ha of tailings has been disturbed for reprocessing, which is likely to continue until all the tailing has been reprocessed. The disturbed cover material has been stockpiled on the undisturbed part of TSF as of now.
- The tailings, in general, were regarded as having very low acid generation potential, and low total metals – meaning a low risk of neutral metalliferous drainage. Extensive investigation to understand the geochemical risk posed by any elevated metals such as copper and cyanide was carried out and noted that the pit, surface water and groundwater quality analysis do not reflect Acid Metalliferous Drainage (AMD) and Neutral Metalliferous Drainage (NMD), which would be expected to be apparent by now given the operation was ceased almost 30 years ago.

- The TSF was not designed to limit the NP, and the monitoring data indicates seepage has been occurring in the groundwater and contaminants have been migrating into the local groundwater aquifer, ultimately reporting to residual voids. Although it has been demonstrated that this will not result in any environmental harm, there is an opportunity to improve the cover system with the disturbance caused by reprocessing activities.

2.4 Examples of TSF cover design

A review of closure designs for TSF covers in Queensland and Western Australia was conducted to inform the identification and evaluation of cover concepts for the Project. A summary of TSF cover designs from 11 relevant Western Australian mines is presented in **Error! Reference source not found.**. The review highlights that there are a wide range of cover designs; from no cover, partial or variable depth covers, to relatively thick soil/waste rock covers, with or without application of a capillary break.

The information presented in **Error! Reference source not found.** has been collated from internal Mine Earth databases and as such, some details are not in the public domain. The names of the mine sites have therefore been excluded. It should also be noted that some of the cover designs presented in **Error! Reference source not found.** may have changed since the information was sourced.

Table 1: Examples of TSF cover designs in Western Australia

Mine details	TSF cover concepts
Metalliferous mine in Cloncurry region	High saline tailings and low capacity PAF. Cover will comprise a 0.3 m clay layer, with 1.0 m subsoil and 0.1 m topsoil cover.
Metalliferous mine in Cloncurry region	Low saline tailings and low capacity PAF. Low permeability and high clay content material used to construct 1.0+ m cap with 0.1 m growth media cover.
Metalliferous mine in Cloncurry region	PAF tailings. TSF cover to comprise capillary break 0.3 m - 0.4 m under 0.5 m reduced permeability layer, 1 m NAF waste rock layer, and 0.2 m growth medium cover.
Metalliferous mine in Cloncurry region	PAF tailings. TSF cover to comprise 0.3 m reduced permeability layer under 2.6 m store and release layer, and 0.3 m growth medium cover.
Gold mine in the WA Goldfields region	Hypersaline tailings. TSF cover will comprise a 0.5 m waste rock layer over the tailings and a final 0.3 m growth medium cover.
Nickel mine in the WA Goldfields region	Hypersaline tailings. TSF cover will comprise a 0.5 m waste rock layer over the tailings and a final 0.3 m growth medium cover.
Nickel mine in the WA Goldfields region	Hypersaline tailings and low capacity PAF. TSF cover will comprise 0.5 m waste rock only (limited growth medium available).
Gold mine in the WA Goldfields region	Hypersaline tailings. TSF was originally closed without a cover based on the assumption that the salt crust would control dust in the long term. This was not the case. The subsequent cover design comprised 0.5 m run-of-mine waste rock.
Nickel mine in the WA Goldfields region	PAF tailings. A non-vegetated upper TSF surface was proposed using a cover of 200 mm mill scats. The cover was designed to mitigate wind erosion.
Gold mine in the WA Goldfields region	Non-saline tailings. TSF cover comprised a layer of oxide mine waste with a surface application of growth medium (soil).
Gold mine in the WA Mid-West region	Hypersaline tailings. TSF cover comprised a 0.5 m waste rock layer.
Gold mine in the WA Goldfields region	Non-saline tailings. TSF cover comprised 2 m cover of oxide and a surface topsoil layer.

Mine details	TSF cover concepts
Gold mine in the WA Goldfields region	Hypersaline tailings. TSF closure plan comprised a coarse rockfill capillary break, transition layer, low permeability clay layer, and growth medium. The cover was to be shaped and graded to facilitate water shedding via a spillway designed to accommodate a 1:10-year ARI rainfall event.
Nickel mine in the WA Kimberly region	PAF tailings. TSF store and release cover comprised 0.3 m soil/waste rock mix overlying 2 m waste rock.
Gold mine in the WA Southwest region	Large valley fill TSF (1,250 ha). The tailings are non-saline but contain elevated cyanide. The TSF closure plan is for a thin cover comprising 300 mm gravel and 100 mm topsoil. The drainage from the TSF is designed to be discharged from the top surface.

3. Field assessment

3.1 Site visit and sample collection

A site visit was undertaken on 29 July – 1 August 2024 to collect samples to improve understanding of the sites' baseline (analogue) soils plus the characteristics of potential rehabilitation material.

Samples of in situ, undisturbed soil, stockpiled soil resources, potential borrow materials, existing decant and tailings cover materials, and waste rock from the waste rock dump were collected by Mine Earth and Tick Hill Mining representatives from 19 sites within the study as shown in Figure 3. Coordinates of the locations are provided in Table 2. The sampling locations comprised of in situ analogue soils (5 sampling locations) collected from 2 to 3 m depth intervals, plus waste rock.

Soil pits were excavated at each sampling location to a maximum depth of 1.5 m for the mechanical excavation sites, or to approximately 30 cm at those sites excavated using hand tools. Details of sample locations, soil profile descriptions, photographs of the soil profiles and surrounding vegetation at each location were recorded.

Table 2: Field sample locations

Site	Target feature	E_GDA94z54	N_GDA94z54	RL (m)
A1	Analogue soil	389082.2	7605553.63	377.46
A2	Analogue soil	389218.02	7606042.2	345.67
A3	Analogue soil	388627.72	7606427.01	346.83
A4	Analogue soil	389123.11	7606432.87	338.39
A5	Analogue soil	388407.14	7606235.13	333.75
B1	Borrow pit	388576.22	7605197.43	353.69
B2	Borrow pit	388637.32	7605832.95	349.98
DC1	Decant Pond cover	388469.02	7605686.87	350.95
DC2	Decant Pond cover	388506.04	7605825.62	351.62
DE1	Decant Pond embankment	388592.55	7605722.49	346.26
T1	Tailings	388637.92	7605581.88	359.5
T2	Tailings	388627.71	7605487.83	358.79
TC1	Tailings cover	388439.37	7605515.86	362.33
TC2	Tailings cover	388547.21	7605410.44	368.59
TS1	Topsoil	388511.08	7605591.74	358.77
TS2	Topsoil	388539.64	7605576.55	359.43
WR1	Waste Rock Dump	389032.14	7606177.97	348.53
WR2	Waste Rock Dump	389075.05	7606319.07	351.52
WR3	Waste Rock Dump	389097.58	7606173.77	342.45
A1	Analogue soil	389082.2	7605553.63	377.46

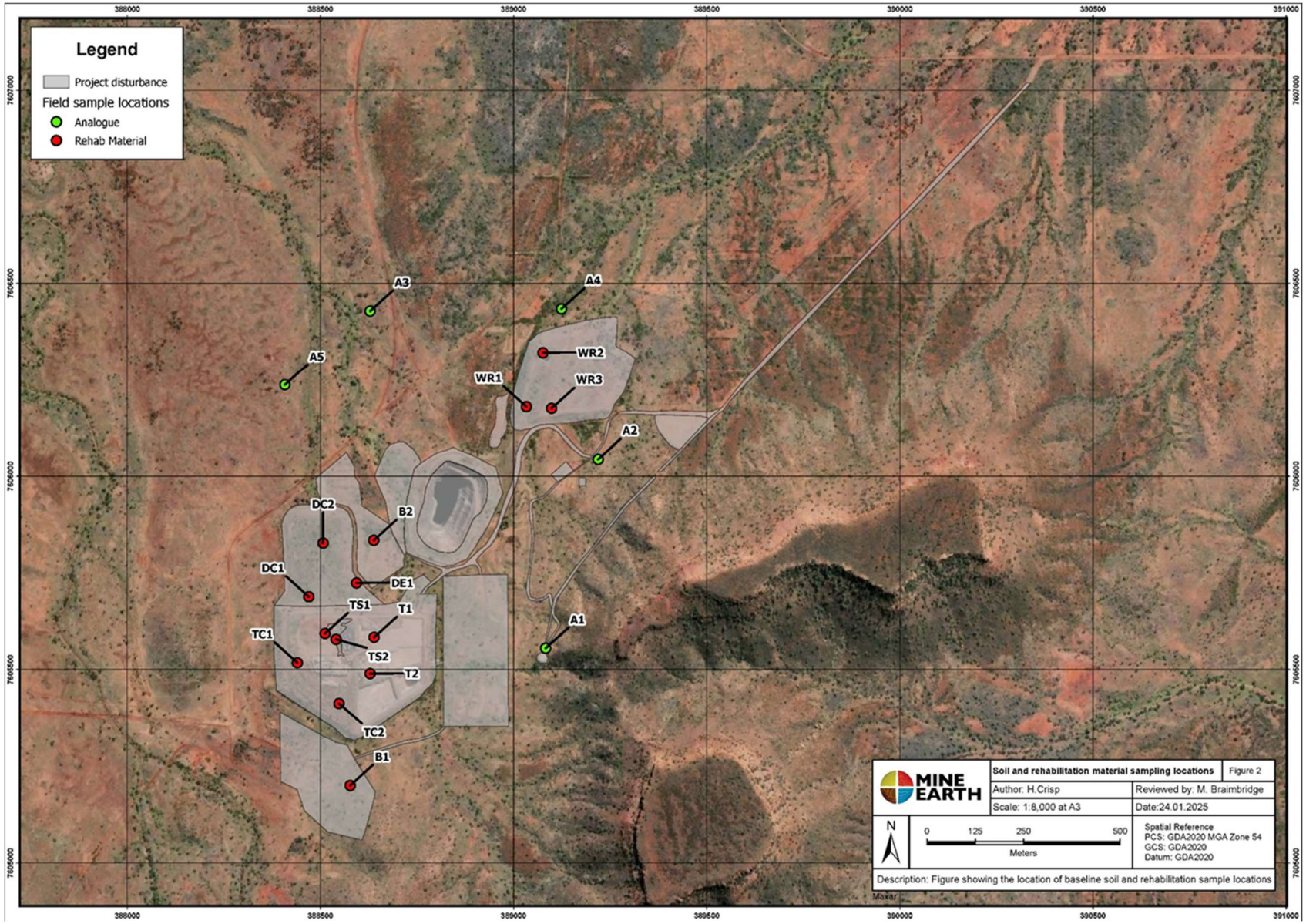

Figure 3: Field sample collection location

3.2 Potential cover material

During the site visit, the following potential cover materials were identified:

1. *Growth media/topsoil* - sand, sandy gravels and caprock should be selectively stockpiled to support vegetation cover.
2. *Weathered waste rock* - oxide and transitional waste from landforms comprising a mixture of high to low-stability material, could be potential cover material for low-permeability cover systems.
3. *Borrow pit material* - Clayey material with low permeability from nearby borrow pits could be another source of cover material.
4. *TSF cover material* - disturbed TSF cover material, currently stockpiled on an undisturbed portion of TSF is a potential cover material readily available at the site.

3.3 Laboratory testing

The constant head and falling head permeability tests, particle size distribution analysis, Emerson class number test, and soil water characteristics assessment were conducted by Trilab, Brisbane Laboratory. ALS Limited, Brisbane, performed the chemical characterisation, including pH, electrical conductivity, nutrient analysis, and organic matter content. The detailed laboratory results are provided in Appendix A for reference.

Mine Earth (2025) reviewed the physical and chemical characteristics of soil resources, waste rock and tailings materials, and found:

- Substantial variability was observed in the soil-sized fraction of waste rock, with clay content ranging from 2% to 24%, and variable hydraulic conductivity (at the measured 95% Maximum Dry Density, or MDD), with drainage classifications of ‘extremely slow’ to ‘very rapid’ was observed for waste rock material.
- The non-saline tailings texture was classified as Sandy Loam, with approximately 12% clay, and a drainage classification (at the measured 95% MDD) of ‘moderately slow and high-water holding capacity.
- The existing tailings cover material, comprising compacted oxide was observed to be variable coarse rock % (up to 80%), and clay content of the soil-sized fraction ranged from 9 to 12%. The existing cover material was found to have a low water-holding capacity and was classified as non-saline.
- The potential borrow material is a single-grained to massively structured sandy clay material (up to 22% clay) with variable coarse fragment content, up to 31%, with ‘extremely slow’ drainage classification (at 95% MDD).

The results were used to determine the Van Genuchten parameters required for SEEP/W (a tool used for cover modelling). The detailed discussion on the derivation of Van Genuchten is discussed in Section 5.3.3.

4. Design criteria

4.1 Type of cover

Cover systems are implemented to rehabilitate surface mine waste storage facilities by providing a stable, reliable, and sustainable engineered barrier between the mine waste and the surrounding environment. This system supports designated land uses while mitigating environmental degradation after mine closure. For reactive materials, minimising environmental impact typically involves controlling net percolation (NP) and/or limiting oxygen ingress during operations and post-closure (International Network for Acid Prevention , 2017).

The International Network for Acid Prevention (INAP) classifies cover systems into the following categories:

- Erosion-protection systems:
- Store-and-release systems:
- Enhanced store-and-release systems:
    - Low permeability layer
    - Capillary break layer
    - Seasonality Frozen Capillary Break Diversion:
- Barrier-type systems:
- Cover systems with engineered layers:
- Saturated soil or rock cover systems:

Given that Tick Hill is in a hot desert zone, characterised by winter drought conditions according to the modified Koppen climate classification system (Section 2.2), the main cover system considered for the Project is a store and release cover. This cover system stores infiltrating water within the rooting zone of the cover and is subsequently released via evapotranspiration, minimising the deep percolation. Additional layers of capillary break material may be added to provide textural discontinuity and enhance the store and release cover system.

While this recommendation aligns with the site's climatic conditions, it could be further validated and refined through a comprehensive multi-criteria assessment, incorporating a detailed evaluation of options and associated risks.

4.2 Models and design criteria

The modelling design criteria for each model are discussed below.

4.2.1 Water balance modelling

NP thresholds are shaped by regulatory frameworks and stakeholder-defined environmental tolerances. Regulations set binding guidelines on acceptable water quality and long-term environmental goals, ensuring compliance with national and regional laws. Stakeholders, including authorities, communities, and industry representatives, influence the NP thresholds based on site-specific environmental, social, and economic risks. Stricter tolerances may apply in sensitive areas, while more flexible thresholds may be allowed in less vulnerable regions, provided risks are manageable. These thresholds ensure compliance with environmental laws and long-term protection goals.

Currently, NP thresholds are not available for the project. Mine Earth reviewed the available information and concluded that a 10% NP threshold can be adopted for the following reasons:

- Overburden material (tailings) will be fully reprocessed, and only non-acid forming (NAF) spoils will remain at closure
- Though the seepage with elevated metals such as copper and cyanide was observed, it is expected to decrease with the removal of tailings.
- The impact of seepage is confined to a nearby pit lake.

4.2.2 Solute transfer/salt dynamics modelling

Salt significantly impacts plant germination and growth, although the extent of this impact varies depending on the plant species, as some are more tolerant to elevated salinity levels.

The Department of Primary Industries and Regional Development, Western Australia provides guidance on salinity tolerance of plants for agriculture and revegetation in Western Australia. The salinity is broadly divided into five major classes (Table 3) and more than 200 plants/species were grouped under these classes based on their salinity tolerance.

The samples tested in the laboratory indicated that all the samples (including tailings) have salinity less than 2 dS/m and are classified as non-saline as per the Table 3. Hence, salinity target and solute transfer modelling is not required for this project.

Table 3: Salinity classification (Department of Primary Industries and Regional Development, 2025)

Salinity (dS/m)	Salinity Class
< 2	non-saline
2–4	slightly saline
4–8	moderately saline
8–16	very saline
>16	extremely saline

5. Vadose zone modelling

5.1 Conceptual model

The conceptual model for the cover system is presented in Figure 4. Precipitation falling on the TSF can generate seepage through the cover layers. As this seepage percolates through zones of high salt concentration, it can dissolve and transport soluble salts downward through the cover.

Concurrently, evaporation creates a suction effect, potentially drawing soluble salts upward through the cover via capillary action. These salts may accumulate in the upper layers as pore water evaporates. The impact of evaporation diminishes with depth and can be effectively interrupted by a layer of coarse rock with low fine content within the unsaturated zone. This coarse layer eliminates the small capillaries necessary for upward capillary movement.

It is important to note that the effectiveness of this capillary break is compromised if the water table rises above it. In such cases, the break becomes ineffective in preventing upward salt migration.

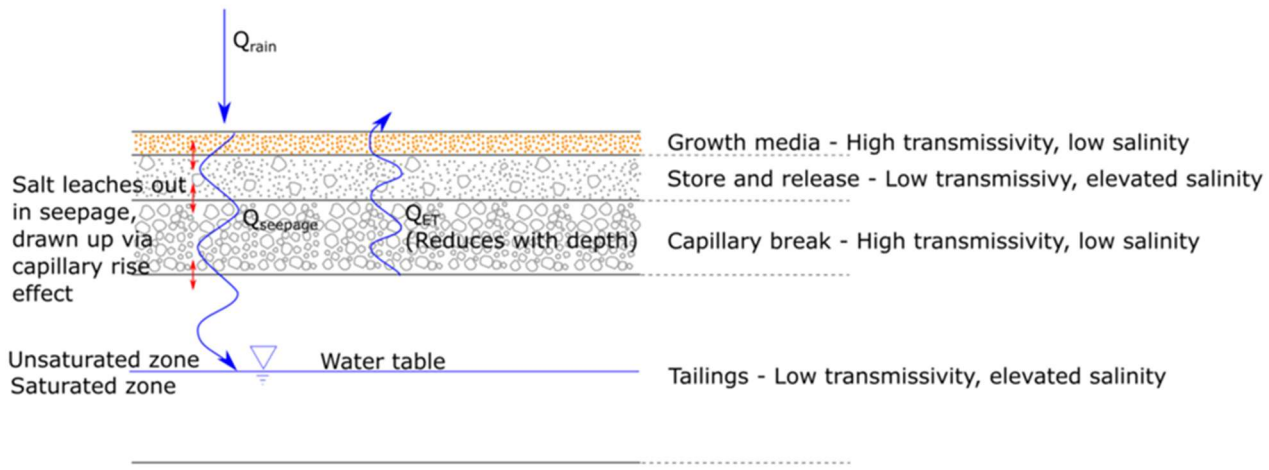

Figure 4: Conceptual cover model

5.2 Water balance modelling

Several cover scenarios were developed considering different cover depths and material types and modelled using SEEP/W analysis in GeoStudio to predict the relative performance of multiple cover scenarios. Water balance modelling was completed using parameters derived for the topsoil, waste rock, tailings and screened fresh rock presented in 5.3.2.

SEEP/W solves the water transfer equation which can be calculated from a mass balance equation at the ground surface, which is given by:

$$\left(q_{P(precipitation)} + q_{M(snowmelt)}\right)\cos\alpha(slope\ ange) + q_{E(Evaporation)} + q_{R(rainfall)} = q_{I(infiltration)}$$

The slope angle is included because precipitation is measured for a horizontal plane. The infiltration is deemed the residual of the surface mass balance equation and therefore forms the boundary condition of the water transfer equation.

5.3 Modelling methods

GeoStudio 2024.2.1 was employed to undertake modelling of the interaction between land and climate in a cover system. This modelling aimed to simulate the hydraulic response in an engineered soil cover and the underlying tailings while considering varying climate conditions. To simulate the water dynamics in these types of systems effectively, the land-climate interaction boundary condition in SEEP/W is preferred because this boundary condition accounts for several factors such as precipitation, evaporation, runoff, and root water uptake that occur beneath the ground surface (GEO-SLOPE International Ltd.)

5.3.1 Climate data

The long-term daily rainfall data was obtained from Monument Station (Bureau of Meteorology Station No. 37107), while other climate data were obtained from Cloncurry Airport Station (Bureau of Meteorology Station No. 29141). The rainfall and climate data were analysed: where <96% of the days have data recorded, the year was excluded and 10 years of data (1981, 1984, 2004-2006, 2008-2010, 2012 and 2013) were selected for analysis. For wind speed and relative humidity, the last twelve months' daily data from the BOM website were used and repeated in cycles to create 10 years of data. The climate data used in the analysis is shown in 5 to 9 below.

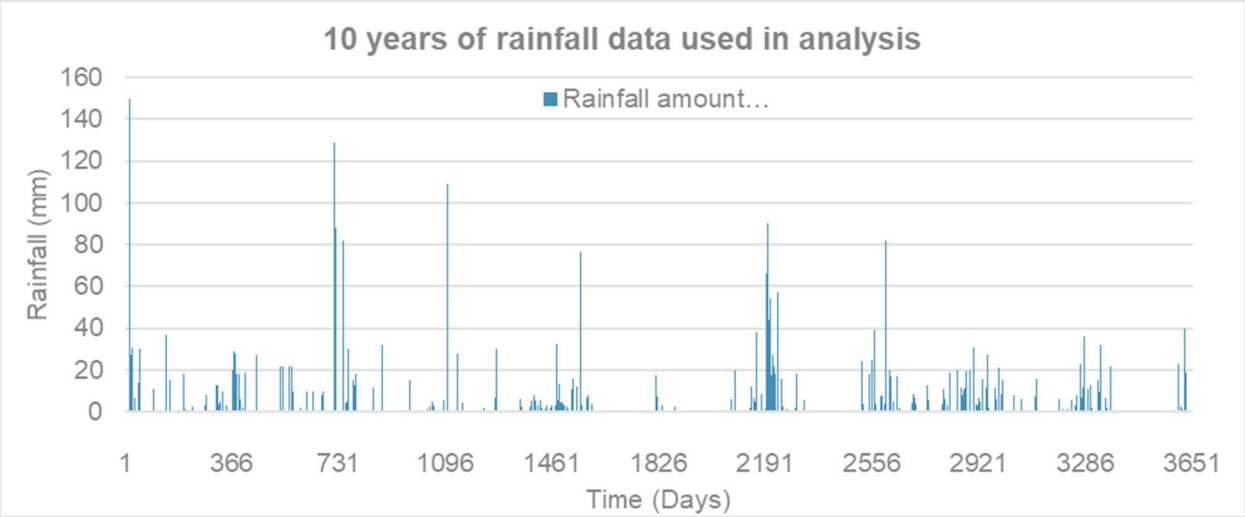

Figure 5: Rainfall data

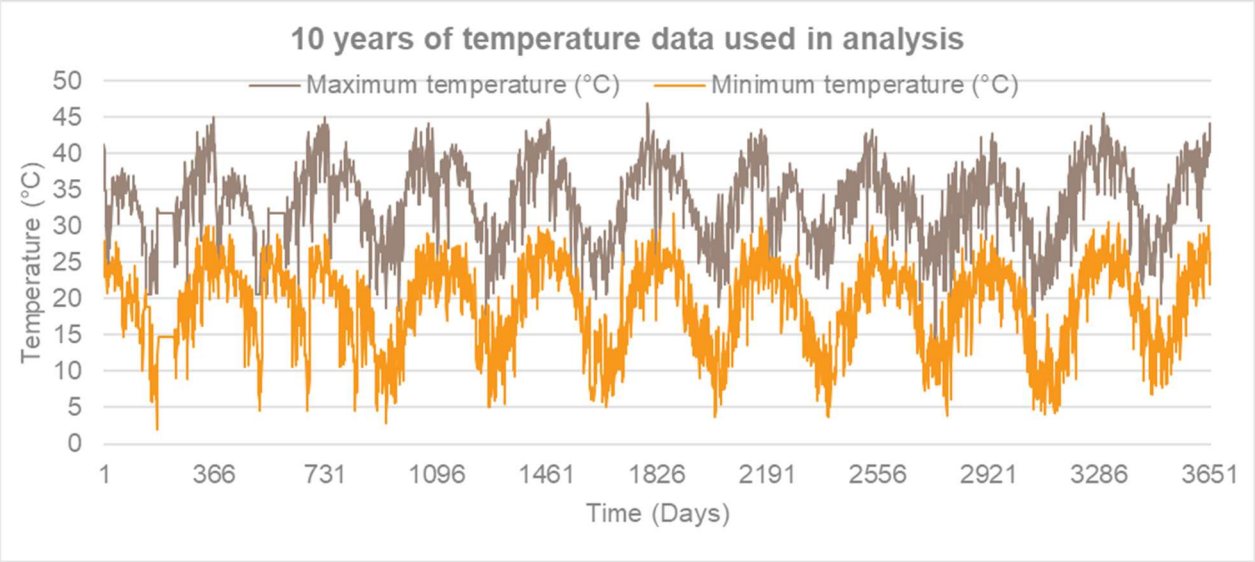

Figure 6: Temperature data

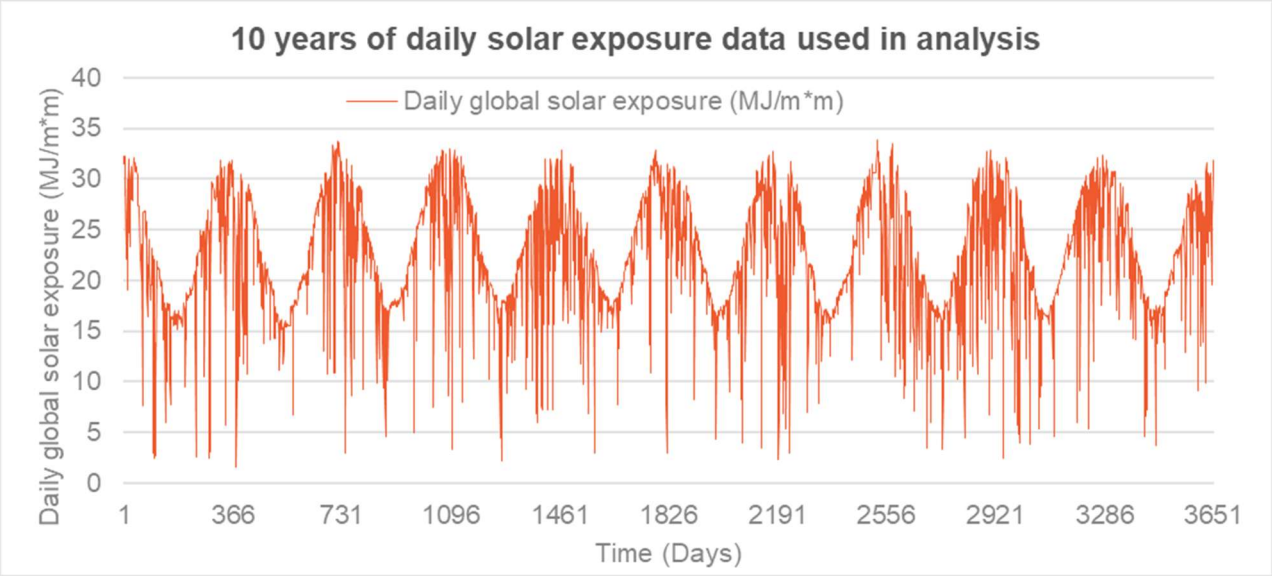

Figure 7: Daily solar exposure data

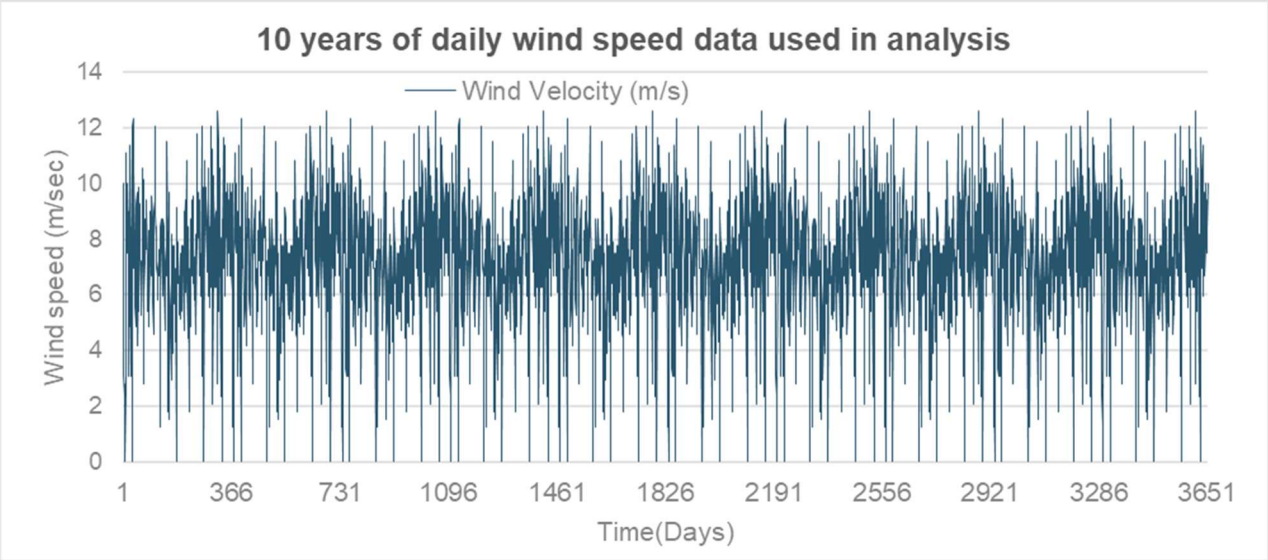

Figure 8: Wind speed data

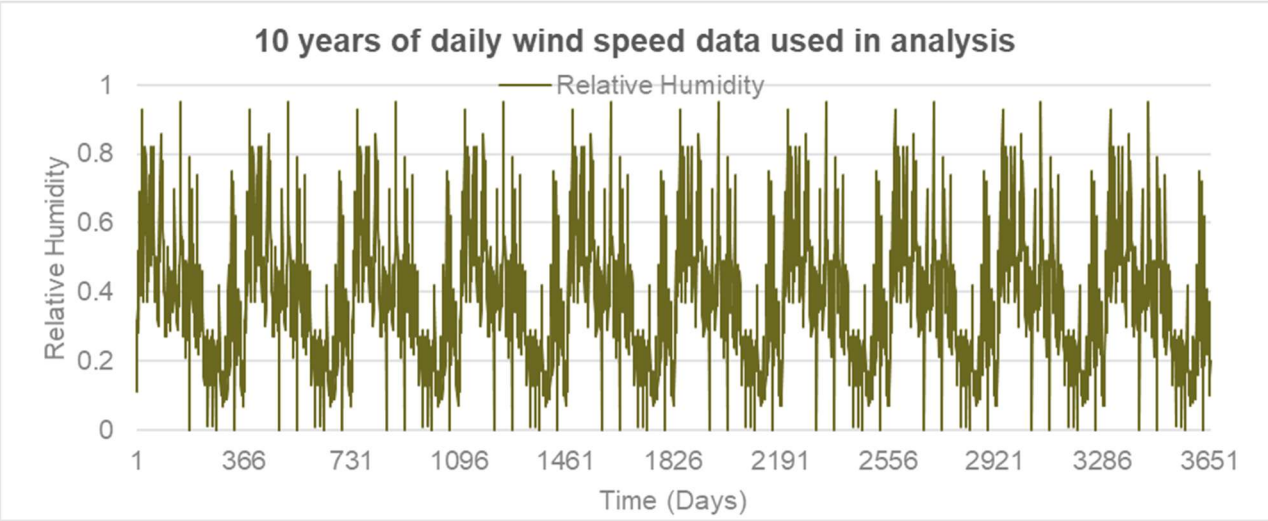

Figure 9: Relative Humidity data

5.3.2 Soil properties

Samples collected during the site visit were sent to laboratories to determine the saturated hydraulic conductivity, water retention curve and salinity. These results were further analysed to finalise input parameters. **Error! Reference source not found.** below provides the salinity, dry density and saturated hydraulic conductivity. The detailed test results are attached in Appendix A.

Table 4: Sample properties

Sample ID	Material	Dry density (kg/m^3)	K_{sat} (m/sec)	Salinity g/m^3
24090391	Tailings	1,570	1.50E-06	-
24090392	Tailings Cover 1	2,210	1.00E-05	35
24090393	Tailings Cover 2	2,190	3.10E-05	-
24090394	Waste Rock Dump1	1,980	7.2E-09	70
24090395	Waste Rock Dump 2	2,060	7.20E-09	-
24090396	Waste Rock Dump 3	2,040	1.80E-08	29
24090397	Borrow material 1	1,880	2.40E-08	10
24090398	Borrow material 2	1,840	9.30E-09	-
24090399	Decant Pond cover 1	-		49
24090400	Decant Pond cover 2	1,880	3.60E-10	239
24090401	Decant Pond embankment	1,860	1.40E-09	-
24090390	Tailings	1,580	3.30E-06	112

5.3.3 Van Genuchten parameter

SEEP/W employs the Van Genuchten-Mualem porosity model to predict unsaturated flow behaviour. The Van Genuchten-Mualem porosity model employs five variables to estimate the Van Genuchten parameter for a specific soil: residual soil water content (θr), saturated soil water content (θs), the α parameter in the soil water retention function (α), the n parameter in the soil water retention function (n) and the saturated hydraulic conductivity (Ks). For a given pressure h, the van Genuchten-Mualem porosity model predicts the water content using the following equation:

$$\theta(h) = \theta_r + \frac{\theta_s - \theta_r}{[1 + (\propto \cdot h)^n]^{1-1/n}}$$

The Van Genuchten parameters for each type of soil were developed using the following approach:

- For all samples, the RETC model v6.02 (Van Genuchten et al, 2009) was utilised to predict the θr, θs, α and n for each soil type using the soil water holding capacity taken from the laboratory analysis of the samples. The r^2 for the modelled water characteristic curve was calculated against the measured value. In all cases, there was a strong correlation between the modelled and observed data.
- Topsoil was not sampled for the project. The parameters of topsoil from similar projects were adopted.

The summary of Van Genuchten's parameters is provided in **Error! Reference source not found.** below. The parameters highlighted in light blue are selected as representative of different cover materials and were used in the analysis.

All the tailings will be harvested and only the 500 mm thick compacted clay base with ground surface below it remains at closure. Assumes that the base material will have parameters similar to the sample Borrow material 2, except for the hydraulic conductivity which was increased by one order. Also, it was assumed that the compacted tailings will have similar properties to Decant Pond cover 1.

Table 5: Summary of Van Genuchten parameters

Material	Θr (cm^3/cm^3)	Θs (cm^3/cm^3)	1/α (kPa)	n	R^2 value
Tailings	0.0247	0.3614	40.5032	3.8094	98%
Tailings Cover 1	0.0080	0.1329	10.9056	1.4358	98%
Tailings Cover 2	0.0165	0.1072	31.1275	2.5125	96%
Waste Rock Dump1	0.0000	0.3686	10.6664	1.2725	98%
Waste Rock Dump 2	0.0000	0.3499	4.9370	1.2647	97%
Waste Rock Dump 3	0.0084	0.1196	36.5822	3.5067	97%
Borrow material 1	0.1128	0.3291	36.6262	2.5793	97%
Borrow material 2	0.0670	0.3513	31.7301	1.5799	99%
Decant Pond cover 1	0.0308	0.2634	44.6329	3.1548	100%
Decant Pond cover 2	0.0000	0.3151	8.3653	1.2020	96%
Decant Pond embankment	0.0000	0.3619	7.8147	1.1973	97%
Tailings	0.0286	0.3901	38.0196	3.4569	96%

5.3.4 Model setup

1D SEEP/W transient flow analysis was set in GeoStudio 2024.2.1. Each scenario was set up with the modelled cover system overlying a 5 m layer of base material. Two scenarios including 0.5 m of compacted clay and 0.3 m of compacted clay were considered to check the model sensitivity to the thickness of the compacted clay layer. The thickness of the material layer in the cover system provides very little advantage over the material properties and constructability in reducing net percolation. The different cover scenarios analysed are shown in Table 6 below.

The model was run assuming no vegetation. This setting is conservative as vegetation will increase evapotranspiration.

The model was set up for 3650 days (10 years) and four hours increments (21,900 steps) were used to run the model.

Table 6: Cover scenarios modelled

Scenario name	Base material	Compacted clay (CCL)	Borrow pit material (BM)	Tailing cover (TC) material (m)	Waste rock (WR) material (m)	Growth media (GM)
0.5CCL+1.5BM+0.2GM	5	0.5	1.5			0.2
0.3CCL+1.5BM+0.2GM	5	0.3	1.5			0.2
0.3CCL+1BM+0.2GM	5	0.3	1			0.2
0.3CCL+1WR+0.2GM	5	0.3			1	0.2
0.3CCL+1TC+0.2GM	5	0.3		1		0.2

5.3.5 Activation pore water pressure

The activation pore water pressure was determined by referring to the moisture content of samples and corresponding matric suction values in the soil water characteristic curves. This activation pore water pressure was applied to the model to define the initial condition for the material types. **Error! Reference source not found.** provides the activation pore water pressure considered for modelling purposes.

Table 7: Activation pore pressure and assumed initial degree of saturation

Parameters	Growth Media	Borrow pit material	Compacted clay	Base material	Tailing cover material	Waste rock material
Assumed initial degree of saturation	40%	40%	40%	40%	35%	15%
Activation pore water pressure (kPa)	-28.5	--100	-110	-100	-100	-100

5.3.6 Boundary conditions

The following boundary conditions were applied:

- The land climate interactions boundary condition at the surface node was used to apply the observed weather data at the top of the model. The Penman-Wilson method was selected to estimate evapotranspiration.
- Use of the free drainage boundary condition should ideally be applied in transient analysis and only specified on bottom mesh boundaries that are relatively far away from your main area of focus (GeoStudio, 2014) . This boundary condition was applied to the bottom of the tailings material.

5.3.7 1D Vadose zone modelling results

A detailed discussion of modelling results from each analysis is presented below.

5.3.7.1 Water balance

SEEP/W partitions precipitation into infiltration, evaporation and runoff. In SEEP/W, when the applied flux(precipitation) exceeds infiltration capacity (zero pressure is reached at the boundary), all excess water is instantaneously removed by surface runoff. The NP (net percolation) was calculated as cumulative water volume moving through the whole cover system for the analysis period of 10 years.

The Figure 10 below presents the water balance components for the 0.3CCL+1BM+0.2GM cover scenario in cumulative water volumes (m^3/m^2). End-of-simulation volumes were used to calculate the yearly average values. These volumes were then divided by the years the model was run to calculate the annual average value. For example, the simulated end-of-simulation rainfall was 4.11 m^3/m^2, which amounts to an average yearly rainfall of 411 mm. This simulated rainfall equals the 10-year average calculated from the input precipitation data. The water balance results for all modelled scenarios are presented in Table 8. The negative value indicates water moving out of the cover system while the positive value indicates water moving into the cover system. The modelled annual average potential evapotranspiration was 2,506 mm.

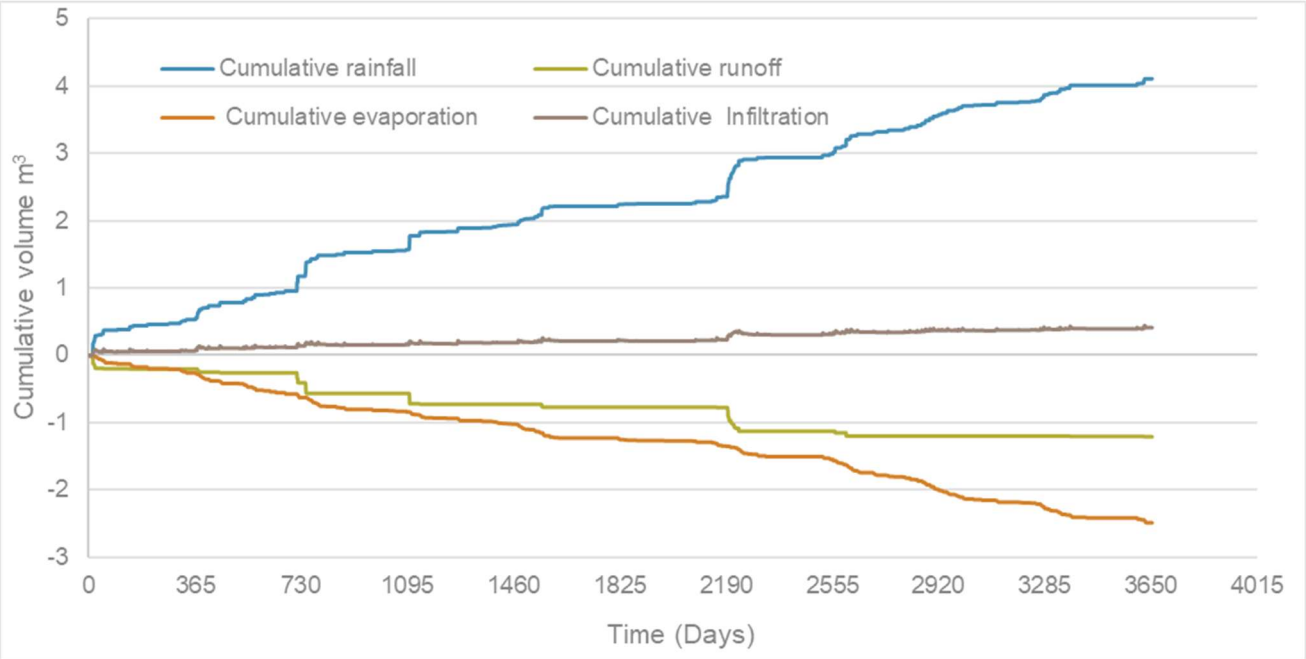

Figure 10: Water balance component of 0.3CCL+1BM+0.2GM scenario

Table 8: Average annual water balance component of all modelled scenarios

Scenario name	Rainfall (mm)	Infiltration (mm)	Evaporation(mm)	Runoff / Ponding (mm)	Net percolation (%)
0.5CCL+1.5BM+0.2GM	411	36.4	252.6	121.9	4.60%
0.3CCL+1.5BM+0.2GM	411	39.6	250.2	212.1	5.57%
0.3CCL+1BM+0.2GM	411	41	249	121	6.36%
0.3CCL+1WR+0.2GM	411	13	264.8	133.2	1.56%
0.3CCL+1TC+0.2GM	411	79	266.7	65.3	15.49%

5.3.7.2 Degree of saturation and rainfall comparison

The degree of saturation at various depths over the years is illustrated below in Figure 11. The degree of saturation at the surface of compacted clay is significantly influenced by rainfall, while the degree of saturation below 1 m of base material remains almost constant, indicating that negligible fluxes go into the base material in the 10-year analysis period.

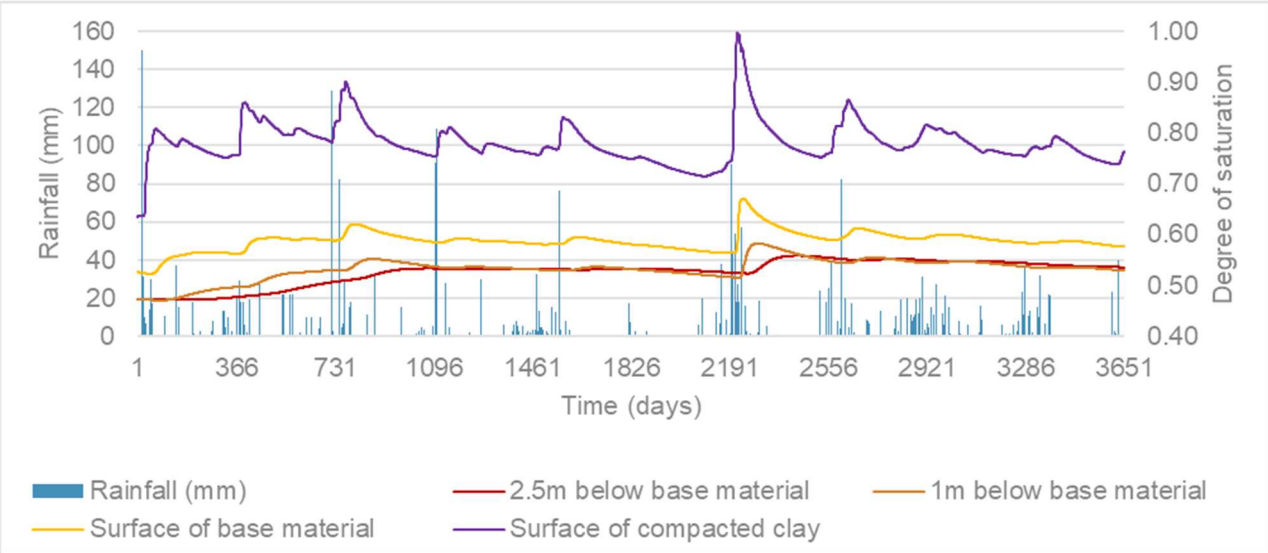

Figure 11: Rainfall and degree of saturation at different depths

5.4 Discussion

The water balance modelling results indicate that all the analysed cover scenarios are technically viable, except for existing cover scenarios (0.3CCL+1TC+0.2GM) in achieving NP less than the threshold value. Among the materials evaluated, borrow pit material and waste rock material demonstrated superior performance in reducing NP compared to the existing TSF cover material as they have relatively lower hydraulic conductivity, which effectively limits water infiltration through the cover system.

5.4.1 Cover design outcomes

The modelling results indicate that except for the existing cover material scenario (0.3CCL+1TC+0.2GM), all other scenarios will have an NP below the threshold value of 10% provided that minimum cover thickness of 1 m plus 200 mm topsoil are achieved. The material from the waste rock dump (WR) outperforms all other cover scenario analyses with NP as low as 1.56%.

This finding highlights the potential benefits of utilising borrow pit material or waste rock for future cover upgrades or replacements. Incorporating these materials could enhance the cover system's ability to minimise infiltration and reduce the risk of seepage.

5.4.2 Cover design uncertainty

It is noted that all models are simplified predictions of real-world behaviour and that there are inherent uncertainties associated with models. To validate the model outputs and inform the final closure approach, it is recommended to undertake trials to assess cover system performance. This could be done via an instrumented cover supported with a lysimeter.

6. Conclusion and recommendations

The conclusion and recommendations are presented below.

6.1 Conclusion

The key conclusions from the study are:

- The hot arid climate with winter droughts supports the adoption of a store-and-release cover system to manage water retention and promote vegetation growth.
- Substantial variability was observed in texture and drainage classification (at 95% MDD) of potential cover material was observed. Sensitivity analysis was not carried out as it requires great deal of time and effort and full still doesn't capture heterogeneity cover material. Hence, field trial are essential to understand the overall performance of cover.
- A threshold NP was taken as 10% based on the information and considering the current scenario, expected spoil remains at closure, and risk of seepage to the surrounding environment. It was assumed that all tailings will be reprocessed leaving NAF spoils at closure reducing the metals concentration in seepage.
- All modelled cover scenarios achieved NP below the threshold value of 10%, except for the existing cover material scenario. By replacing the cover, there is a minimum of 50% reduction in the seepage as indicated by the analysed cover scenarios.
- Borrow pit materials and waste rock exhibited superior performance in minimising NP due to their lower hydraulic conductivity compared to the current TSF cover material.
- Model outputs are subject to simplifications, requiring validation through field trials.
- Salinities in cover material including tailings were very low and may not affect vegetation growth.

6.2 Recommendations

The recommendations from the study are:

- Upgrade the cover system to a store and release cover by incorporating borrow pit or waste rock material to enhance the reduction in seepage.
- Conduct field-scale trials to validate modelling results and optimise cover performance under real-world conditions. Refine the cover design based on trial results and evolving environmental or regulatory requirements.
- Manage the drainage on the top surface to avoid drainage concentrations that may lead to an increased NP.
- Implement or upgrade to a comprehensive long-term monitoring program to track cover system performance, groundwater quality, and vegetation establishment.
- Prepare an inventory of cover materials and assess the required volumes against the available material volumes for each material type.
- Maintain transparent communication with regulators, communities, and stakeholders to address concerns and ensure compliance with closure objectives.

7. References

BOM. (2024). *Bureau of Meteorology*. Retrieved from Bureau of Meteorology: https://reg.bom.gov.au

Carnaby Resources Ltd. (2023). *Progressive Rehabilitation and Closure Plan - Tick Hill Gold Mine.*

Department of Primary Industries and Regional Development. (2025, 1 29). *Salinity tolerance of plants for agriculture and revegetation in Western Australia*. Retrieved from Agriculture and Food: https://www.agric.wa.gov.au/soil-salinity/salinity-tolerance-plants-agriculture-and-revegetation-western-australia#Ref2

GEO-SLOPE International Ltd. (2015). *Seepage Modeling with SEEP/W.*

GEO-SLOPE International Ltd. (n.d.). *Land-climate interaction hydraulic modelling of a soil cover system located in northern Canada.*

GEO-SLOPE International Ltd. (n.d.). *Land-climate interaction hydraulic modelling of a soil cover system located in northern Canada.*

GEO-SLOPE International Ltd. (n.d.). *Land climate interaction hydraulic modelling of a soil cover system located in northern Canada.*

GeoStudio. (2014). *Vadose Zone Modeling with Vadose W.*

International Network for Acid Prevention . (2017). *Global Cover System Design-Technical Guidance Document.*

Mine Earth. (2025). *Tick Hill Project - Materials Characterisation.*

Trpkosova, M. J. (2014). *Modelling capillary barriers. WIT Transactions on Engineering Sciences, Vol 82.*

Van Genuchten et al, F. J. (2009). *The RETC Code for Quantifying the Hydraulic Functions of Unsaturated Soils.*

Appendix A

Laboratory Analysis

Trilab
Soil Rock Calibration

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346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PERMEABILITY BY CONSTANT HEAD TEST REPORT

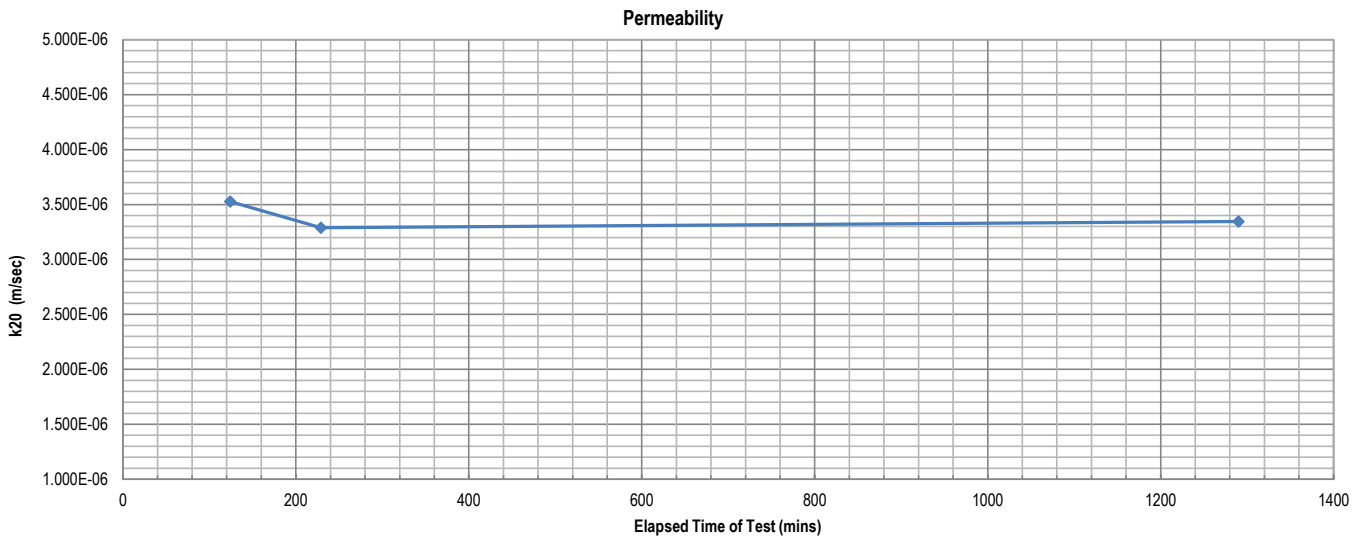
Test Method AS 1289 6.7.1, 5.1.1

Client	Mine Earth	**Report No.**	24090390-CPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	8/10/2024
		Report Date	25/10/2024
Project	TCK-2405		
Client ID	T1	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.58**	Hydraulic Gradient	**2.3**
Optimum Moisture Content (%)	**5.8**	Surcharge (kPa)	**2.9**
Placement Moisture Content (%)	**6.2**	Head Pressure Applied (kPa)	**2.65**
Moisture Ratio (%)	**107.0**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**1.59**	Percentage Material Retained/Sieve Size (mm)	**0 % / 19 mm**
Density Ratio (%)	**94.6**	Sample Height and Diameter (mm)	**116.52 / 101.51 mm**

PERMEABILITY $k_{(20)}$ = **3.3×10^{-06} (m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing

*NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Tested at Trilab Brisbane Laboratory

Approved Signatory

Michael Hamilton

Michael Hamilton

Laboratory No. 9926

The results of calibrations and tests performed apply only to the specific instrument or sample at the time of test unless otherwise clearly stated.
Reference should be made to Trilab's "Standard Terms and Conditions of Business" for further details.
Trilab Pty Ltd ABN 25 065 630 506

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

Trilab
Soil Rock Calibration

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Queens Park
WA 6107
Ph: +61 8 9258 8323

EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090390-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090390
Client ID	T1
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**5**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

Accredited for compliance with ISO/IEC 17025 - Testing

*NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Tested at Trilab Brisbane Laboratory

Approved Signatory

Michael Hamilton

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

The results of calibrations and tests performed apply only to the specific instrument or sample at the time of test unless otherwise clearly stated.
Reference should be made to Trilab's "Standard Terms and Conditions of Business" for further details.
Trilab Pty Ltd ABN 25 065 630 506

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

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Certificate of Analysis

Signatory:

Phone: +617 3289 7179 Bio-Track Pty Ltd ABN 91 056 237 275

Test Code/Name	**[449] Moisture Retention Curve - Soil**		
Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- Moisture Content calculated using Moisture Tension Plate
- Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)

Note: particles ≥ 10mm diameter have been removed prior to measurement. Results for samples with particles ≥ 10mm diameter have been rescaled assuming particles ≥ 10mm are functionally impervious.

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Results Summary			**%Moisture Grav. @ Specified Moisture Tension Points**								
S#	**SampleID**	**≥ 10mm grav. proportion**	**0 kPa (0 Bar)**	**10 kPa (0.1 Bar)**	**33 kPa (0.33 Bar)**	**100 kPa (1 Bar)**	**300 kPa (3 Bar)**	**500 kPa (5 Bar)**	**1000 kPa (10 Bar)**	**1500 kPa (15 Bar)**	**Available Water % Grav.**
1	24090390	0	44.3	33.3	30.9	6.5	*NM	3.8	*NM	2.3	31.0
2	24090391	0	39.7	32.4	29.9	5.6	*NM	3.5	*NM	1.6	30.8
3	24090392	0.43	13.5	10.6	9.4	4.8	*NM	3.4	*NM	2.4	8.2
4	24090393	0.54	11.8	9.2	8.1	3.0	*NM	2.2	*NM	1.5	7.6
5	24090394	0	37.5	30.4	28.7	19.4	*NM	12.8	*NM	10.0	20.4
6	24090395	0	35.5	24.8	23.4	18.2	*NM	9.0	*NM	6.7	18.1
7	24090396	0.43	13.4	10.4	9.2	1.8	*NM	1.1	*NM	0.7	9.7
8	24090397	0	35.0	30.1	28.0	15.5	*NM	13.2	*NM	10.2	19.9
9	24090398	0	36.1	32.2	30.0	20.7	*NM	12.7	*NM	10.0	22.2
10	24090399	0	27.3	25.2	22.7	7.6	*NM	3.9	*NM	2.5	22.7
11	24090400	0	32.2	26.0	23.2	22.3	*NM	13.1	*NM	10.3	15.8
12	24090401	0	36.6	30.8	26.0	24.9	*NM	15.4	*NM	12.3	18.5

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Test Code/Name	**[449] Moisture Retention Curve - Soil**		
Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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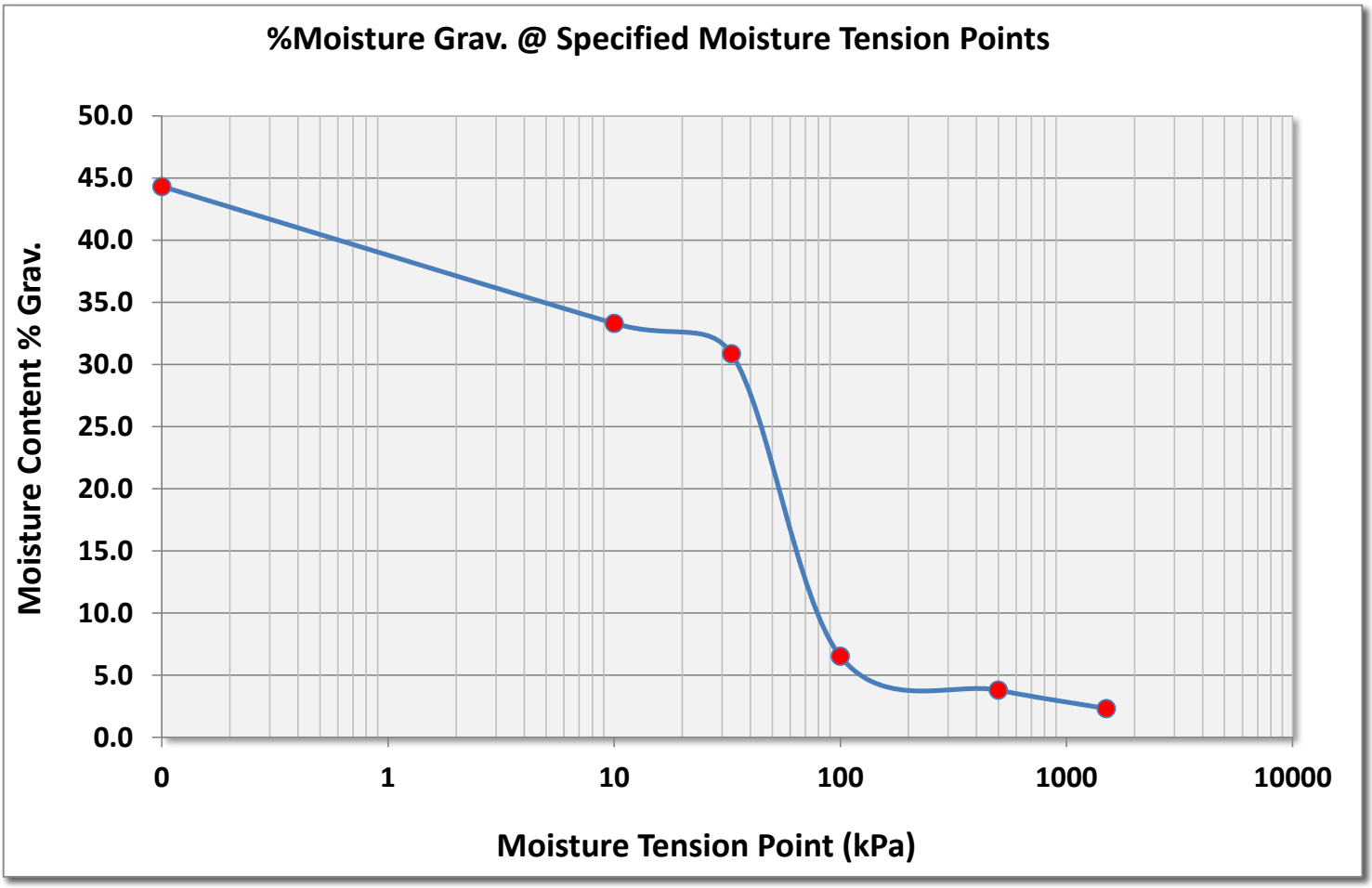
SampleID/Results	**%Moisture @ Specified Moisture Tension Points**										
24090390	**0 kPa (0 Bar)**	**1 kPa (0.01 Bar)**	**10 kPa (0.1 Bar)**	**33 kPa (0.33 Bar)**	**50 kPa (0.5 Bar)**	**100 kPa (1 Bar)**	**300 kPa (3 Bar)**	**500 kPa (5 Bar)**	**1000 kPa (10 Bar)**	**1500 kPa (15 Bar)**	**Available Water % Grav.**
%Moisture Grav.	44.3	*NM	33.3	30.9	*NM	6.5	*NM	3.8	*NM	2.3	31.0



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Test Code/Name	[449] Moisture Retention Curve - Soil		
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SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
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Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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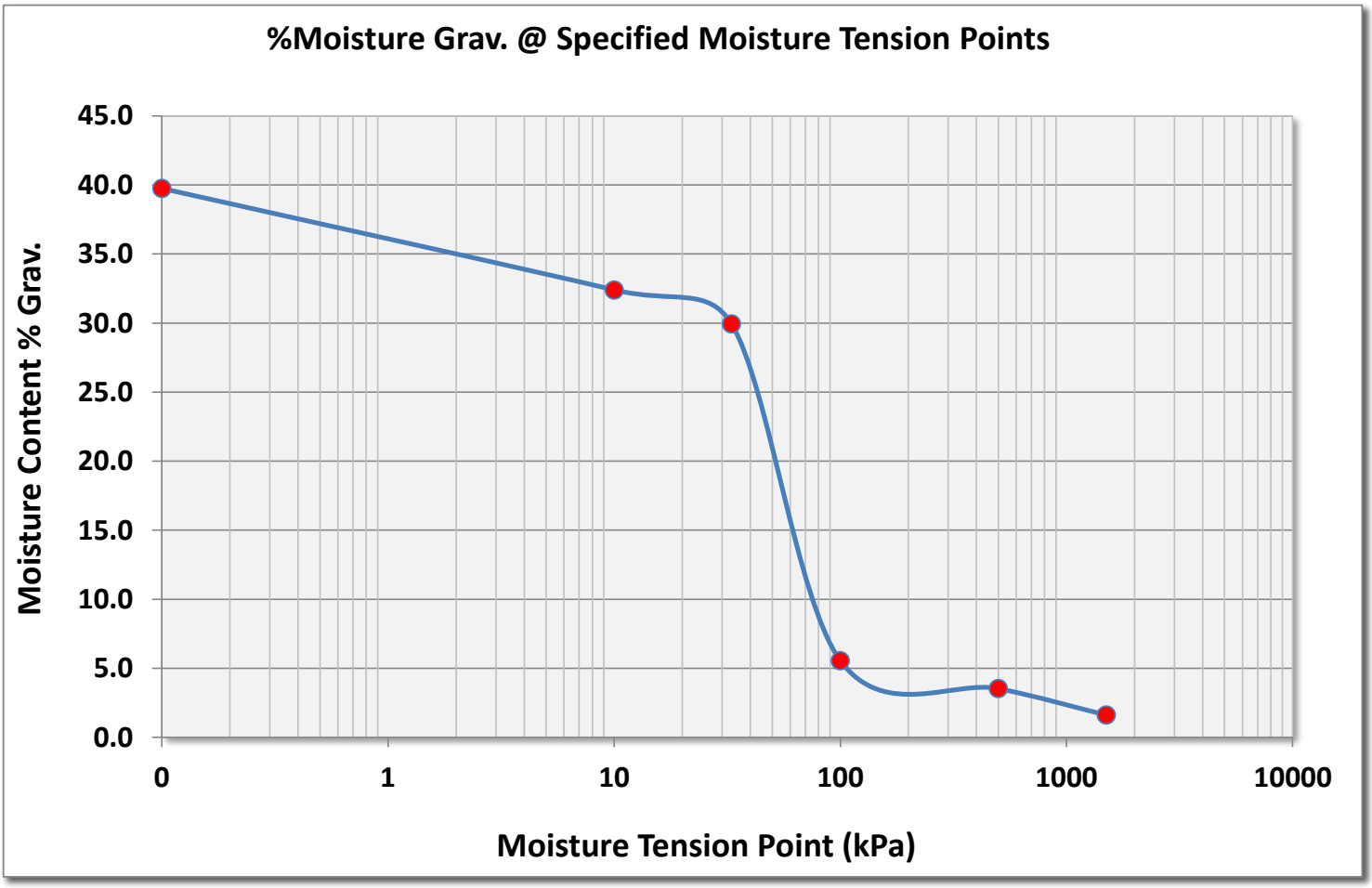
SampleID/Results	%Moisture @ Specified Moisture Tension Points										
24090391	0 kPa (0 Bar)	1 kPa (0.01 Bar)	10 kPa (0.1 Bar)	33 kPa (0.33 Bar)	50 kPa (0.5 Bar)	100 kPa (1 Bar)	300 kPa (3 Bar)	500 kPa (5 Bar)	1000 kPa (10 Bar)	1500 kPa (15 Bar)	Available Water % Grav.
%Moisture Grav.	39.7	*NM	32.4	29.9	*NM	5.6	*NM	3.5	*NM	1.6	30.8



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Test Code/Name	[449] Moisture Retention Curve - Soil		
Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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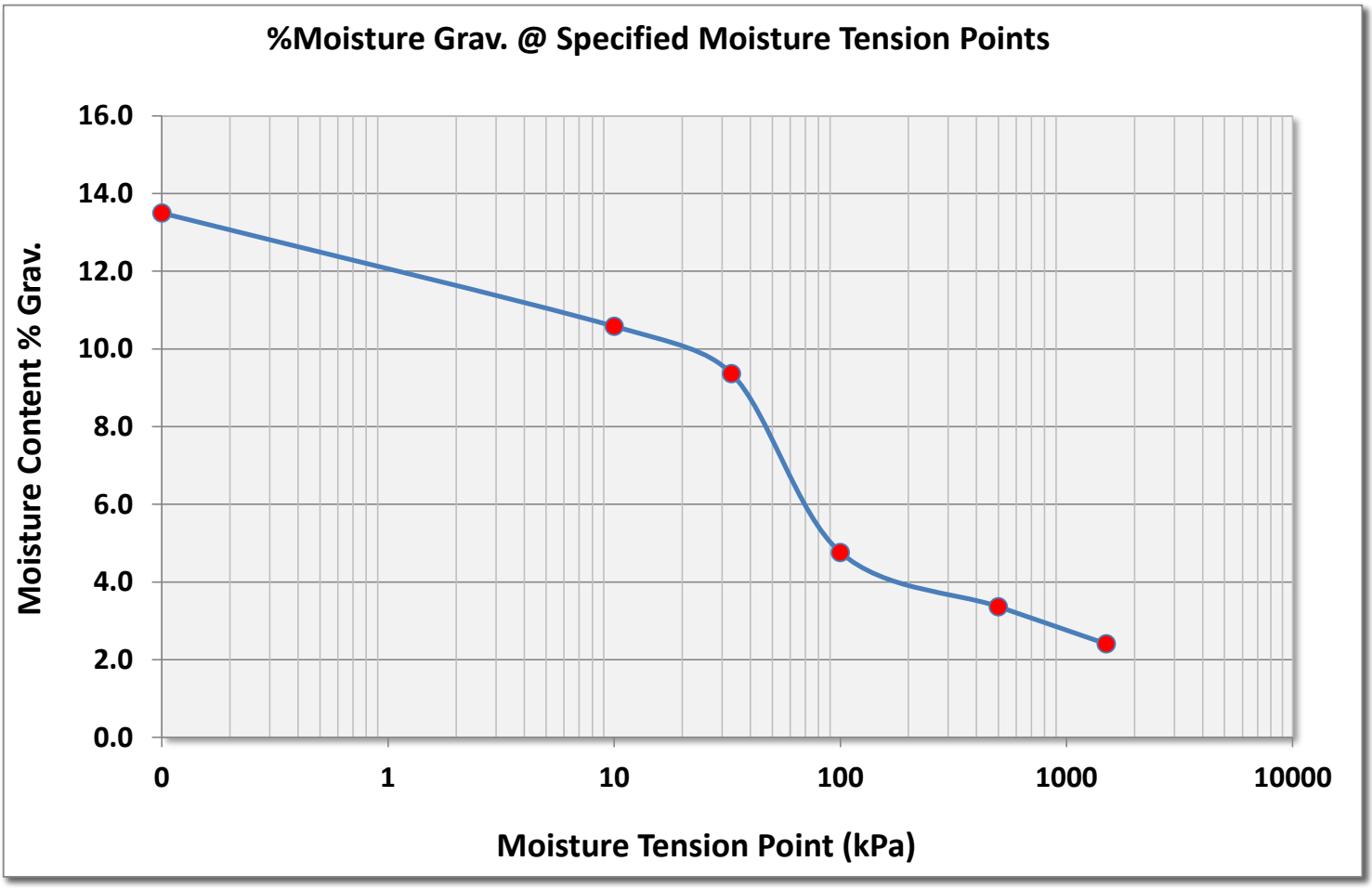
SampleID/Results	%Moisture @ Specified Moisture Tension Points										
24090392 [1]	0 kPa (0 Bar)	1 kPa (0.01 Bar)	10 kPa (0.1 Bar)	33 kPa (0.33 Bar)	50 kPa (0.5 Bar)	100 kPa (1 Bar)	300 kPa (3 Bar)	500 kPa (5 Bar)	1000 kPa (10 Bar)	1500 kPa (15 Bar)	Available Water % Grav.
%Moisture Grav.	13.5	*NM	10.6	9.4	*NM	4.8	*NM	3.4	*NM	2.4	8.2



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Test Code/Name	**[449] Moisture Retention Curve - Soil**		
Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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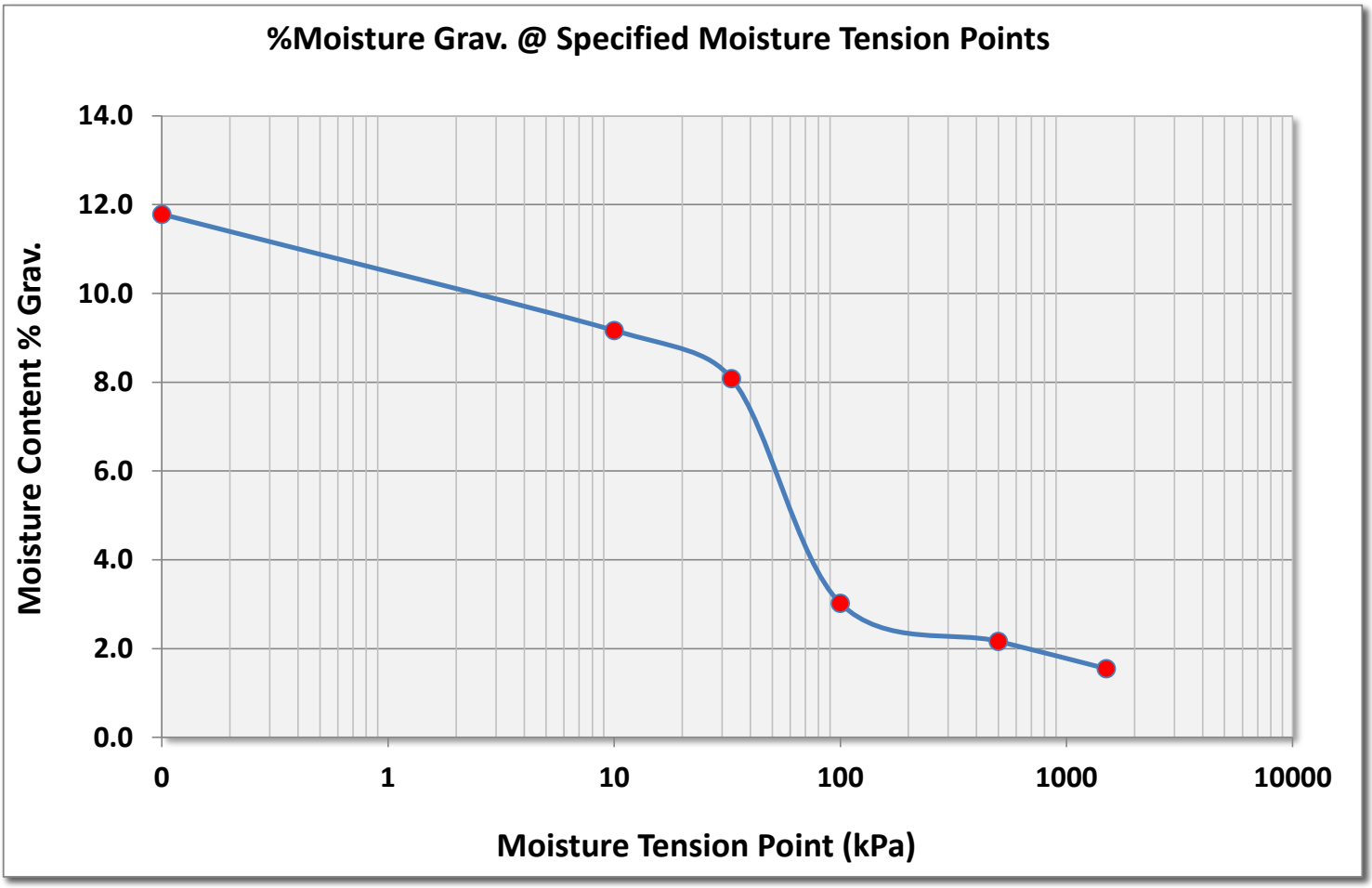
SampleID/Results	**%Moisture @ Specified Moisture Tension Points**										
24090393 [1]	**0 kPa (0 Bar)**	**1 kPa (0.01 Bar)**	**10 kPa (0.1 Bar)**	**33 kPa (0.33 Bar)**	**50 kPa (0.5 Bar)**	**100 kPa (1 Bar)**	**300 kPa (3 Bar)**	**500 kPa (5 Bar)**	**1000 kPa (10 Bar)**	**1500 kPa (15 Bar)**	**Available Water % Grav.**
%Moisture Grav.	11.8	*NM	9.2	8.1	*NM	3.0	*NM	2.2	*NM	1.5	7.6



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SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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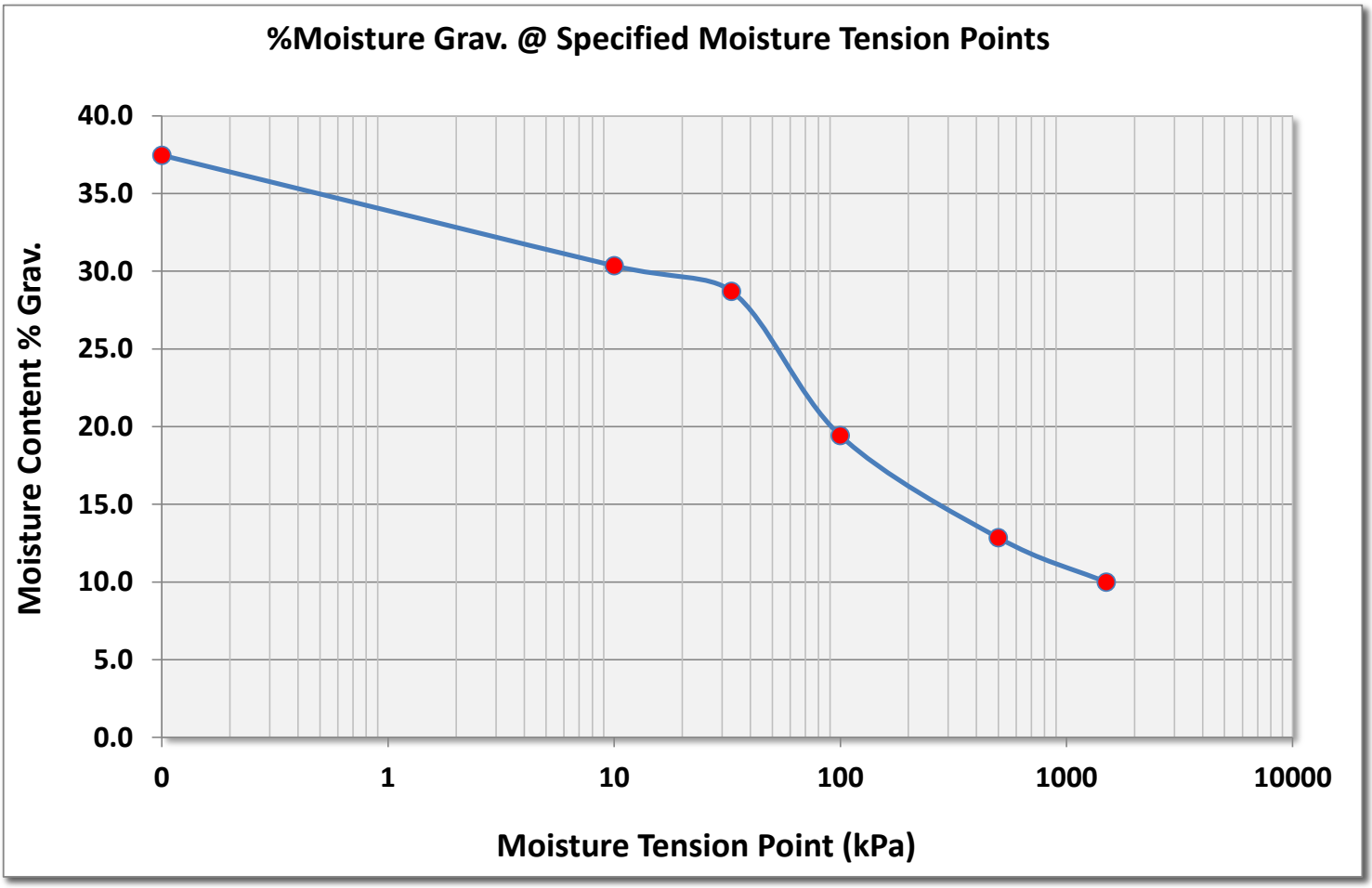
SampleID/Results	%Moisture @ Specified Moisture Tension Points										
24090394	0 kPa (0 Bar)	1 kPa (0.01 Bar)	10 kPa (0.1 Bar)	33 kPa (0.33 Bar)	50 kPa (0.5 Bar)	100 kPa (1 Bar)	300 kPa (3 Bar)	500 kPa (5 Bar)	1000 kPa (10 Bar)	1500 kPa (15 Bar)	Available Water % Grav.
%Moisture Grav.	37.5	*NM	30.4	28.7	*NM	19.4	*NM	12.8	*NM	10.0	20.4



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Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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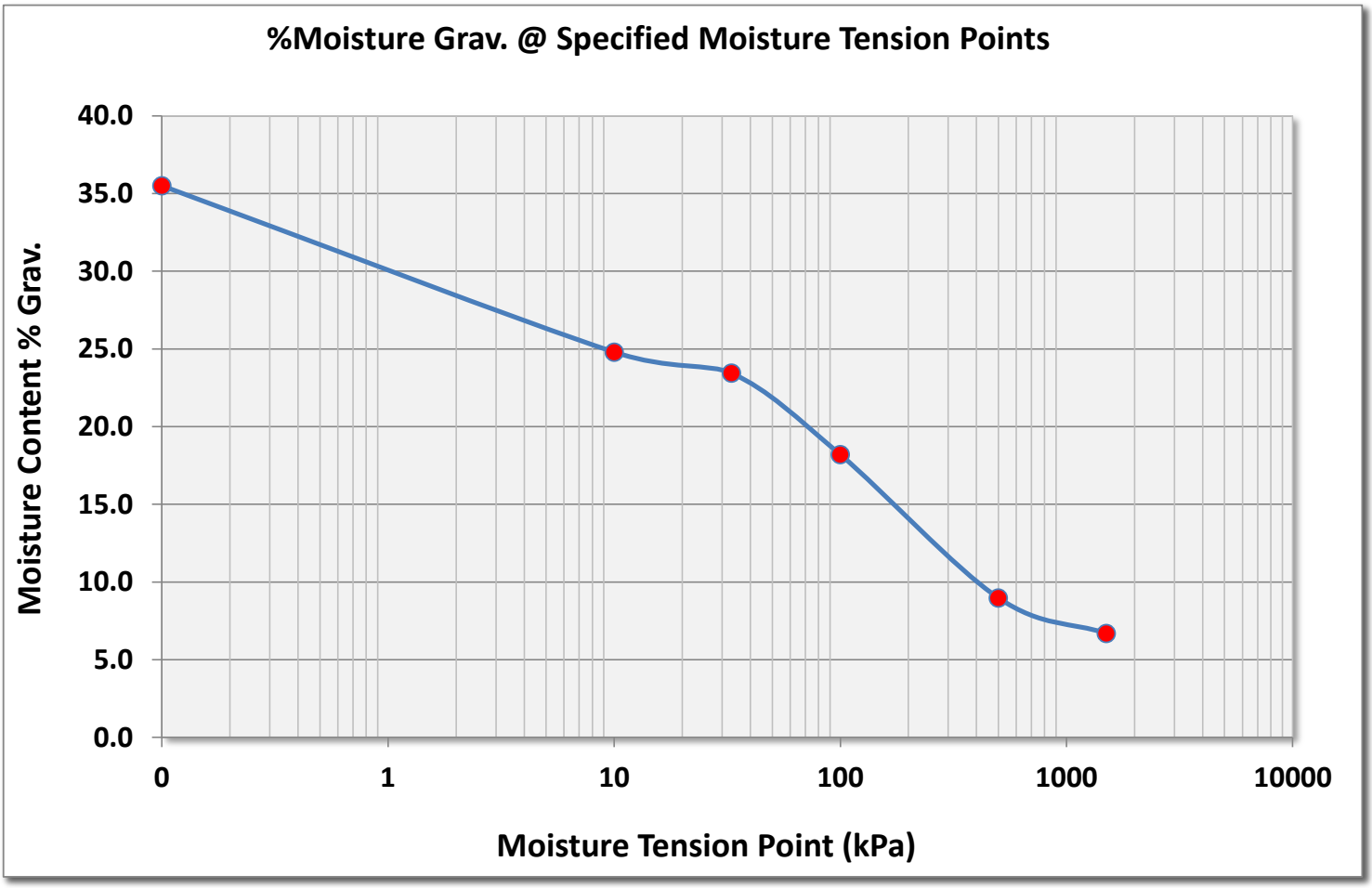
SampleID/Results	%Moisture @ Specified Moisture Tension Points										
24090395	0 kPa (0 Bar)	1 kPa (0.01 Bar)	10 kPa (0.1 Bar)	33 kPa (0.33 Bar)	50 kPa (0.5 Bar)	100 kPa (1 Bar)	300 kPa (3 Bar)	500 kPa (5 Bar)	1000 kPa (10 Bar)	1500 kPa (15 Bar)	Available Water % Grav.
%Moisture Grav.	35.5	*NM	24.8	23.4	*NM	18.2	*NM	9.0	*NM	6.7	18.1



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Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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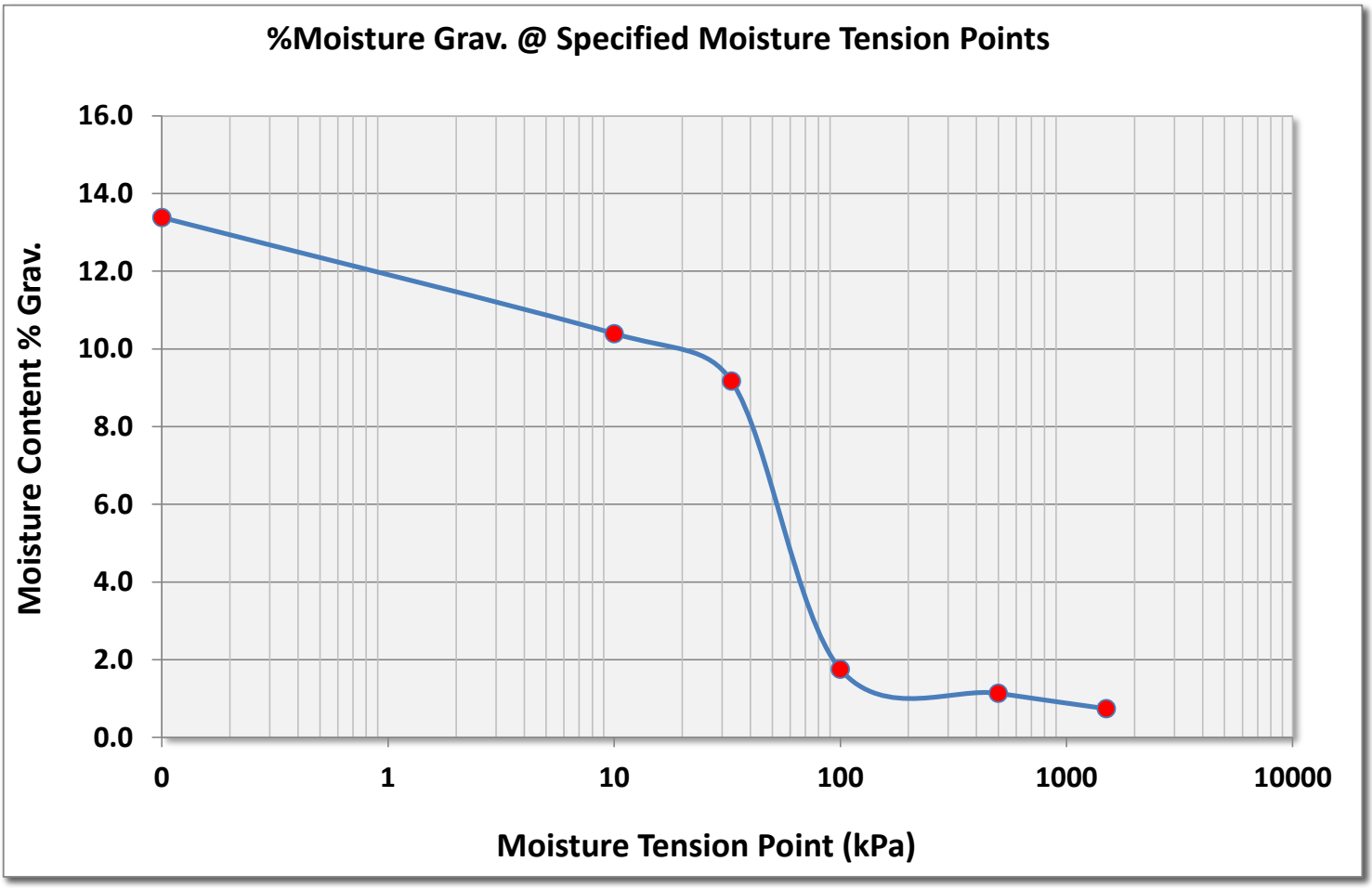
SampleID/Results	**%Moisture @ Specified Moisture Tension Points**										
24090396 [1]	**0 kPa (0 Bar)**	**1 kPa (0.01 Bar)**	**10 kPa (0.1 Bar)**	**33 kPa (0.33 Bar)**	**50 kPa (0.5 Bar)**	**100 kPa (1 Bar)**	**300 kPa (3 Bar)**	**500 kPa (5 Bar)**	**1000 kPa (10 Bar)**	**1500 kPa (15 Bar)**	**Available Water % Grav.**
%Moisture Grav.	13.4	*NM	10.4	9.2	*NM	1.8	*NM	1.1	*NM	0.7	9.7



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SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
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Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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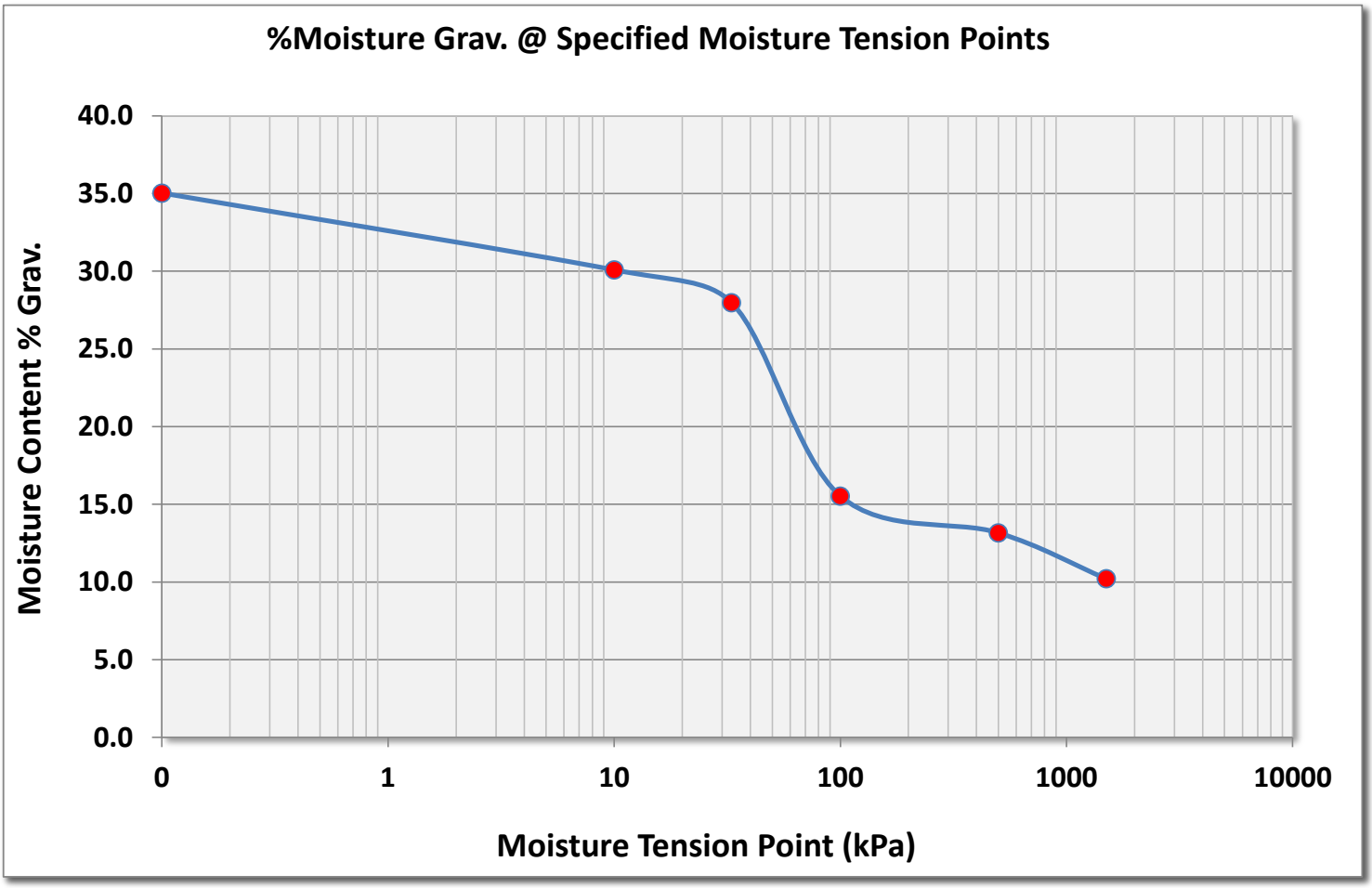
SampleID/Results	%Moisture @ Specified Moisture Tension Points										
24090397	0 kPa (0 Bar)	1 kPa (0.01 Bar)	10 kPa (0.1 Bar)	33 kPa (0.33 Bar)	50 kPa (0.5 Bar)	100 kPa (1 Bar)	300 kPa (3 Bar)	500 kPa (5 Bar)	1000 kPa (10 Bar)	1500 kPa (15 Bar)	Available Water % Grav.
%Moisture Grav.	35.0	*NM	30.1	28.0	*NM	15.5	*NM	13.2	*NM	10.2	19.9



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Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
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[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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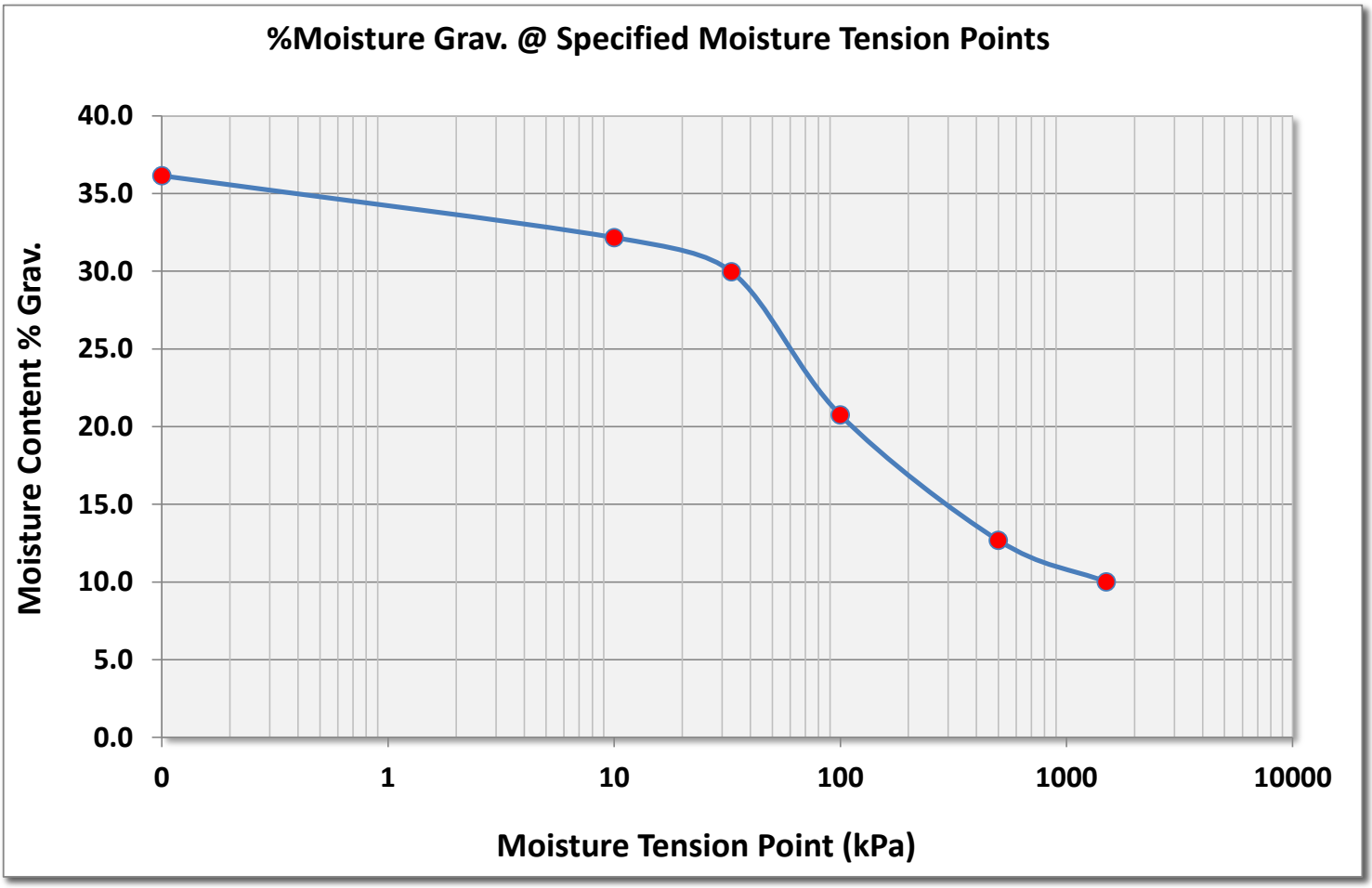
SampleID/Results	**%Moisture @ Specified Moisture Tension Points**										
24090398	**0 kPa (0 Bar)**	**1 kPa (0.01 Bar)**	**10 kPa (0.1 Bar)**	**33 kPa (0.33 Bar)**	**50 kPa (0.5 Bar)**	**100 kPa (1 Bar)**	**300 kPa (3 Bar)**	**500 kPa (5 Bar)**	**1000 kPa (10 Bar)**	**1500 kPa (15 Bar)**	**Available Water % Grav.**
%Moisture Grav.	36.1	*NM	32.2	30.0	*NM	20.7	*NM	12.7	*NM	10.0	22.2



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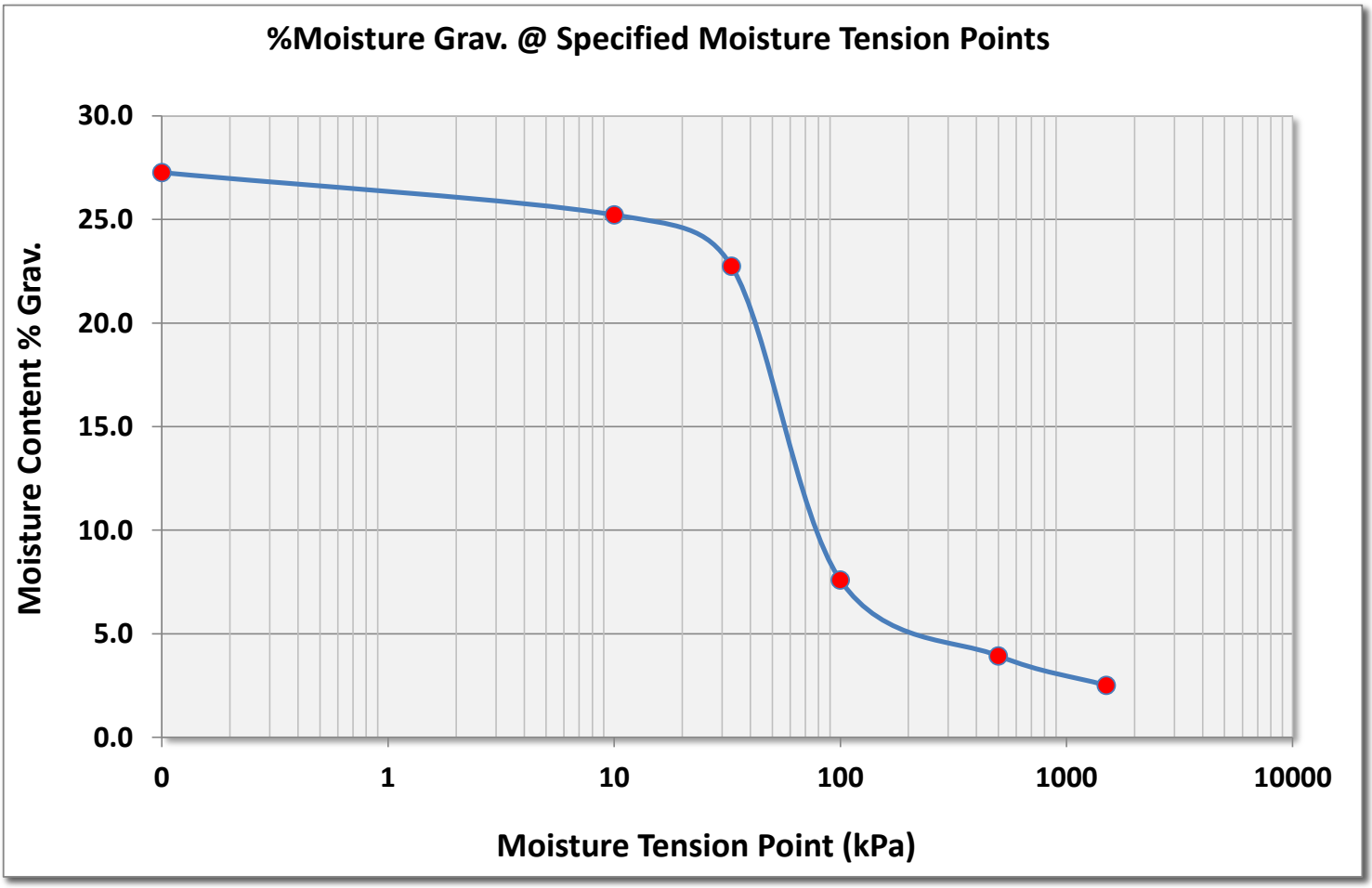
SampleID/Results	%Moisture @ Specified Moisture Tension Points										
24090399	0 kPa (0 Bar)	1 kPa (0.01 Bar)	10 kPa (0.1 Bar)	33 kPa (0.33 Bar)	50 kPa (0.5 Bar)	100 kPa (1 Bar)	300 kPa (3 Bar)	500 kPa (5 Bar)	1000 kPa (10 Bar)	1500 kPa (15 Bar)	Available Water % Grav.
%Moisture Grav.	27.3	*NM	25.2	22.7	*NM	7.6	*NM	3.9	*NM	2.5	22.7



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Certificate of Analysis

Signatory:

Phone: +617 3289 7179 Bio-Track Pty Ltd ABN 91 056 237 275

Test Code/Name	[449] Moisture Retention Curve - Soil		
Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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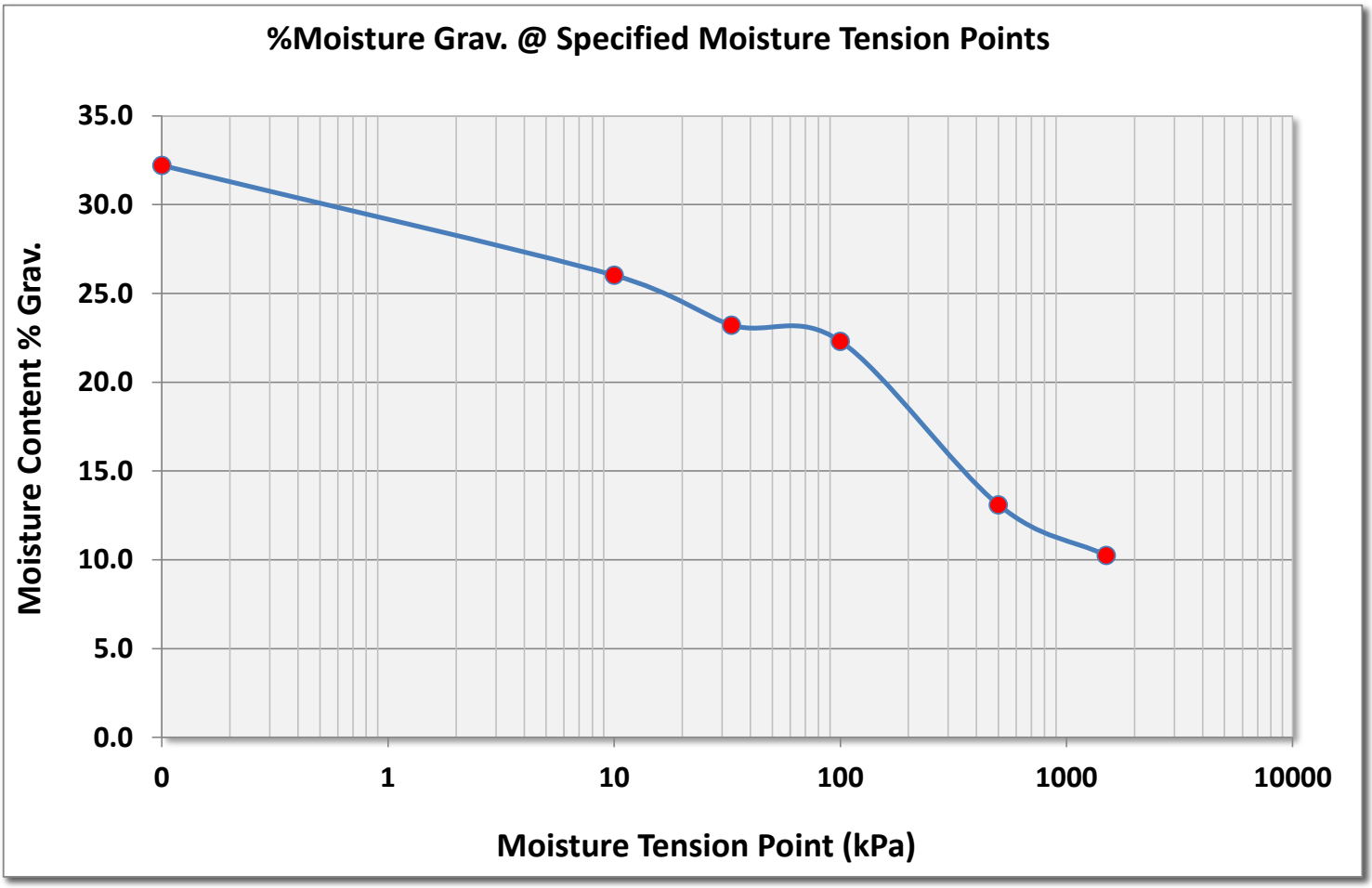
SampleID/Results	%Moisture @ Specified Moisture Tension Points										
24090400	0 kPa (0 Bar)	1 kPa (0.01 Bar)	10 kPa (0.1 Bar)	33 kPa (0.33 Bar)	50 kPa (0.5 Bar)	100 kPa (1 Bar)	300 kPa (3 Bar)	500 kPa (5 Bar)	1000 kPa (10 Bar)	1500 kPa (15 Bar)	Available Water % Grav.
%Moisture Grav.	32.2	*NM	26.0	23.2	*NM	22.3	*NM	13.1	*NM	10.3	15.8



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Test Code/Name	[449] Moisture Retention Curve - Soil		
Lab Reference (LR)	**101024.764**	Client Name	Trilab
SampleID(s)	**As Listed**	Client Contact	James Russell
		Project Name	SWCC Testing
Report Date	28/10/2024	Job Number	9919/P/488
Sample Received Date	8/10/2024	Order Number	
Sample Disposal Date	9/12/2024	Chain of Custody	9919/CC/93
Sample Packaging	Plastic Bag	Client Email	registrationbne@trilab.com.au
Temperature	Ambient	Client Address	346A Bilsen Rd Geebung Queensland 4034

Method:
- **Sample oven dried @ 85°C, sieved < 10mm**
- **Available Water (%Grav.) = Field Capacity (%Grav.) - Wilting Point (%Grav.)**
- **Moisture Content calculated using Moisture Tension Plate**

[1] sample results have been scaled to account for % of impervious rocks ≥ 10mm

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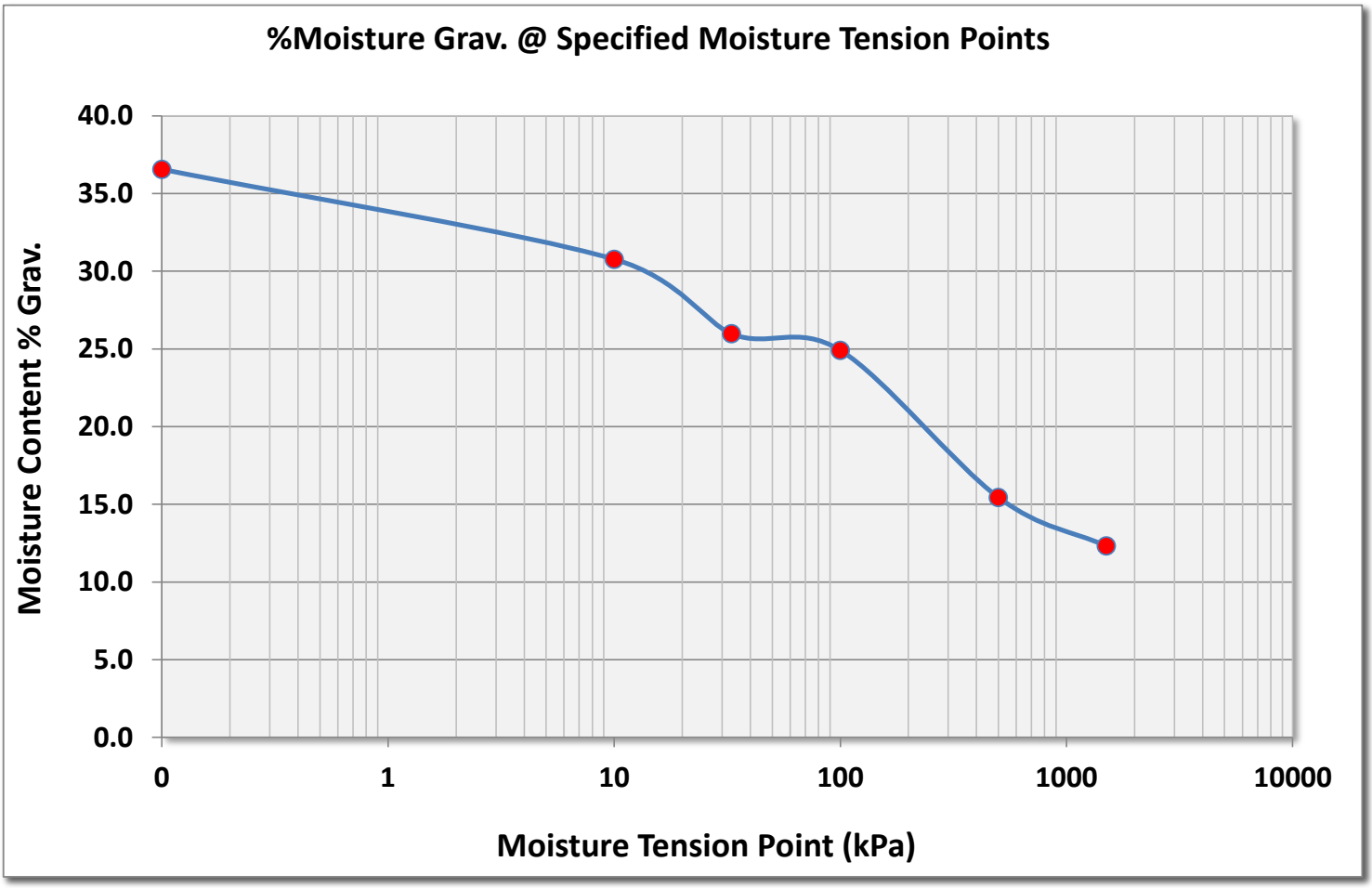
SampleID/Results	%Moisture @ Specified Moisture Tension Points										
24090401	0 kPa (0 Bar)	1 kPa (0.01 Bar)	10 kPa (0.1 Bar)	33 kPa (0.33 Bar)	50 kPa (0.5 Bar)	100 kPa (1 Bar)	300 kPa (3 Bar)	500 kPa (5 Bar)	1000 kPa (10 Bar)	1500 kPa (15 Bar)	Available Water % Grav.
%Moisture Grav.	36.6	*NM	30.8	26.0	*NM	24.9	*NM	15.4	*NM	12.3	18.5



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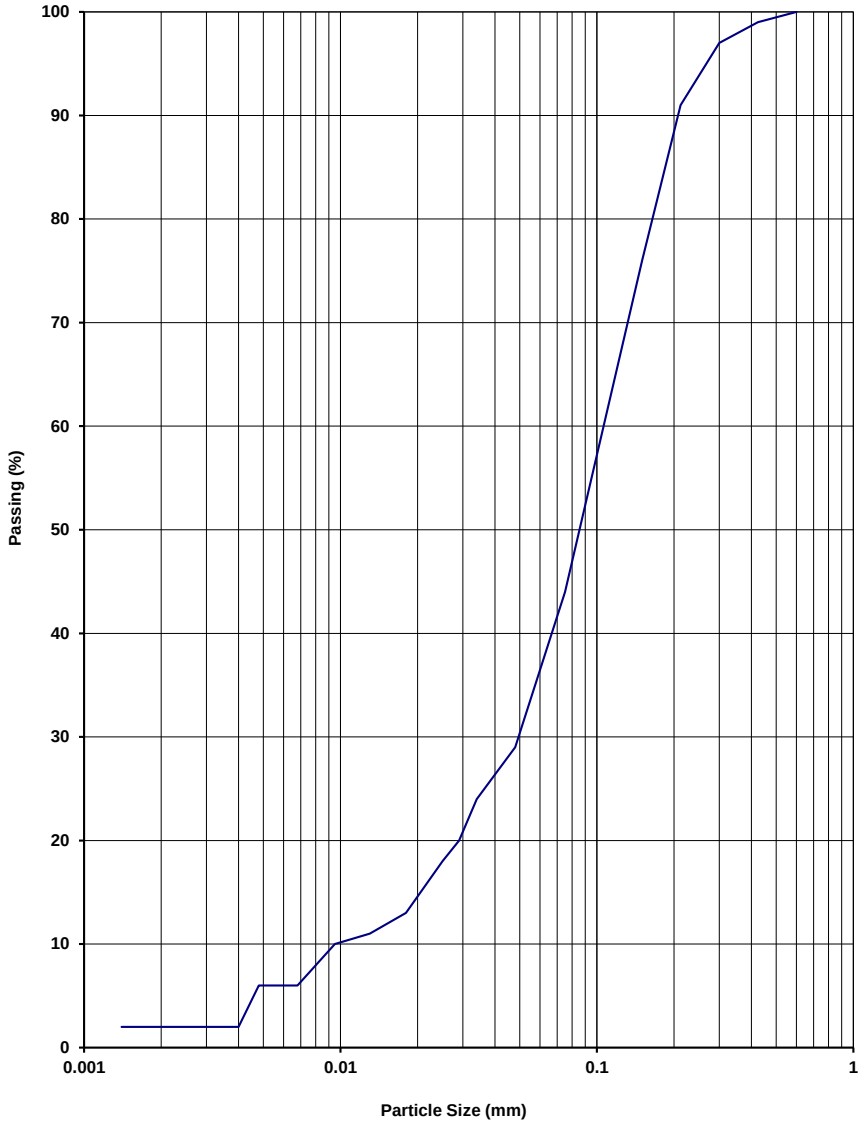
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090390-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	16/9/2024
		Report Date	8/10/2024
Project	TCK-2405		
Client ID	T1	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	
1.18	
0.600	100
0.425	99
0.300	97
0.212	91
0.150	76
0.075	44
0.048	29
0.034	24
0.029	20
0.025	18
0.018	13
0.013	11
0.0095	10
0.0068	6
0.0048	6
0.004	2
0.0034	2
0.0028	2
0.0024	2
0.0014	2



NOTES/REMARKS: -

Moisture Content 3% -2.36mm Soil Particle Density(t/m^3) 2.70

Sample/s supplied by the client

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Approved Signatory

Michael Hamilton

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090391-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090391
Liquid Limit Determination	AS 1289.3.1.2
Test Date	30/09/2024
Client ID	T2
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	Non-attainable
Plastic Limit (%)	Non-attainable
Plasticity Index (%)	Non-plastic
Linear Shrinkage (%)	Non-attainable
Moisture Content (%)	11.6

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred **Page 1 of 1** REP00102

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PERMEABILITY BY CONSTANT HEAD TEST REPORT

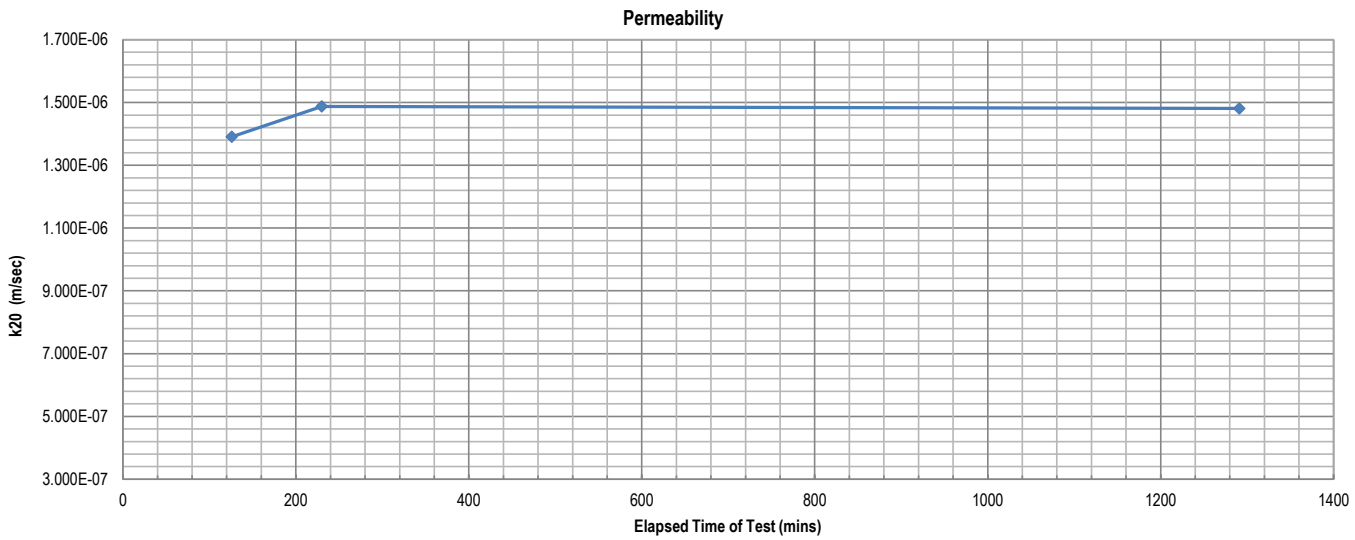
Test Method AS 1289 6.7.1, 5.1.1

Client	Mine Earth	**Report No.**	24090391-CPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	8/10/2024
		Report Date	25/10/2024
Project	TCK-2405		
Client ID	T2	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.57**	Hydraulic Gradient	**2.3**
Optimum Moisture Content (%)	**15.1**	Surcharge (kPa)	**2.8**
Placement Moisture Content (%)	**15.8**	Head Pressure Applied (kPa)	**2.65**
Moisture Ratio (%)	**104.4**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**1.72**	Percentage Material Retained/Sieve Size (mm)	**0 % / 19 mm**
Density Ratio (%)	**94.4**	Sample Height and Diameter (mm)	**116.65 / 101.45 mm**

PERMEABILITY $k_{(20)} = 1.5 \times 10^{-06}$ **(m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090391-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090391
Client ID	T2
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**4 Gypsum**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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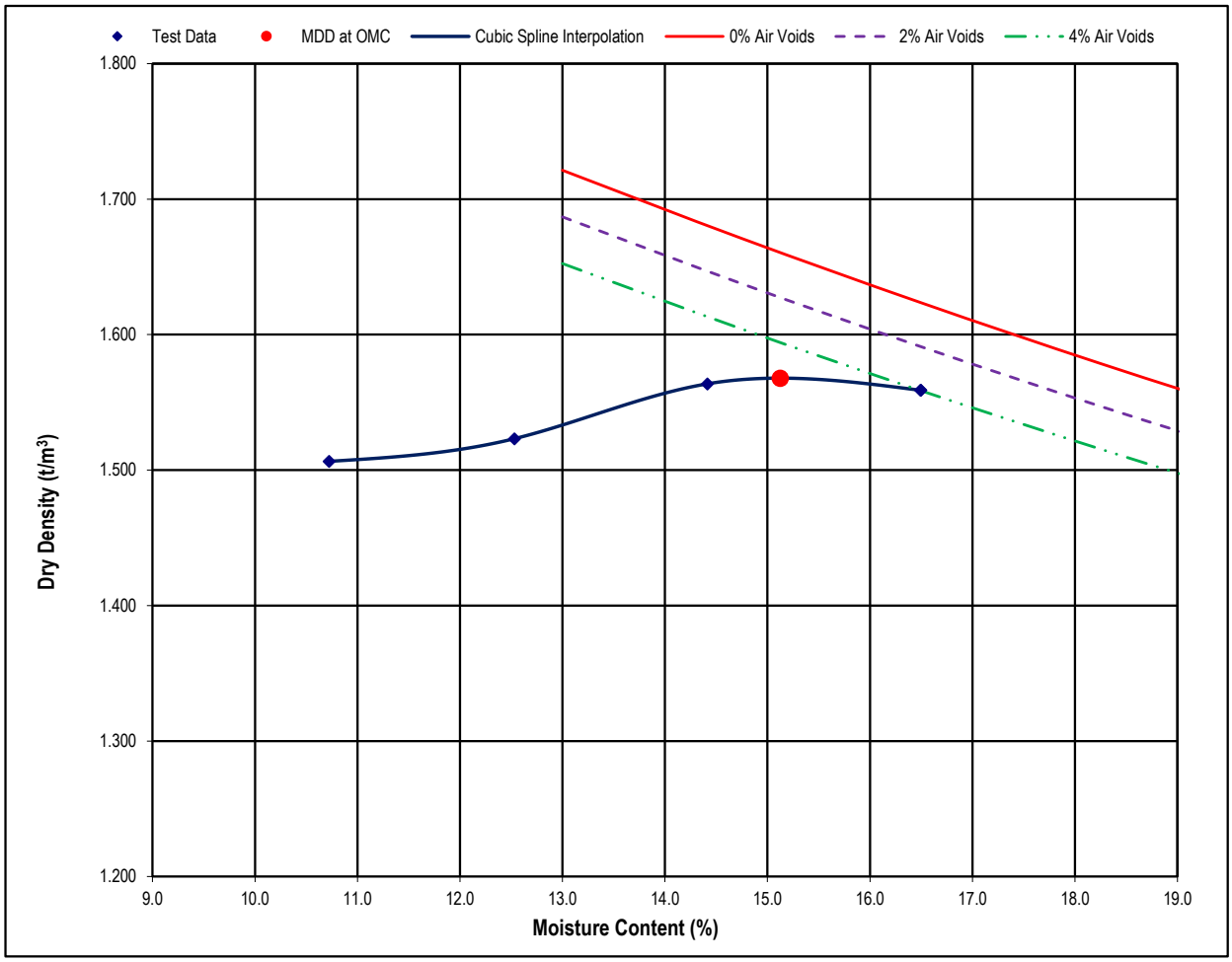
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090391-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	24/09/2024
		Report Date	1/10/2024
Project	TCK-2405		
Client ID	T2	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m³)	1.57	**Optimum Moisture Content (%)**	15.1
Moisture Content (%)	11.6	**Percentage of Oversize/Sieve Size (mm)**	0 / 19

NOTES/REMARKS:

Curing Time (hrs): 0 * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.22

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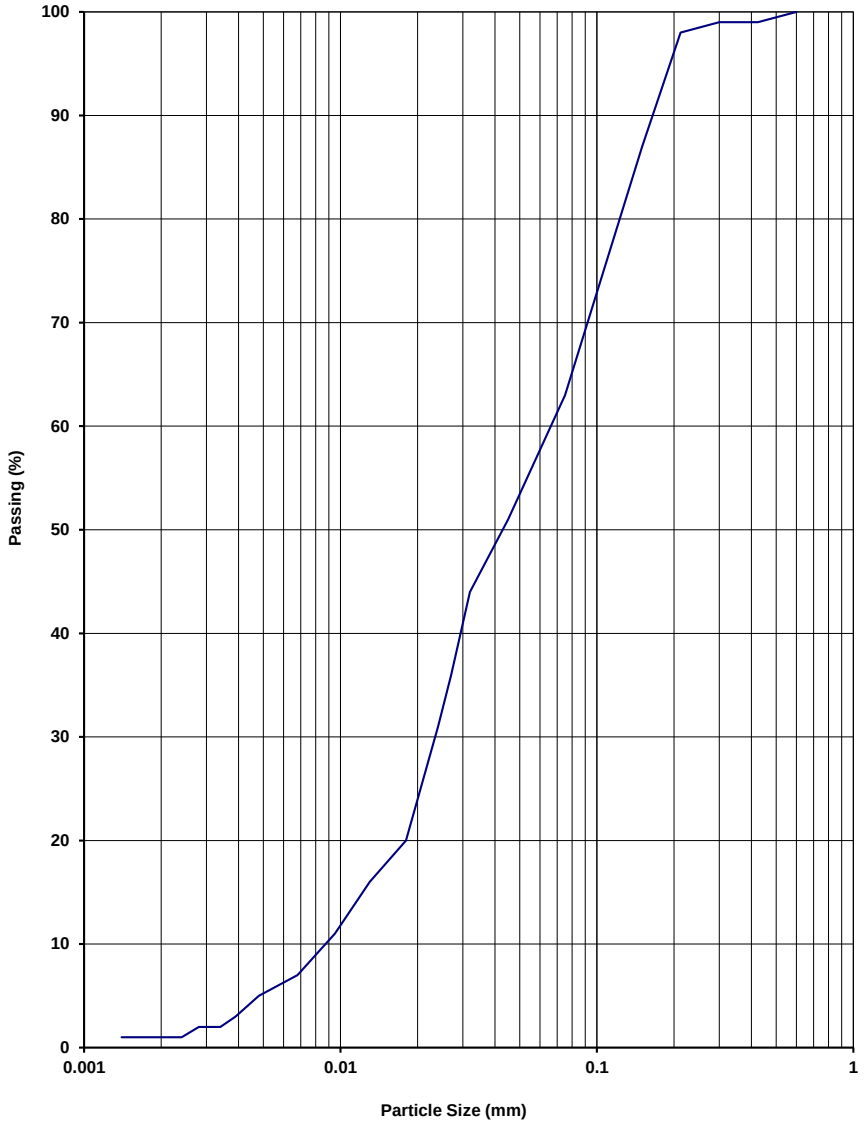
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090391-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	16/9/2024
		Report Date	8/10/2024
Project	TCK-2405		
Client ID	T2	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	
1.18	
0.600	100
0.425	99
0.300	99
0.212	98
0.150	87
0.075	63
0.045	51
0.032	44
0.027	36
0.024	31
0.018	20
0.013	16
0.0095	11
0.0068	7
0.0048	5
0.0039	3
0.0034	2
0.0028	2
0.0024	1
0.0014	1



NOTES/REMARKS: -

Moisture Content 11.6% -2.36mm Soil Particle Density(t/m^3) 2.71

Sample/s supplied by the client

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090392-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090392
Liquid Limit Determination	AS 1289.3.1.2
Test Date	3/10/2024
Client ID	TC1
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	26
Plastic Limit (%)	17
Plasticity Index (%)	9
Linear Shrinkage (%)	7.0 +
Moisture Content (%)	1.3

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred **Page 1 of 1** REP00102

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PERMEABILITY BY CONSTANT HEAD TEST REPORT

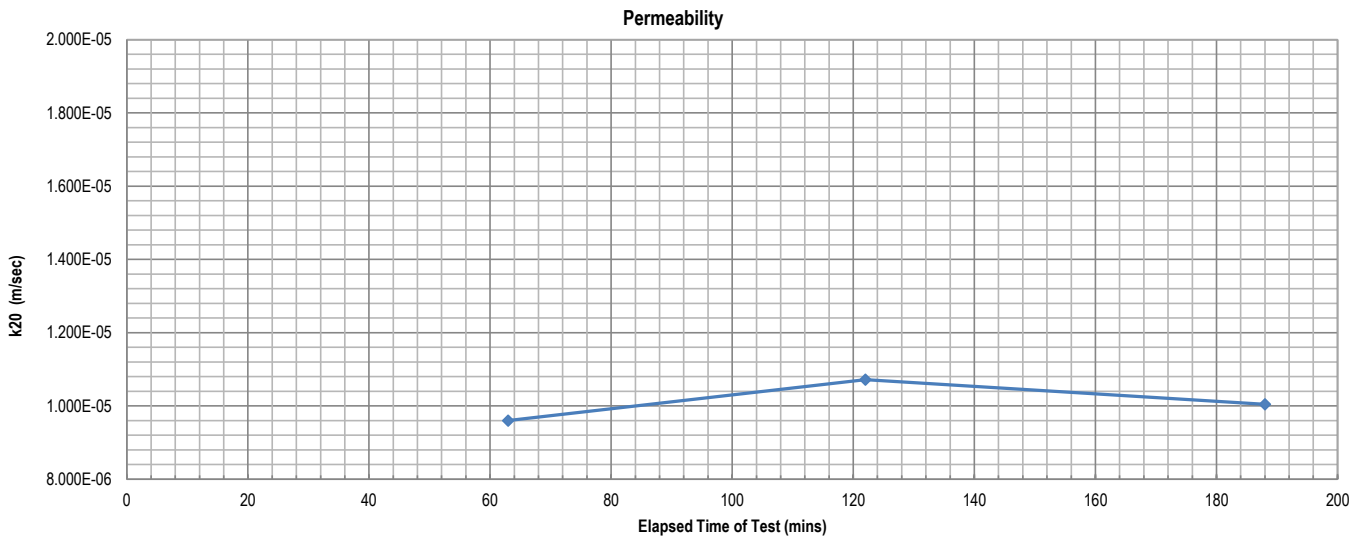
Test Method AS 1289 6.7.1, 5.1.1

Client	Mine Earth	**Report No.**	24090392-CPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	25/10/2024
		Report Date	8/10/2024
Project	TCK-2405		
Client ID	TC1	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**2.21**	Hydraulic Gradient	**2.1**
Optimum Moisture Content (%)	**8.0**	Surcharge (kPa)	**3.6**
Placement Moisture Content (%)	**8.4**	Head Pressure Applied (kPa)	**2.35**
Moisture Ratio (%)	**104.7**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**2.27**	Percentage Material Retained/Sieve Size (mm)	**23 % / 19 mm**
Density Ratio (%)	**94.7**	Sample Height and Diameter (mm)	**116.97 / 152.66 mm**

PERMEABILITY $k_{(20)} =$ **1.0×10^{-05} (m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client

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Approved Signatory

Michael Hamilton

Michael Hamilton

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090392-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090392
Client ID	TC1
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**5**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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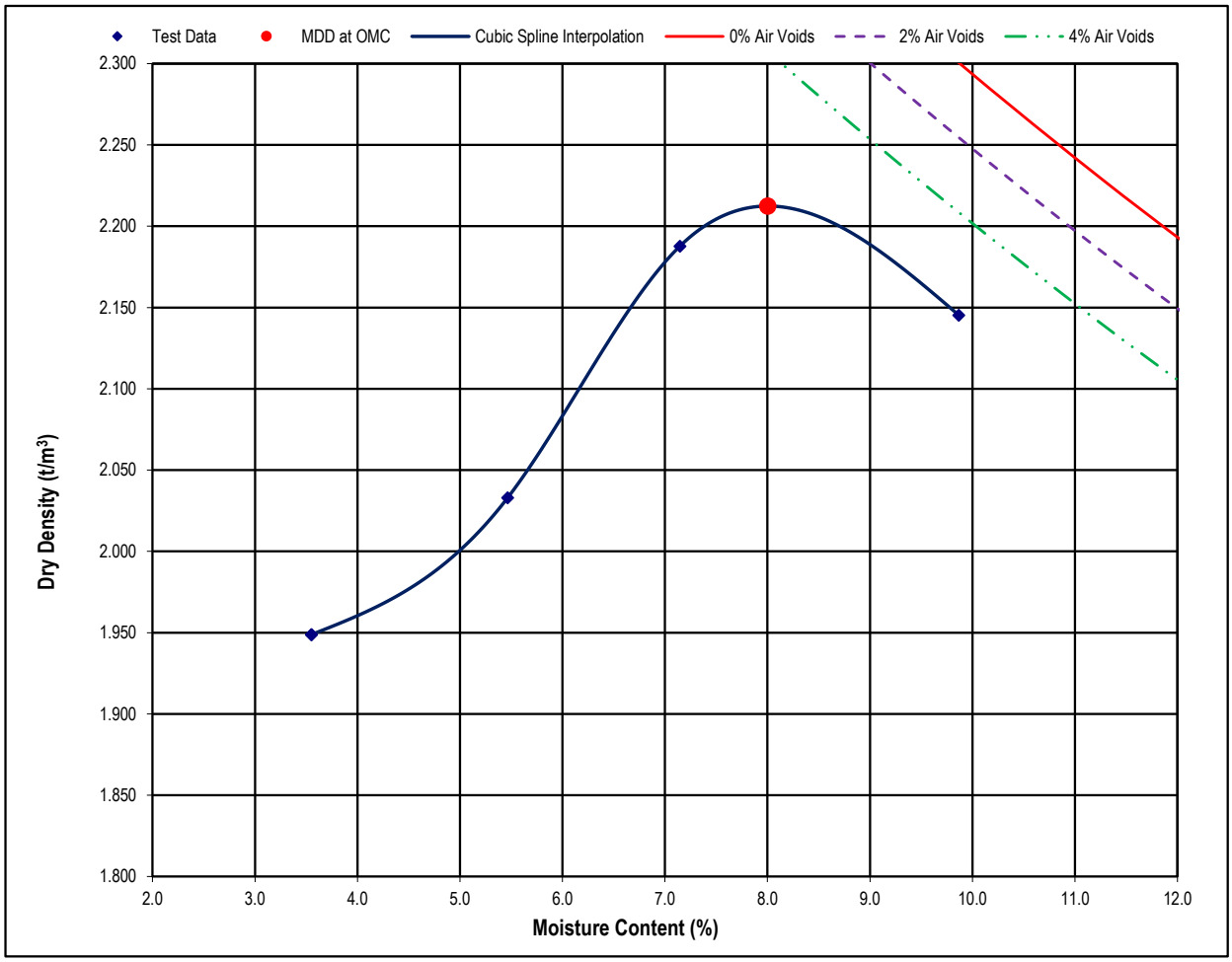
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090392-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	24/09/2024
		Report Date	1/10/2024
Project	TCK-2405		
Client ID	TC1	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m³)	2.21	**Optimum Moisture Content (%)**	8.0
Moisture Content (%)	1.3	**Percentage of Oversize/Sieve Size (mm)**	23/19

NOTES/REMARKS:

Curing Time (hrs): 24 * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.98

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Approved Signatory

Michael Hamilton

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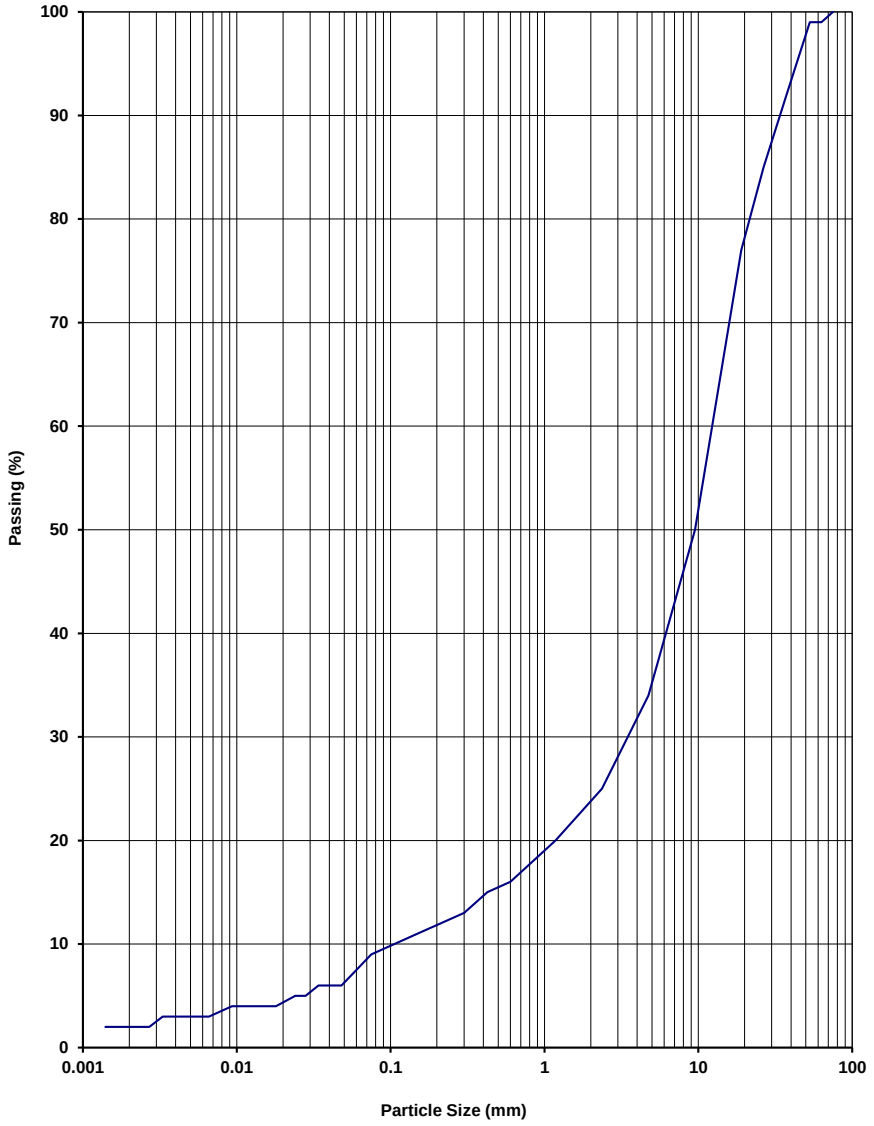
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090392-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	16/9/2024
		Report Date	8/10/2024
Project	TCK-2405		
Client ID	TC1	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	100
63.0	99
53.0	99
37.5	92
26.5	85
19.0	77
13.2	61
9.5	50
6.7	41
4.75	34
2.36	25
1.18	20
0.600	16
0.425	15
0.300	13
0.212	12
0.150	11
0.075	9
0.048	6
0.034	6
0.028	5
0.024	5
0.018	4
0.013	4
0.0093	4
0.0066	3
0.0047	3
0.0038	3
0.0033	3
0.0027	2
0.0023	2
0.0014	2



NOTES/REMARKS: -

Moisture Content 1.3% -2.36mm Soil Particle Density(t/m^3) 2.72

Sample/s supplied by the client

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090393-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090393
Liquid Limit Determination	AS 1289.3.1.2
Test Date	3/10/2024
Client ID	TC2
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	23
Plastic Limit (%)	17
Plasticity Index (%)	6
Linear Shrinkage (%)	4.0
Moisture Content (%)	1.3

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred **Page 1 of 1** REP00102

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PERMEABILITY BY CONSTANT HEAD TEST REPORT

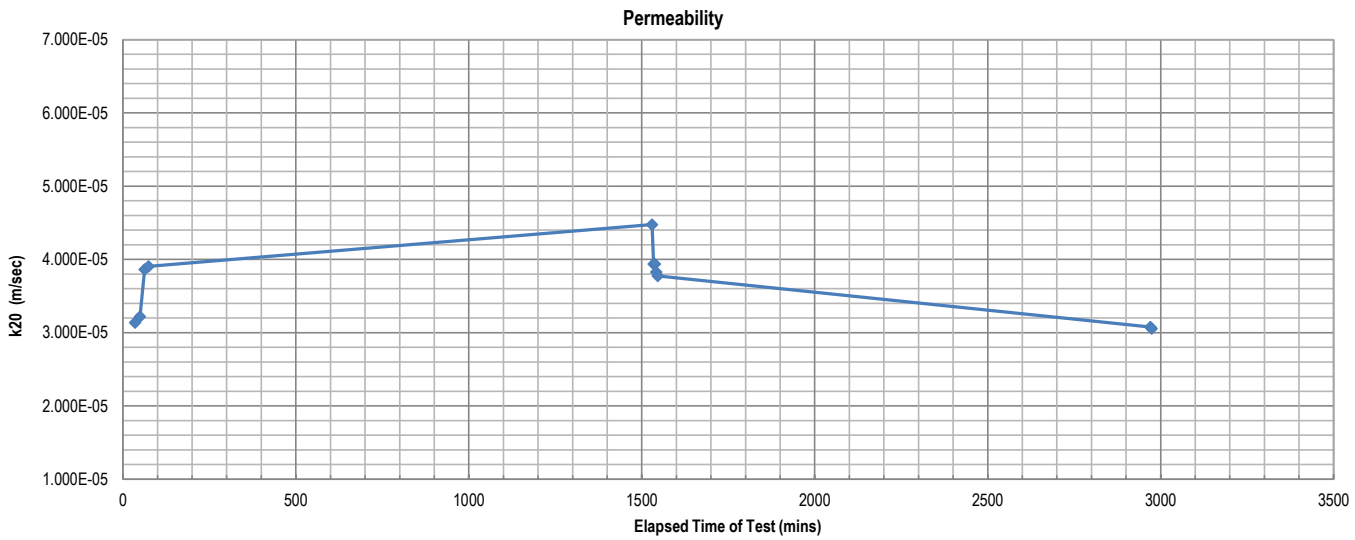
Test Method AS 1289 6.7.1, 5.1.1

Client	Mine Earth	**Report No.**	24090393-CPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	23/10/2024
		Report Date	25/10/2024
Project	TCK-2405		
Client ID	TC2	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**2.19**	Hydraulic Gradient	**4.1**
Optimum Moisture Content (%)	**8.4**	Surcharge (kPa)	**3.6**
Placement Moisture Content (%)	**7.7**	Head Pressure Applied (kPa)	**4.71**
Moisture Ratio (%)	**91.3**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**2.25**	Percentage Material Retained/Sieve Size (mm)	**19 % / 19 mm**
Density Ratio (%)	**95.6**	Sample Height and Diameter (mm)	**116 / 152.26 mm**

PERMEABILITY $k_{(20)} =$ **3.1×10^{-05} (m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090393-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090393
Client ID	TC2
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**5**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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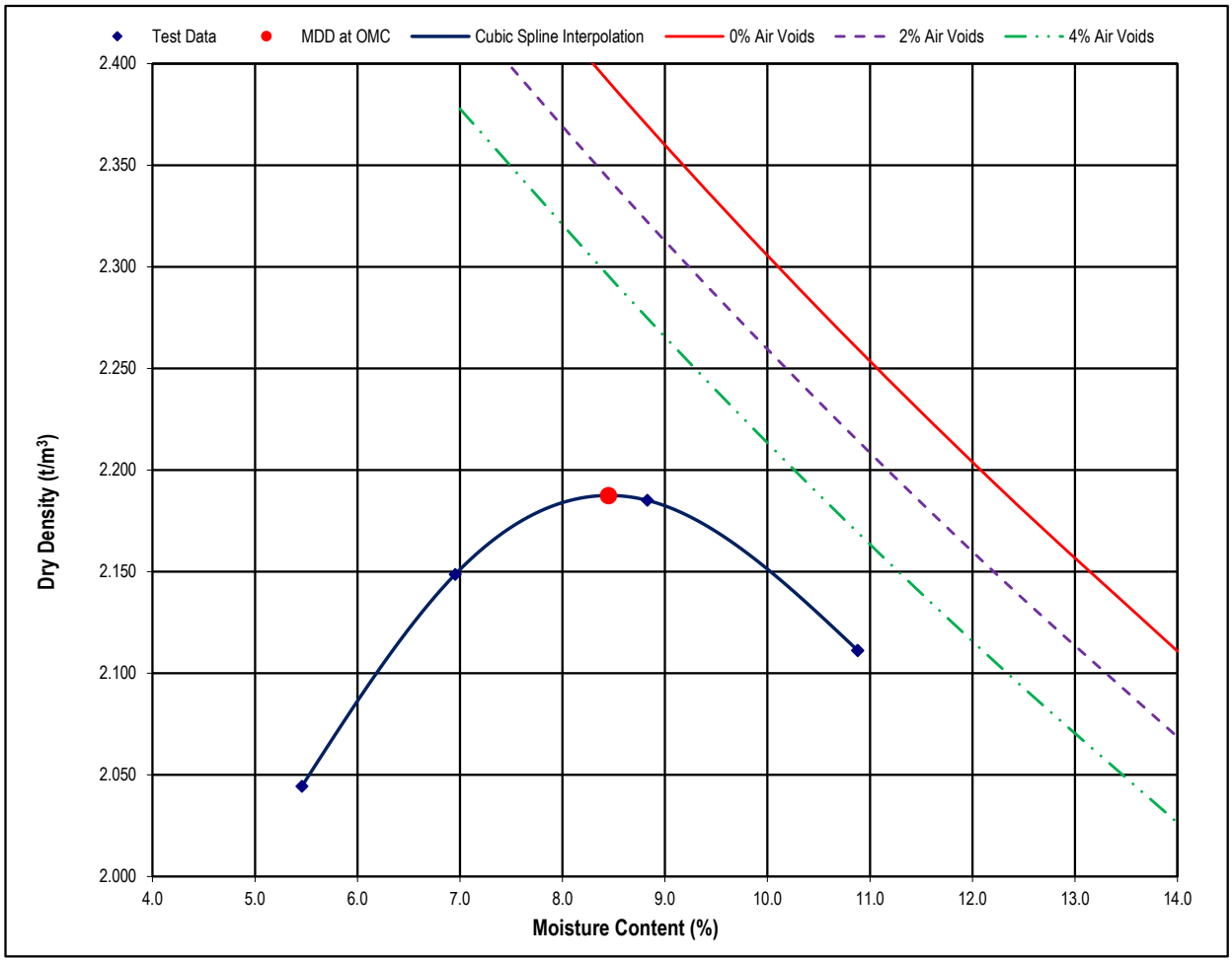
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090393-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	24/09/2024
		Report Date	1/10/2024
Project	TCK-2405		
Client ID	TC2	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m³)	2.19	**Optimum Moisture Content (%)**	8.4
Moisture Content (%)	1.3	**Percentage of Oversize/Sieve Size (mm)**	19/19

NOTES/REMARKS:

Curing Time (hrs): 24 * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 3

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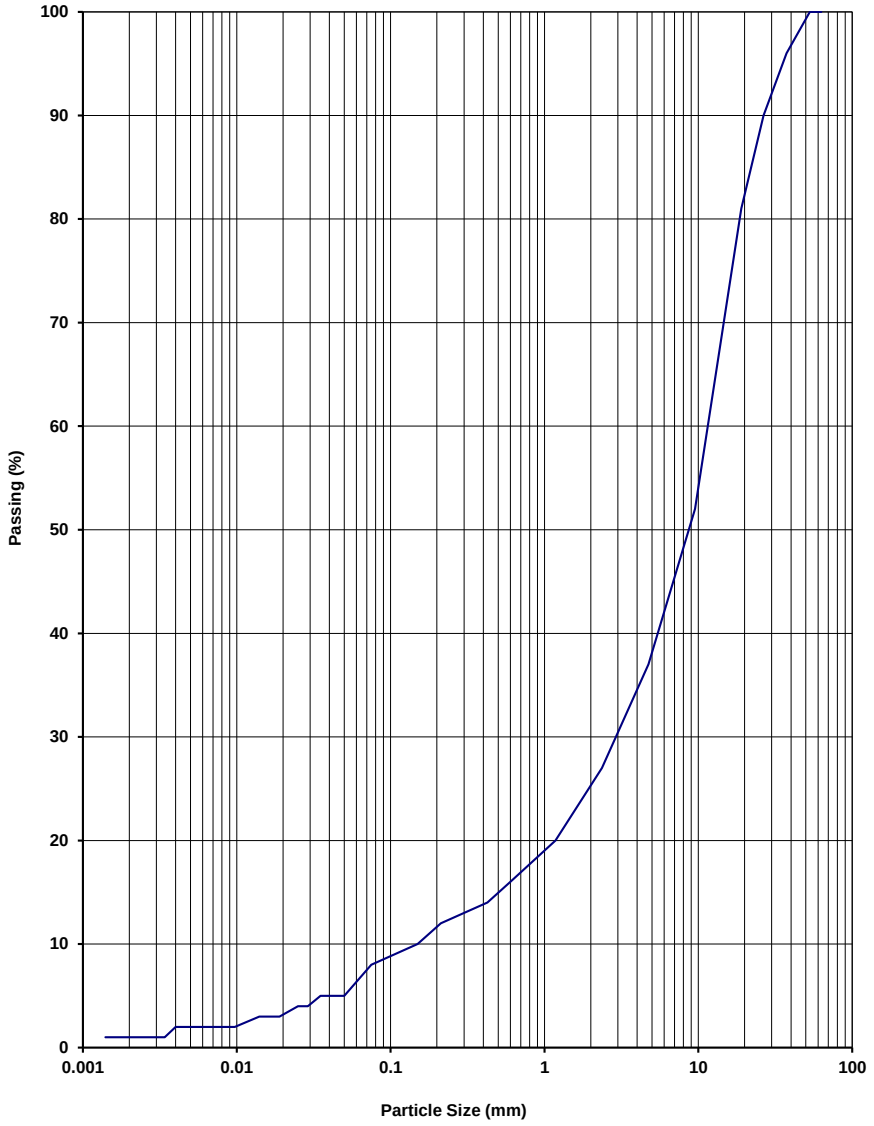
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090393-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	16/9/2024
		Report Date	8/10/2024
Project	TCK-2405		
Client ID	TC2	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	100
37.5	96
26.5	90
19.0	81
13.2	61
9.5	52
6.7	43
4.75	37
2.36	27
1.18	20
0.600	16
0.425	14
0.300	13
0.212	12
0.150	10
0.075	8
0.05	5
0.035	5
0.029	4
0.025	4
0.019	3
0.014	3
0.0097	2
0.0069	2
0.0049	2
0.004	2
0.0034	1
0.0028	1
0.0024	1
0.0014	1



NOTES/REMARKS: -

Moisture Content 1.3% -2.36mm Soil Particle Density(t/m^3) 2.72

Sample/s supplied by the client

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090394-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090394
Client ID	WR1
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**6**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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PERMEABILITY BY FALLING HEAD TEST REPORT

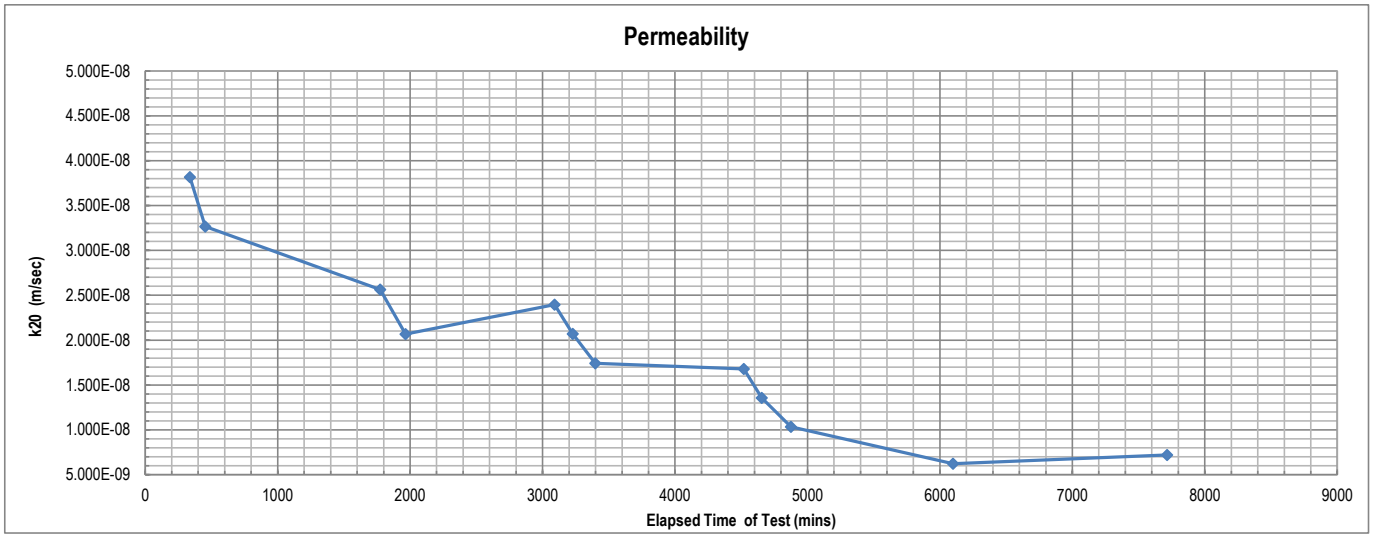
Test Method AS 1289 6.7.2, 5.1.1

Client	Mine Earth	**Report No.**	24090394-FPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	17/10/2024
		Report Date	20/11/2024
Project	TCK-2405		
Client ID	WR1	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.98**	Hydraulic Gradient	**11.2**
Optimum Moisture Content (%)	**10.7**	Surcharge (kPa)	**3.7**
Placement Moisture Content (%)	**10.8**	Head Pressure Applied (kPa)	**12.75**
Moisture Ratio (%)	**101.2**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**2.08**	Percentage Material Retained/Sieve Size (mm)	**0 % /19 mm**
Density Ratio (%)	**94.9**	Sample Height and Diameter (mm)	**116.41 / 152.4 mm**

PERMEABILITY $k_{(20)} = 7.2 \times 10^{-09}$ **(m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client The compaction data was supplied by the client. **Page: 1 of 1** REP06301

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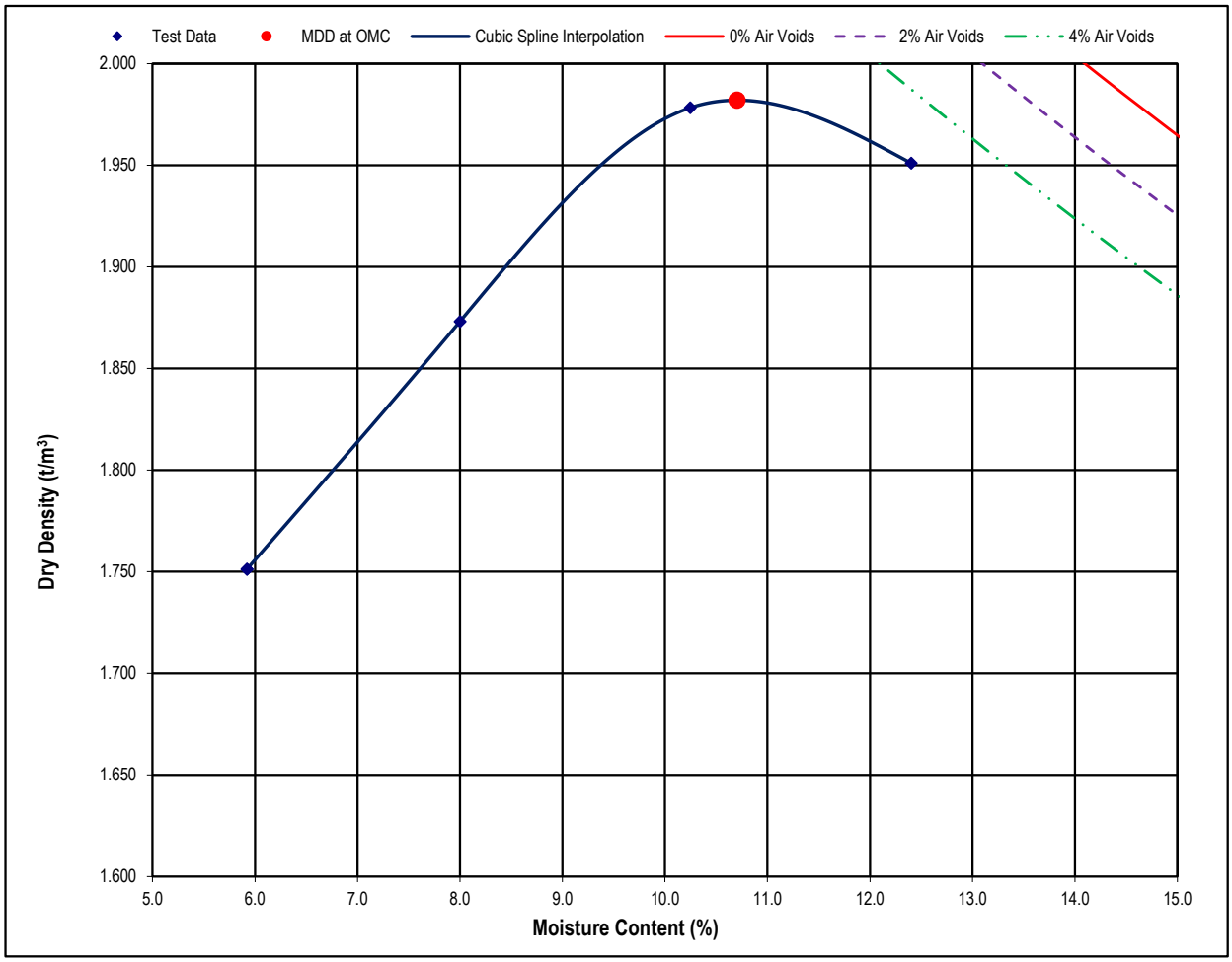
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090394-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	25/09/2024
		Report Date	1/10/2024
Project	TCK-2405		
Client ID	WR1	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m³)	1.98	**Optimum Moisture Content (%)**	10.7
Moisture Content (%)	4.6	**Percentage of Oversize/Sieve Size (mm)**	16/19

NOTES/REMARKS:

Curing Time (hrs): 24 * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.79

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PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090394-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	16/9/2024
		Report Date	8/10/2024
Project	TCK-2405		
Client ID	WR1	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	100
75.0	98
63.0	98
53.0	98
37.5	96
26.5	89
19.0	84
13.2	77
9.5	71
6.7	65
4.75	58
2.36	46
1.18	39
0.600	34
0.425	31
0.300	29
0.212	26
0.150	24
0.075	20
0.047	17
0.034	16
0.028	15
0.024	14
0.018	13
0.013	12
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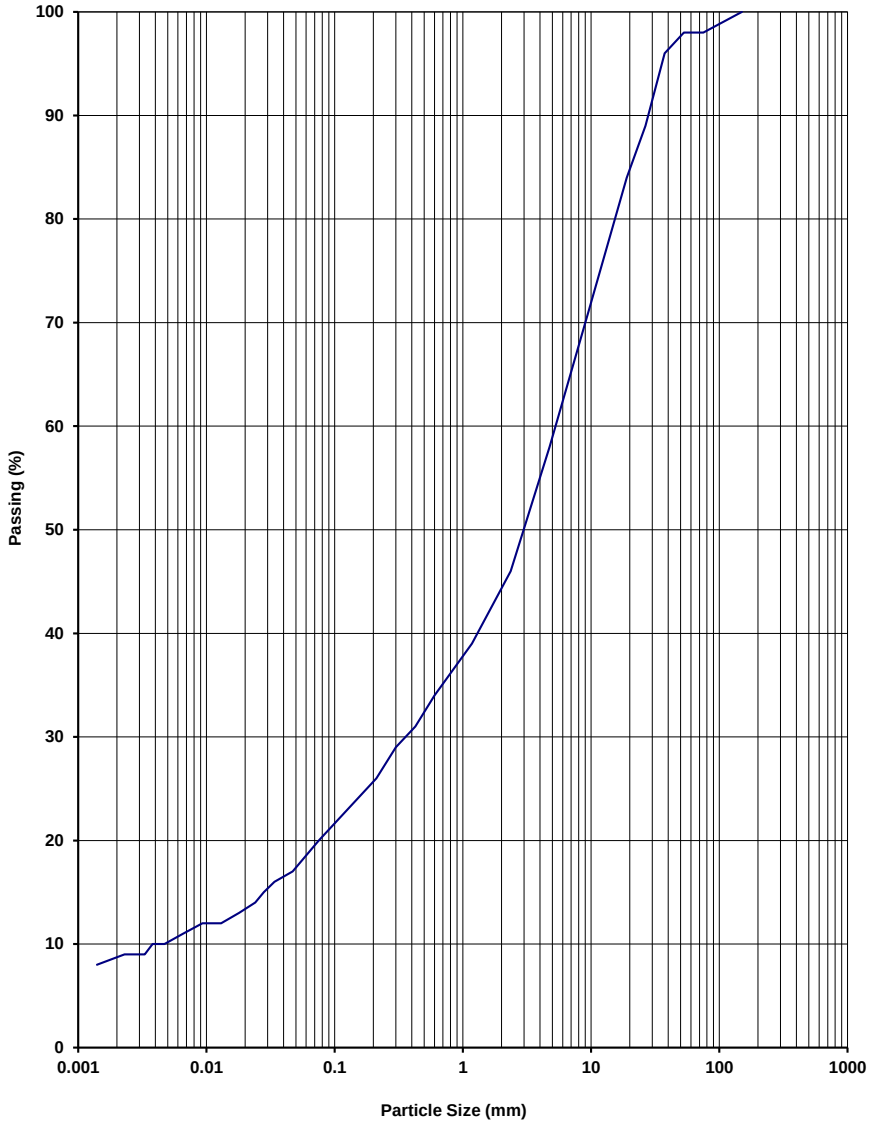
0.0038	10
0.0033	9
0.0027	9
0.0023	9
0.0014	8



NOTES/REMARKS: -

Moisture Content 6% -2.36mm Soil Particle Density(t/m^3) 2.70

Sample/s supplied by the client

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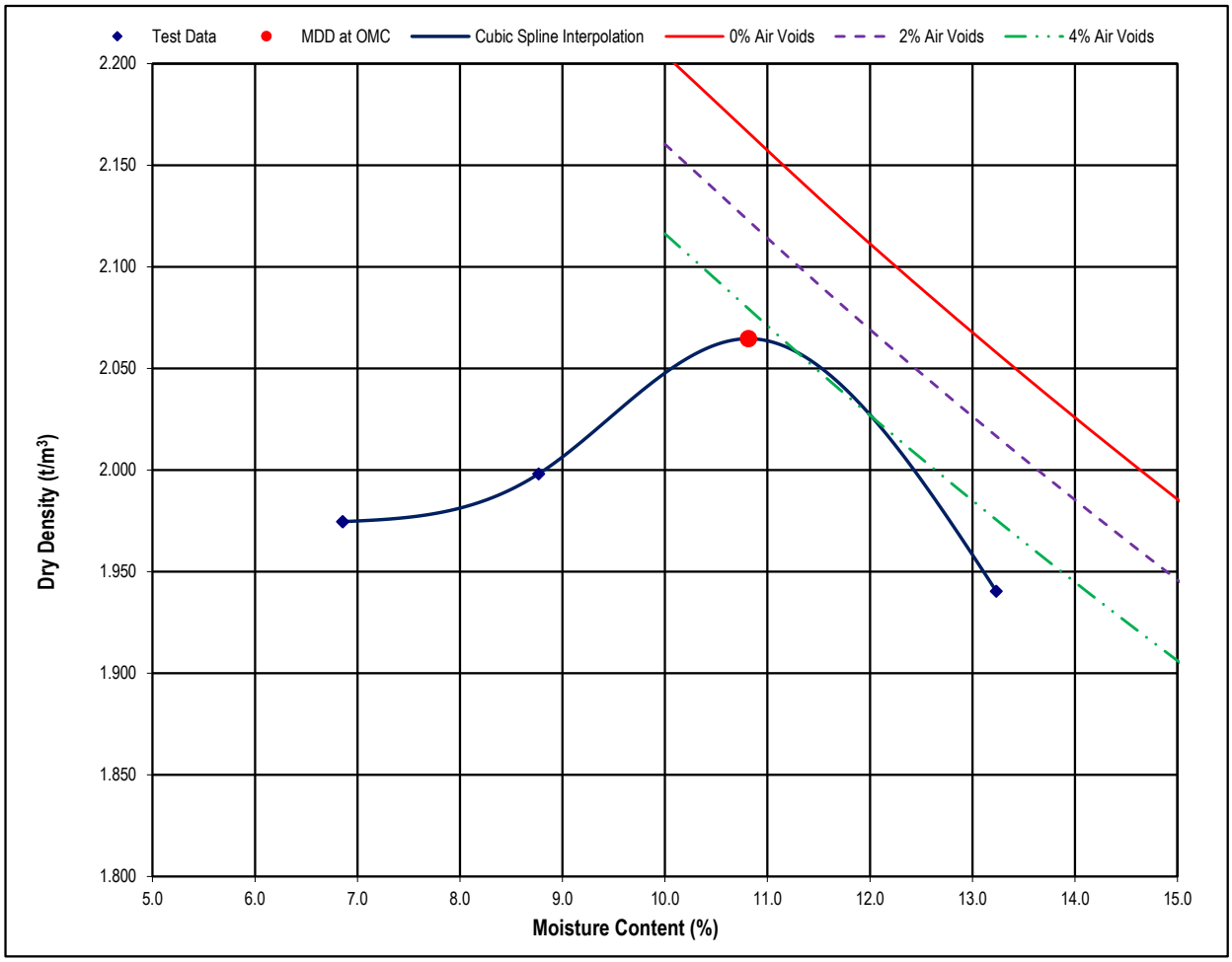
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090395-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	11/10/2024
		Report Date	18/10/2024
Project	TCK-2405		
Client ID	WR2	**Location**	Not Supplied
		Depth (m)	Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m³)	2.06	**Optimum Moisture Content (%)**	10.8
Moisture Content (%)	4.3	**Percentage of Oversize/Sieve Size (mm)**	11 / 19

NOTES/REMARKS:

Curing Time (hrs): 48 * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.83

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ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090395-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090395
Liquid Limit Determination	AS 1289.3.1.2
Test Date	8/10/2024
Client ID	WR2
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	34
Plastic Limit (%)	20
Plasticity Index (%)	14
Linear Shrinkage (%)	7.5
Moisture Content (%)	6.0

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred

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Approved Signatory

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090395-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090395
Client ID	WR2
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**2**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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PERMEABILITY BY FALLING HEAD TEST REPORT

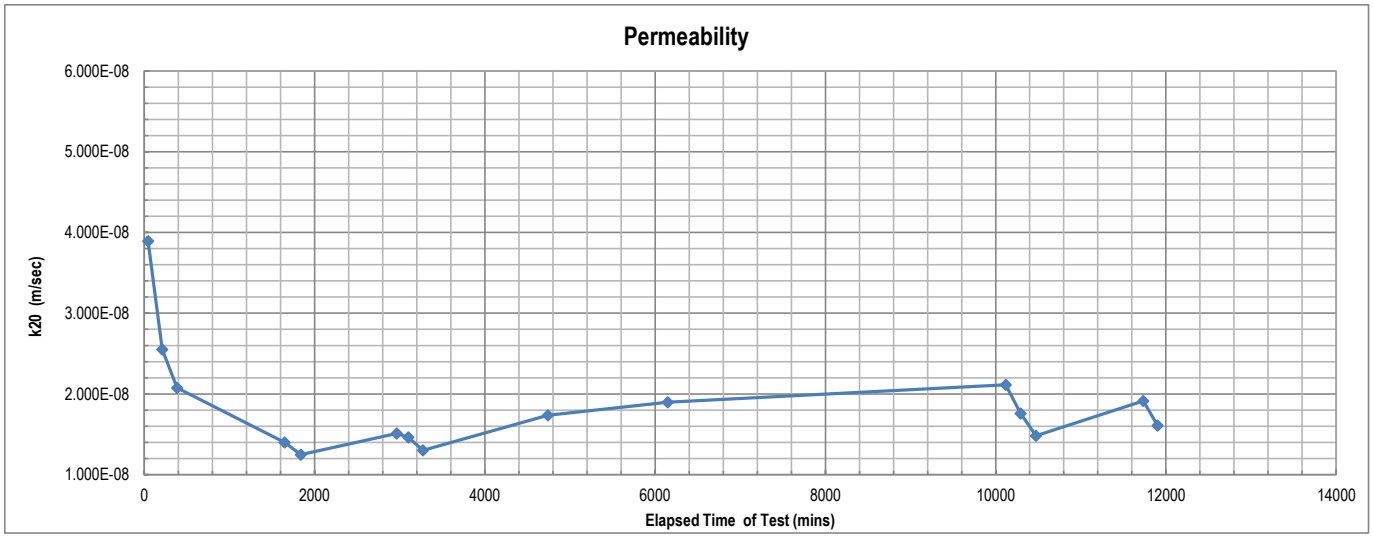
Test Method AS 1289 6.7.2, 5.1.1

Client	Mine Earth	**Report No.**	24090395-FPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	17/10/2024
		Report Date	18/11/2024
Project	TCK-2405		
Client ID	WR2	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**2.06**	Hydraulic Gradient	**11.2**
Optimum Moisture Content (%)	**10.8**	Surcharge (kPa)	**3.7**
Placement Moisture Content (%)	**11.1**	Head Pressure Applied (kPa)	**12.75**
Moisture Ratio (%)	**102.3**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**2.17**	Percentage Material Retained/Sieve Size (mm)	**0 % /19 mm**
Density Ratio (%)	**94.8**	Sample Height and Diameter (mm)	**116.5 / 152.26 mm**

PERMEABILITY $k_{(20)}$ = **1.8×10^{-08} (m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client The compaction data was supplied by the client.

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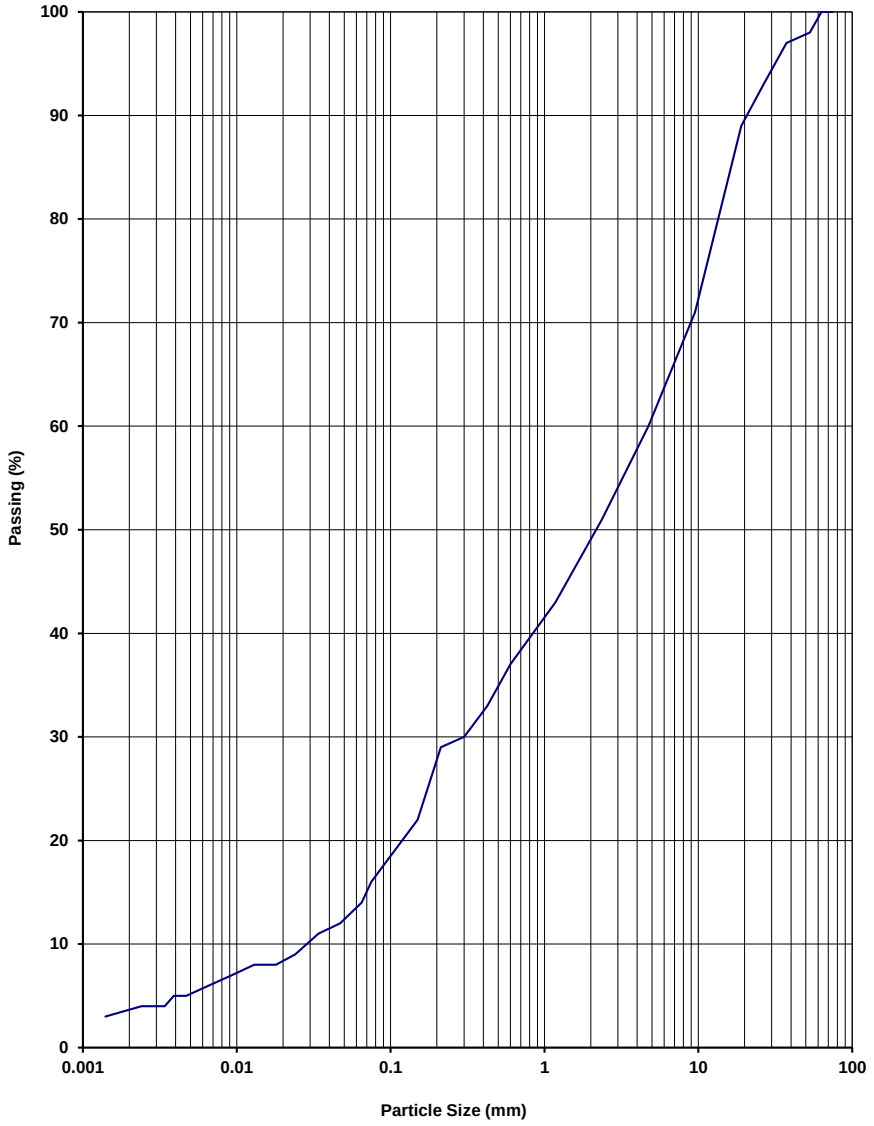
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090395-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	1/10/2024
		Report Date	21/10/2024
Project	TCK-2405		
Client ID	WR2	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	100
53.0	98
37.5	97
26.5	93
19.0	89
13.2	80
9.5	71
6.7	65
4.75	60
2.36	51
1.18	43
0.600	37
0.425	33
0.300	30
0.212	29
0.150	22
0.075	16
0.065	14
0.047	12
0.034	11
0.024	9
0.018	8
0.013	8
0.0093	7
0.0066	6
0.0047	5
0.0039	5
0.0034	4
0.0028	4
0.0024	4
0.0014	3



NOTES/REMARKS: -

Moisture Content 4.3% -2.36mm Soil Particle Density(t/m^3) 2.71

Sample/s supplied by the client

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090396-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090396
Liquid Limit Determination	AS 1289.3.1.2
Test Date	8/10/2024
Client ID	WR3
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	Non-attainable
Plastic Limit (%)	Non-attainable
Plasticity Index (%)	Non-plastic
Linear Shrinkage (%)	Non-attainable
Moisture Content (%)	1.4

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred **Page 1 of 1** REP00102

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PERMEABILITY BY CONSTANT HEAD TEST REPORT

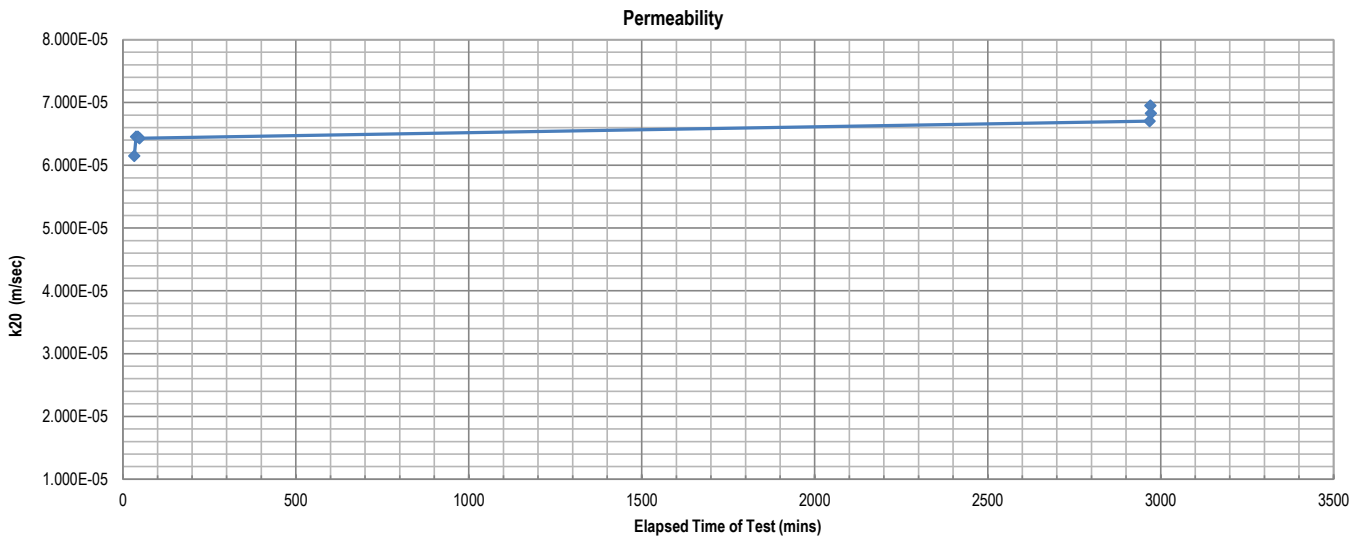
Test Method AS 1289 6.7.1, 5.1.1

Client	Mine Earth	**Report No.**	24090396-CPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	23/10/2024
		Report Date	25/10/2024
Project	TCK-2405		
Client ID	WR3	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**2.04**	Hydraulic Gradient	**3.5**
Optimum Moisture Content (%)	**7.4**	Surcharge (kPa)	**3.7**
Placement Moisture Content (%)	**7.1**	Head Pressure Applied (kPa)	**4.02**
Moisture Ratio (%)	**95.3**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**2.08**	Percentage Material Retained/Sieve Size (mm)	**0 % / 19 mm**
Density Ratio (%)	**95.3**	Sample Height and Diameter (mm)	**116.67 / 152.22 mm**

PERMEABILITY $k_{(20)} =$ **6.8×10^{-05} (m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090396-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090396
Client ID	WR3
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**5**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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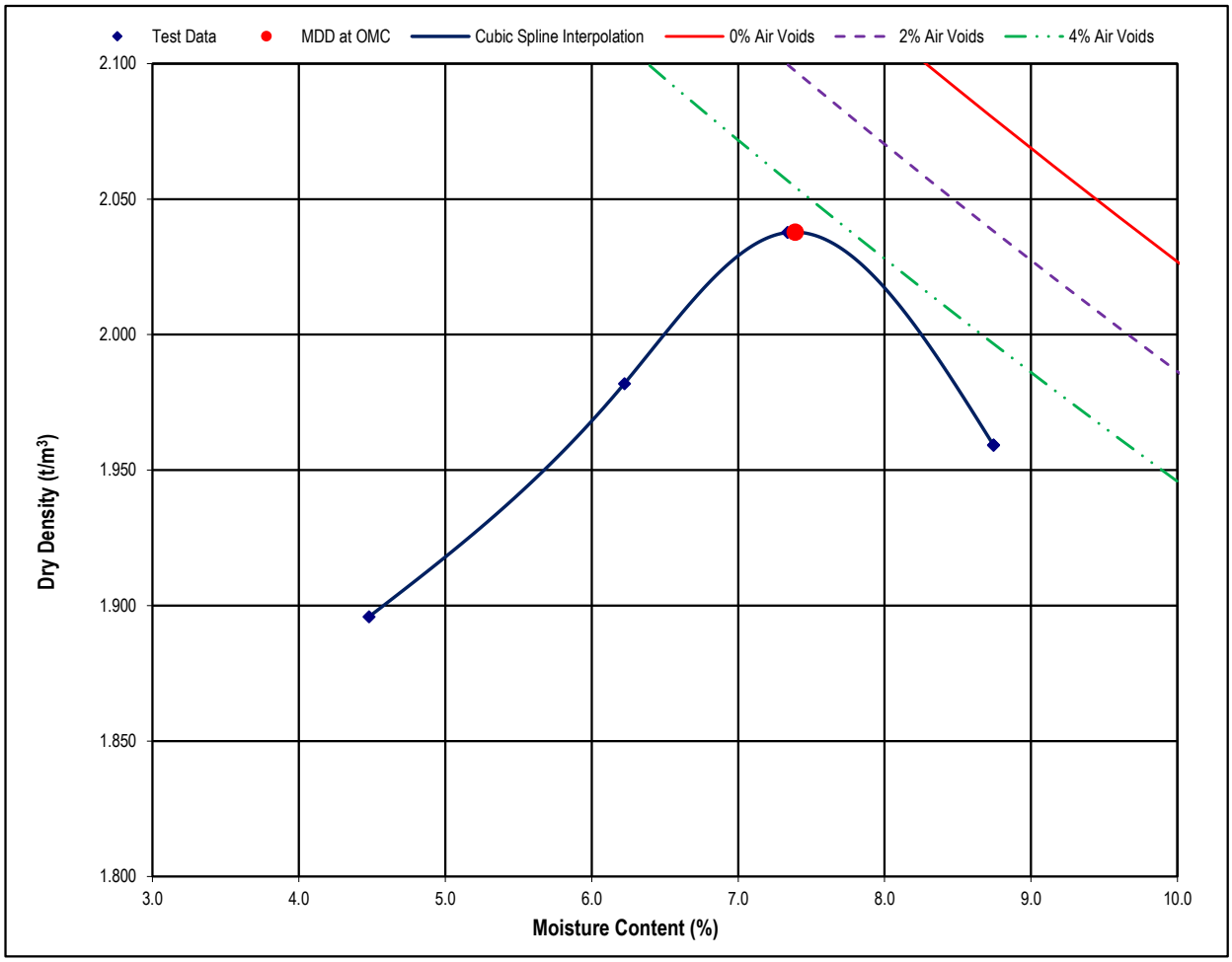
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090396-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	11/10/2024
		Report Date	18/10/2024
Project	TCK-2405		
Client ID	WR3	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m³)	2.04	**Optimum Moisture Content (%)**	7.4
Moisture Content (%)	1.4	**Percentage of Oversize/Sieve Size (mm)**	0 / 19

NOTES/REMARKS:

Curing Time (hrs): 0 * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.54

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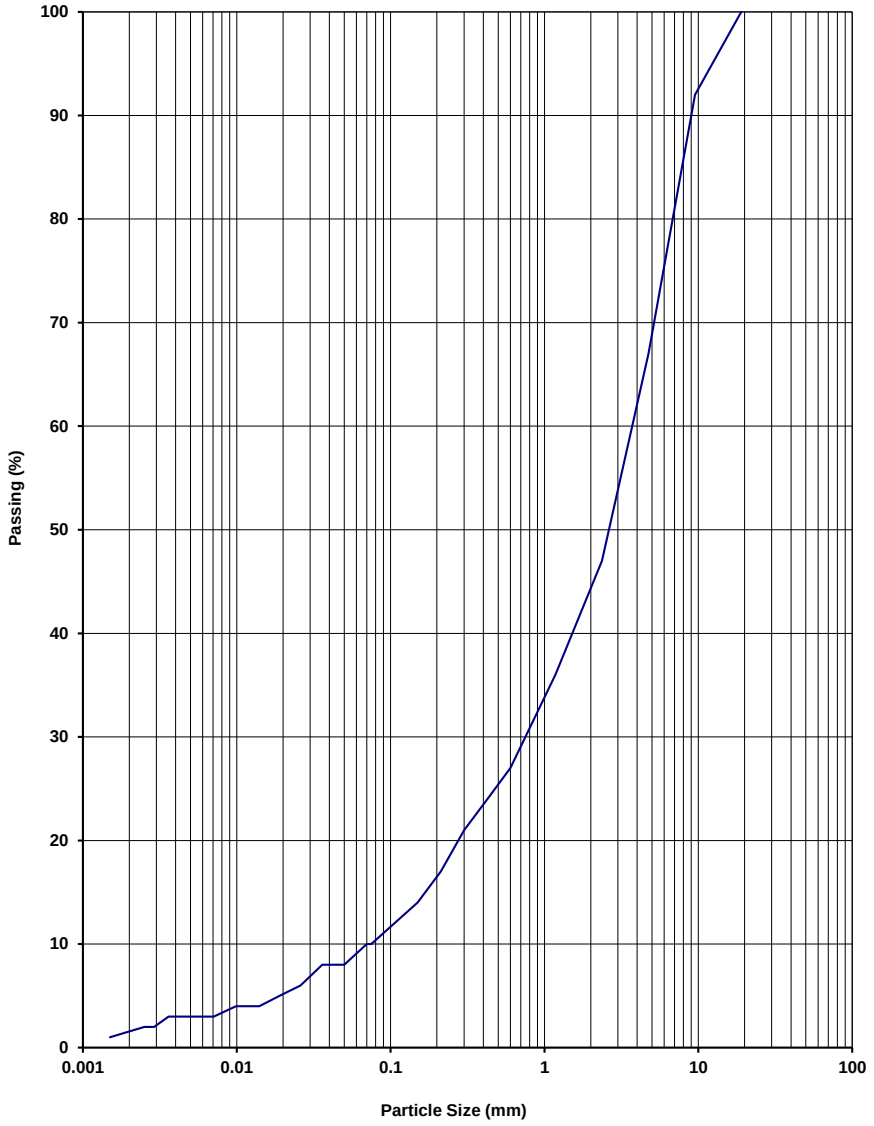
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090396-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	1/10/2024
		Report Date	21/10/2024
Project	TCK-2405		
Client ID	WR3	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	100
9.5	92
6.7	78
4.75	67
2.36	47
1.18	36
0.600	27
0.425	24
0.300	21
0.212	17
0.150	14
0.075	10
0.07	10
0.05	8
0.036	8
0.026	6
0.019	5
0.014	4
0.0099	4
0.0071	3
0.005	3
0.0041	3
0.0036	3
0.0029	2
0.0025	2
0.0015	1



NOTES/REMARKS: -

Moisture Content 1.4% -2.36mm Soil Particle Density(t/m^3) 2.67

Sample/s supplied by the client

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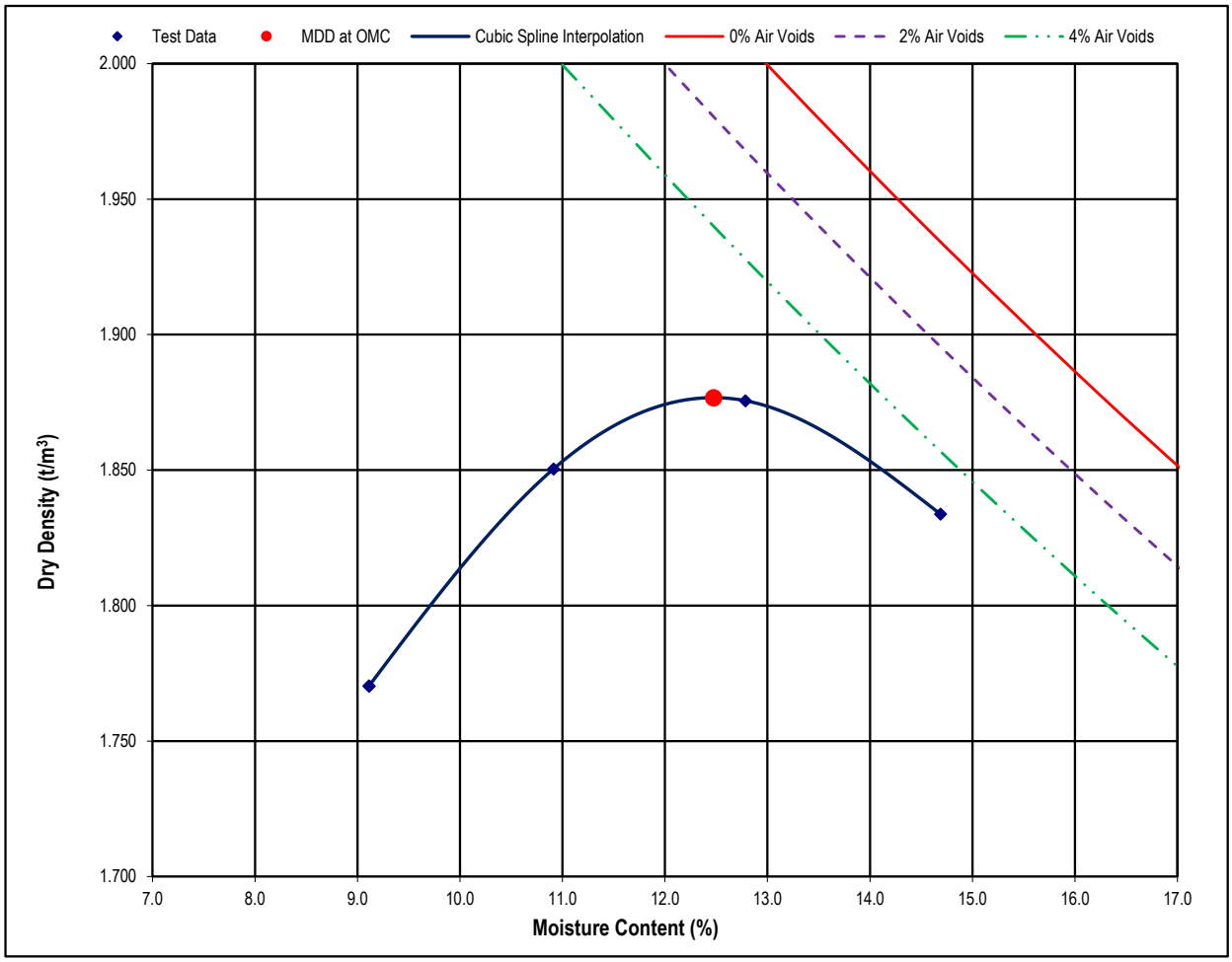
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090397-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	11/10/2024
		Report Date	18/10/2024
Project	TCK-2405		
Client ID	B1	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m³)	1.88	**Optimum Moisture Content (%)**	12.5
Moisture Content (%)	6.6	**Percentage of Oversize/Sieve Size (mm)**	4 /19

NOTES/REMARKS:

Curing Time (hrs): 48 * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.7

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090397-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090397
Liquid Limit Determination	AS 1289.3.1.2
Test Date	8/10/2024
Client ID	B1
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	36
Plastic Limit (%)	19
Plasticity Index (%)	17
Linear Shrinkage (%)	10.0
Moisture Content (%)	6.6

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred

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PERMEABILITY BY CONSTANT HEAD TEST REPORT

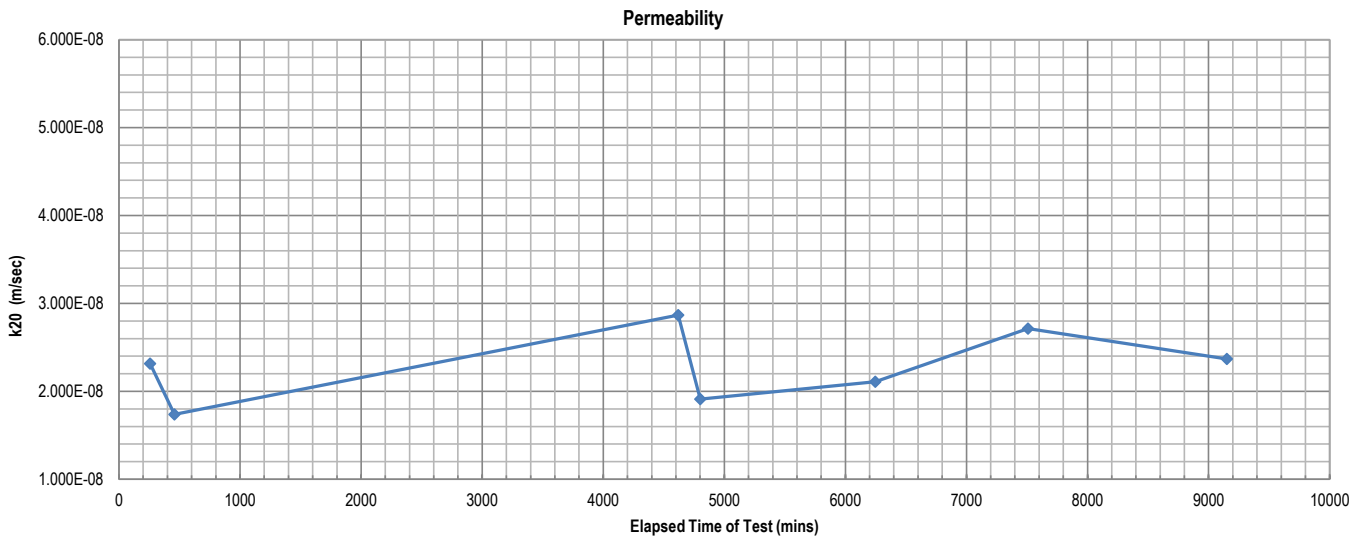
Test Method AS 1289 6.7.1, 5.1.1

Client	Mine Earth	**Report No.**	24090397-CPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	17/10/2024
		Report Date	25/10/2024
Project	TCK-2405		
Client ID	B1	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.88**	Hydraulic Gradient	**3.8**
Optimum Moisture Content (%)	**12.5**	Surcharge (kPa)	**3.6**
Placement Moisture Content (%)	**12.8**	Head Pressure Applied (kPa)	**4.32**
Moisture Ratio (%)	**102.8**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**2.01**	Percentage Material Retained/Sieve Size (mm)	**0 % / 19 mm**
Density Ratio (%)	**94.7**	Sample Height and Diameter (mm)	**116.97 / 152.66 mm**

PERMEABILITY $k_{(20)} = 2.4 \times 10^{-08}$ **(m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client

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Tested at Trilab Brisbane Laboratory

Approved Signatory

Michael Hamilton

Michael Hamilton

Laboratory No. 9926

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090397-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090397
Client ID	B1
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**6**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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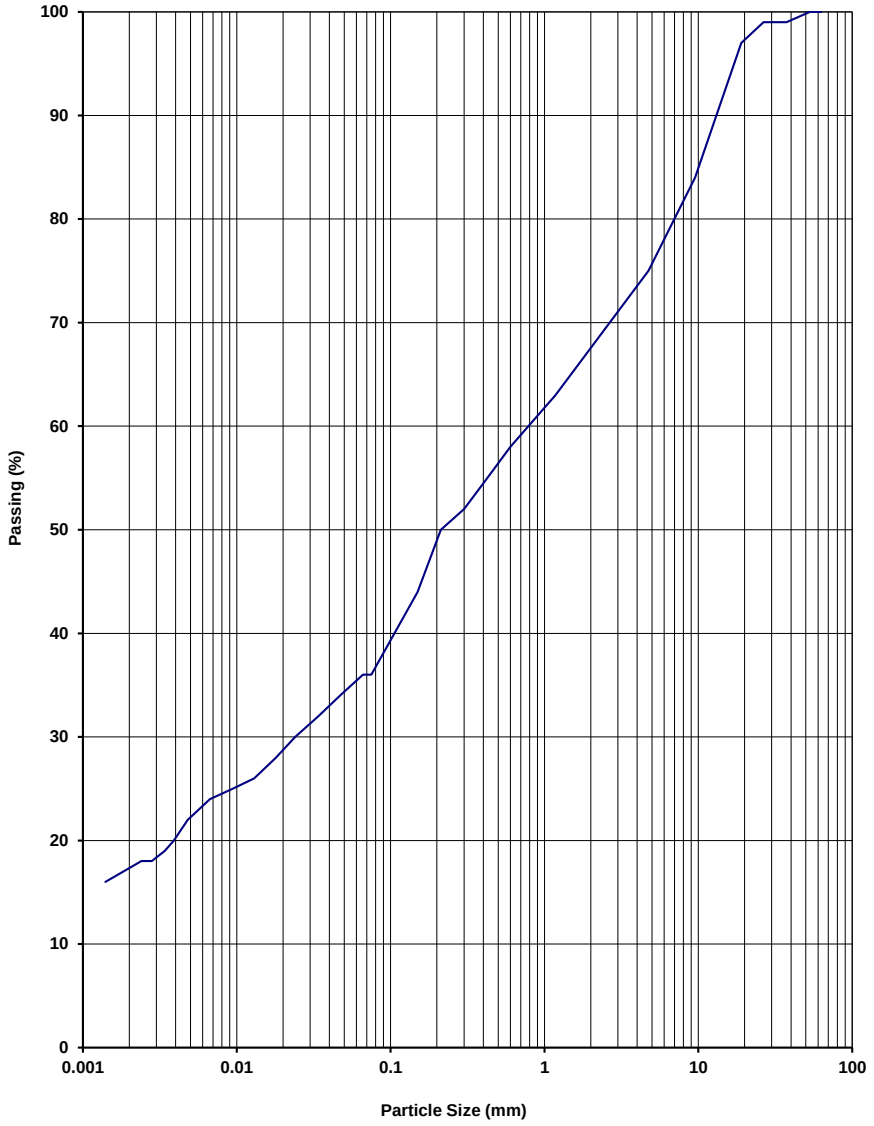
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090397-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	1/10/2024
		Report Date	21/10/2024
Project	TCK-2405		
Client ID	B1	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	100
37.5	99
26.5	99
19.0	97
13.2	89
9.5	84
6.7	80
4.75	75
2.36	69
1.18	63
0.600	58
0.425	55
0.300	52
0.212	50
0.150	44
0.075	36
0.066	36
0.047	34
0.034	32
0.024	30
0.018	28
0.013	26
0.0094	25
0.0067	24
0.0048	22
0.0039	20
0.0034	19
0.0028	18
0.0024	18
0.0014	16



NOTES/REMARKS: -

Moisture Content 6.6% -2.36mm Soil Particle Density(t/m^3) 2.62

Sample/s supplied by the client

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090398-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090398
Liquid Limit Determination	AS 1289.3.1.2
Test Date	8/10/2024
Client ID	B2
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	44
Plastic Limit (%)	21
Plasticity Index (%)	23
Linear Shrinkage (%)	18.0
Moisture Content (%)	8.8

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred **Page 1 of 1** REP00102

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090398-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090398
Client ID	B2
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**3**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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PERMEABILITY BY FALLING HEAD TEST REPORT

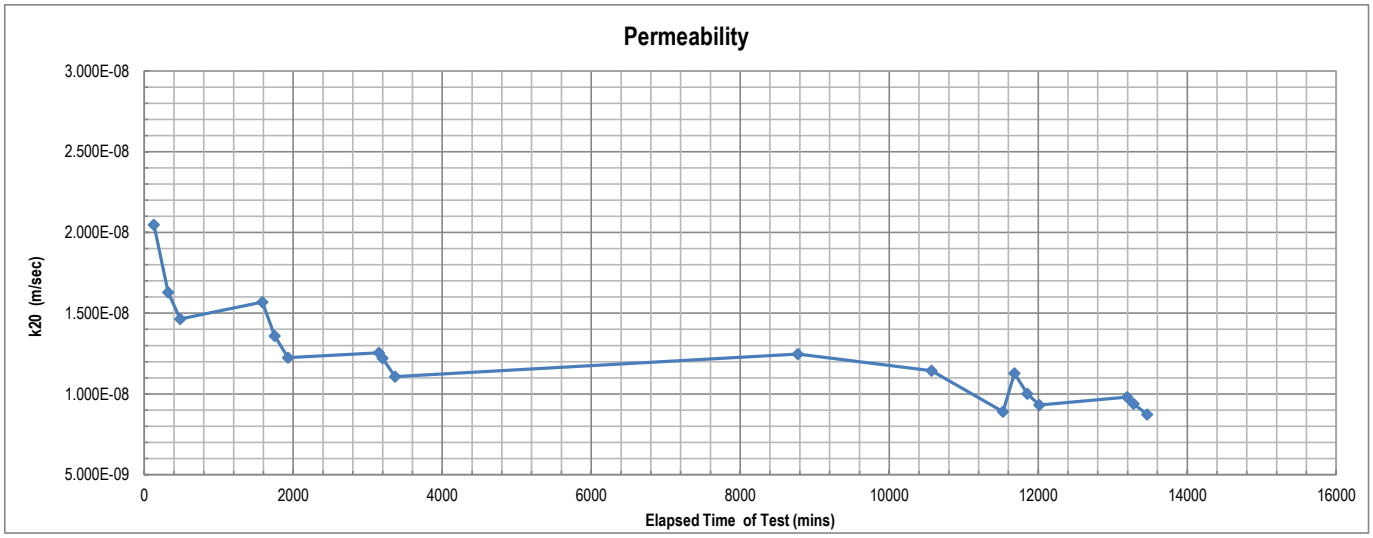
Test Method AS 1289 6.7.2, 5.1.1

Client	Mine Earth	**Report No.**	24090398-FPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	29/10/2024
		Report Date	20/11/2024
Project	TCK-2405		
Client ID	B2	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.84**	Hydraulic Gradient	**11.2**
Optimum Moisture Content (%)	**13.8**	Surcharge (kPa)	**3.7**
Placement Moisture Content (%)	**13.8**	Head Pressure Applied (kPa)	**12.75**
Moisture Ratio (%)	**99.9**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**1.99**	Percentage Material Retained/Sieve Size (mm)	**0 % /19 mm**
Density Ratio (%)	**95.0**	Sample Height and Diameter (mm)	**115.76 / 152.33 mm**

PERMEABILITY $k_{(20)} =$ **9.3×10^{-09} (m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client The compaction data was supplied by the client.

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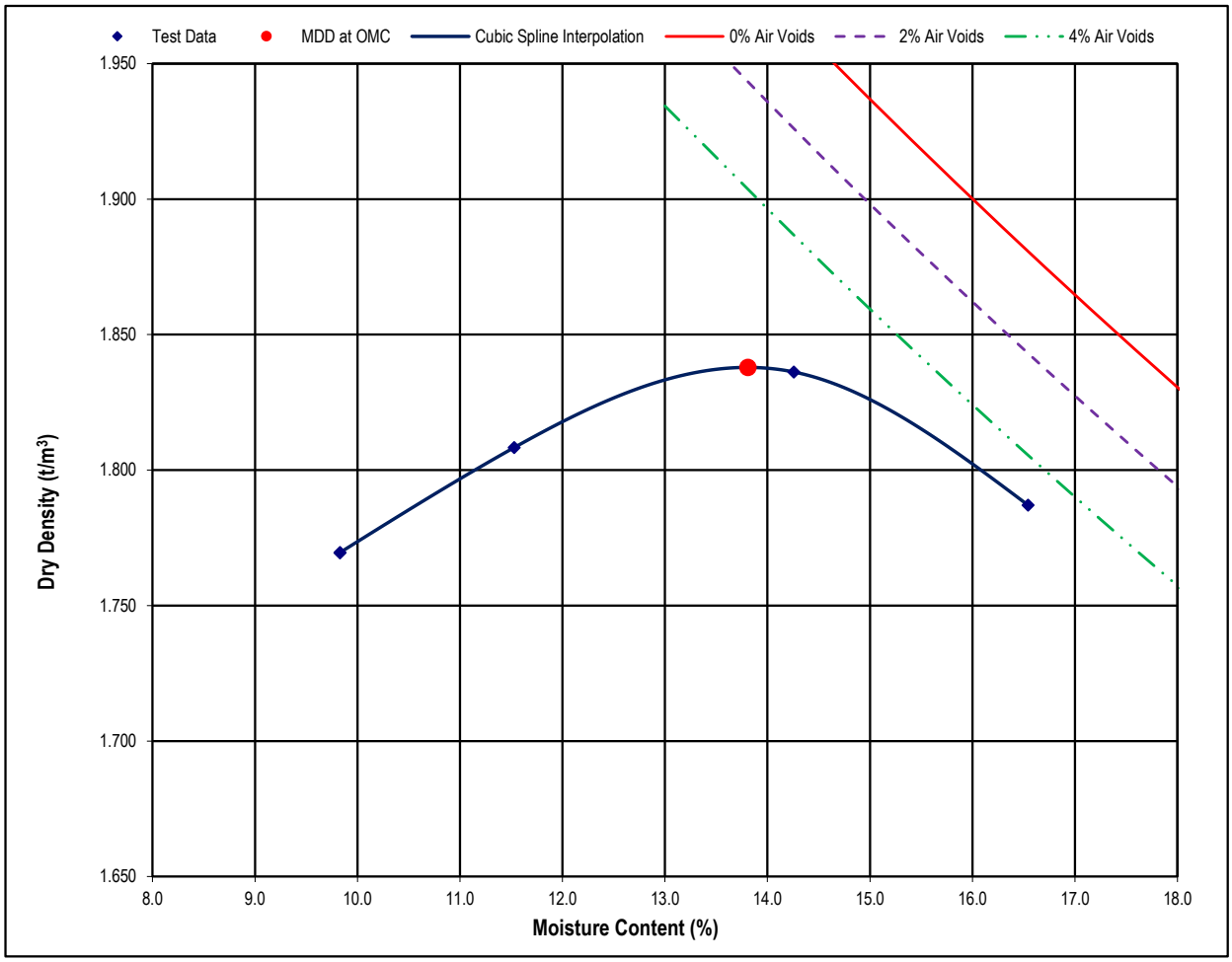
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090398-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	10/10/2024
		Report Date	18/10/2024
Project	TCK-2405		
Client ID	B2	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m³)	1.84	**Optimum Moisture Content (%)**	13.8
Moisture Content (%)	8.8	**Percentage of Oversize/Sieve Size (mm)**	7 / 19

NOTES/REMARKS:

Curing Time (hrs): * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.73

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Approved Signatory

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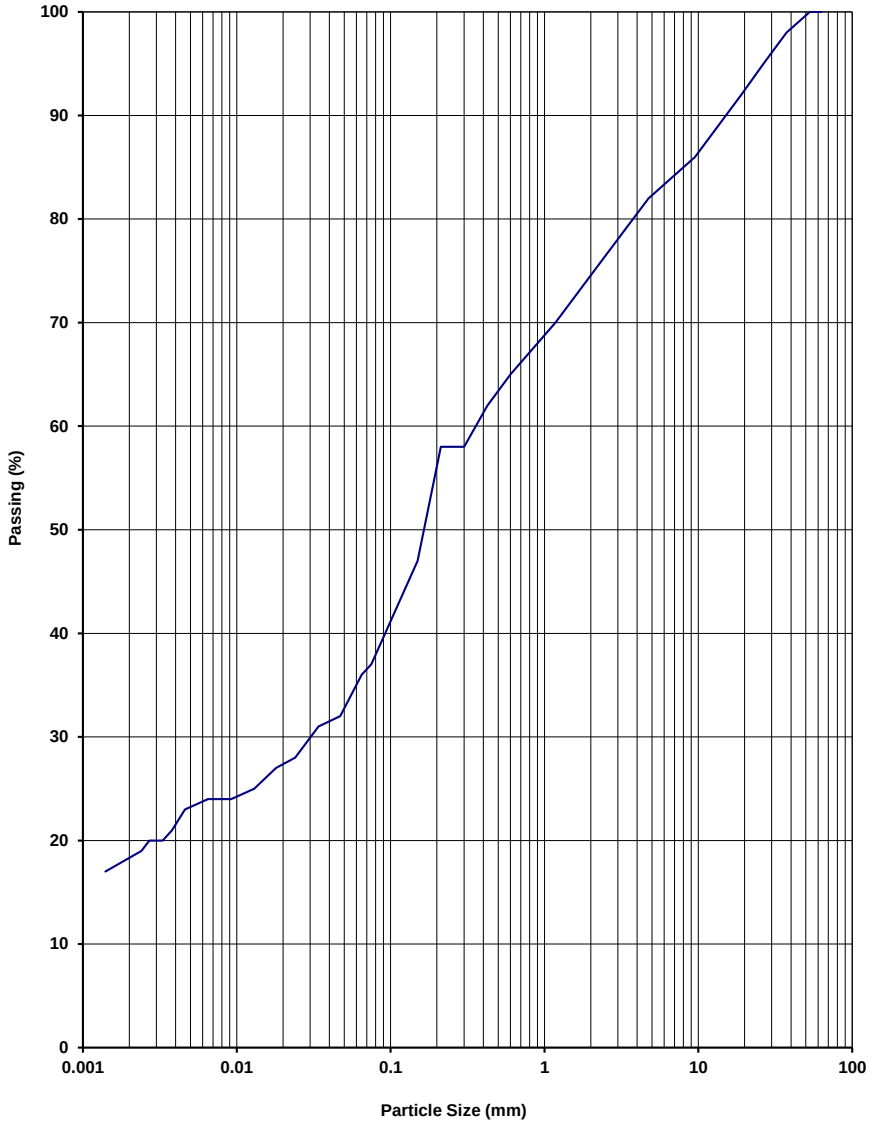
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090398-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	1/10/2024
		Report Date	21/10/2024
Project	TCK-2405		
Client ID	B2	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	100
37.5	98
26.5	95
19.0	92
13.2	88
9.5	86
6.7	84
4.75	82
2.36	76
1.18	70
0.600	65
0.425	62
0.300	58
0.212	58
0.150	47
0.075	37
0.065	36
0.047	32
0.034	31
0.024	28
0.018	27
0.013	25
0.0092	24
0.0065	24
0.0046	23
0.0038	21
0.0033	20
0.0027	20
0.0024	19
0.0014	17



NOTES/REMARKS: -

Moisture Content 8.8% -2.36mm Soil Particle Density(t/m^3) 2.70

Sample/s supplied by the client

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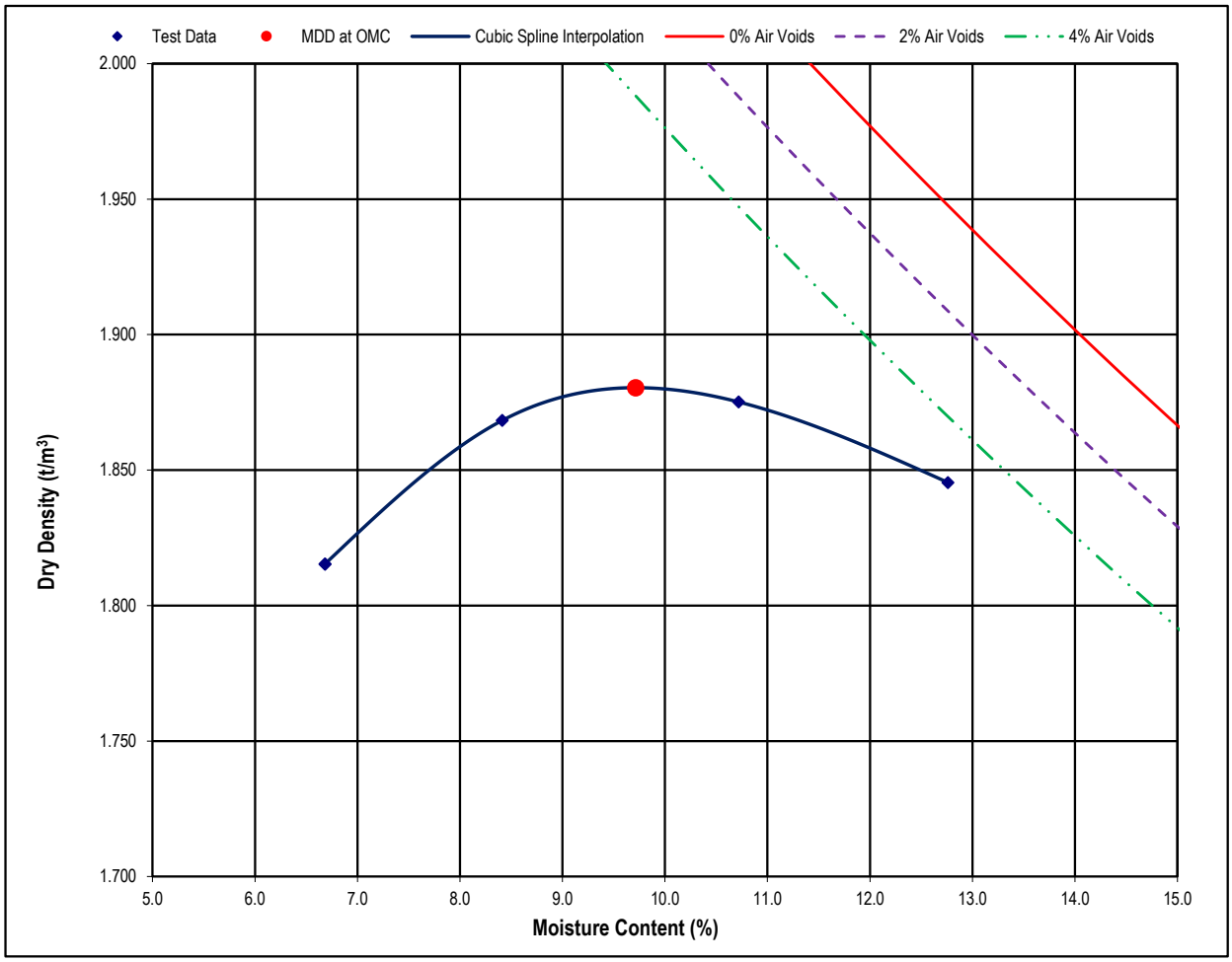
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090399-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	10/10/2024
		Report Date	18/10/2024
Project	TCK-2405		
Client ID	DC1	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m^3)	1.88	**Optimum Moisture Content (%)**	9.7
Moisture Content (%)	2.3	**Percentage of Oversize/Sieve Size (mm)**	15 / 19

NOTES/REMARKS:

Curing Time (hrs): 24 * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.59

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090399-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090399
Liquid Limit Determination	AS 1289.3.1.2
Test Date	8/10/2024
Client ID	DC1
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	Non-attainable
Plastic Limit (%)	Non-attainable
Plasticity Index (%)	Non-plastic
Linear Shrinkage (%)	Non-attainable
Moisture Content (%)	2.3

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred **Page 1 of 1** REP00102

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PERMEABILITY BY CONSTANT HEAD TEST REPORT

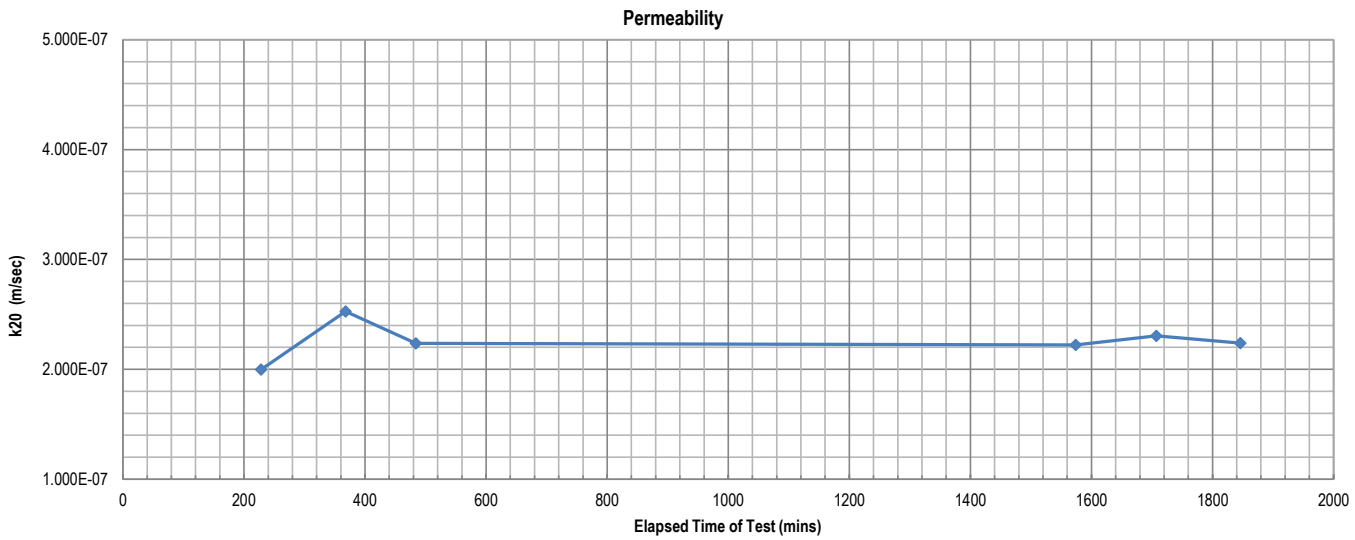
Test Method AS 1289 6.7.1, 5.1.1

Client	Mine Earth	**Report No.**	24090399-CPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	30/10/2024
		Report Date	20/11/2024
Project	TCK-2405		
Client ID	DC1	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.88**	Hydraulic Gradient	**3.6**
Optimum Moisture Content (%)	**9.7**	Surcharge (kPa)	**3.7**
Placement Moisture Content (%)	**10.0**	Head Pressure Applied (kPa)	**4.12**
Moisture Ratio (%)	**103.3**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**1.96**	Percentage Material Retained/Sieve Size (mm)	**0 % / 19 mm**
Density Ratio (%)	**94.7**	Sample Height and Diameter (mm)	**116.57 / 152.36 mm**

PERMEABILITY $k_{(20)} =$ **2.3×10^{-07} (m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090399-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090399
Client ID	DC1
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**3**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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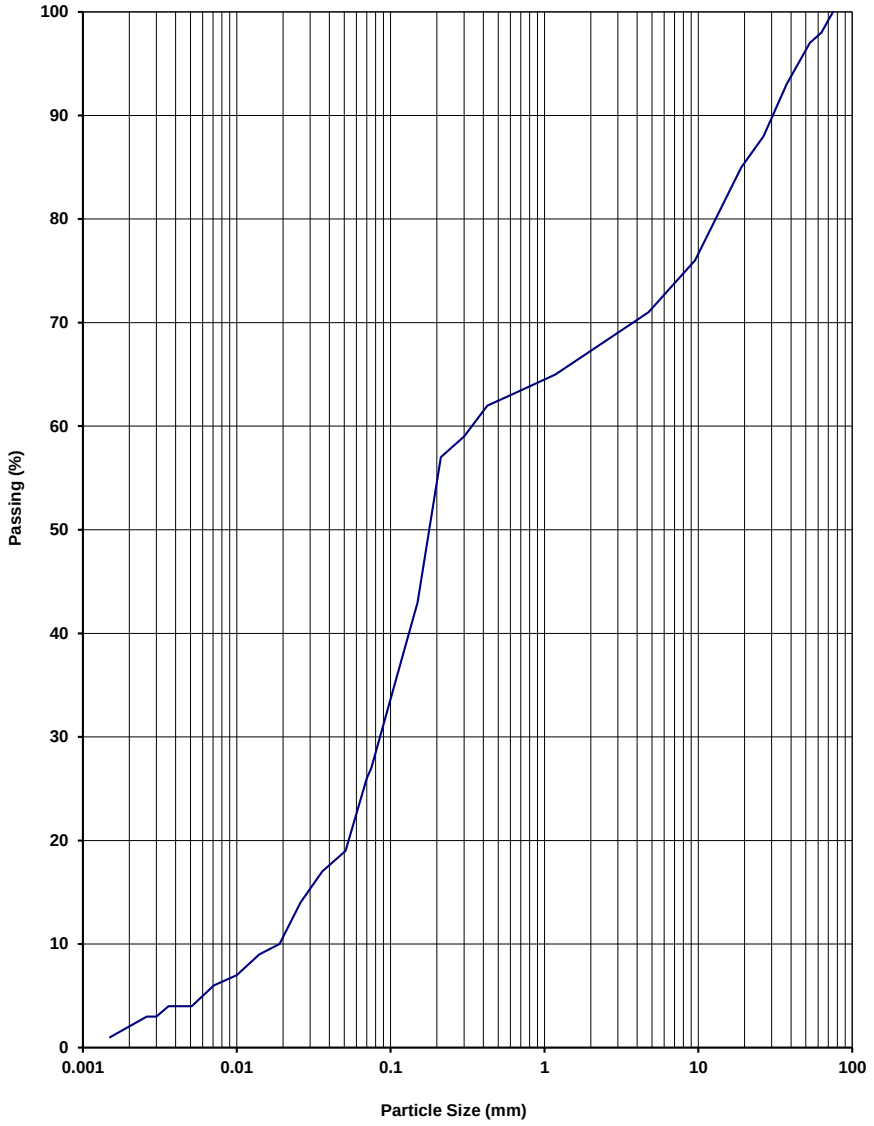
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090399-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	1/10/2024
		Report Date	22/10/2024
Project	TCK-2405		
Client ID	DC1	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	100
63.0	98
53.0	97
37.5	93
26.5	88
19.0	85
13.2	78
9.5	76
6.7	73
4.75	71
2.36	68
1.18	65
0.600	63
0.425	62
0.300	59
0.212	57
0.150	43
0.075	27
0.07	26
0.051	19
0.036	17
0.026	14
0.019	10
0.014	9
0.01	7
0.0071	6
0.0051	4
0.0041	4
0.0036	4
0.003	3
0.0026	3
0.0015	1



NOTES/REMARKS: -

Moisture Content 2.3% -2.36mm Soil Particle Density(t/m^3) 2.69

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing

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Approved Signatory

Michael Hamilton

NATA WORLD RECOGNISED ACCREDITATION

Tested at Trilab Brisbane Laboratory

Laboratory No. 9926

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ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
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Perth
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Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090400-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090400
Liquid Limit Determination	AS 1289.3.1.2
Test Date	8/10/2024
Client ID	DC2
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	41
Plastic Limit (%)	21
Plasticity Index (%)	20
Linear Shrinkage (%)	11.5
Moisture Content (%)	7.0

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred **Page 1 of 1** REP00102

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Approved Signatory

Michael Hamilton

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090400-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090400
Client ID	DC2
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**2**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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Tested at Trilab Brisbane Laboratory

Approved Signatory

Michael Hamilton

NATA
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PERMEABILITY BY FALLING HEAD TEST REPORT

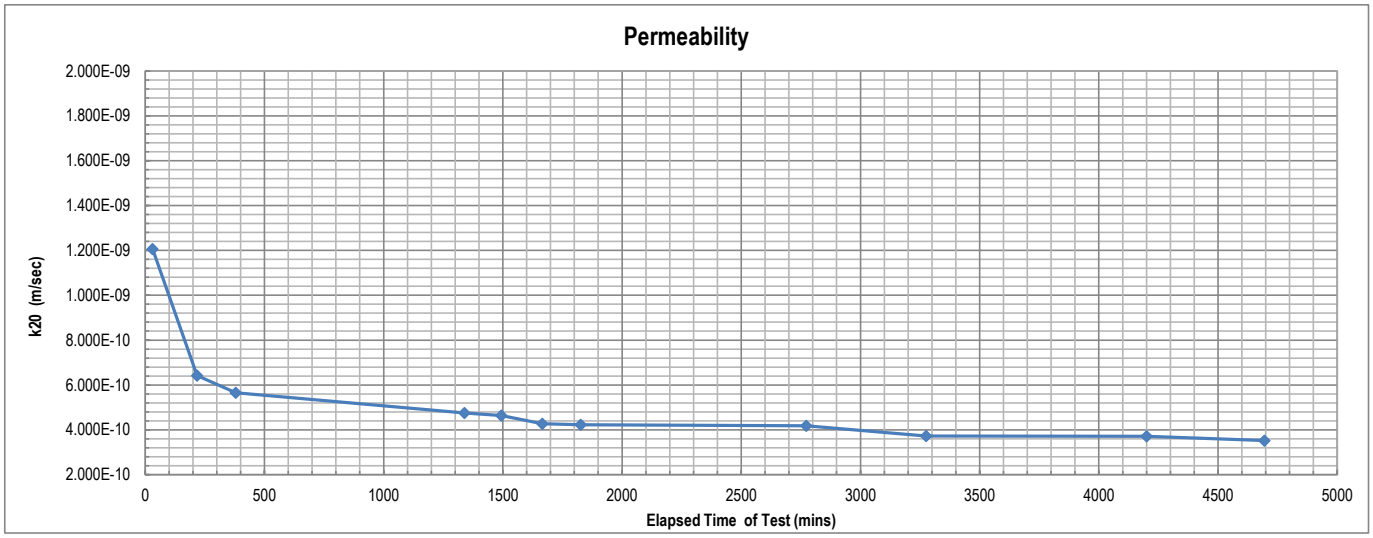
Test Method AS 1289 6.7.2, 5.1.1

Client	Mine Earth	**Report No.**	24090400-FPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	5/11/2024
		Report Date	20/11/2024
Project	TCK-2405		
Client ID	DC2	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.88**	Hydraulic Gradient	**11.2**
Optimum Moisture Content (%)	**13.5**	Surcharge (kPa)	**3.7**
Placement Moisture Content (%)	**13.1**	Head Pressure Applied (kPa)	**12.75**
Moisture Ratio (%)	**97.2**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**2.03**	Percentage Material Retained/Sieve Size (mm)	**0 % /19 mm**
Density Ratio (%)	**95.3**	Sample Height and Diameter (mm)	**116.14 / 152.51 mm**

PERMEABILITY $k_{(20)} =$ **3.6×10^{-10} (m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client The compaction data was supplied by the client.

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Approved Signatory

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Michael Hamilton

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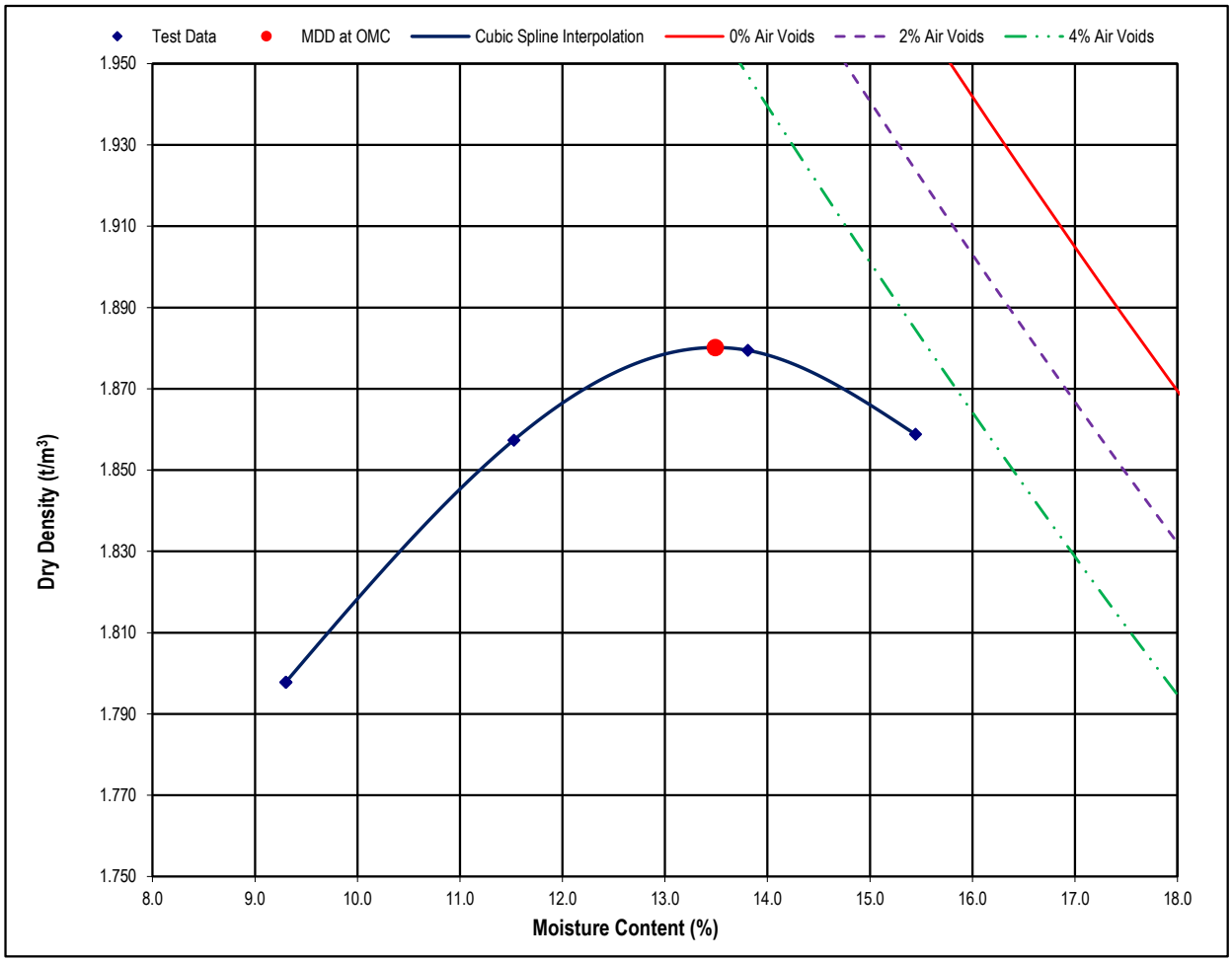
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090400-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	10/10/2024
		Report Date	18/10/2024
Project	TCK-2405		
Client ID	DC2	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m³)	1.88	**Optimum Moisture Content (%)**	13.5
Moisture Content (%)	7.0	**Percentage of Oversize/Sieve Size (mm)**	16 / 19

NOTES/REMARKS:

Curing Time (hrs): 48 * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.82

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Tested at Trilab Brisbane Laboratory

Approved Signatory

Michael Ferguson

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Laboratory No. 9926

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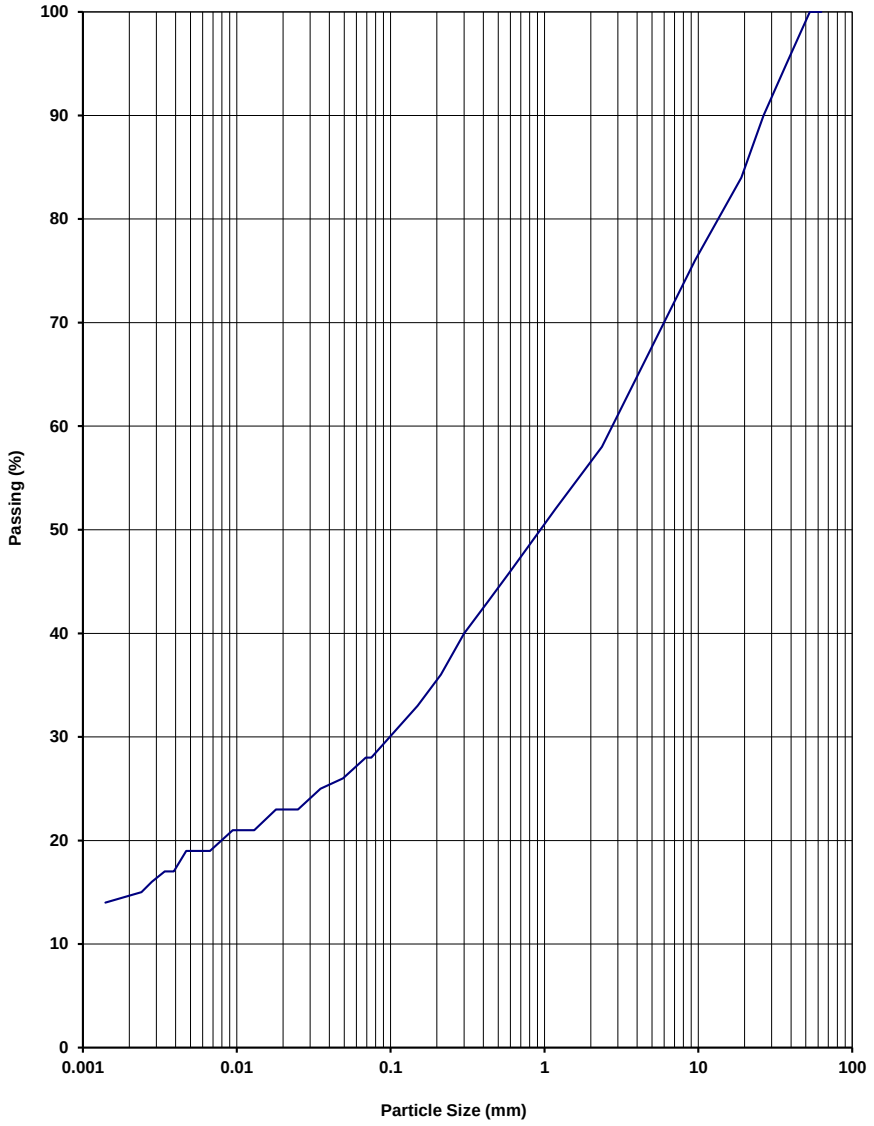
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090400-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	3/10/2024
		Report Date	22/10/2024
Project	TCK-2405		
Client ID	DC2	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	100
37.5	95
26.5	90
19.0	84
13.2	79
9.5	76
6.7	70
4.75	67
2.36	58
1.18	52
0.600	46
0.425	43
0.300	40
0.212	36
0.150	33
0.075	28
0.069	28
0.049	26
0.035	25
0.025	23
0.018	23
0.013	21
0.0094	21
0.0067	19
0.0047	19
0.0039	17
0.0034	17
0.0028	16
0.0024	15
0.0014	14



NOTES/REMARKS: -

Moisture Content 7% -2.36mm Soil Particle Density(t/m^3) 2.69

Sample/s supplied by the client

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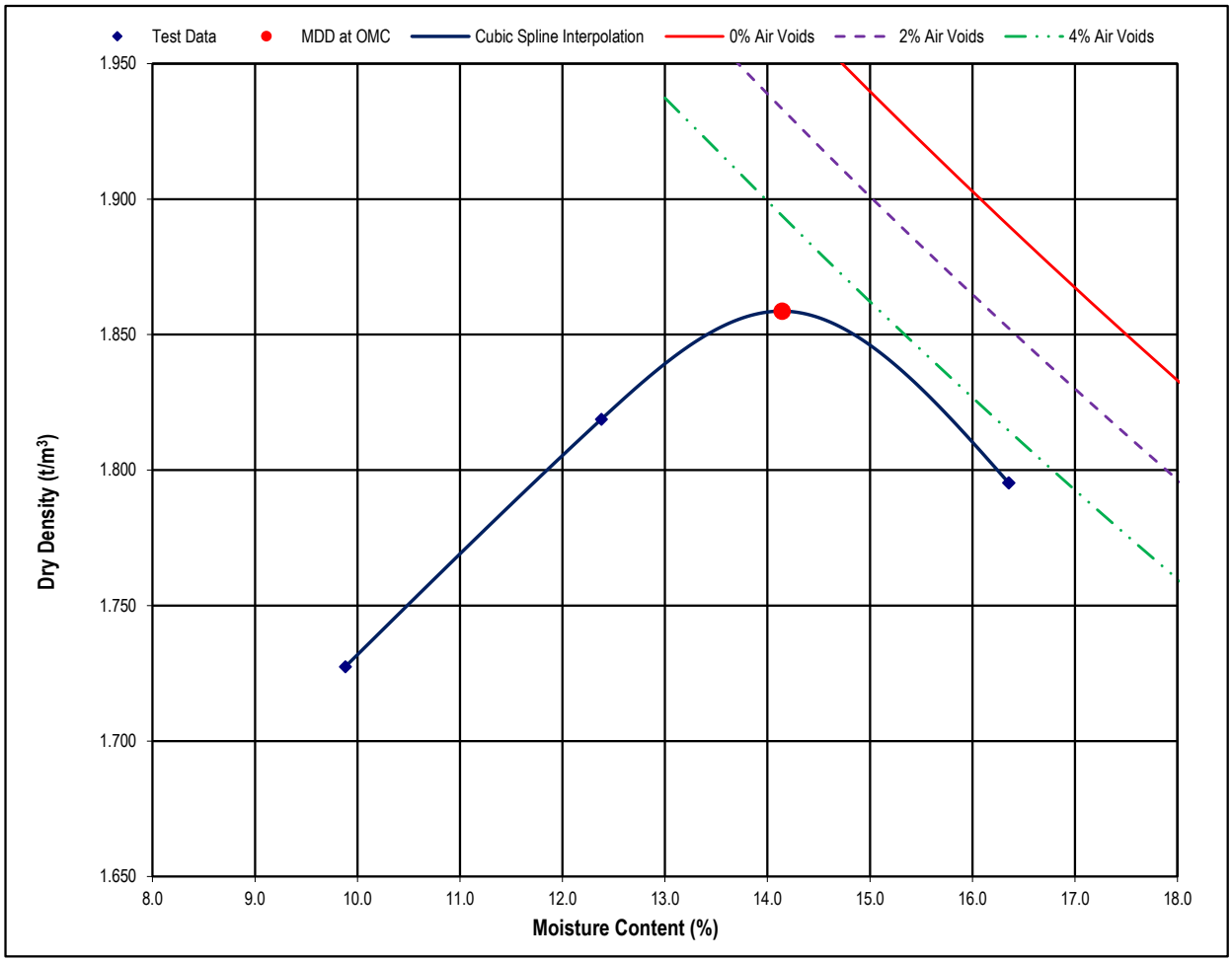
MOISTURE/DENSITY RELATIONSHIP TEST REPORT

Test Method: AS 1289 5.1.1 (Standard) & AS 1289.2.1.1

Client	Mine Earth	**Report No.**	24090401-MDR
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	10/10/2024
		Report Date	18/10/2024
Project	TCK-2405		
Client ID	DE1	**Location** Not Supplied	**Depth (m)** Not Supplied
Description	Not Supplied		



Maximum Dry Density (t/m^3)	1.86	**Optimum Moisture Content (%)**	14.1
Moisture Content (%)	7.7	**Percentage of Oversize/Sieve Size (mm)**	10 / 19

NOTES/REMARKS:

Curing Time (hrs): * Based on Visual/Tactile assessment of material.

Sample/s supplied by the client % Voids based on assumed SG of 2.74

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ATTERBERG LIMITS TEST REPORT

Test Methods: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Mine Earth	**Report No.**	24090401-ATT
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Report Date**	22/10/2024
Project	TCK-2405		

Sample No.	24090401
Liquid Limit Determination	AS 1289.3.1.2
Test Date	8/10/2024
Client ID	DE1
Location	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Liquid Limit (%)	45
Plastic Limit (%)	20
Plasticity Index (%)	25
Linear Shrinkage (%)	14.5 +
Moisture Content (%)	7.7

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred

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EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Mine Earth	**Report No.**	24090401-ECN
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	02/10/2024
		Report Date	02/10/2024
Project	TCK-2405		

Sample No.	24090401
Client ID	DE1
Bore Hole/Test Pit	Not Supplied
Depth (m)	Not Supplied
Description	Not Supplied
Emerson Class Number	**3**

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 20°C

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PERMEABILITY BY FALLING HEAD TEST REPORT

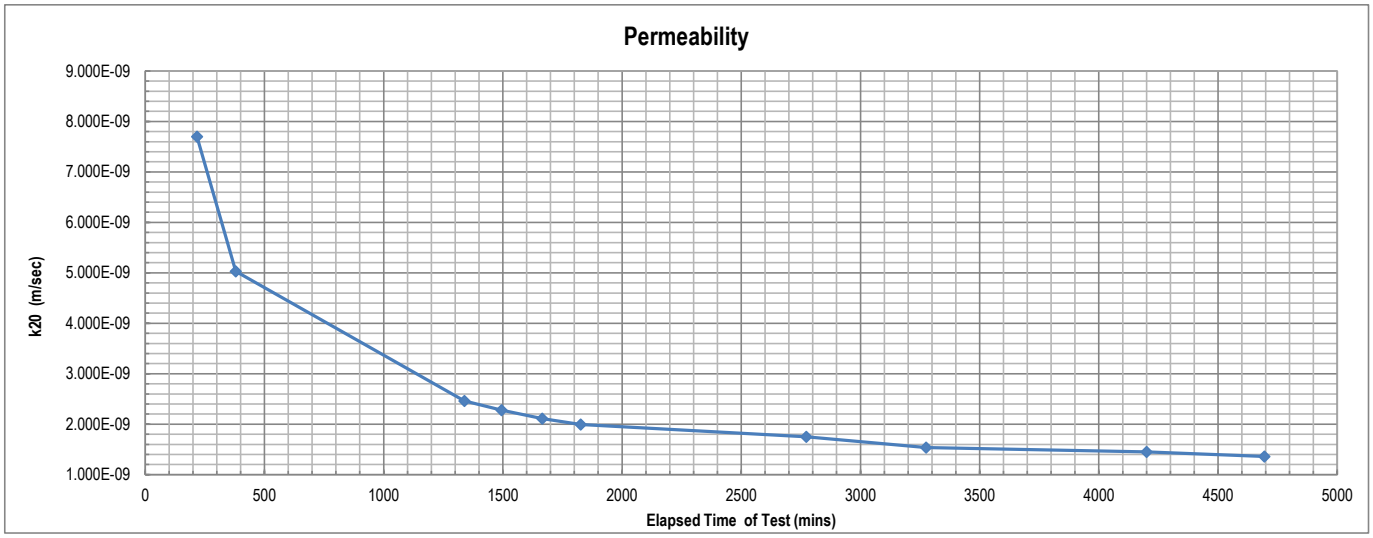
Test Method AS 1289 6.7.2, 5.1.1

Client	Mine Earth	**Report No.**	24090401-FPER
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	5/11/2024
		Report Date	20/11/2024
Project	TCK-2405		
Client ID	DE1	**Depth (m)**	Not Supplied
Description	Not Supplied	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.86**	Hydraulic Gradient	**11.2**
Optimum Moisture Content (%)	**14.1**	Surcharge (kPa)	**3.6**
Placement Moisture Content (%)	**14.0**	Head Pressure Applied (kPa)	**12.75**
Moisture Ratio (%)	**99.6**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**2.02**	Percentage Material Retained/Sieve Size (mm)	**0 % /19 mm**
Density Ratio (%)	**95.0**	Sample Height and Diameter (mm)	**116 / 152.26 mm**

PERMEABILITY $k_{(20)} = 1.4 \times 10^{-09}$ **(m/sec)**



Remarks: The above specimen was remoulded to a target of 95% of Standard Maximum Dry Density and at Optimum Moisture Content.

Sample/s supplied by client The compaction data was supplied by the client.

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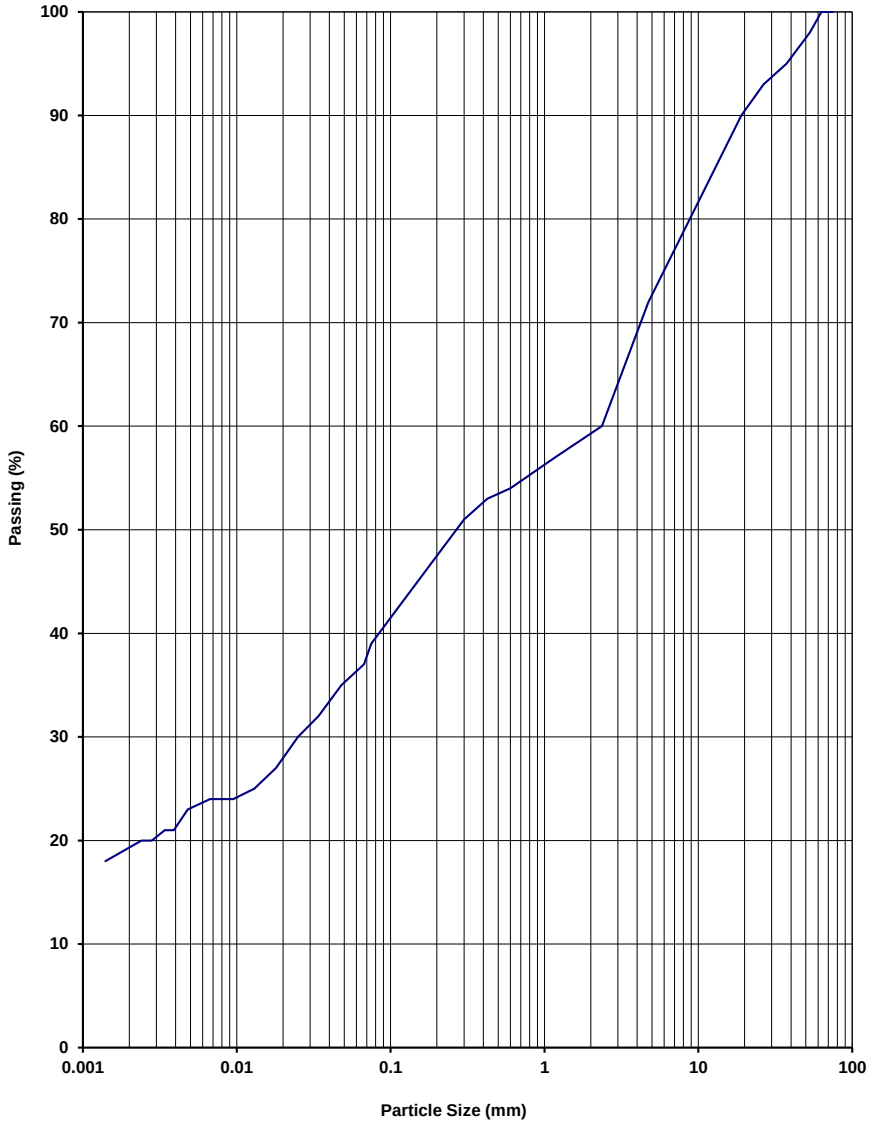
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1, 3.6.3, 3.5.1 & 2.1.1

Client	Mine Earth	**Report No.**	24090401-PSDH
		Workorder No.	9919/T/654
Address	Unit 1, 94 Forsyth Street O'Connor WA 6163	**Test Date**	1/10/2024
		Report Date	22/10/2024
Project	TCK-2405		
Client ID	DE1	**Location**	Not Supplied
Depth (m)	Not Supplied		
Description	Not Supplied		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	100
53.0	98
37.5	95
26.5	93
19.0	90
13.2	84
9.5	81
6.7	77
4.75	72
2.36	60
1.18	57
0.600	54
0.425	53
0.300	51
0.212	48
0.150	45
0.075	39
0.067	37
0.048	35
0.034	32
0.025	30
0.018	27
0.013	25
0.0095	24
0.0067	24
0.0048	23
0.0039	21
0.0034	21
0.0028	20
0.0024	20
0.0014	18



NOTES/REMARKS: -

Moisture Content 7.7% -2.36mm Soil Particle Density(t/m^3) 2.64

Sample/s supplied by the client

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ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

CERTIFICATE OF ANALYSIS

Work Order	: **EB2428229**	Page	: 1 of 24
Client	: **The Trustee for Mine Earth Unit Trust**	Laboratory	: Environmental Division Brisbane
Contact	: Matt Braimbridge	Contact	: Customer Services EB
Address	: 1 BREAKFAST CREEK ROAD NEWSTEAD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: TCK-2405	Date Samples Received	: 07-Aug-2024 09:50
Order number	: ----	Date Analysis Commenced	: 20-Aug-2024
C-O-C number	: ----	Issue Date	: 28-Aug-2024 22:10
Sampler	: JEREMY DURBIN		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 24		
No. of samples analysed	: 24		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Inorganics, Stafford, QLD
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Soil Preparation, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Soil Preparation, Stafford, QLD
Dave Gitsham	Metals Instrument Chemist	Brisbane Inorganics, Stafford, QLD
Layla Hafner	Acid Sulphate Soils - Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Vincent Muller	Chemist - Inorganics	Brisbane Inorganics, Stafford, QLD
Vincent Muller	Chemist - Inorganics	Brisbane Soil Preparation, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED009-X (Standard Anions - Extended Method –by IC): Some samples were diluted due to matrix interference. LOR adjusted accordingly.
- EA150H: Soil particle density results fell outside the scope of AS1289.3.6.3. Results should be scrutinised accordingly.
- ALS is not NATA accredited for the analysis of Exchangeable Aluminium and Exchange Acidity in soils when performed under ALS Method ED005.
- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- As per QWI – EN55-3 Data Interpreting Procedures, Ionic balances are typically calculated using Major Anions - Chloride, Alkalinity and Sulfate; and Major Cations - Calcium, Magnesium, Potassium and Sodium. Where applicable and dependent upon sample matrix, the Ionic Balance may also include the additional contribution of Ammonia, Dissolved Metals by ICPMS and H+ to the Cations and Nitrate, SiO2 and Fluoride to the Anions.
- Ionic Balance out of acceptable limits due to analytes not quantified in this report.
- EG005T (Total Metals by ICP-AES): Sample EB2428324-003 shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- ED093C (Leachable Major Cations): Unable to report Sodium results due to it's inclusion in the extraction fluid.
- ED006 (Exchangeable Cations on Alkaline Soils): Unable to calculate Magnesium/Potassium Ratio result for some samples as required Exchangeable Magnesium and/or Potassium results are less than the limit of reporting.
- ED006 (Exchangeable Cations on Alkaline Soils): Unable to calculate Calcium/Magnesium Ratio result for some samples as required Exchangeable Calcium and/or Magnesium results are less than the limit of reporting.
- ED006 (Exchangeable Cations on Alkaline Soils): Sample DC-ALS (EB2428229-006) shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- It is recognised that EG005T (Total Metals by ICP-AES) is less than EG005C (Leachable Metals by ICP-AES) for some samples. However, the difference is within experimental variation of the methods.
- ED045G (Chloride)/ ED041G (Sulfate as SO4): Some samples were diluted due to matrix interference. LOR adjusted accordingly.
- EA058 Emerson: V. = Very, D. = Dark, L. = Light, VD. = Very Dark
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.
- ED045G: The presence of Thiocyanate, Thiosulfate and Sulfite can positively contribute to the chloride result, thereby may bias results higher than expected. Results should be scrutinised accordingly.

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)			Sample ID	T1-ALS	TC1-ALS	WR1-ALS	WR3-ALS	----
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	----
Compound	CAS Number	LOR	Unit	EB2428229-001	EB2428229-002	EB2428229-003	EB2428229-004	--------
				Result	Result	Result	Result	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**5.04**	**5.65**	**6.42**	**5.06**	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**5990**	**7490**	**7580**	**5600**	----
ED009: Anions								
Iodide	20461-54-5	1.00	mg/L	----	----	<0.500	<0.200	----
ED037P: Alkalinity by PC Titrator								
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**1440**	**2360**	**2880**	**1460**	----
Total Alkalinity as CaCO3	----	1	mg/L	**1440**	**2360**	**2880**	**1460**	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<10	<10	**4**	<10	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<10	<10	<10	**10**	----
ED093C: Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	**93**	**133**	**568**	**91**	----
Magnesium	7439-95-4	1	mg/L	**11**	**14**	**74**	**8**	----
Potassium	7440-09-7	1	mg/L	**4**	**9**	**6**	**4**	----
EG005(ED093)C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**0.7**	<0.1	<0.1	**0.4**	----
Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	----
Barium	7440-39-3	0.1	mg/L	**0.9**	**1.1**	**4.5**	**0.6**	----
Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	----
Boron	7440-42-8	0.1	mg/L	**0.2**	**0.2**	<0.1	**0.1**	----
Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	----
Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	----
Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	----
Copper	7440-50-8	0.1	mg/L	**0.2**	<0.1	<0.1	<0.1	----
Iron	7439-89-6	0.1	mg/L	**0.4**	<0.1	<0.1	**0.2**	----

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)			Sample ID	T1-ALS	TC1-ALS	WR1-ALS	WR3-ALS	----
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	----
Compound	CAS Number	LOR	Unit	EB2428229-001	EB2428229-002	EB2428229-003	EB2428229-004	--------
				Result	Result	Result	Result	----
EG005(ED093)C: Leachable Metals by ICPAES - Continued								
Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	----
Manganese	7439-96-5	0.1	mg/L	**0.5**	**2.7**	<0.1	**0.5**	----
Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	----
Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	----
Strontium	7440-24-6	0.1	mg/L	**0.1**	**0.4**	**1.1**	<0.1	----
Titanium	7440-32-6	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	----
Vanadium	7440-62-2	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	----
Zinc	7440-66-6	0.1	mg/L	**0.3**	**0.3**	**0.2**	**0.3**	----
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.2**	**0.3**	**0.4**	**0.1**	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.05**	**0.06**	<0.01	<0.01	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	**0.02**	<0.01	<0.01	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	**0.06**	<0.01	**0.02**	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	T1-ALS	TC1-ALS	WR1-ALS	WR3-ALS	B1-ALS
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-001	EB2428229-002	EB2428229-003	EB2428229-004	EB2428229-005
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	7.8	8.0	8.0	8.1	6.6
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.9	9.2	9.2	9.5	7.1
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	175	55	110	45	16
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	3.4	<1.0	6.9	1.0	2.9
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Reddish Brown (2.5YR 5/4)	Dark Reddish Gray (5YR 4/2)	Red (2.5YR 4/8)	Reddish Gray (2.5YR 6/1)	Red (2.5YR 5/6)
Texture	----	-	-	Sandy Loam	Sandy Loam	Medium Clay	Course Sand	Sandy Clay Loam
Emerson Class Number	EC/TC	-	-	3	7	3	8	3
EA150: Particle Sizing								
+75µm	----	1	%	53	79	61	90	63
+150µm	----	1	%	17	69	54	80	51
+300µm	----	1	%	1	59	44	67	41
+425µm	----	1	%	<1	53	40	60	38
+600µm	----	1	%	<1	48	35	53	36
+1180µm	----	1	%	<1	37	25	36	34
+2.36mm	----	1	%	<1	24	12	18	31
+4.75mm	----	1	%	<1	10	5	4	23
+9.5mm	----	1	%	<1	<1	<1	<1	13
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	12	9	26	2	22
Silt (2-60 µm)	----	1	%	31	11	12	6	13

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	T1-ALS	TC1-ALS	WR1-ALS	WR3-ALS	B1-ALS
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-001	EB2428229-002	EB2428229-003	EB2428229-004	EB2428229-005
				Result	Result	Result	Result	Result
EA150: Soil Classification based on Particle Size - Continued								
Sand (0.06-2.00 mm)	----	1	%	57	52	46	68	33
Gravel (>2mm)	----	1	%	<1	28	16	24	32
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.67	2.75	2.68	2.66	2.60
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	1.1	1.4	3.6	1.1	----
ø Exchangeable Magnesium	----	0.2	meq/100g	<0.2	0.5	3.4	<0.2	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	<0.2	<0.2	<0.2	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	<0.2	0.4	<0.2	----
ø Cation Exchange Capacity	----	0.2	meq/100g	1.1	1.9	7.3	1.1	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	<0.2	5.1	<0.2	----
ø Calcium/Magnesium Ratio	----	0.2	-	----	2.6	1.1	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	----	----	20.3
Exchangeable Magnesium	----	0.1	meq/100g	----	----	----	----	6.9
Exchangeable Potassium	----	0.1	meq/100g	----	----	----	----	0.8
Exchangeable Sodium	----	0.1	meq/100g	----	----	----	----	0.6
Cation Exchange Capacity	----	0.1	meq/100g	----	----	----	----	28.6
Exchangeable Sodium Percent	----	0.1	%	----	----	----	----	2.1
Calcium/Magnesium Ratio	----	0.1	-	----	----	----	----	2.9
Magnesium/Potassium Ratio	----	0.1	-	----	----	----	----	8.2
ED021: Bicarbonate Extractable Potassium (Colwell)								
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	163	446	280	138	387
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	20	<10	20	<10	<10
ED092: DTPA Extractable Metals								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	T1-ALS	TC1-ALS	WR1-ALS	WR3-ALS	B1-ALS
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-001	EB2428229-002	EB2428229-003	EB2428229-004	EB2428229-005
				Result	Result	Result	Result	Result
ED092: DTPA Extractable Metals - Continued								
ø Copper	7440-50-8	1	mg/kg	**16**	<1	<1	<1	<1
ø Iron	7439-89-6	1	mg/kg	**19**	**15**	**5**	**16**	**10**
ø Manganese	7439-96-5	1	mg/kg	**4**	**4**	<1	**3**	**3**
ø Zinc	7440-66-6	1	mg/kg	<1	<1	<1	<1	<1
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	**30**	**20**	**140**	<10	**30**
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	**17**	**12**	**11**	**3**	**17**
Cobalt	7440-48-4	2	mg/kg	**17**	**7**	**13**	<2	**7**
Copper	7440-50-8	5	mg/kg	**95**	**9**	**9**	**10**	**6**
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg	**75**	**107**	**80**	**30**	**112**
Nickel	7440-02-0	2	mg/kg	**15**	**10**	**7**	<2	**8**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**18**	**22**	**38**	<5	**41**
Zinc	7440-66-6	5	mg/kg	**11**	**10**	**5**	<5	**6**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20	<20	<20	<20	<20
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	**0.1**
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	**0.7**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	T1-ALS	TC1-ALS	WR1-ALS	WR3-ALS	B1-ALS
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-001	EB2428229-002	EB2428229-003	EB2428229-004	EB2428229-005
				Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	**0.8**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**60**	**30**	**80**	<20	**590**
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	**60**	**30**	**80**	<20	**590**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**391**	**446**	**145**	**74**	**180**
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	<5	<5	<5	**9**
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Extraction Fluid pH	----	0.1	pH Unit	**5.0**	**5.0**	**5.0**	**5.0**	**----**
Final pH	----	0.1	pH Unit	**5.1**	**5.1**	**6.4**	**5.1**	**----**
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5	<0.5	<0.5	<0.5	**1.1**
Total Organic Carbon	----	0.5	%	<0.5	<0.5	<0.5	<0.5	**0.6**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	DC-ALS	DC2-ALS	TS1-ALS	TS2-ALS	A1-1
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-006	EB2428229-007	EB2428229-008	EB2428229-009	EB2428229-010
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	8.1	8.2	7.9	7.8	7.8
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.5	9.6	8.7	8.7	8.6
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	77	374	205	98	70
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	2.2	5.6	5.1	2.6	3.4
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Reddish Brown (2.5YR 5/3)	Reddish Brown (2.5YR 5/4)	Reddish Brown (2.5YR 5/4)	Reddish Brown (2.5YR 5/4)	Yellowish Red (5YR 5/6)
Texture	----	-	-	Sandy Loam	Medium Heavy Clay	Medium Clay	Light Clay	Sandy Loam
Emerson Class Number	EC/TC	-	-	3	2	3	3	3
EA150: Particle Sizing								
+75µm	----	1	%	68	53	52	50	67
+150µm	----	1	%	36	46	36	29	52
+300µm	----	1	%	13	36	26	17	36
+425µm	----	1	%	9	32	22	13	29
+600µm	----	1	%	8	28	20	10	25
+1180µm	----	1	%	6	22	16	6	19
+2.36mm	----	1	%	4	14	11	3	11
+4.75mm	----	1	%	<1	5	5	<1	4
+9.5mm	----	1	%	<1	3	<1	<1	<1
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	9	31	28	29	19
Silt (2-60 µm)	----	1	%	22	14	18	18	12

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	DC-ALS	DC2-ALS	TS1-ALS	TS2-ALS	A1-1
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-006	EB2428229-007	EB2428229-008	EB2428229-009	EB2428229-010
				Result	Result	Result	Result	Result
EA150: Soil Classification based on Particle Size - Continued								
Sand (0.06-2.00 mm)	----	1	%	65	39	41	49	56
Gravel (>2mm)	----	1	%	4	16	13	4	13
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.68	2.64	2.65	2.67	2.64
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	1.0	3.1	4.3	5.0	10.0
ø Exchangeable Magnesium	----	0.2	meq/100g	0.9	3.7	1.8	2.6	0.5
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	0.2	0.3	0.3	<0.2
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	2.1	<0.2	<0.2	<0.2
ø Cation Exchange Capacity	----	0.2	meq/100g	1.9	9.2	6.4	7.9	10.7
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	23.2	<0.2	<0.2	<0.2
ø Calcium/Magnesium Ratio	----	0.2	-	1.2	0.8	2.4	1.9	19.9
ø Magnesium/Potassium Ratio	----	0.2	-	----	16.0	6.1	8.2	----
ED021: Bicarbonate Extractable Potassium (Colwell)								
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	221	557	528	391	377
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	70	70	20	<10
ED092: DTPA Extractable Metals								
ø Copper	7440-50-8	1	mg/kg	5	56	4	2	<1
ø Iron	7439-89-6	1	mg/kg	9	32	12	10	4
ø Manganese	7439-96-5	1	mg/kg	3	22	4	3	2
ø Zinc	7440-66-6	1	mg/kg	<1	<1	<1	<1	<1
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	20	180	30	100	120
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	DC-ALS	DC2-ALS	TS1-ALS	TS2-ALS	A1-1
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-006	EB2428229-007	EB2428229-008	EB2428229-009	EB2428229-010
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	7	9	8	26	26
Cobalt	7440-48-4	2	mg/kg	11	10	6	13	14
Copper	7440-50-8	5	mg/kg	34	79	19	34	7
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg	62	112	64	197	195
Nickel	7440-02-0	2	mg/kg	7	10	6	16	20
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	12	21	16	68	68
Zinc	7440-66-6	5	mg/kg	5	9	<5	10	11
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20	<20	<20	<20	<20
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	0.1	<0.1	0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1	4.1	3.2	1.9	0.5
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	4.2	3.2	2.0	0.5
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	40	100	590	380	190
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	40	100	590	380	190
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	348	400	332	337	4330
EK080: Bicarbonate Extractable Phosphorus (Colwell)								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	DC-ALS	DC2-ALS	TS1-ALS	TS2-ALS	A1-1
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-006	EB2428229-007	EB2428229-008	EB2428229-009	EB2428229-010
				Result	Result	Result	Result	Result
EK080: Bicarbonate Extractable Phosphorus (Colwell) - Continued								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	<5	<5	<5	<5
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5	<0.5	**0.7**	**0.7**	**0.6**
Total Organic Carbon	----	0.5	%	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A1-2	A2-1	A2-2	A2-3	A3-1
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-011	EB2428229-012	EB2428229-013	EB2428229-014	EB2428229-015
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	7.4	6.0	6.4	6.6	7.0
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.7	7.1	7.5	7.6	7.6
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	25	42	12	8	28
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	1.1	<1.0	5.8	2.6	4.5
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Pink (7.5YR 7/4)	Reddish Brown (2.5YR 4/4)	Red (2.5YR 4/6)	Red (2.5YR 5/6)	Reddish Brown (2.5YR 5/4)
Texture	----	-	-	Clayey Sand	Sandy Loam	Light Clay	Sandy Loam	Light Medium Clay
Emerson Class Number	EC/TC	-	-	5	3	3	7	3
EA150: Particle Sizing								
+75µm	----	1	%	80	67	49	79	33
+150µm	----	1	%	65	54	39	70	20
+300µm	----	1	%	52	40	28	55	11
+425µm	----	1	%	46	34	22	46	9
+600µm	----	1	%	41	30	18	34	8
+1180µm	----	1	%	31	25	12	19	6
+2.36mm	----	1	%	19	20	7	10	4
+4.75mm	----	1	%	10	6	<1	2	2
+9.5mm	----	1	%	4	<1	<1	<1	<1
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	9	19	42	14	43
Silt (2-60 µm)	----	1	%	9	12	7	7	22

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A1-2	A2-1	A2-2	A2-3	A3-1
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-011	EB2428229-012	EB2428229-013	EB2428229-014	EB2428229-015
				Result	Result	Result	Result	Result
EA150: Soil Classification based on Particle Size - Continued								
Sand (0.06-2.00 mm)	----	1	%	60	47	42	66	31
Gravel (>2mm)	----	1	%	22	22	9	13	4
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.61	2.57	2.64	2.75	2.54
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	3.3	----	4.2	1.9	6.9
ø Exchangeable Magnesium	----	0.2	meq/100g	<0.2	----	1.4	0.6	2.7
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	0.3	<0.2	0.6
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	<0.2	<0.2	<0.2
ø Cation Exchange Capacity	----	0.2	meq/100g	3.3	----	5.9	2.5	10.1
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	<0.2	<0.2	<0.2
ø Calcium/Magnesium Ratio	----	0.2	-	----	----	3.1	3.4	2.6
ø Magnesium/Potassium Ratio	----	0.2	-	----	----	4.7	----	4.5
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	11.8	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	----	4.2	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	----	0.4	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	----	0.7	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	----	17.2	----	----	----
Exchangeable Sodium Percent	----	0.1	%	----	4.0	----	----	----
Calcium/Magnesium Ratio	----	0.1	-	----	2.8	----	----	----
Magnesium/Potassium Ratio	----	0.1	-	----	10.3	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)								
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	101	424	334	<100	633
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	<10

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A1-2	A2-1	A2-2	A2-3	A3-1
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-011	EB2428229-012	EB2428229-013	EB2428229-014	EB2428229-015
				Result	Result	Result	Result	Result
ED092: DTPA Extractable Metals								
ø Copper	7440-50-8	1	mg/kg	<1	<1	<1	<1	1
ø Iron	7439-89-6	1	mg/kg	2	13	7	4	8
ø Manganese	7439-96-5	1	mg/kg	<1	7	2	<1	4
ø Zinc	7440-66-6	1	mg/kg	<1	<1	<1	<1	<1
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	10	10	20	30	80
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	<2	5	12	16	17
Cobalt	7440-48-4	2	mg/kg	<2	2	4	8	7
Copper	7440-50-8	5	mg/kg	<5	<5	<5	6	11
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg	51	54	43	63	185
Nickel	7440-02-0	2	mg/kg	<2	2	4	8	9
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	6	13	33	33	49
Zinc	7440-66-6	5	mg/kg	<5	<5	<5	<5	7
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20	<20	<20	<20	<20
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	0.3	<0.1	<0.1	0.2
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1	1.4	0.5	0.1	0.8

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A1-2	A2-1	A2-2	A2-3	A3-1
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-011	EB2428229-012	EB2428229-013	EB2428229-014	EB2428229-015
				Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	1.7	0.5	0.1	1.0
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	40	480	480	180	380
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	40	480	480	180	380
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	198	155	156	127	127
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	10	<5	<5	<5
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5	1.8	0.9	<0.5	1.1
Total Organic Carbon	----	0.5	%	<0.5	1.0	0.5	<0.5	0.6

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A3-2	A3-3	A4-1	A4-2	A4-3
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-016	EB2428229-017	EB2428229-018	EB2428229-019	EB2428229-020
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	7.8	7.8	7.7	7.4	7.4
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.7	8.7	8.5	8.3	8.4
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	78	83	83	36	84
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	9.3	5.1	3.6	8.3	7.8
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Reddish Brown (2.5YR 5/4)	Reddish Brown (2.5YR 5/4)	Reddish Brown (2.5YR 5/4)	Reddish Brown (2.5YR 5/4)	Red (2.5YR 5/6)
Texture	----	-	-	Medium Clay	Medium Clay	Light Medium Clay	Medium Clay	Light Medium Clay
Emerson Class Number	EC/TC	-	-	3	4	7	3	3
EA150: Particle Sizing								
+75µm	----	1	%	30	29	27	40	40
+150µm	----	1	%	20	18	17	27	27
+300µm	----	1	%	13	11	11	15	16
+425µm	----	1	%	11	9	9	12	12
+600µm	----	1	%	10	7	8	9	9
+1180µm	----	1	%	7	3	5	5	5
+2.36mm	----	1	%	3	2	2	2	2
+4.75mm	----	1	%	<1	<1	<1	<1	1
+9.5mm	----	1	%	<1	<1	<1	<1	<1
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	49	45	48	44	38
Silt (2-60 µm)	----	1	%	19	23	22	14	16

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A3-2	A3-3	A4-1	A4-2	A4-3
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-016	EB2428229-017	EB2428229-018	EB2428229-019	EB2428229-020
				Result	Result	Result	Result	Result
EA150: Soil Classification based on Particle Size - Continued								
Sand (0.06-2.00 mm)	----	1	%	28	30	27	39	43
Gravel (>2mm)	----	1	%	4	2	3	3	3
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.59	2.57	2.50	2.55	2.60
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	7.5	10.6	5.4	5.7	6.0
ø Exchangeable Magnesium	----	0.2	meq/100g	2.6	3.4	1.8	2.2	2.3
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	0.2	0.4	0.5	0.4
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	<0.2	<0.2	<0.2	<0.2
ø Cation Exchange Capacity	----	0.2	meq/100g	10.3	14.2	7.6	8.4	8.7
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	<0.2	<0.2	<0.2	<0.2
ø Calcium/Magnesium Ratio	----	0.2	-	2.9	3.1	3.1	2.5	2.6
ø Magnesium/Potassium Ratio	----	0.2	-	----	14.5	4.1	4.4	5.8
ED021: Bicarbonate Extractable Potassium (Colwell)								
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	250	232	927	694	555
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	20	<10	<10
ED092: DTPA Extractable Metals								
ø Copper	7440-50-8	1	mg/kg	1	1	<1	<1	<1
ø Iron	7439-89-6	1	mg/kg	7	6	5	6	5
ø Manganese	7439-96-5	1	mg/kg	1	2	3	2	2
ø Zinc	7440-66-6	1	mg/kg	<1	<1	<1	<1	<1
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	40	110	130	80	60
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A3-2	A3-3	A4-1	A4-2	A4-3
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-016	EB2428229-017	EB2428229-018	EB2428229-019	EB2428229-020
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	8	20	31	31	23
Cobalt	7440-48-4	2	mg/kg	4	8	13	8	6
Copper	7440-50-8	5	mg/kg	<5	12	20	10	6
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg	97	193	194	150	98
Nickel	7440-02-0	2	mg/kg	4	10	16	12	9
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	25	58	76	74	46
Zinc	7440-66-6	5	mg/kg	<5	7	11	6	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20	<20	<20	<20	<20
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	0.2	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	0.1	<0.1	0.3	0.2	0.1
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.1	<0.1	0.5	0.2	0.1
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	350	320	550	450	460
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	350	320	550	450	460
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	138	136	251	289	178
EK080: Bicarbonate Extractable Phosphorus (Colwell)								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A3-2	A3-3	A4-1	A4-2	A4-3
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00
Compound	CAS Number	LOR	Unit	EB2428229-016	EB2428229-017	EB2428229-018	EB2428229-019	EB2428229-020
				Result	Result	Result	Result	Result
EK080: Bicarbonate Extractable Phosphorus (Colwell) - Continued								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	<5	<5	<5	<5
EP004: Organic Matter								
Organic Matter	----	0.5	%	**0.7**	**0.9**	**1.4**	**0.8**	**0.6**
Total Organic Carbon	----	0.5	%	<0.5	<0.5	**0.8**	<0.5	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A5-1	A5-2	A5-3	T2	----
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	----
Compound	CAS Number	LOR	Unit	EB2428229-021	EB2428229-022	EB2428229-023	EB2428229-024	--------
				Result	Result	Result	Result	----
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	6.5	6.4	7.9	7.9	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	7.3	7.8	9.0	8.6	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	53	15	200	219	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	3.0	7.9	10.7	10.9	----
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Reddish Brown (2.5YR 5/4)	Reddish Brown (2.5YR 4/3)	Reddish Brown (2.5YR 4/3)	Weak Red (2.5YR 5/2)	----
Texture	----	-	-	Light Clay	Medium Heavy Clay	Medium Heavy Clay	Sandy Clay Loam	----
Emerson Class Number	EC/TC	-	-	3	3	3	3	----
EA150: Particle Sizing								
+75µm	----	1	%	41	39	29	49	----
+150µm	----	1	%	28	32	22	14	----
+300µm	----	1	%	17	24	16	<1	----
+425µm	----	1	%	14	22	14	<1	----
+600µm	----	1	%	12	20	13	<1	----
+1180µm	----	1	%	8	16	10	<1	----
+2.36mm	----	1	%	4	12	6	<1	----
+4.75mm	----	1	%	1	6	3	<1	----
+9.5mm	----	1	%	<1	<1	<1	<1	----
+19.0mm	----	1	%	<1	<1	<1	<1	----
+37.5mm	----	1	%	<1	<1	<1	<1	----
+75.0mm	----	1	%	<1	<1	<1	<1	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	33	38	49	11	----
Silt (2-60 µm)	----	1	%	20	18	21	35	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A5-1	A5-2	A5-3	T2	----
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	----
Compound	CAS Number	LOR	Unit	EB2428229-021	EB2428229-022	EB2428229-023	EB2428229-024	--------
				Result	Result	Result	Result	----
EA150: Soil Classification based on Particle Size - Continued								
Sand (0.06-2.00 mm)	----	1	%	42	31	22	54	----
Gravel (>2mm)	----	1	%	5	13	8	<1	----
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.44	2.60	2.60	2.82	----
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	3.0	6.9	9.2	0.9	----
ø Exchangeable Magnesium	----	0.2	meq/100g	2.0	4.2	7.1	<0.2	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.4	0.2	<0.2	<0.2	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	0.4	2.2	<0.2	----
ø Cation Exchange Capacity	----	0.2	meq/100g	5.4	11.8	18.7	0.9	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	3.3	11.7	<0.2	----
ø Calcium/Magnesium Ratio	----	0.2	-	1.5	1.6	1.3	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	5.0	16.2	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)								
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	840	290	166	381	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	20	<10	90	<10	----
ED092: DTPA Extractable Metals								
ø Copper	7440-50-8	1	mg/kg	1	1	1	11	----
ø Iron	7439-89-6	1	mg/kg	18	20	14	16	----
ø Manganese	7439-96-5	1	mg/kg	11	10	6	4	----
ø Zinc	7440-66-6	1	mg/kg	<1	<1	<1	<1	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	----
Barium	7440-39-3	10	mg/kg	80	90	130	<10	----
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A5-1	A5-2	A5-3	T2	----
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	----
Compound	CAS Number	LOR	Unit	EB2428229-021	EB2428229-022	EB2428229-023	EB2428229-024	--------
				Result	Result	Result	Result	----
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	----
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	----
Chromium	7440-47-3	2	mg/kg	17	20	16	10	----
Cobalt	7440-48-4	2	mg/kg	9	9	9	9	----
Copper	7440-50-8	5	mg/kg	11	12	9	37	----
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	----
Manganese	7439-96-5	5	mg/kg	268	283	246	44	----
Nickel	7440-02-0	2	mg/kg	9	11	9	9	----
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	----
Vanadium	7440-62-2	5	mg/kg	49	62	53	9	----
Zinc	7440-66-6	5	mg/kg	9	8	6	7	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20	<20	<20	<20	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	0.6	<0.1	<0.1	<0.1	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	4.0	0.4	0.5	1.1	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	4.6	0.4	0.5	1.1	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	860	430	540	50	----
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	860	430	540	50	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	249	171	146	425	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	A5-1	A5-2	A5-3	T2	----
			Sampling date / time	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	07-Aug-2024 00:00	----
Compound	CAS Number	LOR	Unit	EB2428229-021	EB2428229-022	EB2428229-023	EB2428229-024	--------
				Result	Result	Result	Result	----
EK080: Bicarbonate Extractable Phosphorus (Colwell) - Continued								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	**10**	<5	<5	<5	**----**
EP004: Organic Matter								
Organic Matter	----	0.5	%	**2.0**	**2.0**	**1.2**	<0.5	**----**
Total Organic Carbon	----	0.5	%	**1.1**	**1.1**	**0.7**	<0.5	**----**

CERTIFICATE OF ANALYSIS with GUIDELINE COMPARISON

Work Order	: **EB2428229**	Page	: 1 of 58
Client	: **The Trustee for Mine Earth Unit Trust**	Laboratory	: Environmental Division Brisbane
Contact	: Matt Braimbridge	Contact	: Customer Services EB
Address	: 1 BREAKFAST CREEK ROAD NEWSTEAD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: TCK-2405		
Order number	: ----		
C-O-C number	: ----	No. of samples received	: 24
Site	: ----	No. of samples analysed	: 24
Sampled by	: JEREMY DURBIN	Issue Date	: 28-Aug-2024 22:10
Quote number	: EP2021MINEAR0001 (EN/222)	Date Samples Received	: 07-Aug-2024 09:50

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. All pages of this report have been checked and approved for release. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to Assist with Quality Review and Sample Receipt Notification.

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position (Accreditation Category)
Beatriz Llarinas	Senior Chemist - Inorganics (Brisbane Inorganics, Stafford, QLD)
	Senior Chemist - Inorganics (Brisbane Soil Preparation, Stafford, QLD)
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist (Brisbane Acid Sulphate Soils, Stafford, QLD)
	Senior Acid Sulfate Soil Chemist (Brisbane Soil Preparation, Stafford, QLD)
Dave Gitsham	Metals Instrument Chemist (Brisbane Inorganics, Stafford, QLD)
Layla Hafner	Acid Sulphate Soils - Chemist (Brisbane Acid Sulphate Soils, Stafford, QLD)
Vincent Muller	Chemist - Inorganics (Brisbane Inorganics, Stafford, QLD)
	Chemist - Inorganics (Brisbane Soil Preparation, Stafford, QLD)

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.
Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.
Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Where a result is required to meet compliance limits, the associated uncertainty **must be** considered. Refer to the ALS Contract Terms and Conditions for details, and EnviroMail 53 for a guide on how to interpret the measurement of uncertainty (MU).

Work Order Specific Comments

- ED009-X (Standard Anions - Extended Method –by IC): Some samples were diluted due to matrix interference. LOR adjusted accordingly.
- EA150H: Soil particle density results fell outside the scope of AS1289.3.6.3. Results should be scrutinised accordingly.
- ALS is not NATA accredited for the analysis of Exchangeable Aluminium and Exchange Acidity in soils when performed under ALS Method ED005.
- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- As per QWI – EN55-3 Data Interpreting Procedures, Ionic balances are typically calculated using Major Anions - Chloride, Alkalinity and Sulfate; and Major Cations - Calcium, Magnesium, Potassium and Sodium. Where applicable and dependent upon sample matrix, the Ionic Balance may also include the additional contribution of Ammonia, Dissolved Metals by ICPMS and H+ to the Cations and Nitrate, SiO2 and Fluoride to the Anions.
- Ionic Balance out of acceptable limits due to analytes not quantified in this report.
- EG005T (Total Metals by ICP-AES): Sample EB2428324-003 shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- ED093C (Leachable Major Cations): Unable to report Sodium results due to it's inclusion in the extraction fluid.
- ED006 (Exchangeable Cations on Alkaline Soils): Unable to calculate Magnesium/Potassium Ratio result for some samples as required Exchangeable Magnesium and/or Potassium results are less than the limit of reporting.
- ED006 (Exchangeable Cations on Alkaline Soils): Unable to calculate Calcium/Magnesium Ratio result for some samples as required Exchangeable Calcium and/or Magnesium results are less than the limit of reporting.
- ED006 (Exchangeable Cations on Alkaline Soils): Sample DC-ALS (EB2428229-006) shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- It is recognised that EG005T (Total Metals by ICP-AES) is less than EG005C (Leachable Metals by ICP-AES) for some samples. However, the difference is within experimental variation of the methods.
- ED045G (Chloride)/ ED041G (Sulfate as SO4): Some samples were diluted due to matrix interference. LOR adjusted accordingly.
- EA058 Emerson: V. = Very, D. = Dark, L. = Light, VD. = Very Dark
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.
- ED045G: The presence of Thiocyanate, Thiosulfate and Sulfite can positively contribute to the chloride result, thereby may bias results higher than expected. Results should be scrutinised accordingly.

Analytical Results

Sub-Matrix: **SOIL**			*Sample ID*	**T1-ALS**		**Guideline comparison not requested for sample**		
			Laboratory sample ID	*EB2428229001*				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	*CAS Number*	*LOR*	*----*	Result	MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	**7.8**		----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**8.9**		----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**175**		----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**3.4**		----	----	----
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	**Reddish Brown (2.5YR**		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	T1-ALS	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229001			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
Texture	----	-	-	Sandy Loam	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	53	----	----	----
+150µm	----	1	%	17	----	----	----
+300µm	----	1	%	1	----	----	----
+425µm	----	1	%	<1	----	----	----
+600µm	----	1	%	<1	----	----	----
+1180µm	----	1	%	<1	----	----	----
+2.36mm	----	1	%	<1	----	----	----
+4.75mm	----	1	%	<1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	12	----	----	----
Silt (2-60 µm)	----	1	%	31	----	----	----
Sand (0.06-2.00 mm)	----	1	%	57	----	----	----
Gravel (>2mm)	----	1	%	<1	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.67	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	1.1	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	1.1	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	163	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	20	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	16	----	----	----
ø Iron	7439-89-6	1	mg/kg	19	----	----	----
ø Manganese	7439-96-5	1	mg/kg	4	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----
EG005(ED093)T: Total Metals by ICP-AES							
Arsenic	7440-38-2	5	mg/kg	<5	----	----	----
Barium	7440-39-3	10	mg/kg	30	----	----	----
Beryllium	7440-41-7	1	mg/kg	<1	----	----	----
Boron	7440-42-8	50	mg/kg	<50	----	----	----
Cadmium	7440-43-9	1	mg/kg	<1	----	----	----
Chromium	7440-47-3	2	mg/kg	17	----	----	----
Cobalt	7440-48-4	2	mg/kg	17	----	----	----
Copper	7440-50-8	5	mg/kg	95	----	----	----
Lead	7439-92-1	5	mg/kg	<5	----	----	----
Manganese	7439-96-5	5	mg/kg	75	----	----	----
Nickel	7440-02-0	2	mg/kg	15	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	T1-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229001				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**18**		----	----	----
Zinc	7440-66-6	5	mg/kg	**11**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**60**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**60**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**391**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Extraction Fluid pH	----	0.1	pH Unit	**5.0**		----	----	----
Final pH	----	0.1	pH Unit	**5.1**		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	TC1-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229002				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	**8.0**		----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**9.2**		----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**55**		----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0		----	----	----
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	**Dark Reddish Gray (5Y**		----	----	----
Texture	----	-	-	**Sandy Loam**		----	----	----
Emerson Class Number	EC/TC	-	-	**7**		----	----	----
EA150: Particle Sizing								
+75µm	----	1	%	**79**		----	----	----
+150µm	----	1	%	**69**		----	----	----
+300µm	----	1	%	**59**		----	----	----
+425µm	----	1	%	**53**		----	----	----
+600µm	----	1	%	**48**		----	----	----
+1180µm	----	1	%	**37**		----	----	----
+2.36mm	----	1	%	**24**		----	----	----
+4.75mm	----	1	%	**10**		----	----	----
+9.5mm	----	1	%	<1		----	----	----
+19.0mm	----	1	%	<1		----	----	----
+37.5mm	----	1	%	<1		----	----	----
+75.0mm	----	1	%	<1		----	----	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	**9**		----	----	----
Silt (2-60 µm)	----	1	%	**11**		----	----	----
Sand (0.06-2.00 mm)	----	1	%	**52**		----	----	----
Gravel (>2mm)	----	1	%	**28**		----	----	----
Cobbles (>6cm)	----	1	%	<1		----	----	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	**2.75**		----	----	----
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	**1.4**		----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	**0.5**		----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2		----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2		----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	**1.9**		----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2		----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	**2.6**		----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)								
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	**446**		----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10		----	----	----
ED092: DTPA Extractable Metals								
ø Copper	7440-50-8	1	mg/kg	<1		----	----	----
ø Iron	7439-89-6	1	mg/kg	**15**		----	----	----
ø Manganese	7439-96-5	1	mg/kg	**4**		----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1		----	----	----
EG005(ED093)T: Total Metals by ICP-AES								

Analytical Results

Sub-Matrix: SOIL			Sample ID	TC1-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229002				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**20**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**12**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**7**		----	----	----
Copper	7440-50-8	5	mg/kg	**9**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**107**		----	----	----
Nickel	7440-02-0	2	mg/kg	**10**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**22**		----	----	----
Zinc	7440-66-6	5	mg/kg	**10**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**30**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**30**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**446**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Extraction Fluid pH	----	0.1	pH Unit	**5.0**		----	----	----
Final pH	----	0.1	pH Unit	**5.1**		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Total Concentration: Category B

Sub-Matrix: **SOIL**

				Sample ID	WR1-ALS		Table 2: Category B : Waste Disposal contamination concentrations:		
				Laboratory sample ID	EB2428229003				
				Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	Unit		Result	MU	Low	High	Unit
ED092: DTPA Extractable Metals									
ø Copper	7440-50-8	1	mg/kg		<1		----	20000	mg/kg
ø Zinc	7440-66-6	1	mg/kg		<1		----	140000	mg/kg
EG005(ED093)T: Total Metals by ICP-AES									
Arsenic	7440-38-2	5	mg/kg		<5		----	2000	mg/kg
Barium	7440-39-3	10	mg/kg		**140**		----	25000	mg/kg
Beryllium	7440-41-7	1	mg/kg		<1		----	400	mg/kg
Boron	7440-42-8	50	mg/kg		<50		----	60000	mg/kg
Cadmium	7440-43-9	1	mg/kg		<1		----	400	mg/kg
Copper	7440-50-8	5	mg/kg		**9**		----	20000	mg/kg
Lead	7439-92-1	5	mg/kg		<5		----	6000	mg/kg
Nickel	7440-02-0	2	mg/kg		**7**		----	12000	mg/kg
Selenium	7782-49-2	5	mg/kg		<5		----	40000	mg/kg
Zinc	7440-66-6	5	mg/kg		**5**		----	140000	mg/kg
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1		----	300	mg/kg

Total Concentration: Category C

Sub-Matrix: **SOIL**

				Sample ID	WR1-ALS		Table 2: Category C : Waste Disposal contamination concentrations		
				Laboratory sample ID	EB2428229003				
				Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	Unit		Result	MU	Low	High	Unit
ED092: DTPA Extractable Metals									
ø Copper	7440-50-8	1	mg/kg		<1		----	5000	mg/kg
ø Zinc	7440-66-6	1	mg/kg		<1		----	35000	mg/kg
EG005(ED093)T: Total Metals by ICP-AES									
Arsenic	7440-38-2	5	mg/kg		<5		----	500	mg/kg
Barium	7440-39-3	10	mg/kg		**140**		----	6250	mg/kg
Beryllium	7440-41-7	1	mg/kg		<1		----	100	mg/kg
Boron	7440-42-8	50	mg/kg		<50		----	15000	mg/kg
Cadmium	7440-43-9	1	mg/kg		<1		----	100	mg/kg
Copper	7440-50-8	5	mg/kg		**9**		----	5000	mg/kg
Lead	7439-92-1	5	mg/kg		<5		----	1500	mg/kg
Nickel	7440-02-0	2	mg/kg		**7**		----	3000	mg/kg
Selenium	7782-49-2	5	mg/kg		<5		----	10000	mg/kg
Zinc	7440-66-6	5	mg/kg		**5**		----	35000	mg/kg
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1		----	75	mg/kg

Analytical Results

Total Concentration: Category D/Industrial Waste

Sub-Matrix: **SOIL**

				Sample ID	WR1-ALS		Table 2: Category D/Industrial Waste : Waste Disposal contamination concentrations		
				Laboratory sample ID	EB2428229003				
				Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	Unit		Result	MU	Low	High	Unit
ED092: DTPA Extractable Metals									
ø Copper	7440-50-8	1	mg/kg		<1		----	5000	mg/kg
ø Zinc	7440-66-6	1	mg/kg		<1		----	35000	mg/kg
EG005(ED093)T: Total Metals by ICP-AES									
Arsenic	7440-38-2	5	mg/kg		<5		----	500	mg/kg
Barium	7440-39-3	10	mg/kg		**140**		----	6250	mg/kg
Beryllium	7440-41-7	1	mg/kg		<1		----	100	mg/kg
Boron	7440-42-8	50	mg/kg		<50		----	15000	mg/kg
Cadmium	7440-43-9	1	mg/kg		<1		----	100	mg/kg
Copper	7440-50-8	5	mg/kg		**9**		----	5000	mg/kg
Lead	7439-92-1	5	mg/kg		<5		----	1500	mg/kg
Nickel	7440-02-0	2	mg/kg		**7**		----	3000	mg/kg
Selenium	7782-49-2	5	mg/kg		<5		----	10000	mg/kg
Zinc	7440-66-6	5	mg/kg		**5**		----	35000	mg/kg
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1		----	75	mg/kg

Analytical Results

Sub-Matrix: SOIL			Sample ID	WR1-ALS	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229003			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	8.0	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	9.2	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	110	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	6.9	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Red (2.5YR 4/8)	----	----	----
Texture	----	-	-	Medium Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	61	----	----	----
+150µm	----	1	%	54	----	----	----
+300µm	----	1	%	44	----	----	----
+425µm	----	1	%	40	----	----	----
+600µm	----	1	%	35	----	----	----
+1180µm	----	1	%	25	----	----	----
+2.36mm	----	1	%	12	----	----	----
+4.75mm	----	1	%	5	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	26	----	----	----
Silt (2-60 µm)	----	1	%	12	----	----	----
Sand (0.06-2.00 mm)	----	1	%	46	----	----	----
Gravel (>2mm)	----	1	%	16	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.68	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	3.6	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	3.4	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	0.4	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	7.3	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	5.1	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	1.1	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	280	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	20	----	----	----
ED092: DTPA Extractable Metals							
ø Iron	7439-89-6	1	mg/kg	5	----	----	----
ø Manganese	7439-96-5	1	mg/kg	<1	----	----	----
EG005(ED093)T: Total Metals by ICP-AES							
Chromium	7440-47-3	2	mg/kg	11	----	----	----
Cobalt	7440-48-4	2	mg/kg	13	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	WR1-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229003				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Manganese	7439-96-5	5	mg/kg	**80**		----	----	----
Vanadium	7440-62-2	5	mg/kg	**38**		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**80**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**80**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**145**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Extraction Fluid pH	----	0.1	pH Unit	**5.0**		----	----	----
Final pH	----	0.1	pH Unit	**6.4**		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Total Concentration: Category B

Sub-Matrix: SOIL			Sample ID	WR3-ALS		Table 2: Category B : Waste Disposal contamination concentrations:		
			Laboratory sample ID	EB2428229004				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	Unit	Result	MU	Low	High	Unit
ED092: DTPA Extractable Metals								
ø Copper	7440-50-8	1	mg/kg	<1		----	20000	mg/kg
ø Zinc	7440-66-6	1	mg/kg	<1		----	140000	mg/kg
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	2000	mg/kg
Barium	7440-39-3	10	mg/kg	<10		----	25000	mg/kg
Beryllium	7440-41-7	1	mg/kg	<1		----	400	mg/kg
Boron	7440-42-8	50	mg/kg	<50		----	60000	mg/kg
Cadmium	7440-43-9	1	mg/kg	<1		----	400	mg/kg
Copper	7440-50-8	5	mg/kg	**10**		----	20000	mg/kg
Lead	7439-92-1	5	mg/kg	<5		----	6000	mg/kg
Nickel	7440-02-0	2	mg/kg	<2		----	12000	mg/kg
Selenium	7782-49-2	5	mg/kg	<5		----	40000	mg/kg
Zinc	7440-66-6	5	mg/kg	<5		----	140000	mg/kg
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	300	mg/kg

Analytical Results

Total Concentration: Category C

Sub-Matrix: **SOIL**

				Sample ID		WR3-ALS		Table 2: Category C : Waste Disposal contamination concentrations		
				Laboratory sample ID		EB2428229004				
				Sampling date / time		07-Aug-2024 13:03				
Parameter	CAS Number	LOR	Unit			Result	MU	Low	High	Unit
ED092: DTPA Extractable Metals										
ø Copper	7440-50-8	1	mg/kg			<1		----	5000	mg/kg
ø Zinc	7440-66-6	1	mg/kg			<1		----	35000	mg/kg
EG005(ED093)T: Total Metals by ICP-AES										
Arsenic	7440-38-2	5	mg/kg			<5		----	500	mg/kg
Barium	7440-39-3	10	mg/kg			<10		----	6250	mg/kg
Beryllium	7440-41-7	1	mg/kg			<1		----	100	mg/kg
Boron	7440-42-8	50	mg/kg			<50		----	15000	mg/kg
Cadmium	7440-43-9	1	mg/kg			<1		----	100	mg/kg
Copper	7440-50-8	5	mg/kg			**10**		----	5000	mg/kg
Lead	7439-92-1	5	mg/kg			<5		----	1500	mg/kg
Nickel	7440-02-0	2	mg/kg			<2		----	3000	mg/kg
Selenium	7782-49-2	5	mg/kg			<5		----	10000	mg/kg
Zinc	7440-66-6	5	mg/kg			<5		----	35000	mg/kg
EG035T: Total Recoverable Mercury by FIMS										
Mercury	7439-97-6	0.1	mg/kg			<0.1		----	75	mg/kg

Total Concentration: Category D/Industrial Waste

Sub-Matrix: **SOIL**

				Sample ID		WR3-ALS		Table 2: Category D/Industrial Waste : Waste Disposal contamination concentrations		
				Laboratory sample ID		EB2428229004				
				Sampling date / time		07-Aug-2024 13:03				
Parameter	CAS Number	LOR	Unit			Result	MU	Low	High	Unit
ED092: DTPA Extractable Metals										
ø Copper	7440-50-8	1	mg/kg			<1		----	5000	mg/kg
ø Zinc	7440-66-6	1	mg/kg			<1		----	35000	mg/kg
EG005(ED093)T: Total Metals by ICP-AES										
Arsenic	7440-38-2	5	mg/kg			<5		----	500	mg/kg
Barium	7440-39-3	10	mg/kg			<10		----	6250	mg/kg
Beryllium	7440-41-7	1	mg/kg			<1		----	100	mg/kg
Boron	7440-42-8	50	mg/kg			<50		----	15000	mg/kg
Cadmium	7440-43-9	1	mg/kg			<1		----	100	mg/kg
Copper	7440-50-8	5	mg/kg			**10**		----	5000	mg/kg
Lead	7439-92-1	5	mg/kg			<5		----	1500	mg/kg
Nickel	7440-02-0	2	mg/kg			<2		----	3000	mg/kg
Selenium	7782-49-2	5	mg/kg			<5		----	10000	mg/kg
Zinc	7440-66-6	5	mg/kg			<5		----	35000	mg/kg
EG035T: Total Recoverable Mercury by FIMS										
Mercury	7439-97-6	0.1	mg/kg			<0.1		----	75	mg/kg

Analytical Results

Sub-Matrix: SOIL			Sample ID	WR3-ALS	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229004			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	8.1	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	9.5	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	45	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	1.0	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Gray (2.5YR 6/	----	----	----
Texture	----	-	-	Course Sand	----	----	----
Emerson Class Number	EC/TC	-	-	8	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	90	----	----	----
+150µm	----	1	%	80	----	----	----
+300µm	----	1	%	67	----	----	----
+425µm	----	1	%	60	----	----	----
+600µm	----	1	%	53	----	----	----
+1180µm	----	1	%	36	----	----	----
+2.36mm	----	1	%	18	----	----	----
+4.75mm	----	1	%	4	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	2	----	----	----
Silt (2-60 µm)	----	1	%	6	----	----	----
Sand (0.06-2.00 mm)	----	1	%	68	----	----	----
Gravel (>2mm)	----	1	%	24	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.66	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	1.1	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	1.1	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	138	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Iron	7439-89-6	1	mg/kg	16	----	----	----
ø Manganese	7439-96-5	1	mg/kg	3	----	----	----
EG005(ED093)T: Total Metals by ICP-AES							
Chromium	7440-47-3	2	mg/kg	3	----	----	----
Cobalt	7440-48-4	2	mg/kg	<2	----	----	----
Manganese	7439-96-5	5	mg/kg	30	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	WR3-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229004				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Vanadium	7440-62-2	5	mg/kg	<5		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	<20		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**74**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Extraction Fluid pH	----	0.1	pH Unit	**5.0**		----	----	----
Final pH	----	0.1	pH Unit	**5.1**		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	B1-ALS	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229005			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	6.6	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	7.1	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	16	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	2.9	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Red (2.5YR 5/6)	----	----	----
Texture	----	-	-	Sandy Clay Loam	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	63	----	----	----
+150µm	----	1	%	51	----	----	----
+300µm	----	1	%	41	----	----	----
+425µm	----	1	%	38	----	----	----
+600µm	----	1	%	36	----	----	----
+1180µm	----	1	%	34	----	----	----
+2.36mm	----	1	%	31	----	----	----
+4.75mm	----	1	%	23	----	----	----
+9.5mm	----	1	%	13	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	22	----	----	----
Silt (2-60 µm)	----	1	%	13	----	----	----
Sand (0.06-2.00 mm)	----	1	%	33	----	----	----
Gravel (>2mm)	----	1	%	32	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.60	----	----	----
ED007: Exchangeable Cations							
Exchangeable Calcium	----	0.1	meq/100g	20.3	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	6.9	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	0.8	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	0.6	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	28.6	----	----	----
Exchangeable Sodium Percent	----	0.1	%	2.1	----	----	----
Calcium/Magnesium Ratio	----	0.1	-	2.9	----	----	----
Magnesium/Potassium Ratio	----	0.1	-	8.2	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	387	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	<1	----	----	----
ø Iron	7439-89-6	1	mg/kg	10	----	----	----
ø Manganese	7439-96-5	1	mg/kg	3	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	B1-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229005				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**30**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**17**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**7**		----	----	----
Copper	7440-50-8	5	mg/kg	**6**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**112**		----	----	----
Nickel	7440-02-0	2	mg/kg	**8**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**41**		----	----	----
Zinc	7440-66-6	5	mg/kg	**6**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	**0.1**		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.7**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.8**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**590**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**590**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**180**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	**9**		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**1.1**		----	----	----
Total Organic Carbon	----	0.5	%	**0.6**		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	DC-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229006				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	**8.1**		----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**9.5**		----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**77**		----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**2.2**		----	----	----
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	**Reddish Brown (2.5YR**		----	----	----
Texture	----	-	-	**Sandy Loam**		----	----	----
Emerson Class Number	EC/TC	-	-	**3**		----	----	----
EA150: Particle Sizing								
+75µm	----	1	%	**68**		----	----	----
+150µm	----	1	%	**36**		----	----	----
+300µm	----	1	%	**13**		----	----	----
+425µm	----	1	%	**9**		----	----	----
+600µm	----	1	%	**8**		----	----	----
+1180µm	----	1	%	**6**		----	----	----
+2.36mm	----	1	%	**4**		----	----	----
+4.75mm	----	1	%	<1		----	----	----
+9.5mm	----	1	%	<1		----	----	----
+19.0mm	----	1	%	<1		----	----	----
+37.5mm	----	1	%	<1		----	----	----
+75.0mm	----	1	%	<1		----	----	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	**9**		----	----	----
Silt (2-60 µm)	----	1	%	**22**		----	----	----
Sand (0.06-2.00 mm)	----	1	%	**65**		----	----	----
Gravel (>2mm)	----	1	%	**4**		----	----	----
Cobbles (>6cm)	----	1	%	<1		----	----	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	**2.68**		----	----	----
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	**1.0**		----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	**0.9**		----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2		----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2		----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	**1.9**		----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2		----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	**1.2**		----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)								
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	**221**		----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10		----	----	----
ED092: DTPA Extractable Metals								
ø Copper	7440-50-8	1	mg/kg	**5**		----	----	----
ø Iron	7439-89-6	1	mg/kg	**9**		----	----	----
ø Manganese	7439-96-5	1	mg/kg	**3**		----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1		----	----	----
EG005(ED093)T: Total Metals by ICP-AES								

Analytical Results

Sub-Matrix: SOIL			Sample ID	DC-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229006				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**20**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**7**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**11**		----	----	----
Copper	7440-50-8	5	mg/kg	**34**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**62**		----	----	----
Nickel	7440-02-0	2	mg/kg	**7**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**12**		----	----	----
Zinc	7440-66-6	5	mg/kg	**5**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**40**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**40**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**348**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	DC2-ALS	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229007			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	8.2	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	9.6	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	374	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	5.6	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Medium Heavy Clay	----	----	----
Emerson Class Number	EC/TC	-	-	2	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	53	----	----	----
+150µm	----	1	%	46	----	----	----
+300µm	----	1	%	36	----	----	----
+425µm	----	1	%	32	----	----	----
+600µm	----	1	%	28	----	----	----
+1180µm	----	1	%	22	----	----	----
+2.36mm	----	1	%	14	----	----	----
+4.75mm	----	1	%	5	----	----	----
+9.5mm	----	1	%	3	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	31	----	----	----
Silt (2-60 µm)	----	1	%	14	----	----	----
Sand (0.06-2.00 mm)	----	1	%	39	----	----	----
Gravel (>2mm)	----	1	%	16	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.64	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	3.1	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	3.7	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	2.1	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	9.2	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	23.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	0.8	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	16.0	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	557	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	70	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	56	----	----	----
ø Iron	7439-89-6	1	mg/kg	32	----	----	----
ø Manganese	7439-96-5	1	mg/kg	22	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	DC2-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229007				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**180**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**9**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**10**		----	----	----
Copper	7440-50-8	5	mg/kg	**79**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**112**		----	----	----
Nickel	7440-02-0	2	mg/kg	**10**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**21**		----	----	----
Zinc	7440-66-6	5	mg/kg	**9**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	**0.1**		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**4.1**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**4.2**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**100**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**100**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**400**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	TS1-ALS	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229008			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.9	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.7	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	205	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	5.1	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Medium Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	52	----	----	----
+150µm	----	1	%	36	----	----	----
+300µm	----	1	%	26	----	----	----
+425µm	----	1	%	22	----	----	----
+600µm	----	1	%	20	----	----	----
+1180µm	----	1	%	16	----	----	----
+2.36mm	----	1	%	11	----	----	----
+4.75mm	----	1	%	5	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	28	----	----	----
Silt (2-60 µm)	----	1	%	18	----	----	----
Sand (0.06-2.00 mm)	----	1	%	41	----	----	----
Gravel (>2mm)	----	1	%	13	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.65	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	4.3	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	1.8	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.3	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	6.4	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	2.4	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	6.1	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	528	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	70	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	4	----	----	----
ø Iron	7439-89-6	1	mg/kg	12	----	----	----
ø Manganese	7439-96-5	1	mg/kg	4	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	TS1-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229008				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**30**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**8**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**6**		----	----	----
Copper	7440-50-8	5	mg/kg	**19**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**64**		----	----	----
Nickel	7440-02-0	2	mg/kg	**6**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**16**		----	----	----
Zinc	7440-66-6	5	mg/kg	<5		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**3.2**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**3.2**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**590**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**590**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**332**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**0.7**		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	TS2-ALS	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229009			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.8	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.7	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	98	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	2.6	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Light Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	50	----	----	----
+150µm	----	1	%	29	----	----	----
+300µm	----	1	%	17	----	----	----
+425µm	----	1	%	13	----	----	----
+600µm	----	1	%	10	----	----	----
+1180µm	----	1	%	6	----	----	----
+2.36mm	----	1	%	3	----	----	----
+4.75mm	----	1	%	<1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	29	----	----	----
Silt (2-60 µm)	----	1	%	18	----	----	----
Sand (0.06-2.00 mm)	----	1	%	49	----	----	----
Gravel (>2mm)	----	1	%	4	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.67	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	5.0	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	2.6	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.3	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	7.9	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	1.9	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	8.2	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	391	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	20	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	2	----	----	----
ø Iron	7439-89-6	1	mg/kg	10	----	----	----
ø Manganese	7439-96-5	1	mg/kg	3	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	TS2-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229009				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**100**		----	----	----
Beryllium	7440-41-7	1	mg/kg	**1**		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**26**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**13**		----	----	----
Copper	7440-50-8	5	mg/kg	**34**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**197**		----	----	----
Nickel	7440-02-0	2	mg/kg	**16**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**68**		----	----	----
Zinc	7440-66-6	5	mg/kg	**10**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	**0.1**		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**1.9**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**2.0**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**380**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**380**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**337**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**0.7**		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A1-1	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229010			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.8	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.6	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	70	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	3.4	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Yellowish Red (5YR 5/6	----	----	----
Texture	----	-	-	Sandy Loam	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	67	----	----	----
+150µm	----	1	%	52	----	----	----
+300µm	----	1	%	36	----	----	----
+425µm	----	1	%	29	----	----	----
+600µm	----	1	%	25	----	----	----
+1180µm	----	1	%	19	----	----	----
+2.36mm	----	1	%	11	----	----	----
+4.75mm	----	1	%	4	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	19	----	----	----
Silt (2-60 µm)	----	1	%	12	----	----	----
Sand (0.06-2.00 mm)	----	1	%	56	----	----	----
Gravel (>2mm)	----	1	%	13	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.64	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	10.0	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	0.5	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	10.7	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	19.9	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	377	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	<1	----	----	----
ø Iron	7439-89-6	1	mg/kg	4	----	----	----
ø Manganese	7439-96-5	1	mg/kg	2	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----
EG005(ED093)T: Total Metals by ICP-AES							

Analytical Results

Sub-Matrix: SOIL			Sample ID	A1-1		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229010				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**120**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**26**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**14**		----	----	----
Copper	7440-50-8	5	mg/kg	**7**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**195**		----	----	----
Nickel	7440-02-0	2	mg/kg	**20**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**68**		----	----	----
Zinc	7440-66-6	5	mg/kg	**11**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.5**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.5**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**190**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**190**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**4330**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**0.6**		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A1-2	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229011			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.4	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.7	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	25	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	1.1	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Pink (7.5YR 7/4)	----	----	----
Texture	----	-	-	Clayey Sand	----	----	----
Emerson Class Number	EC/TC	-	-	5	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	80	----	----	----
+150µm	----	1	%	65	----	----	----
+300µm	----	1	%	52	----	----	----
+425µm	----	1	%	46	----	----	----
+600µm	----	1	%	41	----	----	----
+1180µm	----	1	%	31	----	----	----
+2.36mm	----	1	%	19	----	----	----
+4.75mm	----	1	%	10	----	----	----
+9.5mm	----	1	%	4	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	9	----	----	----
Silt (2-60 µm)	----	1	%	9	----	----	----
Sand (0.06-2.00 mm)	----	1	%	60	----	----	----
Gravel (>2mm)	----	1	%	22	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.61	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	3.3	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	3.3	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	101	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	<1	----	----	----
ø Iron	7439-89-6	1	mg/kg	2	----	----	----
ø Manganese	7439-96-5	1	mg/kg	<1	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----
EG005(ED093)T: Total Metals by ICP-AES							
Arsenic	7440-38-2	5	mg/kg	<5	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A1-2		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229011				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Barium	7440-39-3	10	mg/kg	**10**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	<2		----	----	----
Cobalt	7440-48-4	2	mg/kg	<2		----	----	----
Copper	7440-50-8	5	mg/kg	<5		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**51**		----	----	----
Nickel	7440-02-0	2	mg/kg	<2		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**6**		----	----	----
Zinc	7440-66-6	5	mg/kg	<5		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**40**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**40**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**198**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A2-1	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229012			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	6.0	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	7.1	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	42	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	<1.0	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Sandy Loam	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	67	----	----	----
+150µm	----	1	%	54	----	----	----
+300µm	----	1	%	40	----	----	----
+425µm	----	1	%	34	----	----	----
+600µm	----	1	%	30	----	----	----
+1180µm	----	1	%	25	----	----	----
+2.36mm	----	1	%	20	----	----	----
+4.75mm	----	1	%	6	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	19	----	----	----
Silt (2-60 µm)	----	1	%	12	----	----	----
Sand (0.06-2.00 mm)	----	1	%	47	----	----	----
Gravel (>2mm)	----	1	%	22	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.57	----	----	----
ED007: Exchangeable Cations							
Exchangeable Calcium	----	0.1	meq/100g	11.8	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	4.2	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	0.4	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	0.7	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	17.2	----	----	----
Exchangeable Sodium Percent	----	0.1	%	4.0	----	----	----
Calcium/Magnesium Ratio	----	0.1	-	2.8	----	----	----
Magnesium/Potassium Ratio	----	0.1	-	10.3	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	424	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	<1	----	----	----
ø Iron	7439-89-6	1	mg/kg	13	----	----	----
ø Manganese	7439-96-5	1	mg/kg	7	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A2-1		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229012				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**10**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**5**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**2**		----	----	----
Copper	7440-50-8	5	mg/kg	<5		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**54**		----	----	----
Nickel	7440-02-0	2	mg/kg	**2**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**13**		----	----	----
Zinc	7440-66-6	5	mg/kg	<5		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	**0.3**		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**1.4**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**1.7**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**480**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**480**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**155**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	**10**		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**1.8**		----	----	----
Total Organic Carbon	----	0.5	%	**1.0**		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A2-2	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229013			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	6.4	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	7.5	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	12	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	5.8	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Red (2.5YR 4/6)	----	----	----
Texture	----	-	-	Light Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	49	----	----	----
+150µm	----	1	%	39	----	----	----
+300µm	----	1	%	28	----	----	----
+425µm	----	1	%	22	----	----	----
+600µm	----	1	%	18	----	----	----
+1180µm	----	1	%	12	----	----	----
+2.36mm	----	1	%	7	----	----	----
+4.75mm	----	1	%	<1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	42	----	----	----
Silt (2-60 µm)	----	1	%	7	----	----	----
Sand (0.06-2.00 mm)	----	1	%	42	----	----	----
Gravel (>2mm)	----	1	%	9	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.64	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	4.2	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	1.4	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.3	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	5.9	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	3.1	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	4.7	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	334	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	<1	----	----	----
ø Iron	7439-89-6	1	mg/kg	7	----	----	----
ø Manganese	7439-96-5	1	mg/kg	2	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A2-2		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229013				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**20**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**12**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**4**		----	----	----
Copper	7440-50-8	5	mg/kg	<5		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**43**		----	----	----
Nickel	7440-02-0	2	mg/kg	**4**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**33**		----	----	----
Zinc	7440-66-6	5	mg/kg	<5		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.5**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.5**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**480**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**480**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**156**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**0.9**		----	----	----
Total Organic Carbon	----	0.5	%	**0.5**		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A2-3	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229014			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	6.6	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	7.6	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	8	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	2.6	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Red (2.5YR 5/6)	----	----	----
Texture	----	-	-	Sandy Loam	----	----	----
Emerson Class Number	EC/TC	-	-	7	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	79	----	----	----
+150µm	----	1	%	70	----	----	----
+300µm	----	1	%	55	----	----	----
+425µm	----	1	%	46	----	----	----
+600µm	----	1	%	34	----	----	----
+1180µm	----	1	%	19	----	----	----
+2.36mm	----	1	%	10	----	----	----
+4.75mm	----	1	%	2	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	14	----	----	----
Silt (2-60 µm)	----	1	%	7	----	----	----
Sand (0.06-2.00 mm)	----	1	%	66	----	----	----
Gravel (>2mm)	----	1	%	13	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.75	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	1.9	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	0.6	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	2.5	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	3.4	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	<100	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	<1	----	----	----
ø Iron	7439-89-6	1	mg/kg	4	----	----	----
ø Manganese	7439-96-5	1	mg/kg	<1	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----
EG005(ED093)T: Total Metals by ICP-AES							

Analytical Results

Sub-Matrix: SOIL			Sample ID	A2-3		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229014				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**30**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**16**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**8**		----	----	----
Copper	7440-50-8	5	mg/kg	**6**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**63**		----	----	----
Nickel	7440-02-0	2	mg/kg	**8**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**33**		----	----	----
Zinc	7440-66-6	5	mg/kg	<5		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.1**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.1**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**180**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**180**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**127**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A3-1	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229015			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.0	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	7.6	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	28	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	4.5	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Light Medium Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	33	----	----	----
+150µm	----	1	%	20	----	----	----
+300µm	----	1	%	11	----	----	----
+425µm	----	1	%	9	----	----	----
+600µm	----	1	%	8	----	----	----
+1180µm	----	1	%	6	----	----	----
+2.36mm	----	1	%	4	----	----	----
+4.75mm	----	1	%	2	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	43	----	----	----
Silt (2-60 µm)	----	1	%	22	----	----	----
Sand (0.06-2.00 mm)	----	1	%	31	----	----	----
Gravel (>2mm)	----	1	%	4	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.54	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	6.9	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	2.7	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.6	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	10.1	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	2.6	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	4.5	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	633	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	1	----	----	----
ø Iron	7439-89-6	1	mg/kg	8	----	----	----
ø Manganese	7439-96-5	1	mg/kg	4	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A3-1		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229015				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**80**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**17**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**7**		----	----	----
Copper	7440-50-8	5	mg/kg	**11**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**185**		----	----	----
Nickel	7440-02-0	2	mg/kg	**9**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**49**		----	----	----
Zinc	7440-66-6	5	mg/kg	**7**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	**0.2**		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.8**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**1.0**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**380**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**380**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**127**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**1.1**		----	----	----
Total Organic Carbon	----	0.5	%	**0.6**		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A3-2	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229016			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.8	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.7	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	78	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	9.3	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Medium Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	30	----	----	----
+150µm	----	1	%	20	----	----	----
+300µm	----	1	%	13	----	----	----
+425µm	----	1	%	11	----	----	----
+600µm	----	1	%	10	----	----	----
+1180µm	----	1	%	7	----	----	----
+2.36mm	----	1	%	3	----	----	----
+4.75mm	----	1	%	<1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	49	----	----	----
Silt (2-60 µm)	----	1	%	19	----	----	----
Sand (0.06-2.00 mm)	----	1	%	28	----	----	----
Gravel (>2mm)	----	1	%	4	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.59	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	7.5	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	2.6	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	10.3	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	2.9	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	250	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	1	----	----	----
ø Iron	7439-89-6	1	mg/kg	7	----	----	----
ø Manganese	7439-96-5	1	mg/kg	1	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----
EG005(ED093)T: Total Metals by ICP-AES							

Analytical Results

Sub-Matrix: SOIL			Sample ID	A3-2		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229016				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**40**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**8**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**4**		----	----	----
Copper	7440-50-8	5	mg/kg	<5		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**97**		----	----	----
Nickel	7440-02-0	2	mg/kg	**4**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**25**		----	----	----
Zinc	7440-66-6	5	mg/kg	<5		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.1**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.1**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**350**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**350**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**138**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**0.7**		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A3-3	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229017			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.8	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.7	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	83	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	5.1	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Medium Clay	----	----	----
Emerson Class Number	EC/TC	-	-	4	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	29	----	----	----
+150µm	----	1	%	18	----	----	----
+300µm	----	1	%	11	----	----	----
+425µm	----	1	%	9	----	----	----
+600µm	----	1	%	7	----	----	----
+1180µm	----	1	%	3	----	----	----
+2.36mm	----	1	%	2	----	----	----
+4.75mm	----	1	%	<1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	45	----	----	----
Silt (2-60 µm)	----	1	%	23	----	----	----
Sand (0.06-2.00 mm)	----	1	%	30	----	----	----
Gravel (>2mm)	----	1	%	2	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.57	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	10.6	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	3.4	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	14.2	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	3.1	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	14.5	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	232	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	1	----	----	----
ø Iron	7439-89-6	1	mg/kg	6	----	----	----
ø Manganese	7439-96-5	1	mg/kg	2	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A3-3		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229017				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**110**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**20**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**8**		----	----	----
Copper	7440-50-8	5	mg/kg	**12**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**193**		----	----	----
Nickel	7440-02-0	2	mg/kg	**10**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**58**		----	----	----
Zinc	7440-66-6	5	mg/kg	**7**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**320**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**320**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**136**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**0.9**		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A4-1	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229018			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.7	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.5	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	83	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	3.6	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Light Medium Clay	----	----	----
Emerson Class Number	EC/TC	-	-	7	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	27	----	----	----
+150µm	----	1	%	17	----	----	----
+300µm	----	1	%	11	----	----	----
+425µm	----	1	%	9	----	----	----
+600µm	----	1	%	8	----	----	----
+1180µm	----	1	%	5	----	----	----
+2.36mm	----	1	%	2	----	----	----
+4.75mm	----	1	%	<1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	48	----	----	----
Silt (2-60 µm)	----	1	%	22	----	----	----
Sand (0.06-2.00 mm)	----	1	%	27	----	----	----
Gravel (>2mm)	----	1	%	3	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.50	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	5.4	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	1.8	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.4	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	7.6	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	3.1	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	4.1	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	927	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	20	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	<1	----	----	----
ø Iron	7439-89-6	1	mg/kg	5	----	----	----
ø Manganese	7439-96-5	1	mg/kg	3	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A4-1		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229018				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**130**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**31**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**13**		----	----	----
Copper	7440-50-8	5	mg/kg	**20**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**194**		----	----	----
Nickel	7440-02-0	2	mg/kg	**16**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**76**		----	----	----
Zinc	7440-66-6	5	mg/kg	**11**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	**0.2**		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.3**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.5**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**550**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**550**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**251**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**1.4**		----	----	----
Total Organic Carbon	----	0.5	%	**0.8**		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A4-2	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229019			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.4	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.3	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	36	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	8.3	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Medium Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	40	----	----	----
+150µm	----	1	%	27	----	----	----
+300µm	----	1	%	15	----	----	----
+425µm	----	1	%	12	----	----	----
+600µm	----	1	%	9	----	----	----
+1180µm	----	1	%	5	----	----	----
+2.36mm	----	1	%	2	----	----	----
+4.75mm	----	1	%	<1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	44	----	----	----
Silt (2-60 µm)	----	1	%	14	----	----	----
Sand (0.06-2.00 mm)	----	1	%	39	----	----	----
Gravel (>2mm)	----	1	%	3	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.55	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	5.7	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	2.2	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.5	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	8.4	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	2.5	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	4.4	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	694	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	<1	----	----	----
ø Iron	7439-89-6	1	mg/kg	6	----	----	----
ø Manganese	7439-96-5	1	mg/kg	2	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A4-2		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229019				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**80**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**31**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**8**		----	----	----
Copper	7440-50-8	5	mg/kg	**10**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**150**		----	----	----
Nickel	7440-02-0	2	mg/kg	**12**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**74**		----	----	----
Zinc	7440-66-6	5	mg/kg	**6**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.2**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.2**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**450**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**450**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**289**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**0.8**		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A4-3	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229020			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.4	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.4	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	84	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	7.8	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Red (2.5YR 5/6)	----	----	----
Texture	----	-	-	Light Medium Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	40	----	----	----
+150µm	----	1	%	27	----	----	----
+300µm	----	1	%	16	----	----	----
+425µm	----	1	%	12	----	----	----
+600µm	----	1	%	9	----	----	----
+1180µm	----	1	%	5	----	----	----
+2.36mm	----	1	%	2	----	----	----
+4.75mm	----	1	%	1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	38	----	----	----
Silt (2-60 µm)	----	1	%	16	----	----	----
Sand (0.06-2.00 mm)	----	1	%	43	----	----	----
Gravel (>2mm)	----	1	%	3	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.60	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	6.0	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	2.3	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.4	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	8.7	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	2.6	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	5.8	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	555	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	<1	----	----	----
ø Iron	7439-89-6	1	mg/kg	5	----	----	----
ø Manganese	7439-96-5	1	mg/kg	2	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A4-3		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229020				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**60**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**23**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**6**		----	----	----
Copper	7440-50-8	5	mg/kg	**6**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**98**		----	----	----
Nickel	7440-02-0	2	mg/kg	**9**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**46**		----	----	----
Zinc	7440-66-6	5	mg/kg	<5		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.1**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.1**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**460**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**460**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**178**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**0.6**		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A5-1	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229021			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	6.5	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	7.3	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	53	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	3.0	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Light Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	41	----	----	----
+150µm	----	1	%	28	----	----	----
+300µm	----	1	%	17	----	----	----
+425µm	----	1	%	14	----	----	----
+600µm	----	1	%	12	----	----	----
+1180µm	----	1	%	8	----	----	----
+2.36mm	----	1	%	4	----	----	----
+4.75mm	----	1	%	1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	33	----	----	----
Silt (2-60 µm)	----	1	%	20	----	----	----
Sand (0.06-2.00 mm)	----	1	%	42	----	----	----
Gravel (>2mm)	----	1	%	5	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.44	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	3.0	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	2.0	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.4	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	5.4	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	1.5	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	5.0	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	840	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	20	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	1	----	----	----
ø Iron	7439-89-6	1	mg/kg	18	----	----	----
ø Manganese	7439-96-5	1	mg/kg	11	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A5-1		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229021				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**80**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**17**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**9**		----	----	----
Copper	7440-50-8	5	mg/kg	**11**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**268**		----	----	----
Nickel	7440-02-0	2	mg/kg	**9**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**49**		----	----	----
Zinc	7440-66-6	5	mg/kg	**9**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	**0.6**		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**4.0**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**4.6**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**860**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**860**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**249**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	**10**		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**2.0**		----	----	----
Total Organic Carbon	----	0.5	%	**1.1**		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A5-2	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229022			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	6.4	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	7.8	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	15	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	7.9	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Medium Heavy Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	39	----	----	----
+150µm	----	1	%	32	----	----	----
+300µm	----	1	%	24	----	----	----
+425µm	----	1	%	22	----	----	----
+600µm	----	1	%	20	----	----	----
+1180µm	----	1	%	16	----	----	----
+2.36mm	----	1	%	12	----	----	----
+4.75mm	----	1	%	6	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	38	----	----	----
Silt (2-60 µm)	----	1	%	18	----	----	----
Sand (0.06-2.00 mm)	----	1	%	31	----	----	----
Gravel (>2mm)	----	1	%	13	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.60	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	6.9	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	4.2	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	0.4	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	11.8	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	3.3	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	1.6	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	16.2	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	290	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	1	----	----	----
ø Iron	7439-89-6	1	mg/kg	20	----	----	----
ø Manganese	7439-96-5	1	mg/kg	10	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A5-2		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229022				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**90**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**20**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**9**		----	----	----
Copper	7440-50-8	5	mg/kg	**12**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**283**		----	----	----
Nickel	7440-02-0	2	mg/kg	**11**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**62**		----	----	----
Zinc	7440-66-6	5	mg/kg	**8**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.4**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.4**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**430**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**430**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**171**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**2.0**		----	----	----
Total Organic Carbon	----	0.5	%	**1.1**		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	A5-3	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229023			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.9	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	9.0	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	200	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	10.7	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Reddish Brown (2.5YR	----	----	----
Texture	----	-	-	Medium Heavy Clay	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	29	----	----	----
+150µm	----	1	%	22	----	----	----
+300µm	----	1	%	16	----	----	----
+425µm	----	1	%	14	----	----	----
+600µm	----	1	%	13	----	----	----
+1180µm	----	1	%	10	----	----	----
+2.36mm	----	1	%	6	----	----	----
+4.75mm	----	1	%	3	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	49	----	----	----
Silt (2-60 µm)	----	1	%	21	----	----	----
Sand (0.06-2.00 mm)	----	1	%	22	----	----	----
Gravel (>2mm)	----	1	%	8	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.60	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	9.2	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	7.1	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	2.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	18.7	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	11.7	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	1.3	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	166	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	90	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	1	----	----	----
ø Iron	7439-89-6	1	mg/kg	14	----	----	----
ø Manganese	7439-96-5	1	mg/kg	6	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----
EG005(ED093)T: Total Metals by ICP-AES							

Analytical Results

Sub-Matrix: SOIL			Sample ID	A5-3		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229023				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Arsenic	7440-38-2	5	mg/kg	<5		----	----	----
Barium	7440-39-3	10	mg/kg	**130**		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**16**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**9**		----	----	----
Copper	7440-50-8	5	mg/kg	**9**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**246**		----	----	----
Nickel	7440-02-0	2	mg/kg	**9**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**53**		----	----	----
Zinc	7440-66-6	5	mg/kg	**6**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**0.5**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.5**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**540**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**540**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**146**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	**1.2**		----	----	----
Total Organic Carbon	----	0.5	%	**0.7**		----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	T2	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229024			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA001: pH in soil using 0.01M CaCl extract							
pH (CaCl2)	----	0.1	pH Unit	7.9	----	----	----
EA002: pH 1:5 (Soils)							
pH Value	----	0.1	pH Unit	8.6	----	----	----
EA010: Conductivity (1:5)							
Electrical Conductivity @ 25°C	----	1	µS/cm	219	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Moisture Content	----	1.0	%	10.9	----	----	----
EA058: Emerson Aggregate Test							
Color (Munsell)	----	-	-	Weak Red (2.5YR 5/2)	----	----	----
Texture	----	-	-	Sandy Clay Loam	----	----	----
Emerson Class Number	EC/TC	-	-	3	----	----	----
EA150: Particle Sizing							
+75µm	----	1	%	49	----	----	----
+150µm	----	1	%	14	----	----	----
+300µm	----	1	%	<1	----	----	----
+425µm	----	1	%	<1	----	----	----
+600µm	----	1	%	<1	----	----	----
+1180µm	----	1	%	<1	----	----	----
+2.36mm	----	1	%	<1	----	----	----
+4.75mm	----	1	%	<1	----	----	----
+9.5mm	----	1	%	<1	----	----	----
+19.0mm	----	1	%	<1	----	----	----
+37.5mm	----	1	%	<1	----	----	----
+75.0mm	----	1	%	<1	----	----	----
EA150: Soil Classification based on Particle Size							
Clay (<2 µm)	----	1	%	11	----	----	----
Silt (2-60 µm)	----	1	%	35	----	----	----
Sand (0.06-2.00 mm)	----	1	%	54	----	----	----
Gravel (>2mm)	----	1	%	<1	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----
EA152: Soil Particle Density							
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.82	----	----	----
ED006: Exchangeable Cations on Alkaline Soils							
ø Exchangeable Calcium	----	0.2	meq/100g	0.9	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	0.9	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)							
Bicarbonate Extractable K (Colwell)	----	100	mg/kg	381	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	10	mg/kg	<10	----	----	----
ED092: DTPA Extractable Metals							
ø Copper	7440-50-8	1	mg/kg	11	----	----	----
ø Iron	7439-89-6	1	mg/kg	16	----	----	----
ø Manganese	7439-96-5	1	mg/kg	4	----	----	----
ø Zinc	7440-66-6	1	mg/kg	<1	----	----	----
EG005(ED093)T: Total Metals by ICP-AES							
Arsenic	7440-38-2	5	mg/kg	<5	----	----	----

Analytical Results

Sub-Matrix: SOIL			Sample ID	T2		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229024				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
Barium	7440-39-3	10	mg/kg	<10		----	----	----
Beryllium	7440-41-7	1	mg/kg	<1		----	----	----
Boron	7440-42-8	50	mg/kg	<50		----	----	----
Cadmium	7440-43-9	1	mg/kg	<1		----	----	----
Chromium	7440-47-3	2	mg/kg	**10**		----	----	----
Cobalt	7440-48-4	2	mg/kg	**9**		----	----	----
Copper	7440-50-8	5	mg/kg	**37**		----	----	----
Lead	7439-92-1	5	mg/kg	<5		----	----	----
Manganese	7439-96-5	5	mg/kg	**44**		----	----	----
Nickel	7440-02-0	2	mg/kg	**9**		----	----	----
Selenium	7782-49-2	5	mg/kg	<5		----	----	----
Vanadium	7440-62-2	5	mg/kg	**9**		----	----	----
Zinc	7440-66-6	5	mg/kg	**7**		----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1		----	----	----
EK055-P: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	**1.1**		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**1.1**		----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**50**		----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
Total Nitrogen as N	----	20	mg/kg	**50**		----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**425**		----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5		----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5		----	----	----
Total Organic Carbon	----	0.5	%	<0.5		----	----	----

Analytical Results

Sub-Matrix: ASLP LEACHATE			Sample ID	T1-ALS	Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229001			
			Sampling date / time	07-Aug-2024 13:03			
Parameter	CAS Number	LOR	----	Result MU	----	----	----
EA005P: pH by PC Titrator							
pH Value	----	0.01	pH Unit	**5.04**	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C							
Total Dissolved Solids @180°C	----	10	mg/L	**5990**	----	----	----
ED037P: Alkalinity by PC Titrator							
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**1440**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**1440**	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<10	----	----	----
ED045G: Chloride by Discrete Analyser							
Chloride	16887-00-6	1	mg/L	<10	----	----	----
ED093C: Leachable Major Cations							
Calcium	7440-70-2	1	mg/L	**93**	----	----	----
Magnesium	7439-95-4	1	mg/L	**11**	----	----	----
Potassium	7440-09-7	1	mg/L	**4**	----	----	----
EG005(ED093)C: Leachable Metals by ICPAES							
Aluminium	7429-90-5	0.1	mg/L	**0.7**	----	----	----
Arsenic	7440-38-2	0.1	mg/L	<0.1	----	----	----
Barium	7440-39-3	0.1	mg/L	**0.9**	----	----	----
Beryllium	7440-41-7	0.05	mg/L	<0.05	----	----	----
Boron	7440-42-8	0.1	mg/L	**0.2**	----	----	----
Cadmium	7440-43-9	0.05	mg/L	<0.05	----	----	----
Chromium	7440-47-3	0.1	mg/L	<0.1	----	----	----
Cobalt	7440-48-4	0.1	mg/L	<0.1	----	----	----
Copper	7440-50-8	0.1	mg/L	**0.2**	----	----	----
Iron	7439-89-6	0.1	mg/L	**0.4**	----	----	----
Lead	7439-92-1	0.1	mg/L	<0.1	----	----	----
Manganese	7439-96-5	0.1	mg/L	**0.5**	----	----	----
Nickel	7440-02-0	0.1	mg/L	<0.1	----	----	----
Selenium	7782-49-2	0.05	mg/L	<0.05	----	----	----
Strontium	7440-24-6	0.1	mg/L	**0.1**	----	----	----
Titanium	7440-32-6	0.1	mg/L	<0.1	----	----	----
Vanadium	7440-62-2	0.1	mg/L	<0.1	----	----	----
Zinc	7440-66-6	0.1	mg/L	**0.3**	----	----	----
EG035C: Leachable Mercury by FIMS							
Mercury	7439-97-6	0.0010	mg/L	<0.0010	----	----	----
EK040P: Fluoride by PC Titrator							
Fluoride	16984-48-8	0.1	mg/L	**0.2**	----	----	----
EK055G: Ammonia as N by Discrete Analyser							
Ammonia as N	7664-41-7	0.01	mg/L	**0.05**	----	----	----
EK057G: Nitrite as N by Discrete Analyser							
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser							
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser							
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	----	----	----

Analytical Results

Sub-Matrix: ASLP LEACHATE			Sample ID	TC1-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229002				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**5.65**		----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**7490**		----	----	----
ED037P: Alkalinity by PC Titrator								
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**2360**		----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**2360**		----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<10		----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<10		----	----	----
ED093C: Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	**133**		----	----	----
Magnesium	7439-95-4	1	mg/L	**14**		----	----	----
Potassium	7440-09-7	1	mg/L	**9**		----	----	----
EG005(ED093)C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	<0.1		----	----	----
Arsenic	7440-38-2	0.1	mg/L	<0.1		----	----	----
Barium	7440-39-3	0.1	mg/L	**1.1**		----	----	----
Beryllium	7440-41-7	0.05	mg/L	<0.05		----	----	----
Boron	7440-42-8	0.1	mg/L	**0.2**		----	----	----
Cadmium	7440-43-9	0.05	mg/L	<0.05		----	----	----
Chromium	7440-47-3	0.1	mg/L	<0.1		----	----	----
Cobalt	7440-48-4	0.1	mg/L	<0.1		----	----	----
Copper	7440-50-8	0.1	mg/L	<0.1		----	----	----
Iron	7439-89-6	0.1	mg/L	<0.1		----	----	----
Lead	7439-92-1	0.1	mg/L	<0.1		----	----	----
Manganese	7439-96-5	0.1	mg/L	**2.7**		----	----	----
Nickel	7440-02-0	0.1	mg/L	<0.1		----	----	----
Selenium	7782-49-2	0.05	mg/L	<0.05		----	----	----
Strontium	7440-24-6	0.1	mg/L	**0.4**		----	----	----
Titanium	7440-32-6	0.1	mg/L	<0.1		----	----	----
Vanadium	7440-62-2	0.1	mg/L	<0.1		----	----	----
Zinc	7440-66-6	0.1	mg/L	**0.3**		----	----	----
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	<0.0010		----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.3**		----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.06**		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.02**		----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	**0.06**		----	----	----

Analytical Results

Sub-Matrix: ASLP LEACHATE			Sample ID	WR1-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229003				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**6.42**		----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**7580**		----	----	----
ED009: Anions								
Iodide	20461-54-5	1.00	mg/L	<0.500		----	----	----
ED037P: Alkalinity by PC Titrator								
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**2880**		----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**2880**		----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**4**		----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<10		----	----	----
ED093C: Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	**568**		----	----	----
Magnesium	7439-95-4	1	mg/L	**74**		----	----	----
Potassium	7440-09-7	1	mg/L	**6**		----	----	----
EG005(ED093)C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	<0.1		----	----	----
Arsenic	7440-38-2	0.1	mg/L	<0.1		----	----	----
Barium	7440-39-3	0.1	mg/L	**4.5**		----	----	----
Beryllium	7440-41-7	0.05	mg/L	<0.05		----	----	----
Boron	7440-42-8	0.1	mg/L	<0.1		----	----	----
Cadmium	7440-43-9	0.05	mg/L	<0.05		----	----	----
Chromium	7440-47-3	0.1	mg/L	<0.1		----	----	----
Cobalt	7440-48-4	0.1	mg/L	<0.1		----	----	----
Copper	7440-50-8	0.1	mg/L	<0.1		----	----	----
Iron	7439-89-6	0.1	mg/L	<0.1		----	----	----
Lead	7439-92-1	0.1	mg/L	<0.1		----	----	----
Manganese	7439-96-5	0.1	mg/L	<0.1		----	----	----
Nickel	7440-02-0	0.1	mg/L	<0.1		----	----	----
Selenium	7782-49-2	0.05	mg/L	<0.05		----	----	----
Strontium	7440-24-6	0.1	mg/L	**1.1**		----	----	----
Titanium	7440-32-6	0.1	mg/L	<0.1		----	----	----
Vanadium	7440-62-2	0.1	mg/L	<0.1		----	----	----
Zinc	7440-66-6	0.1	mg/L	**0.2**		----	----	----
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	<0.0010		----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.4**		----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.01		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01		----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01		----	----	----

Analytical Results

Sub-Matrix: ASLP LEACHATE			Sample ID	WR3-ALS		Guideline comparison not requested for sample		
			Laboratory sample ID	EB2428229004				
			Sampling date / time	07-Aug-2024 13:03				
Parameter	CAS Number	LOR	----	Result	MU	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**5.06**		----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**5600**		----	----	----
ED009: Anions								
Iodide	20461-54-5	1.00	mg/L	<0.200		----	----	----
ED037P: Alkalinity by PC Titrator								
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**1460**		----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**1460**		----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<10		----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**10**		----	----	----
ED093C: Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	**91**		----	----	----
Magnesium	7439-95-4	1	mg/L	**8**		----	----	----
Potassium	7440-09-7	1	mg/L	**4**		----	----	----
EG005(ED093)C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**0.4**		----	----	----
Arsenic	7440-38-2	0.1	mg/L	<0.1		----	----	----
Barium	7440-39-3	0.1	mg/L	**0.6**		----	----	----
Beryllium	7440-41-7	0.05	mg/L	<0.05		----	----	----
Boron	7440-42-8	0.1	mg/L	**0.1**		----	----	----
Cadmium	7440-43-9	0.05	mg/L	<0.05		----	----	----
Chromium	7440-47-3	0.1	mg/L	<0.1		----	----	----
Cobalt	7440-48-4	0.1	mg/L	<0.1		----	----	----
Copper	7440-50-8	0.1	mg/L	<0.1		----	----	----
Iron	7439-89-6	0.1	mg/L	**0.2**		----	----	----
Lead	7439-92-1	0.1	mg/L	<0.1		----	----	----
Manganese	7439-96-5	0.1	mg/L	**0.5**		----	----	----
Nickel	7440-02-0	0.1	mg/L	<0.1		----	----	----
Selenium	7782-49-2	0.05	mg/L	<0.05		----	----	----
Strontium	7440-24-6	0.1	mg/L	<0.1		----	----	----
Titanium	7440-32-6	0.1	mg/L	<0.1		----	----	----
Vanadium	7440-62-2	0.1	mg/L	<0.1		----	----	----
Zinc	7440-66-6	0.1	mg/L	**0.3**		----	----	----
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	<0.0010		----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.1**		----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.01		----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01		----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01		----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	**0.02**		----	----	----

Key: CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
~ = Indicates an estimated value.
ø = ALS is not NATA accredited for these tests.

QUALITY CONTROL REPORT

Work Order	: **EB2428229**	Page	: 1 of 22
Client	: **The Trustee for Mine Earth Unit Trust**	Laboratory	: Environmental Division Brisbane
Contact	: Matt Braimbridge	Contact	: Customer Services EB
Address	: 1 BREAKFAST CREEK ROAD NEWSTEAD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: TCK-2405	Date Samples Received	: 07-Aug-2024
Order number	: ----	Date Analysis Commenced	: 20-Aug-2024
C-O-C number	: ----	Issue Date	: 28-Aug-2024
Sampler	: JEREMY DURBIN		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 24		
No. of samples analysed	: 24		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Inorganics, Stafford, QLD
Beatriz Llarinas	Senior Chemist - Inorganics	Brisbane Soil Preparation, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Soil Preparation, Stafford, QLD
Dave Gitsham	Metals Instrument Chemist	Brisbane Inorganics, Stafford, QLD
Layla Hafner	Acid Sulphate Soils - Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Vincent Muller	Chemist - Inorganics	Brisbane Inorganics, Stafford, QLD
Vincent Muller	Chemist - Inorganics	Brisbane Soil Preparation, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC
* = The final LOR has been raised due to dilution or other sample specific cause; adjusted LOR is shown in brackets. The duplicate ranges for Acceptable RPD% are applied to the final LOR where applicable.

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 5998897)									
EB2428229-001	T1-ALS	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	30	40	40.1	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	17	22	26.0	0% - 50%
		EG005T: Cobalt	7440-48-4	2	mg/kg	17	19	11.7	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	15	18	17.0	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	5	0.0	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	95	98	3.2	0% - 50%
		EG005T: Lead	7439-92-1	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	75	93	21.0	0% - 50%
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Vanadium	7440-62-2	5	mg/kg	18	27	36.6	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	11	14	25.0	No Limit
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.0	No Limit
EB2428229-011	A1-2	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	10	20	0.0	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	<2	<2	0.0	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	<2	<2	0.0	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	<2	<2	0.0	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.0	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 5998897) - continued									
EB2428229-011	A1-2	EG005T: Copper	7440-50-8	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	<5	7	33.6	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	51	71	33.9	0% - 50%
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Vanadium	7440-62-2	5	mg/kg	6	8	31.0	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.0	No Limit
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 5998900)									
EB2428324-003	Anonymous	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	30	40	47.2	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	7	8	0.0	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	4	5	0.0	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	8	10	23.6	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	9	8	0.0	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	16	14	14.6	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	11	21	64.9	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	245	# 438	56.5	0% - 20%
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Vanadium	7440-62-2	5	mg/kg	6	8	29.1	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	46	67	38.7	0% - 50%
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.0	No Limit
EB2428229-021	A5-1	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	80	80	0.0	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	17	17	0.0	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	9	9	0.0	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	9	10	0.0	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	11	11	0.0	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	268	274	2.1	0% - 20%
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Vanadium	7440-62-2	5	mg/kg	49	49	0.0	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	9	9	0.0	No Limit
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.0	No Limit
EK055-P: Ammonia as N (QC Lot: 5999538)									

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EK055-P: Ammonia as N (QC Lot: 5999538) - continued									
EB2428229-001	T1-ALS	EK055-P: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.0	No Limit
EB2428229-011	A1-2	EK055-P: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.0	No Limit
EK055-P: Ammonia as N (QC Lot: 5999539)									
EB2428146-001	Anonymous	EK055-P: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.0	No Limit
EA001: pH in soil using 0.01M CaCl extract (QC Lot: 5999520)									
EB2428185-001	Anonymous	EA001: pH (CaCl2)	----	0.1	pH Unit	6.7	6.8	2.1	0% - 20%
EB2428229-009	TS2-ALS	EA001: pH (CaCl2)	----	0.1	pH Unit	7.8	7.8	0.0	0% - 20%
EA001: pH in soil using 0.01M CaCl extract (QC Lot: 5999521)									
EB2428229-020	A4-3	EA001: pH (CaCl2)	----	0.1	pH Unit	7.4	7.6	2.4	0% - 20%
EA002: pH 1:5 (Soils) (QC Lot: 5998882)									
EB2428229-001	T1-ALS	EA002: pH Value	----	0.1	pH Unit	8.9	8.9	0.0	0% - 20%
EB2428229-011	A1-2	EA002: pH Value	----	0.1	pH Unit	8.7	8.7	0.0	0% - 20%
EA002: pH 1:5 (Soils) (QC Lot: 5998883)									
EB2428229-021	A5-1	EA002: pH Value	----	0.1	pH Unit	7.3	7.3	0.0	0% - 20%
EA010: Conductivity (1:5) (QC Lot: 5998881)									
EB2428229-001	T1-ALS	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	175	188	7.4	0% - 20%
EB2428229-011	A1-2	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	25	24	0.0	0% - 20%
EA010: Conductivity (1:5) (QC Lot: 5998886)									
EB2428229-021	A5-1	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	53	49	7.2	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 5998990)									
EB2422887-001	Anonymous	EA055: Moisture Content	----	0.1 (1.0)*	%	21.4	19.9	7.2	0% - 20%
EB2428229-007	DC2-ALS	EA055: Moisture Content	----	0.1 (1.0)*	%	5.6	6.0	7.1	No Limit
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 5998991)									
EB2428229-017	A3-3	EA055: Moisture Content	----	0.1 (1.0)*	%	5.1	4.8	6.1	No Limit
EB2428300-003	Anonymous	EA055: Moisture Content	----	0.1 (1.0)*	%	10.9	10.1	7.6	0% - 50%
ED006: Exchangeable Cations on Alkaline Soils (QC Lot: 6004098)									
EB2428159-009	Anonymous	ED006: Exchangeable Calcium	----	0.2	meq/100g	5.5	4.7	16.0	0% - 20%
		ED006: Exchangeable Magnesium	----	0.2	meq/100g	2.9	2.4	19.6	0% - 50%
		ED006: Exchangeable Potassium	----	0.2	meq/100g	0.6	0.4	27.7	No Limit
		ED006: Exchangeable Sodium	----	0.2	meq/100g	<0.2	<0.2	0.0	No Limit
		ED006: Cation Exchange Capacity	----	0.2	meq/100g	8.9	7.4	17.9	0% - 20%
EB2428229-006	DC-ALS	ED006: Exchangeable Calcium	----	0.2	meq/100g	1.0	1.8	52.9	No Limit
		ED006: Exchangeable Magnesium	----	0.2	meq/100g	0.9	1.5	51.9	No Limit
		ED006: Exchangeable Potassium	----	0.2	meq/100g	<0.2	<0.2	0.0	No Limit
		ED006: Exchangeable Sodium	----	0.2	meq/100g	<0.2	<0.2	0.0	No Limit
		ED006: Cation Exchange Capacity	----	0.2	meq/100g	1.9	# 3.2	52.5	0% - 50%

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
ED006: Exchangeable Cations on Alkaline Soils (QC Lot: 6004106)									
EB2428229-017	A3-3	ED006: Exchangeable Calcium	----	0.2	meq/100g	10.6	10.5	1.2	0% - 20%
		ED006: Exchangeable Magnesium	----	0.2	meq/100g	3.4	3.3	0.0	0% - 50%
		ED006: Exchangeable Potassium	----	0.2	meq/100g	0.2	0.2	0.0	No Limit
		ED006: Exchangeable Sodium	----	0.2	meq/100g	<0.2	<0.2	0.0	No Limit
		ED006: Cation Exchange Capacity	----	0.2	meq/100g	14.2	14.0	1.3	0% - 20%
ED007: Exchangeable Cations (QC Lot: 6004086)									
EB2428158-003	Anonymous	ED007: Exchangeable Calcium	----	0.1	meq/100g	1.8	1.7	9.6	0% - 50%
		ED007: Exchangeable Magnesium	----	0.1	meq/100g	0.9	0.9	0.0	No Limit
		ED007: Exchangeable Potassium	----	0.1	meq/100g	0.3	0.3	0.0	No Limit
		ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	0.0	No Limit
ED021: Bicarbonate Extractable Potassium (Colwell) (QC Lot: 6004113)									
EB2428229-001	T1-ALS	ED021: Bicarbonate Extractable K (Colwell)	----	100	mg/kg	163	170	3.9	No Limit
EB2428229-011	A1-2	ED021: Bicarbonate Extractable K (Colwell)	----	100	mg/kg	101	<100	0.0	No Limit
ED021: Bicarbonate Extractable Potassium (Colwell) (QC Lot: 6004120)									
EB2428229-023	A5-3	ED021: Bicarbonate Extractable K (Colwell)	----	100	mg/kg	166	149	11.2	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 5998880)									
EB2428229-001	T1-ALS	ED045G: Chloride	16887-00-6	10	mg/kg	20	30	0.0	No Limit
EB2428229-011	A1-2	ED045G: Chloride	16887-00-6	10	mg/kg	<10	<10	0.0	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 5998885)									
EB2428229-021	A5-1	ED045G: Chloride	16887-00-6	10	mg/kg	20	20	0.0	No Limit
ED092: DTPA Extractable Metals (QC Lot: 6004114)									
EB2428229-001	T1-ALS	ED092: Copper	7440-50-8	1	mg/kg	16	17	0.0	0% - 50%
		ED092: Iron	7439-89-6	1	mg/kg	19	20	0.0	0% - 50%
		ED092: Manganese	7439-96-5	1	mg/kg	4	4	0.0	No Limit
		ED092: Zinc	7440-66-6	1	mg/kg	<1	<1	0.0	No Limit
EB2428229-010	A1-1	ED092: Copper	7440-50-8	1	mg/kg	<1	<1	0.0	No Limit
		ED092: Iron	7439-89-6	1	mg/kg	4	4	0.0	No Limit
		ED092: Manganese	7439-96-5	1	mg/kg	2	2	0.0	No Limit
		ED092: Zinc	7440-66-6	1	mg/kg	<1	<1	0.0	No Limit
ED092: DTPA Extractable Metals (QC Lot: 6004121)									
EB2428159-007	Anonymous	ED092: Copper	7440-50-8	1	mg/kg	<1	<1	0.0	No Limit
		ED092: Iron	7439-89-6	1	mg/kg	11	10	0.0	0% - 50%
		ED092: Manganese	7439-96-5	1	mg/kg	9	10	0.0	No Limit
		ED092: Zinc	7440-66-6	1	mg/kg	<1	<1	0.0	No Limit
EB2428229-022	A5-2	ED092: Copper	7440-50-8	1	mg/kg	1	1	0.0	No Limit
		ED092: Iron	7439-89-6	1	mg/kg	20	22	11.0	0% - 20%
		ED092: Manganese	7439-96-5	1	mg/kg	10	11	14.4	0% - 50%

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
ED092: DTPA Extractable Metals (QC Lot: 6004121) - continued									
EB2428229-022	A5-2	ED092: Zinc	7440-66-6	1	mg/kg	<1	<1	0.0	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 5998898)									
EB2428229-001	T1-ALS	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EB2428229-011	A1-2	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 5998899)									
EB2428229-021	A5-1	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 5998878)									
EB2428229-001	T1-ALS	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EB2428229-011	A1-2	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 5998887)									
EB2428229-021	A5-1	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	0.6	0.8	22.1	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 5998879)									
EB2428229-001	T1-ALS	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EB2428229-011	A1-2	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 5998884)									
EB2428229-021	A5-1	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	4.6	5.4	14.7	0% - 20%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 6000533)									
EB2428229-001	T1-ALS	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	60	60	0.0	No Limit
EB2428229-011	A1-2	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	40	100	80.9	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 6000534)									
EB2428229-021	A5-1	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	860	890	3.4	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 6000532)									
EB2428229-001	T1-ALS	EK067G: Total Phosphorus as P	----	2	mg/kg	391	376	4.0	0% - 20%
EB2428229-011	A1-2	EK067G: Total Phosphorus as P	----	2	mg/kg	198	224	12.3	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 6000535)									
EB2428229-021	A5-1	EK067G: Total Phosphorus as P	----	2	mg/kg	249	241	3.2	0% - 20%
EK080: Bicarbonate Extractable Phosphorus (Colwell) (QC Lot: 6004112)									
EB2428229-001	T1-ALS	EK080: Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	<5	0.0	No Limit
EB2428229-011	A1-2	EK080: Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	<5	0.0	No Limit
EK080: Bicarbonate Extractable Phosphorus (Colwell) (QC Lot: 6004119)									
EB2428159-007	Anonymous	EK080: Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	<5	0.0	No Limit
EB2428229-023	A5-3	EK080: Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	<5	0.0	No Limit
EP004: Organic Matter (QC Lot: 5999526)									
EB2428159-007	Anonymous	EP004: Organic Matter	----	0.5	%	1.5	1.5	0.0	No Limit
		EP004: Total Organic Carbon	----	0.5	%	0.9	0.8	0.0	No Limit
EB2428229-002	TC1-ALS	EP004: Organic Matter	----	0.5	%	<0.5	<0.5	0.0	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EP004: Organic Matter (QC Lot: 5999526) - continued									
EB2428229-002	TC1-ALS	EP004: Total Organic Carbon	----	0.5	%	<0.5	<0.5	0.0	No Limit
EP004: Organic Matter (QC Lot: 5999531)									
EB2428229-013	A2-2	EP004: Organic Matter	----	0.5	%	0.9	0.9	0.0	No Limit
		EP004: Total Organic Carbon	----	0.5	%	0.5	0.5	0.0	No Limit
EB2428229-022	A5-2	EP004: Organic Matter	----	0.5	%	2.0	2.0	0.0	No Limit
		EP004: Total Organic Carbon	----	0.5	%	1.1	1.1	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
ED009: Anions (QC Lot: 6005965)									
EB2428179-001	Anonymous	ED009-X: Iodide	20461-54-5	0.01 (0.050)*	mg/L	2.03	2.13	4.8	0% - 20%
EB2428615-002	Anonymous	ED009-X: Iodide	20461-54-5	0.01 (0.500)*	mg/L	<0.500	<0.500	0.0	No Limit
EG005(ED093)C: Leachable Metals by ICPAES (QC Lot: 6007953)									
EB2428608-008	Anonymous	EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Aluminium	7429-90-5	0.1	mg/L	1.0	1.2	12.4	0% - 50%
		EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Barium	7440-39-3	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Boron	7440-42-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Iron	7439-89-6	0.1	mg/L	4.6	4.8	4.1	0% - 20%
		EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Manganese	7439-96-5	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Strontium	7440-24-6	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Titanium	7440-32-6	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Vanadium	7440-62-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Zinc	7440-66-6	0.1	mg/L	0.1	0.1	0.0	No Limit
EB2428229-003	WR1-ALS	EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Aluminium	7429-90-5	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Barium	7440-39-3	0.1	mg/L	4.5	4.4	0.0	0% - 20%
		EG005C: Boron	7440-42-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EG005(ED093)C: Leachable Metals by ICPAES (QC Lot: 6007953) - continued									
EB2428229-003	WR1-ALS	EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Iron	7439-89-6	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Manganese	7439-96-5	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Strontium	7440-24-6	0.1	mg/L	1.1	1.0	0.0	0% - 50%
		EG005C: Titanium	7440-32-6	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Vanadium	7440-62-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Zinc	7440-66-6	0.1	mg/L	0.2	0.2	0.0	No Limit
EG005(ED093)C: Leachable Metals by ICPAES (QC Lot: 6011331)									
EB2428590-007	Anonymous	EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Aluminium	7429-90-5	0.1	mg/L	0.5	0.5	0.0	No Limit
		EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Barium	7440-39-3	0.1	mg/L	3.8	3.9	0.0	0% - 20%
		EG005C: Boron	7440-42-8	0.1	mg/L	0.3	0.3	0.0	No Limit
		EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Iron	7439-89-6	0.1	mg/L	60.0	60.1	0.0	0% - 20%
		EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Manganese	7439-96-5	0.1	mg/L	1.0	1.0	0.0	No Limit
		EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Strontium	7440-24-6	0.1	mg/L	0.4	0.4	0.0	No Limit
		EG005C: Titanium	7440-32-6	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Vanadium	7440-62-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Zinc	7440-66-6	0.1	mg/L	31.2	31.1	0.0	0% - 20%
EB2428229-001	T1-ALS	EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Aluminium	7429-90-5	0.1	mg/L	0.7	0.7	0.0	No Limit
		EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Barium	7440-39-3	0.1	mg/L	0.9	0.9	0.0	No Limit
		EG005C: Boron	7440-42-8	0.1	mg/L	0.2	0.2	0.0	No Limit
		EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
EG005(ED093)C: Leachable Metals by ICPAES (QC Lot: 6011331) - continued									
EB2428229-001	T1-ALS	EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Copper	7440-50-8	0.1	mg/L	0.2	0.2	0.0	No Limit
		EG005C: Iron	7439-89-6	0.1	mg/L	0.4	0.4	0.0	No Limit
		EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Manganese	7439-96-5	0.1	mg/L	0.5	0.5	0.0	No Limit
		EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Strontium	7440-24-6	0.1	mg/L	0.1	0.1	0.0	No Limit
		EG005C: Titanium	7440-32-6	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Vanadium	7440-62-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Zinc	7440-66-6	0.1	mg/L	0.3	0.3	0.0	No Limit
EA005P: pH by PC Titrator (QC Lot: 6007979)									
EB2428463-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	8.57	8.60	0.3	0% - 20%
EB2428703-026	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	7.45	7.49	0.5	0% - 20%
EA005P: pH by PC Titrator (QC Lot: 6011537)									
EB2428029-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	6.29	6.24	0.8	0% - 20%
EB2428229-002	TC1-ALS	EA005-P: pH Value	----	0.01	pH Unit	5.65	5.64	0.2	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 6010662)									
EB2428343-001	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	3110	3150	1.1	0% - 20%
EB2428456-002	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	1180	1180	0.3	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 6012013)									
EB2428229-001	T1-ALS	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	5990	5930	1.0	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 6007982)									
EB2428463-001	Anonymous	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	48	48	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	59	58	0.0	0% - 20%
EB2428703-026	Anonymous	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	532	535	0.6	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	532	535	0.6	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 6011538)									
EB2428175-001	Anonymous	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	14	16	16.3	0% - 50%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	26	28	10.3	0% - 20%
EB2428229-002	TC1-ALS	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	2360	2360	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	2360	2360	0.0	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 6007601)									
EB2428655-009	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	31	31	0.0	0% - 20%
EB2427608-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	26	26	0.0	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 6011038)									
EB2428753-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	35	35	0.0	0% - 20%

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
				Laboratory Duplicate (DUP) Report					
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 6011038) - continued									
EB2428229-001	T1-ALS	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1 (10)*	mg/L	<10	<10	0.0	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 6006716)									
EB2428229-003	WR1-ALS	ED045G: Chloride	16887-00-6	1 (10)*	mg/L	<10	<10	0.0	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 6011037)									
EB2428844-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	14	13	0.0	0% - 50%
ED093C: Leachable Major Cations (QC Lot: 6007954)									
EB2428229-003	WR1-ALS	ED093C: Calcium	7440-70-2	1	mg/L	568	553	2.7	0% - 20%
		ED093C: Magnesium	7439-95-4	1	mg/L	74	71	4.0	0% - 20%
		ED093C: Potassium	7440-09-7	1	mg/L	6	5	0.0	No Limit
ED093C: Leachable Major Cations (QC Lot: 6011332)									
EB2428229-001	T1-ALS	ED093C: Calcium	7440-70-2	1	mg/L	93	92	1.6	0% - 20%
		ED093C: Magnesium	7439-95-4	1	mg/L	11	10	0.0	0% - 50%
		ED093C: Potassium	7440-09-7	1	mg/L	4	4	0.0	No Limit
EG035C: Leachable Mercury by FIMS (QC Lot: 6007974)									
EB2428229-003	WR1-ALS	EG035C: Mercury	7439-97-6	0.0001 (0.0010)*	mg/L	<0.0010	<0.0010	0.0	No Limit
EG035C: Leachable Mercury by FIMS (QC Lot: 6011334)									
EB2428229-001	T1-ALS	EG035C: Mercury	7439-97-6	0.0001 (0.0010)*	mg/L	<0.0010	<0.0010	0.0	No Limit
EB2428590-007	Anonymous	EG035C: Mercury	7439-97-6	0.0001 (0.0010)*	mg/L	<0.0010	<0.0010	0.0	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 6007983)									
EB2428463-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
EB2428703-026	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	1.9	1.9	0.0	0% - 50%
EK040P: Fluoride by PC Titrator (QC Lot: 6011539)									
EB2428175-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.3	0.3	0.0	No Limit
EB2428229-002	TC1-ALS	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.3	0.3	0.0	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 6010885)									
EB2427441-005	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EB2428229-002	TC1-ALS	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.06	0.05	0.0	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 6006715)									
EB2428229-003	WR1-ALS	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EB2428484-010	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 6011039)									
EB2428753-002	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	0.09	0.09	0.0	No Limit
EB2428229-001	T1-ALS	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 6007603)									
EB2428503-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 6011036)									
EB2428844-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5998897)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	65.7 mg/kg	95.7	84.0	123
EG005T: Barium	7440-39-3	10	mg/kg	<10	78.4 mg/kg	99.6	89.0	129
EG005T: Beryllium	7440-41-7	1	mg/kg	<1	----	----	----	----
EG005T: Boron	7440-42-8	50	mg/kg	<50	----	----	----	----
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	----	----	----	----
EG005T: Chromium	7440-47-3	2	mg/kg	<2	14.9 mg/kg	105	83.0	125
EG005T: Cobalt	7440-48-4	2	mg/kg	<2	7.78 mg/kg	104	82.0	118
EG005T: Copper	7440-50-8	5	mg/kg	<5	38 mg/kg	108	86.0	122
EG005T: Lead	7439-92-1	5	mg/kg	<5	46.8 mg/kg	102	84.0	119
EG005T: Manganese	7439-96-5	5	mg/kg	<5	449 mg/kg	98.4	84.0	113
EG005T: Nickel	7440-02-0	2	mg/kg	<2	12.4 mg/kg	103	81.5	118
EG005T: Selenium	7782-49-2	5	mg/kg	<5	----	----	----	----
EG005T: Vanadium	7440-62-2	5	mg/kg	<5	40.7 mg/kg	103	88.0	127
EG005T: Zinc	7440-66-6	5	mg/kg	<5	160 mg/kg	99.7	80.0	120
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5998900)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	65.7 mg/kg	93.5	84.0	123
EG005T: Barium	7440-39-3	10	mg/kg	<10	78.4 mg/kg	102	89.0	129
EG005T: Beryllium	7440-41-7	1	mg/kg	<1	----	----	----	----
EG005T: Boron	7440-42-8	50	mg/kg	<50	----	----	----	----
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	----	----	----	----
EG005T: Chromium	7440-47-3	2	mg/kg	<2	14.9 mg/kg	105	83.0	125
EG005T: Cobalt	7440-48-4	2	mg/kg	<2	7.78 mg/kg	105	82.0	118
EG005T: Copper	7440-50-8	5	mg/kg	<5	38 mg/kg	114	86.0	122
EG005T: Lead	7439-92-1	5	mg/kg	<5	46.8 mg/kg	98.8	84.0	119
EG005T: Manganese	7439-96-5	5	mg/kg	<5	449 mg/kg	98.0	84.0	113
EG005T: Nickel	7440-02-0	2	mg/kg	<2	12.4 mg/kg	103	81.5	118
EG005T: Selenium	7782-49-2	5	mg/kg	<5	----	----	----	----
EG005T: Vanadium	7440-62-2	5	mg/kg	<5	40.7 mg/kg	105	88.0	127
EG005T: Zinc	7440-66-6	5	mg/kg	<5	160 mg/kg	99.3	80.0	120
EK055-P: Ammonia as N (QCLot: 5999538)								

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EK055-P: Ammonia as N (QCLot: 5999538) - continued								
EK055-P: Ammonia as N	7664-41-7	20	mg/kg	<20	25 mg/kg	97.7	90.0	110
EK055-P: Ammonia as N (QCLot: 5999539)								
EK055-P: Ammonia as N	7664-41-7	20	mg/kg	<20	25 mg/kg	99.3	90.0	110
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel) (QCLot: 5999043)								
EN60a-G: Final pH	----	0.1	pH Unit	5.0	----	----	----	----
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel) (QCLot: 6007074)								
EN60a-G: Final pH	----	0.1	pH Unit	5.0	----	----	----	----
EA001: pH in soil using 0.01M CaCl extract (QCLot: 5999520)								
EA001: pH (CaCl2)	----	----	pH Unit	----	4 pH Unit	101	99.0	101
				----	7 pH Unit	99.8	99.0	101
EA001: pH in soil using 0.01M CaCl extract (QCLot: 5999521)								
EA001: pH (CaCl2)	----	----	pH Unit	----	4 pH Unit	101	99.0	101
				----	7 pH Unit	99.8	99.0	101
EA002: pH 1:5 (Soils) (QCLot: 5998882)								
EA002: pH Value	----	----	pH Unit	----	4 pH Unit	101	98.0	102
				----	7 pH Unit	100	98.0	102
EA002: pH 1:5 (Soils) (QCLot: 5998883)								
EA002: pH Value	----	----	pH Unit	----	4 pH Unit	101	98.0	102
				----	7 pH Unit	100	98.0	102
EA010: Conductivity (1:5) (QCLot: 5998881)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1412 µS/cm	98.5	95.0	105
EA010: Conductivity (1:5) (QCLot: 5998886)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1412 µS/cm	97.9	95.0	105
EA152: Soil Particle Density (QCLot: 5999070)								
EA152: Soil Particle Density (Clay/Silt/Sand)	----	----	g/cm3	----	2.68 g/cm3	97.4	80.0	120
EA152: Soil Particle Density (QCLot: 5999072)								
EA152: Soil Particle Density (Clay/Silt/Sand)	----	----	g/cm3	----	2.68 g/cm3	98.1	80.0	120
ED006: Exchangeable Cations on Alkaline Soils (QCLot: 6004098)								
ED006: Exchangeable Calcium	----	0.2	meq/100g	<0.2	8.583 meq/100g	94.5	70.0	130
ED006: Exchangeable Magnesium	----	0.2	meq/100g	<0.2	5.911 meq/100g	85.2	70.0	130
ED006: Exchangeable Potassium	----	0.2	meq/100g	<0.2	1.283 meq/100g	105	70.0	130
ED006: Exchangeable Sodium	----	0.2	meq/100g	<0.2	14.195 meq/100g	94.9	70.0	130
ED006: Cation Exchange Capacity	----	0.2	meq/100g	<0.2	29.972 meq/100g	93.3	70.0	130
ED006: Exchangeable Cations on Alkaline Soils (QCLot: 6004106)								

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
ED006: Exchangeable Cations on Alkaline Soils (QCLot: 6004106) - continued								
ED006: Exchangeable Calcium	----	0.2	meq/100g	<0.2	8.583 meq/100g	78.8	70.0	130
ED006: Exchangeable Magnesium	----	0.2	meq/100g	<0.2	5.911 meq/100g	79.2	70.0	130
ED006: Exchangeable Potassium	----	0.2	meq/100g	<0.2	1.283 meq/100g	71.6	70.0	130
ED006: Exchangeable Sodium	----	0.2	meq/100g	<0.2	14.195 meq/100g	71.3	70.0	130
ED006: Cation Exchange Capacity	----	0.2	meq/100g	<0.2	29.972 meq/100g	75.0	70.0	130
ED007: Exchangeable Cations (QCLot: 6004086)								
ED007: Exchangeable Calcium	----	0.1	meq/100g	<0.1	8.9 meq/100g	102	79.0	113
ED007: Exchangeable Magnesium	----	0.1	meq/100g	<0.1	9.52 meq/100g	95.0	85.0	115
ED007: Exchangeable Potassium	----	0.1	meq/100g	<0.1	1.49 meq/100g	95.6	70.0	122
ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.1	1.3726 meq/100g	94.0	76.0	112
ED007: Cation Exchange Capacity	----	0.1	meq/100g	<0.1	21.283 meq/100g	97.7	82.0	112
ED021: Bicarbonate Extractable Potassium (Colwell) (QCLot: 6004113)								
ED021: Bicarbonate Extractable K (Colwell)	----	100	mg/kg	<100	300.66 mg/kg	70.2	70.0	130
ED021: Bicarbonate Extractable Potassium (Colwell) (QCLot: 6004120)								
ED021: Bicarbonate Extractable K (Colwell)	----	100	mg/kg	<100	300.66 mg/kg	71.8	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 5998880)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	50 mg/kg	97.2	83.0	119
				<10	5000 mg/kg	108	83.0	119
ED045G: Chloride by Discrete Analyser (QCLot: 5998885)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	50 mg/kg	96.9	83.0	119
				<10	5000 mg/kg	107	83.0	119
ED092: DTPA Extractable Metals (QCLot: 6004114)								
ED092: Copper	7440-50-8	1	mg/kg	<1	0.62 mg/kg	110	84.0	122
ED092: Iron	7439-89-6	1	mg/kg	<1	19.75 mg/kg	128	70.0	130
ED092: Manganese	7439-96-5	1	mg/kg	<1	2.87 mg/kg	126	70.0	130
ED092: Zinc	7440-66-6	1	mg/kg	<1	3.71 mg/kg	105	79.0	122
ED092: DTPA Extractable Metals (QCLot: 6004121)								
ED092: Copper	7440-50-8	1	mg/kg	<1	0.62 mg/kg	104	84.0	122
ED092: Iron	7439-89-6	1	mg/kg	<1	20 mg/kg	124	70.0	130
ED092: Manganese	7439-96-5	1	mg/kg	<1	2.87 mg/kg	127	70.0	130
ED092: Zinc	7440-66-6	1	mg/kg	<1	3.72 mg/kg	96.7	79.0	122
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5998898)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	0.0922 mg/kg	89.5	70.0	125
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5998899)								

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5998899) - continued								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	0.0922 mg/kg	93.1	70.0	125
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5998878)								
EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	2.5 mg/kg	100	83.0	111
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5998887)								
EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	2.5 mg/kg	101	83.0	111
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 5998879)								
EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	2.5 mg/kg	99.4	83.2	111
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 5998884)								
EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	2.5 mg/kg	96.2	83.2	111
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 6000533)								
EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20	306 mg/kg	111	70.0	130
				<20	2180 mg/kg	87.6	72.0	128
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 6000534)								
EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20	306 mg/kg	99.7	70.0	130
				<20	2180 mg/kg	85.8	72.0	128
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 6000532)								
EK067G: Total Phosphorus as P	----	2	mg/kg	<2	142 mg/kg	112	70.0	130
				<2	1200 mg/kg	108	79.0	121
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 6000535)								
EK067G: Total Phosphorus as P	----	2	mg/kg	<2	142 mg/kg	104	70.0	130
				<2	1200 mg/kg	100	79.0	121
EK080: Bicarbonate Extractable Phosphorus (Colwell) (QCLot: 6004112)								
EK080: Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	100 mg/kg	105	90.0	110
				<5	20.7 mg/kg	87.0	70.0	130
				<5	155 mg/kg	93.5	80.0	120
EK080: Bicarbonate Extractable Phosphorus (Colwell) (QCLot: 6004119)								
EK080: Bicarbonate Ext. P (Colwell)	----	5	mg/kg	<5	100 mg/kg	94.2	90.0	110
				<5	20.7 mg/kg	86.0	70.0	130
				<5	155 mg/kg	97.6	80.0	120
EP004: Organic Matter (QCLot: 5999526)								
EP004: Organic Matter	----	0.5	%	<0.5	80 %	97.6	83.0	115
EP004: Total Organic Carbon	----	0.5	%	<0.5	46.4 %	97.6	85.0	115
EP004: Organic Matter (QCLot: 5999531)								
EP004: Organic Matter	----	0.5	%	<0.5	80 %	97.6	83.0	115

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EP004: Organic Matter (QCLot: 5999531) - continued								
EP004: Total Organic Carbon	----	0.5	%	<0.5	46.4 %	97.6	85.0	115

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
ED009: Anions (QCLot: 6005965)								
ED009-X: Iodide	20461-54-5	0.01	mg/L	<0.010	0.5 mg/L	104	80.0	113
EG005(ED093)C: Leachable Metals by ICPAES (QCLot: 6007953)								
EG005C: Aluminium	7429-90-5	0.1	mg/L	<0.1	0.5 mg/L	94.8	70.0	130
EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	0.1 mg/L	102	89.0	123
EG005C: Barium	7440-39-3	0.1	mg/L	<0.1	0.1 mg/L	91.3	90.0	120
EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	0.1 mg/L	92.3	70.0	130
EG005C: Boron	7440-42-8	0.1	mg/L	<0.1	0.5 mg/L	91.6	70.0	130
EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	0.1 mg/L	90.0	88.0	120
EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	0.1 mg/L	92.1	86.0	115
EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	0.1 mg/L	90.8	87.0	116
EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	0.1 mg/L	90.0	87.0	117
EG005C: Iron	7439-89-6	0.1	mg/L	<0.1	0.5 mg/L	93.8	70.0	130
EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	0.1 mg/L	86.7	85.0	117
EG005C: Manganese	7439-96-5	0.1	mg/L	<0.1	0.1 mg/L	90.8	83.0	117
EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	0.1 mg/L	92.7	90.0	116
EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	0.1 mg/L	94.6	70.0	130
EG005C: Strontium	7440-24-6	0.1	mg/L	<0.1	0.1 mg/L	70.0	70.0	130
EG005C: Titanium	7440-32-6	0.1	mg/L	<0.1	0.1 mg/L	90.0	70.0	130
EG005C: Vanadium	7440-62-2	0.1	mg/L	<0.1	0.1 mg/L	92.4	88.0	112
EG005C: Zinc	7440-66-6	0.1	mg/L	<0.1	0.1 mg/L	91.6	87.0	122
EG005(ED093)C: Leachable Metals by ICPAES (QCLot: 6011331)								
EG005C: Aluminium	7429-90-5	0.1	mg/L	<0.1	0.5 mg/L	101	70.0	130
EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	0.1 mg/L	104	89.0	123
EG005C: Barium	7440-39-3	0.1	mg/L	<0.1	0.1 mg/L	98.6	90.0	120
EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	0.1 mg/L	98.3	70.0	130
EG005C: Boron	7440-42-8	0.1	mg/L	<0.1	0.5 mg/L	99.0	70.0	130
EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	0.1 mg/L	96.1	88.0	120
EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	0.1 mg/L	96.9	86.0	115
EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	0.1 mg/L	97.5	87.0	116

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG005(ED093)C: Leachable Metals by ICPAES (QCLot: 6011331) - continued								
EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	0.1 mg/L	100	87.0	117
EG005C: Iron	7439-89-6	0.1	mg/L	<0.1	0.5 mg/L	99.8	70.0	130
EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	0.1 mg/L	92.4	85.0	117
EG005C: Manganese	7439-96-5	0.1	mg/L	<0.1	0.1 mg/L	95.7	83.0	117
EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	0.1 mg/L	94.7	90.0	116
EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	0.1 mg/L	92.4	70.0	130
EG005C: Strontium	7440-24-6	0.1	mg/L	<0.1	0.1 mg/L	70.8	70.0	130
EG005C: Titanium	7440-32-6	0.1	mg/L	<0.1	0.1 mg/L	99.5	70.0	130
EG005C: Vanadium	7440-62-2	0.1	mg/L	<0.1	0.1 mg/L	100	88.0	112
EG005C: Zinc	7440-66-6	0.1	mg/L	<0.1	0.1 mg/L	93.6	87.0	122
EA005P: pH by PC Titrator (QCLot: 6007979)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	100	98.0	102
				----	7 pH Unit	99.8	98.0	102
EA005P: pH by PC Titrator (QCLot: 6011537)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	99.8	98.0	102
				----	7 pH Unit	99.7	98.0	102
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 6010662)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	104	70.0	130
				<10	2000 mg/L	102	80.9	118
				<10	2320 mg/L	109	80.6	119
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 6012013)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	113	70.0	130
				<10	2000 mg/L	97.3	80.9	118
				<10	2320 mg/L	109	80.6	119
ED037P: Alkalinity by PC Titrator (QCLot: 6007982)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	50 mg/L	106	80.0	120
ED037P: Alkalinity by PC Titrator (QCLot: 6011538)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	104	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6007601)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	97.1	85.0	118
				<1	100 mg/L	97.1	85.0	118
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6011038)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	96.0	85.0	118
				<1	100 mg/L	96.1	85.0	118

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
ED045G: Chloride by Discrete Analyser (QCLot: 6006716)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	101	90.0	115
				<1	1000 mg/L	109	90.0	115
ED045G: Chloride by Discrete Analyser (QCLot: 6011037)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	98.2	90.0	115
				<1	1000 mg/L	108	90.0	115
ED093C: Leachable Major Cations (QCLot: 6007954)								
ED093C: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	110	70.0	130
ED093C: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	102	70.0	130
ED093C: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	104	70.0	130
ED093C: Leachable Major Cations (QCLot: 6011332)								
ED093C: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	103	70.0	130
ED093C: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	101	70.0	130
ED093C: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	98.4	70.0	130
EG035C: Leachable Mercury by FIMS (QCLot: 6007974)								
EG035C: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	94.6	84.0	117
EG035C: Leachable Mercury by FIMS (QCLot: 6011334)								
EG035C: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	105	84.0	117
EK040P: Fluoride by PC Titrator (QCLot: 6007983)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	10 mg/L	100	80.0	117
EK040P: Fluoride by PC Titrator (QCLot: 6011539)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	10 mg/L	92.5	80.0	117
EK055G: Ammonia as N by Discrete Analyser (QCLot: 6010885)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	96.8	83.5	114
EK057G: Nitrite as N by Discrete Analyser (QCLot: 6006715)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	100.0	90.0	110
EK057G: Nitrite as N by Discrete Analyser (QCLot: 6011039)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	101	90.0	110
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 6007603)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	103	81.7	117
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 6011036)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	106	81.7	117

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5998897)							
EB2428229-002	TC1-ALS	EG005T: Arsenic	7440-38-2	50 mg/kg	85.7	70.0	130
		EG005T: Cadmium	7440-43-9	50 mg/kg	85.3	70.0	130
		EG005T: Chromium	7440-47-3	50 mg/kg	86.6	70.0	130
		EG005T: Copper	7440-50-8	250 mg/kg	96.3	70.0	130
		EG005T: Lead	7439-92-1	250 mg/kg	84.3	70.0	130
		EG005T: Nickel	7440-02-0	50 mg/kg	87.3	70.0	130
		EG005T: Selenium	7782-49-2	50 mg/kg	85.8	70.0	130
		EG005T: Zinc	7440-66-6	250 mg/kg	82.9	70.0	130
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5998900)							
EB2428229-022	A5-2	EG005T: Arsenic	7440-38-2	50 mg/kg	77.6	70.0	130
		EG005T: Cadmium	7440-43-9	50 mg/kg	85.4	70.0	130
		EG005T: Chromium	7440-47-3	50 mg/kg	84.0	70.0	130
		EG005T: Copper	7440-50-8	250 mg/kg	93.6	70.0	130
		EG005T: Lead	7439-92-1	250 mg/kg	83.8	70.0	130
		EG005T: Nickel	7440-02-0	50 mg/kg	85.5	70.0	130
		EG005T: Selenium	7782-49-2	50 mg/kg	74.1	70.0	130
		EG005T: Zinc	7440-66-6	250 mg/kg	83.2	70.0	130
EK055-P: Ammonia as N (QCLot: 5999538)							
EB2428229-002	TC1-ALS	EK055-P: Ammonia as N	7664-41-7	100 mg/kg	87.1	70.0	130
EK055-P: Ammonia as N (QCLot: 5999539)							
EB2428146-002	Anonymous	EK055-P: Ammonia as N	7664-41-7	100 mg/kg	87.8	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5998898)							
EB2428229-002	TC1-ALS	EG035T: Mercury	7439-97-6	0.5 mg/kg	84.6	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5998899)							
EB2428229-022	A5-2	EG035T: Mercury	7439-97-6	0.5 mg/kg	79.6	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5998878)							
EB2428229-002	TC1-ALS	EK057G: Nitrite as N (Sol.)	14797-65-0	2.5 mg/kg	98.3	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5998887)							
EB2428229-022	A5-2	EK057G: Nitrite as N (Sol.)	14797-65-0	2.5 mg/kg	96.2	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 5998879)							
EB2428229-002	TC1-ALS	EK059G: Nitrite + Nitrate as N (Sol.)	----	2.5 mg/kg	82.8	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 5998884)							
EB2428229-022	A5-2	EK059G: Nitrite + Nitrate as N (Sol.)	----	2.5 mg/kg	101	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 6000533)							

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%) MS	Acceptable Limits (%) Low	High
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 6000533) - continued							
EB2428229-002	TC1-ALS	EK061G: Total Kjeldahl Nitrogen as N	----	500 mg/kg	96.8	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 6000534)							
EB2428229-022	A5-2	EK061G: Total Kjeldahl Nitrogen as N	----	500 mg/kg	89.5	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 6000532)							
EB2428229-002	TC1-ALS	EK067G: Total Phosphorus as P	----	100 mg/kg	# Not Determined	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 6000535)							
EB2428229-022	A5-2	EK067G: Total Phosphorus as P	----	100 mg/kg	98.0	70.0	130
EK080: Bicarbonate Extractable Phosphorus (Colwell) (QCLot: 6004112)							
EB2428229-002	TC1-ALS	EK080: Bicarbonate Ext. P (Colwell)	----	40 mg/kg	88.8	70.0	130
EK080: Bicarbonate Extractable Phosphorus (Colwell) (QCLot: 6004119)							
EB2428159-008	Anonymous	EK080: Bicarbonate Ext. P (Colwell)	----	40 mg/kg	96.2	70.0	130
EP004: Organic Matter (QCLot: 5999526)							
EB2428159-008	Anonymous	EP004: Organic Matter	----	1.6 %	95.6	70.0	130
		EP004: Total Organic Carbon	----	0.928 %	95.4	70.0	130
EP004: Organic Matter (QCLot: 5999531)							
EB2428229-014	A2-3	EP004: Organic Matter	----	1.84 %	82.6	70.0	130
		EP004: Total Organic Carbon	----	1.04 %	84.5	70.0	130

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%) MS	Acceptable Limits (%) Low	High
ED009: Anions (QCLot: 6005965)							
EB2428179-002	Anonymous	ED009-X: Iodide	20461-54-5	100 mg/L	108	70.0	130
EG005(ED093)C: Leachable Metals by ICPAES (QCLot: 6007953)							
EB2428229-004	WR3-ALS	EG005C: Arsenic	7440-38-2	1 mg/L	100	70.0	130
		EG005C: Barium	7440-39-3	1 mg/L	95.4	70.0	130
		EG005C: Beryllium	7440-41-7	1 mg/L	96.8	70.0	130
		EG005C: Cadmium	7440-43-9	0.25 mg/L	96.3	70.0	130
		EG005C: Chromium	7440-47-3	1 mg/L	94.9	70.0	130
		EG005C: Cobalt	7440-48-4	1 mg/L	92.6	70.0	130
		EG005C: Copper	7440-50-8	1 mg/L	97.2	70.0	130
		EG005C: Lead	7439-92-1	1 mg/L	99.1	70.0	130
		EG005C: Manganese	7439-96-5	1 mg/L	94.0	70.0	130
		EG005C: Nickel	7440-02-0	1 mg/L	94.5	70.0	130
		EG005C: Vanadium	7440-62-2	1 mg/L	96.7	70.0	130
		EG005C: Zinc	7440-66-6	1 mg/L	93.2	70.0	130

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%) MS	Acceptable Limits (%) Low	High
EG005(ED093)C: Leachable Metals by ICPAES (QCLot: 6011331)							
EB2428229-002	TC1-ALS	EG005C: Arsenic	7440-38-2	1 mg/L	105	70.0	130
		EG005C: Barium	7440-39-3	1 mg/L	103	70.0	130
		EG005C: Beryllium	7440-41-7	1 mg/L	90.2	70.0	130
		EG005C: Cadmium	7440-43-9	0.25 mg/L	88.5	70.0	130
		EG005C: Chromium	7440-47-3	1 mg/L	92.1	70.0	130
		EG005C: Cobalt	7440-48-4	1 mg/L	90.4	70.0	130
		EG005C: Copper	7440-50-8	1 mg/L	102	70.0	130
		EG005C: Lead	7439-92-1	1 mg/L	91.9	70.0	130
		EG005C: Manganese	7439-96-5	1 mg/L	94.8	70.0	130
		EG005C: Nickel	7440-02-0	1 mg/L	88.1	70.0	130
		EG005C: Vanadium	7440-62-2	1 mg/L	96.4	70.0	130
		EG005C: Zinc	7440-66-6	1 mg/L	82.7	70.0	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6007601)							
EB2427608-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	# Not Determined	70.0	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6011038)							
EB2428229-002	TC1-ALS	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	200 mg/L	128	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 6006716)							
EB2428229-004	WR3-ALS	ED045G: Chloride	16887-00-6	400 mg/L	115	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 6011037)							
EB2428229-002	TC1-ALS	ED045G: Chloride	16887-00-6	4000 mg/L	110	70.0	130
EG035C: Leachable Mercury by FIMS (QCLot: 6007974)							
EB2428229-004	WR3-ALS	EG035C: Mercury	7439-97-6	0.01 mg/L	87.0	70.0	130
EG035C: Leachable Mercury by FIMS (QCLot: 6011334)							
EB2428229-002	TC1-ALS	EG035C: Mercury	7439-97-6	0.01 mg/L	77.1	70.0	130
EK040P: Fluoride by PC Titrator (QCLot: 6007983)							
EB2428463-004	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	93.1	70.0	130
EK040P: Fluoride by PC Titrator (QCLot: 6011539)							
EB2428175-002	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	82.9	70.0	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 6010885)							
EB2428229-001	T1-ALS	EK055G: Ammonia as N	7664-41-7	0.5 mg/L	103	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 6006715)							
EB2428229-004	WR3-ALS	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	104	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 6011039)							
EB2428229-002	TC1-ALS	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	96.8	70.0	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 6007603)							
EB2428229-004	WR3-ALS	EK071G: Reactive Phosphorus as P	14265-44-2	0.5 mg/L	102	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 6011036)							
EB2428229-002	TC1-ALS	EK071G: Reactive Phosphorus as P	14265-44-2	0.5 mg/L	117	70.0	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2428229**	Page	: 1 of 24
Client	: **The Trustee for Mine Earth Unit Trust**	Laboratory	: Environmental Division Brisbane
Contact	: Matt Braimbridge	Telephone	: +61-7-3243 7222
Project	: TCK-2405	Date Samples Received	: 07-Aug-2024
Site	: ----	Issue Date	: 28-Aug-2024
Sampler	: JEREMY DURBIN	No. of samples received	: 24
Order number	: ----	No. of samples analysed	: 24

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Duplicate outliers exist - please see following pages for full details.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, where applicable to the methodology, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Duplicate (DUP) RPDs							
EG005(ED093)T: Total Metals by ICP-AES	EB2428324--003	Anonymous	**Manganese**	7439-96-5	56.5 %	0% - 20%	**RPD exceeds LOR based limits**
ED006: Exchangeable Cations on Alkaline Soils	EB2428229--006	DC-ALS	**Cation Exchange Capacity**	----	52.5 %	0% - 50%	**RPD exceeds LOR based limits**
Matrix Spike (MS) Recoveries							
EK067G: Total Phosphorus as P by Discrete Analyser	EB2428229--002	TC1-ALS	**Total Phosphorus as P**	----	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	EB2427608--002	Anonymous	**Sulfate as SO4 - Turbidimetric**	14808-79-8	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Outliers : Analysis Holding Time Compliance

Matrix: **SOIL**

Method		*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)		*Date extracted*	*Due for extraction*	***Days overdue***	*Date analysed*	*Due for analysis*	***Days overdue***
EA001: pH in soil using 0.01M CaCl extract							
Soil Glass Jar - Unpreserved							
T1-ALS,	TC1-ALS,	21-Aug-2024	14-Aug-2024	**7**	----	----	----
WR1-ALS,	WR3-ALS,						
B1-ALS,	DC-ALS,						
DC2-ALS,	TS1-ALS,						
TS2-ALS,	A1-1,						
A1-2,	A2-1,						
A2-2,	A2-3,						
A3-1,	A3-2,						
A3-3,	A4-1,						
A4-2,	A4-3,						
A5-1,	A5-2,						
A5-3,	T2						
EA002: pH 1:5 (Soils)							

Matrix: **SOIL**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EA002: pH 1:5 (Soils) - Analysis Holding Time Compliance							
Soil Glass Jar - Unpreserved							
T1-ALS,	TC1-ALS,	21-Aug-2024	14-Aug-2024	**7**	----	----	----
WR1-ALS,	WR3-ALS,						
B1-ALS,	DC-ALS,						
DC2-ALS,	TS1-ALS,						
TS2-ALS,	A1-1,						
A1-2,	A2-1,						
A2-2,	A2-3,						
A3-1,	A3-2,						
A3-3,	A4-1,						
A4-2,	A4-3,						
A5-1,	A5-2,						
A5-3,	T2						
EA010: Conductivity (1:5)							
Soil Glass Jar - Unpreserved							
T1-ALS,	TC1-ALS,	21-Aug-2024	14-Aug-2024	**7**	----	----	----
WR1-ALS,	WR3-ALS,						
B1-ALS,	DC-ALS,						
DC2-ALS,	TS1-ALS,						
TS2-ALS,	A1-1,						
A1-2,	A2-1,						
A2-2,	A2-3,						
A3-1,	A3-2,						
A3-3,	A4-1,						
A4-2,	A4-3,						
A5-1,	A5-2,						
A5-3,	T2						
EK057G: Nitrite as N by Discrete Analyser							

Matrix: **SOIL**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EK057G: Nitrite as N by Discrete Analyser - Analysis Holding Time Compliance							
Soil Glass Jar - Unpreserved							
T1-ALS,	TC1-ALS,	21-Aug-2024	14-Aug-2024	**7**	----	----	----
WR1-ALS,	WR3-ALS,						
B1-ALS,	DC-ALS,						
DC2-ALS,	TS1-ALS,						
TS2-ALS,	A1-1,						
A1-2,	A2-1,						
A2-2,	A2-3,						
A3-1,	A3-2,						
A3-3,	A4-1,						
A4-2,	A4-3,						
A5-1,	A5-2,						
A5-3,	T2						
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)							
Non-Volatile Leach: 7 day HT(e.g. Nitrite and Nitrate as N, Nitrate etc..)							
WR1-ALS,	WR3-ALS	20-Aug-2024	14-Aug-2024	**6**	----	----	----
Non-Volatile Leach: 7 day HT(e.g. Nitrite and Nitrate as N, Nitrate etc..)							
T1-ALS,	TC1-ALS	22-Aug-2024	14-Aug-2024	**8**	----	----	----

Matrix: **WATER**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural							
WR1-ALS,	WR3-ALS	----	----	----	23-Aug-2024	20-Aug-2024	**3**
Clear Plastic Bottle - Natural							
T1-ALS,	TC1-ALS	----	----	----	26-Aug-2024	22-Aug-2024	**4**

Outliers : Frequency of Quality Control Samples

Matrix: **SOIL**

Quality Control Sample Type / Analytical Methods	Method	Count: QC	Count: Regular	Rate (%): Actual	Rate (%): Expected	Quality Control Specification
Laboratory Duplicates (DUP)						
Soil Particle Density	EA152	0	24	0.00	10.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / *Container / Client Sample ID(s)*		*Sample Date*	*Extraction / Preparation*			*Analysis*		
			Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EA001: pH in soil using 0.01M CaCl extract								
Soil Glass Jar - Unpreserved (EA001)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**21-Aug-2024**	14-Aug-2024	×	**21-Aug-2024**	21-Aug-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EA002: pH 1:5 (Soils)								
Soil Glass Jar - Unpreserved (EA002)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**21-Aug-2024**	14-Aug-2024	×	**21-Aug-2024**	21-Aug-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA010: Conductivity (1:5)								
Soil Glass Jar - Unpreserved (EA010)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**21-Aug-2024**	14-Aug-2024	×	**21-Aug-2024**	18-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EA055: Moisture Content (Dried @ 105-110°C)								
Soil Glass Jar - Unpreserved (EA055)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**----**	----	----	**20-Aug-2024**	21-Aug-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EA058: Emerson Aggregate Test								
Soil Glass Jar - Unpreserved (EA058)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**----**	----	----	**21-Aug-2024**	03-Feb-2025	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA150: Particle Sizing								
Plastic Bag (EA150H)								
T1-ALS,	TC1-ALS,	07-Aug-2024	----	----	----	28-Aug-2024	03-Feb-2025	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EA150: Soil Classification based on Particle Size								
Plastic Bag (EA150H)								
T1-ALS,	TC1-ALS,	07-Aug-2024	----	----	----	28-Aug-2024	03-Feb-2025	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EA152: Soil Particle Density								
Plastic Bag (EA152)								
T1-ALS,	TC1-ALS,	07-Aug-2024	----	----	----	28-Aug-2024	03-Feb-2025	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED005: Exchange Acidity								
Soil Glass Jar - Unpreserved (ED005)								
B1-ALS,	A2-1	**07-Aug-2024**	**21-Aug-2024**	04-Sep-2024	✓	**22-Aug-2024**	04-Sep-2024	✓
Soil Glass Jar - Unpreserved (ED005)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**22-Aug-2024**	04-Sep-2024	✓	**22-Aug-2024**	04-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
DC-ALS,	DC2-ALS,							
TS1-ALS,	TS2-ALS,							
A1-1,	A1-2,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
ED006: Exchangeable Cations on Alkaline Soils								
Soil Glass Jar - Unpreserved (ED006)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**21-Aug-2024**	04-Sep-2024	✓	**23-Aug-2024**	04-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
DC-ALS,	DC2-ALS,							
TS1-ALS,	TS2-ALS,							
A1-1,	A1-2,							
A2-2,	A2-3,							
A3-1,	A3-2							
Soil Glass Jar - Unpreserved (ED006)								
A3-3,	A4-1,	**07-Aug-2024**	**21-Aug-2024**	04-Sep-2024	✓	**26-Aug-2024**	04-Sep-2024	✓
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
Soil Glass Jar - Unpreserved (ED006)								
B1-ALS,	A2-1	**07-Aug-2024**	**22-Aug-2024**	04-Sep-2024	✓	**22-Aug-2024**	04-Sep-2024	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED007: Exchangeable Cations								
Soil Glass Jar - Unpreserved (ED007)								
B1-ALS,	A2-1	**07-Aug-2024**	**21-Aug-2024**	04-Sep-2024	✓	**22-Aug-2024**	04-Sep-2024	✓
Soil Glass Jar - Unpreserved (ED007)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**22-Aug-2024**	04-Sep-2024	✓	**22-Aug-2024**	04-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
DC-ALS,	DC2-ALS,							
TS1-ALS,	TS2-ALS,							
A1-1,	A1-2,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
ED008: Exchangeable Cations								
Soil Glass Jar - Unpreserved (ED008)								
B1-ALS,	A2-1	**07-Aug-2024**	**21-Aug-2024**	04-Sep-2024	✓	**22-Aug-2024**	04-Sep-2024	✓
Soil Glass Jar - Unpreserved (ED008)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**22-Aug-2024**	04-Sep-2024	✓	**22-Aug-2024**	04-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
DC-ALS,	DC2-ALS,							
TS1-ALS,	TS2-ALS,							
A1-1,	A1-2,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED021: Bicarbonate Extractable Potassium (Colwell)							
Soil Glass Jar - Unpreserved (ED021) A5-1, A5-2, A5-3, T2	**07-Aug-2024**	**22-Aug-2024**	03-Feb-2025	✓	**23-Aug-2024**	03-Feb-2025	✓
Soil Glass Jar - Unpreserved (ED021) T1-ALS, TC1-ALS, WR1-ALS, WR3-ALS, B1-ALS, DC-ALS, DC2-ALS, TS1-ALS, TS2-ALS, A1-1, A1-2, A2-1, A2-2, A2-3, A3-1, A3-2, A3-3, A4-1, A4-2, A4-3	**07-Aug-2024**	**22-Aug-2024**	03-Feb-2025	✓	**27-Aug-2024**	03-Feb-2025	✓
ED045G: Chloride by Discrete Analyser							
Soil Glass Jar - Unpreserved (ED045G) T1-ALS, TC1-ALS, WR1-ALS, WR3-ALS, B1-ALS, DC-ALS, DC2-ALS, TS1-ALS, TS2-ALS, A1-1, A1-2, A2-1, A2-2, A2-3, A3-1, A3-2, A3-3, A4-1, A4-2, A4-3, A5-1, A5-2, A5-3, T2	**07-Aug-2024**	**21-Aug-2024**	04-Sep-2024	✓	**21-Aug-2024**	18-Sep-2024	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED092: DTPA Extractable Metals							
Soil Glass Jar - Unpreserved (ED092) A5-1, A5-2, A5-3, T2	**07-Aug-2024**	**22-Aug-2024**	03-Feb-2025	✓	**26-Aug-2024**	03-Feb-2025	✓
Soil Glass Jar - Unpreserved (ED092) T1-ALS, TC1-ALS, WR1-ALS, WR3-ALS, B1-ALS, DC-ALS, DC2-ALS, TS1-ALS, TS2-ALS, A1-1, A1-2, A2-1, A2-2, A2-3, A3-1, A3-2, A3-3, A4-1, A4-2, A4-3	**07-Aug-2024**	**23-Aug-2024**	03-Feb-2025	✓	**26-Aug-2024**	03-Feb-2025	✓
EG005(ED093)T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T) T1-ALS, TC1-ALS, WR1-ALS, WR3-ALS, B1-ALS, DC-ALS, DC2-ALS, TS1-ALS, TS2-ALS, A1-1, A1-2, A2-1, A2-2, A2-3, A3-1, A3-2, A3-3, A4-1, A4-2, A4-3, A5-1, A5-2, A5-3, T2	**07-Aug-2024**	**20-Aug-2024**	03-Feb-2025	✓	**20-Aug-2024**	03-Feb-2025	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG035T: Total Recoverable Mercury by FIMS								
Soil Glass Jar - Unpreserved (EG035T)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**20-Aug-2024**	04-Sep-2024	✓	**21-Aug-2024**	04-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EK055-P: Ammonia as N								
Soil Glass Jar - Unpreserved (EK055-P)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**----**	----	----	**20-Aug-2024**	04-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EK057G: Nitrite as N by Discrete Analyser								
Soil Glass Jar - Unpreserved (EK057G)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**21-Aug-2024**	14-Aug-2024	×	**21-Aug-2024**	23-Aug-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Soil Glass Jar - Unpreserved (EK059G)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**21-Aug-2024**	04-Sep-2024	✓	**21-Aug-2024**	23-Aug-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Soil Glass Jar - Unpreserved (EK061G)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**20-Aug-2024**	04-Sep-2024	✓	**22-Aug-2024**	17-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EK067G: Total Phosphorus as P by Discrete Analyser								
Soil Glass Jar - Unpreserved (EK067G)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**20-Aug-2024**	04-Sep-2024	✓	**22-Aug-2024**	17-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK080: Bicarbonate Extractable Phosphorus (Colwell)								
Soil Glass Jar - Unpreserved (EK080)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**22-Aug-2024**	03-Feb-2025	✓	**27-Aug-2024**	03-Feb-2025	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Non-Volatile Leach: 7 day HT(e.g. Nitrite and Nitrate as N, Nitrate etc..) (EN60a-G)								
WR1-ALS,	WR3-ALS	**07-Aug-2024**	**20-Aug-2024**	14-Aug-2024	×	**----**	----	----
Non-Volatile Leach: 7 day HT(e.g. Nitrite and Nitrate as N, Nitrate etc..) (EN60a-G)								
T1-ALS,	TC1-ALS	**07-Aug-2024**	**22-Aug-2024**	14-Aug-2024	×	**----**	----	----
EP004: Organic Matter								
Soil Glass Jar - Unpreserved (EP004)								
T1-ALS,	TC1-ALS,	**07-Aug-2024**	**26-Aug-2024**	04-Sep-2024	✓	**26-Aug-2024**	04-Sep-2024	✓
WR1-ALS,	WR3-ALS,							
B1-ALS,	DC-ALS,							
DC2-ALS,	TS1-ALS,							
TS2-ALS,	A1-1,							
A1-2,	A2-1,							
A2-2,	A2-3,							
A3-1,	A3-2,							
A3-3,	A4-1,							
A4-2,	A4-3,							
A5-1,	A5-2,							
A5-3,	T2							

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA005P: pH by PC Titrator								
Clear Plastic Bottle - Natural (EA005-P)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	**----**	**23-Aug-2024**	20-Aug-2024	×
Clear Plastic Bottle - Natural (EA005-P)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	**----**	**26-Aug-2024**	22-Aug-2024	×

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Clear Plastic Bottle - Natural (EA015H)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**24-Aug-2024**	27-Aug-2024	✓
Clear Plastic Bottle - Natural (EA015H)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	----	**26-Aug-2024**	29-Aug-2024	✓
ED009: Anions								
Clear Plastic Bottle - Natural (ED009-X)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**22-Aug-2024**	17-Sep-2024	✓
ED037P: Alkalinity by PC Titrator								
Clear Plastic Bottle - Natural (ED037-P)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**23-Aug-2024**	03-Sep-2024	✓
Clear Plastic Bottle - Natural (ED037-P)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	----	**26-Aug-2024**	05-Sep-2024	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Clear Plastic Bottle - Natural (ED041G)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**22-Aug-2024**	17-Sep-2024	✓
Clear Plastic Bottle - Natural (ED041G)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	----	**24-Aug-2024**	19-Sep-2024	✓
ED045G: Chloride by Discrete Analyser								
Clear Plastic Bottle - Natural (ED045G)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**22-Aug-2024**	17-Sep-2024	✓
Clear Plastic Bottle - Natural (ED045G)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	----	**24-Aug-2024**	19-Sep-2024	✓
ED093C: Leachable Major Cations								
Clear Plastic Bottle - Natural (ED093C)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**23-Aug-2024**	27-Aug-2024	✓	**24-Aug-2024**	27-Aug-2024	✓
Clear Plastic Bottle - Nitric Acid; Unfiltered (ED093C)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**26-Aug-2024**	19-Sep-2024	✓	**26-Aug-2024**	19-Sep-2024	✓
EG005(ED093)C: Leachable Metals by ICPAES								
Clear Plastic Bottle - Natural (EG005C)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**23-Aug-2024**	16-Feb-2025	✓	**23-Aug-2024**	16-Feb-2025	✓
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG005C)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**26-Aug-2024**	18-Feb-2025	✓	**26-Aug-2024**	18-Feb-2025	✓
EG035C: Leachable Mercury by FIMS								
Clear Plastic Bottle - Natural (EG035C)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**23-Aug-2024**	17-Sep-2024	✓
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035C)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	----	**26-Aug-2024**	19-Sep-2024	✓
EK040P: Fluoride by PC Titrator								
Clear Plastic Bottle - Natural (EK040P)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**23-Aug-2024**	17-Sep-2024	✓
Clear Plastic Bottle - Natural (EK040P)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	----	**26-Aug-2024**	19-Sep-2024	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK055G: Ammonia as N by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK055G)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**26-Aug-2024**	17-Sep-2024	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	----	**26-Aug-2024**	19-Sep-2024	✓
EK057G: Nitrite as N by Discrete Analyser								
Clear Plastic Bottle - Natural (EK057G)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**22-Aug-2024**	22-Aug-2024	✓
Clear Plastic Bottle - Natural (EK057G)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	----	**24-Aug-2024**	24-Aug-2024	✓
EK071G: Reactive Phosphorus as P by discrete analyser								
Clear Plastic Bottle - Natural (EK071G)								
WR1-ALS,	WR3-ALS	**20-Aug-2024**	**----**	----	----	**22-Aug-2024**	22-Aug-2024	✓
Clear Plastic Bottle - Natural (EK071G)								
T1-ALS,	TC1-ALS	**22-Aug-2024**	**----**	----	----	**24-Aug-2024**	24-Aug-2024	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Ammonia Using Steam Distillation and Titrimetric Finish	EK055-P	3	27	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Bicarbonate Extractable K (Colwell)	ED021	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Bicarbonate Extractable P (Colwell)	EK080	4	32	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
DTPA Extractable Metals	ED092	4	32	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations on Alkaline Soils	ED006	3	28	**10.71**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	4	32	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH (1:5)	EA002	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH in soil using a 0.01M CaCl2 extract	EA001	3	25	**12.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Soil Particle Density	EA152	0	24	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	3	29	**10.34**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	4	33	**12.12**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus By Discrete Analyser	EK067G	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Ammonia Using Steam Distillation and Titrimetric Finish	EK055-P	2	27	**7.41**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Bicarbonate Extractable K (Colwell)	ED021	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Bicarbonate Extractable P (Colwell)	EK080	6	32	**18.75**	**15.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	4	24	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
DTPA Extractable Metals	ED092	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations on Alkaline Soils	ED006	2	28	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH (1:5)	EA002	4	24	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH in soil using a 0.01M CaCl2 extract	EA001	4	25	**16.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Soil Particle Density	EA152	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Control Samples (LCS) - Continued							
TKN as N By Discrete Analyser	EK061G	4	24	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus By Discrete Analyser	EK067G	4	24	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia Using Steam Distillation and Titrimetric Finish	EK055-P	2	27	**7.41**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
ASLP for Non & Semivolatile Analytes - Glass Leaching Vessel	EN60a-G	2	4	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Bicarbonate Extractable K (Colwell)	ED021	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Bicarbonate Extractable P (Colwell)	EK080	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
DTPA Extractable Metals	ED092	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations on Alkaline Soils	ED006	2	28	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus By Discrete Analyser	EK067G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia Using Steam Distillation and Titrimetric Finish	EK055-P	2	27	**7.41**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Bicarbonate Extractable P (Colwell)	EK080	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus By Discrete Analyser	EK067G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by Auto Titrator	ED037-P	4	32	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP) - Continued							
Ammonia as N by Discrete analyser	EK055G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	4	25	**16.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Major Cations	ED093C	2	4	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	3	19	**15.79**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	4	33	**12.12**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	4	31	**12.90**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by Auto Titrator	EA005-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	2	4	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	4	29	**13.79**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	3	28	**10.71**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by Auto Titrator	ED037-P	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	4	13	**30.77**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	2	25	**8.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Major Cations	ED093C	2	4	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	2	19	**10.53**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	31	**6.45**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by Auto Titrator	EA005-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	13	**15.38**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	4	29	**13.79**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	6	28	**21.43**	**15.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	13	**15.38**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	2	25	**8.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Major Cations	ED093C	2	4	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	2	19	**10.53**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	31	**6.45**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	13	**15.38**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	28	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Matrix Spikes (MS) - Continued							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	13	**15.38**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	2	25	**8.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	2	19	**10.53**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	31	**6.45**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	13	**15.38**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH in soil using a 0.01M CaCl2 extract	EA001	SOIL	In house: Referenced to Rayment and Lyons 4B3 (mod.) or 4B4 (mod.) 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM Schedule B(3).
pH (1:5)	EA002	SOIL	In house: Referenced to Rayment and Lyons 4A1 and APHA 4500H+. pH is determined on soil samples after a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
pH by Auto Titrator	EA005-P	SOIL	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM Schedule B(3)
Electrical Conductivity (1:5)	EA010	SOIL	In house: Referenced to Rayment and Lyons 3A1 and APHA 2510. Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
Total Dissolved Solids (High Level)	EA015H	SOIL	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM Schedule B(3)
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM Schedule B(3).
Emerson Aggregate Test	EA058	SOIL	In house: Referenced to AS1289.3.8.1. Testing is performed only on soils with suitable aggregates; sands and gravels are usually unsuitable for this test. The test classifies the behaviour of soil aggregates, when immersed, on their coherence in water.
Particle Size Analysis by Hydrometer	EA150H	SOIL	Particle Size Analysis by Hydrometer according to AS1289.3.6.3
Soil Particle Density	EA152	SOIL	Soil Particle Density by AS 1289.3.5.1: Methods of testing soils for engineering purposes - Soil classification tests - Determination of the soil particle density of a soil - Standard method
Exchange Acidity by 1M Potassium Chloride	* ED005	SOIL	In house: referenced to Rayment and Lyons, method 15G1. This method is unsuitable for near neutral and alkaline soils. NATA accreditation does not cover performance of this service.
Exchangeable Cations on Alkaline Soils	* ED006	SOIL	In house: Referenced to Soil Survey Test Method C5. Soluble salts are removed from the sample prior to analysis. Cations are exchanged from the sample by contact with alcoholic ammonium chloride at pH 8.5. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil.
Exchangeable Cations	ED007	SOIL	In house: Referenced to Rayment & Lyons Method 15A1. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM Schedule B(3).
Exchangeable Cations with pre-treatment	ED008	SOIL	In house: Referenced to Rayment & Lyons Method 15A2. Soluble salts are removed from the sample prior to analysis. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM Schedule B(3).
Standard Anions -by IC (Extended Method)	ED009-X	SOIL	In house: Referenced to APHA 4110B. This method is compliant with NEPM Schedule B(3)
Bicarbonate Extractable K (Colwell)	ED021	SOIL	In house: Referenced to Rayment & Lyons Method 18A1 Potassium is extracted from the soil using 0.5M NaHCO3 at a 1:100 soil:solution ratio and determined by ICP.

Analytical Methods	Method	Matrix	Method Descriptions
Alkalinity by Auto Titrator	ED037-P	SOIL	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	SOIL	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	SOIL	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm.
DTPA Extractable Metals	* ED092	SOIL	In house: Referenced to Rayment and Lyons 12A1
Leachable Major Cations	ED093C	SOIL	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations in leachates are determined by either ICP-AES or ICP-MS techniques.
Leachable Metals by ICPAES	EG005C	SOIL	In house: referenced to APHA 3120; USEPA SW 846 - 6010: The ICPAES technique ionises leachate sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM Schedule B(3).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3)
Leachable Mercury by FIMS	EG035C	SOIL	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the TCLP solution. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl2) (Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3)
Fluoride by Auto Titrator	EK040P	SOIL	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	SOIL	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Ammonia Using Steam Distillation and Titrimetric Finish	EK055-P	SOIL	In house: Referenced to APHA 4500-NH3 B&G, H Samples are steam distilled prior to analysis and quantified using titration, FIA or Discrete Analyser.
Nitrite as N - Soluble by Discrete Analyser	EK057G	SOIL	In house: Referenced to APHA 4500-NO3- B. Nitrite in a water extract is determined by direct colourimetry by Discrete Analyser.

Analytical Methods	Method	Matrix	Method Descriptions
Nitrate as N - Soluble by Discrete Analyser	EK058G	SOIL	In house: Referenced to APHA 4500-NO3- F. Nitrate in the 1:5 soil:water extract is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results.
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	SOIL	In house: Thermo Scientific Method D08727 and NEMI (National Environmental Method Index) Method ID: 9171. This method covers the determination of total oxidised nitrogen (NOx-N) and nitrate (NO3-N) by calculation, Combined oxidised Nitrogen (NO2+NO3) in a water extract is determined by direct colourimetry by Discrete Analyser.
TKN as N By Discrete Analyser	EK061G	SOIL	In house: Referenced to APHA 4500-Norg-D Soil samples are digested using Kjeldahl digestion followed by determination by Discrete Analyser.
Total Nitrogen as N (TKN + NOx) By Discrete Analyser	EK062G	SOIL	In house: Referenced to APHA 4500 Norg/NO3- Total Nitrogen is determined as the sum of TKN and Oxidised Nitrrogen, each determined seperately as N.
Total Phosphorus By Discrete Analyser	EK067G	SOIL	In house: Referenced to APHA 4500 P-B&F This procedure involves sulfuric acid digestion and quantification using Discrete Analyser.
Reactive Phosphorus as P-By Discrete Analyser	EK071G	SOIL	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Bicarbonate Extractable P (Colwell)	EK080	SOIL	In house: Referenced to Rayment & Lyons Method 9B1 Phosphorus is extracted from the soil using 0.5M NaHCO3 at a 1:100 soil:solution ratio and determined by FIA.
Organic Matter	EP004	SOIL	In house: Referenced to AS1289.4.1.1. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
pH in soil using a 0.01M CaCl2 extract	EA001-PR	SOIL	In house: Referenced to Rayment and Lyons 4B1, 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM Schedule B(3).
Exchangeable Cations Preparation Method (Alkaline Soils)	* ED006PR	SOIL	In house: Referenced to Rayment and Lyons method 15C1.
Exchangeable Cations Preparation Method	ED007PR	SOIL	In house: Referenced to Rayment & Lyons method 15A1. A 1M NH4Cl extraction by end over end tumbling at a ratio of 1:20. There is no pretreatment for soluble salts. Extracts can be run by ICP for cations.
Bicarbonate Extractable K (Colwell)	ED021PR	SOIL	In house: Referenced to Rayment & Lyons Method 18A1 Potassium is extracted from the soil using 0.5M NaHCO3 at a 1:100 soil:solution ratio and determined by ICP.
DTPA Extraction for Cu, Zn, Mn, Fe (2 hour leach)	ED092PR	SOIL	In house: Referenced to Rayment & Lyons Method 12A1 2 hour end over end tumbler extraction with 0.005M DTPA at a ratio of 1:2. Extracts can be run by ICP for metals.
TKN/TP Digestion	EK061/EK067	SOIL	In house: Referenced to APHA 4500 Norg- D; APHA 4500 P - H. Macro Kjeldahl digestion.
Sample Preparation for Bicarbonate Extractable P (Colwell)	EK080-PR	SOIL	In house: Referenced to Rayment & Lyons Method 9B1 Phosphorus is extracted from the soil using 0.5M NaHCO3 at a 1:100 soil:solution ratio.
Digestion for Total Recoverable Metals in TCLP Leachate	EN25C	SOIL	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
ASLP for Non & Semivolatile Analytes - Glass Leaching Vessel	EN60a-G	SOIL	In house QWI-EN/60 referenced to AS4439.3 Preparation of Leachates
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM Schedule B(3).
Organic Matter	EP004-PR	SOIL	In house: Referenced to AS1289.4.1.1. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM Schedule B(3).

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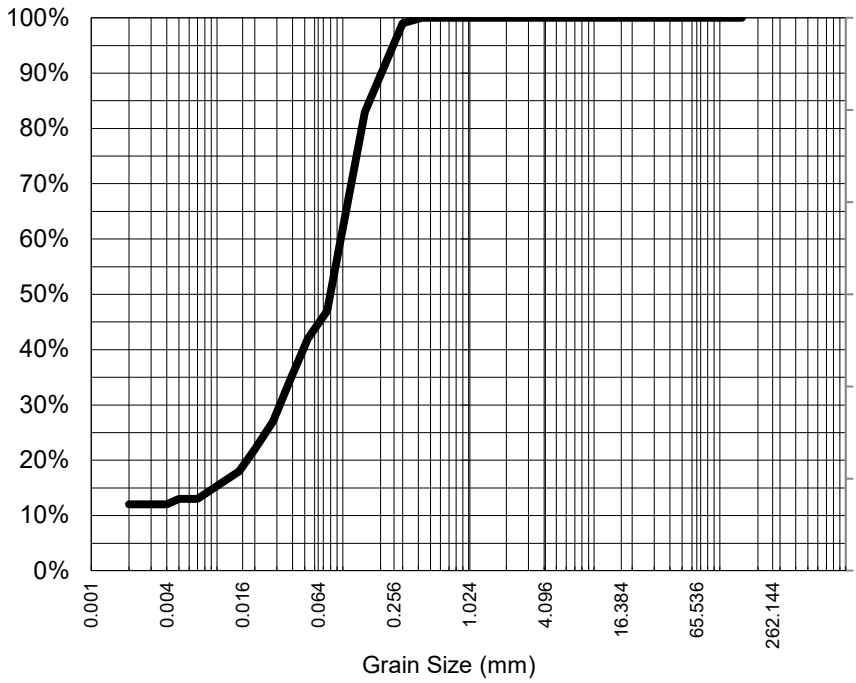
ALS Environmental

Brisbane QLD

CLIENT:	Matt Braimbridge	**DATE REPORTED:**	28-Aug-2024
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-001 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	T1-ALS

Particle Size Distribution



Particle Size (mm)	% Passing
0.425	100%
0.300	99%
0.150	83%
0.075	47%
Particle Size (microns)	
53	42%
39	35%
28	27%
20	22%
15	18%
11	16%
7	13%
5	13%
2	12%

Median Particle Size (mm)*	0.081

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.67

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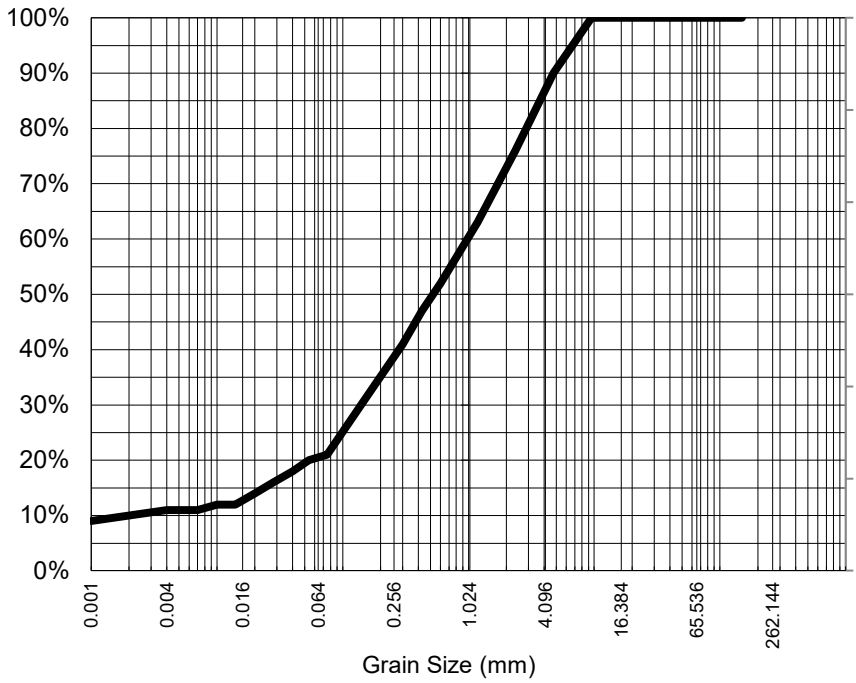
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-002 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	TC1-ALS

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	90%
2.36	76%
1.18	63%
0.600	52%
0.425	47%
0.300	41%
0.150	31%
0.075	21%
Particle Size (microns)	
54	20%
40	18%
28	16%
20	14%
14	12%
10	12%
7	11%
5	11%
1	9%

Median Particle Size (mm)*	0.530

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.75

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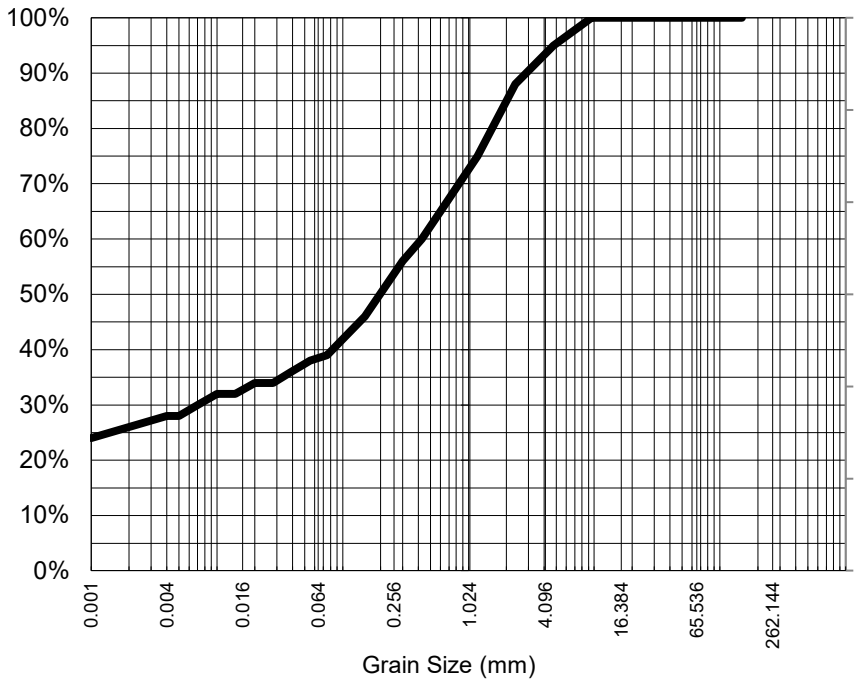
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-003 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	WR1-ALS

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	95%
2.36	88%
1.18	75%
0.600	65%
0.425	60%
0.300	56%
0.150	46%
0.075	39%
Particle Size (microns)	
55	38%
39	36%
28	34%
20	34%
14	32%
10	32%
7	30%
5	28%
1	24%

Median Particle Size (mm)*	0.210

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.68

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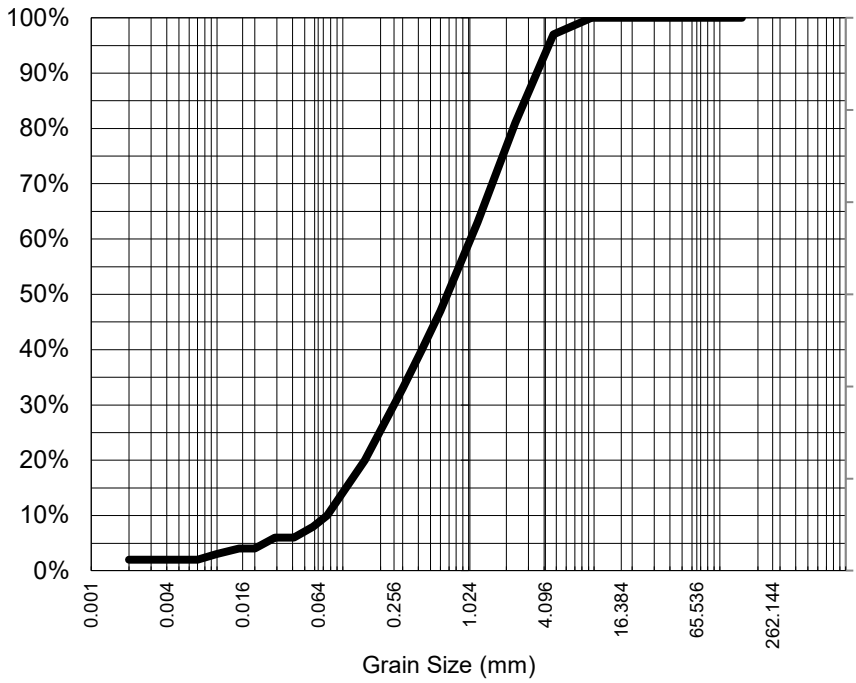
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-004 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	WR3-ALS

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	97%
2.36	81%
1.18	63%
0.600	47%
0.425	40%
0.300	33%
0.150	20%
0.075	10%
Particle Size (microns)	
58	8%
41	6%
29	6%
20	4%
15	4%
10	3%
7	2%
5	2%
2	2%

Median Particle Size (mm)*	0.709

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.66

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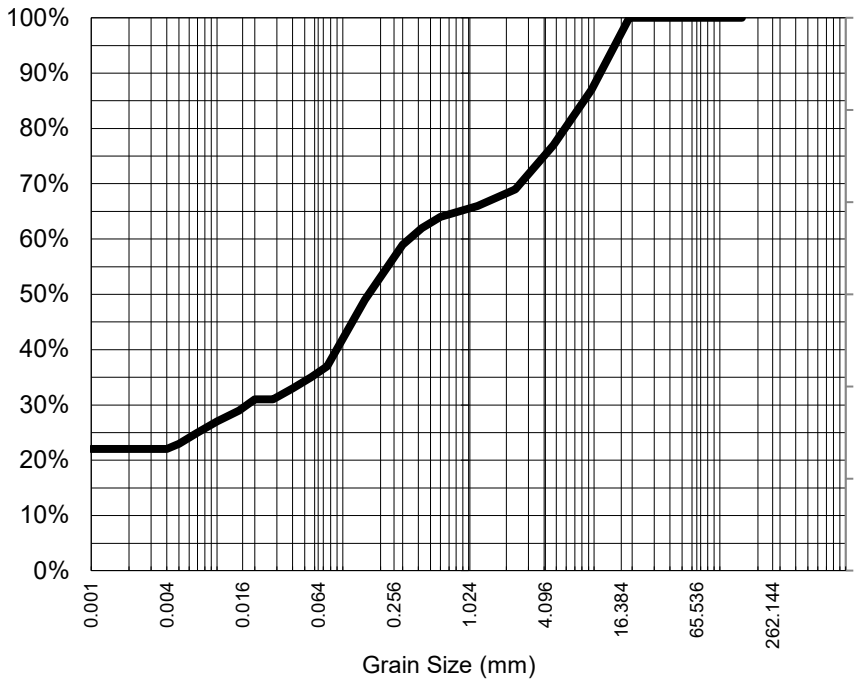
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-005 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	B1-ALS

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	87%
4.75	77%
2.36	69%
1.18	66%
0.600	64%
0.425	62%
0.300	59%
0.150	49%
0.075	37%
Particle Size (microns)	
56	35%
40	33%
28	31%
20	31%
15	29%
10	27%
7	25%
5	23%
1	22%

Median Particle Size (mm)*	0.165

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.6

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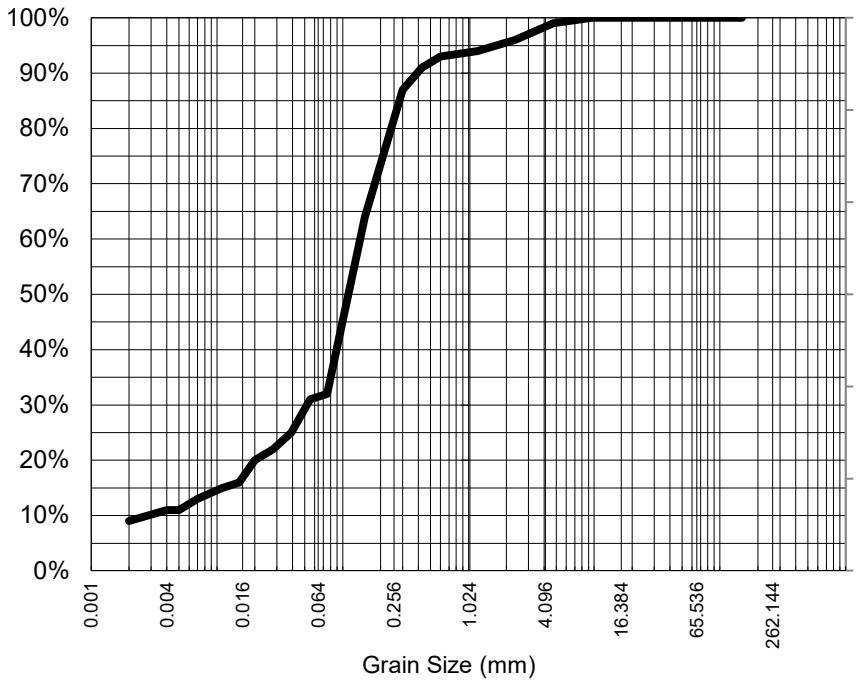
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-006 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	DC-ALS

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	99%
2.36	96%
1.18	94%
0.600	93%
0.425	91%
0.300	87%
0.150	64%
0.075	32%
Particle Size (microns)	
55	31%
39	25%
28	22%
20	20%
15	16%
11	15%
7	13%
5	11%
2	9%

Median Particle Size (mm)*	0.117

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.68

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CLIENT:	Matt Braimbridge	**DATE REPORTED:**	28-Aug-2024
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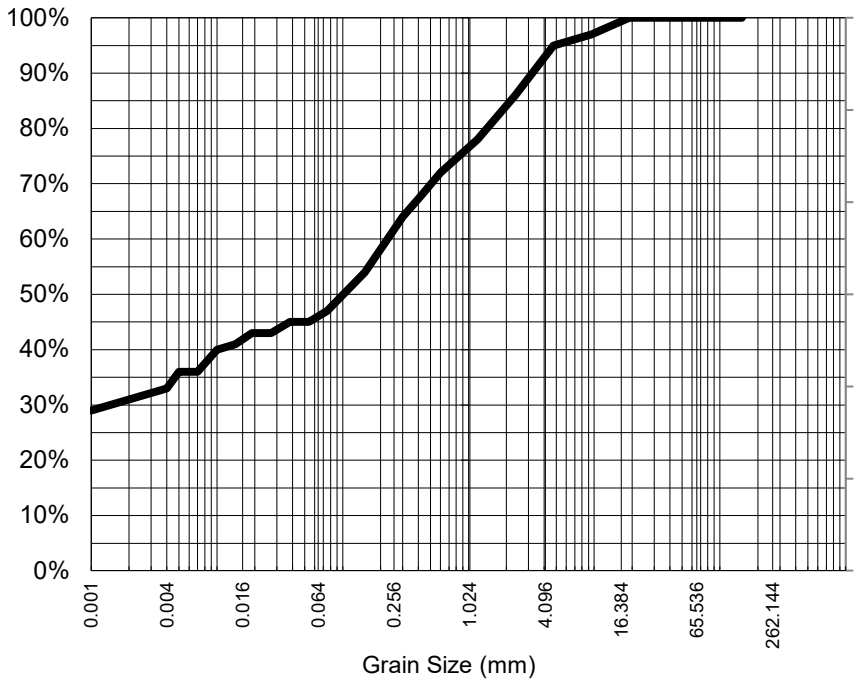
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-007 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	DC2-ALS

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	97%
4.75	95%
2.36	86%
1.18	78%
0.600	72%
0.425	68%
0.300	64%
0.150	54%
0.075	47%
Particle Size (microns)	
54	45%
38	45%
27	43%
19	43%
14	41%
10	40%
7	36%
5	36%
1	29%

Median Particle Size (mm)*	0.107

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.64

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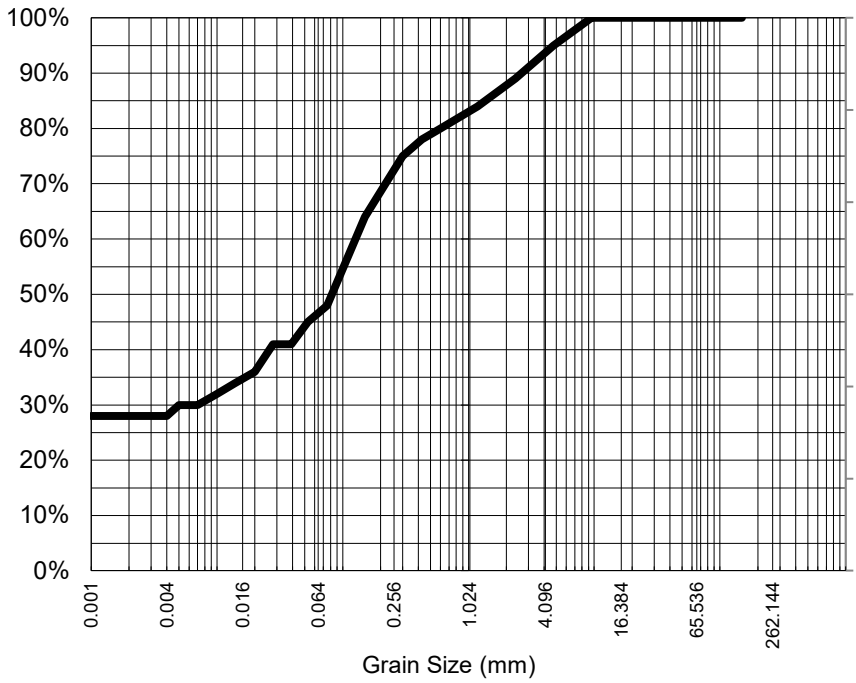
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-008 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	TS1-ALS

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	95%
2.36	89%
1.18	84%
0.600	80%
0.425	78%
0.300	75%
0.150	64%
0.075	48%
Particle Size (microns)	
53	45%
39	41%
28	41%
20	36%
14	34%
10	32%
7	30%
5	30%
1	28%

Median Particle Size (mm)*	0.084

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.65

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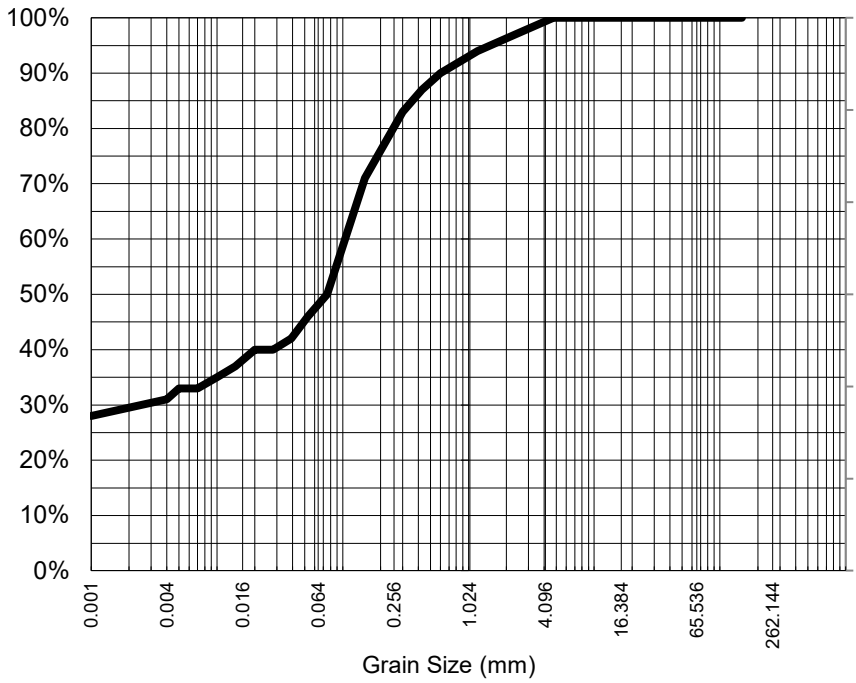
CLIENT:	Matt Braimbridge	**DATE REPORTED:**	28-Aug-2024
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-009 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	TS2-ALS

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	97%
1.18	94%
0.600	90%
0.425	87%
0.300	83%
0.150	71%
0.075	50%
Particle Size (microns)	
53	46%
39	42%
28	40%
20	40%
14	37%
10	35%
7	33%
5	33%
1	28%

Median Particle Size (mm)*	0.075

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.67

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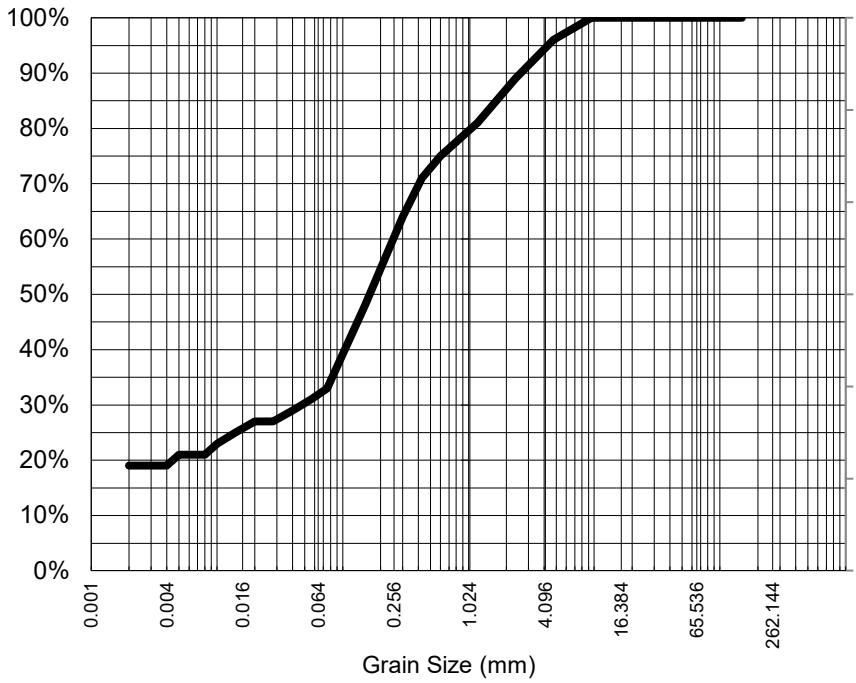
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-010 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A1-1

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	96%
2.36	89%
1.18	81%
0.600	75%
0.425	71%
0.300	64%
0.150	48%
0.075	33%
Particle Size (microns)	
56	31%
40	29%
28	27%
20	27%
14	25%
10	23%
8	21%
5	21%
2	19%

Median Particle Size (mm)*	0.169

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.64

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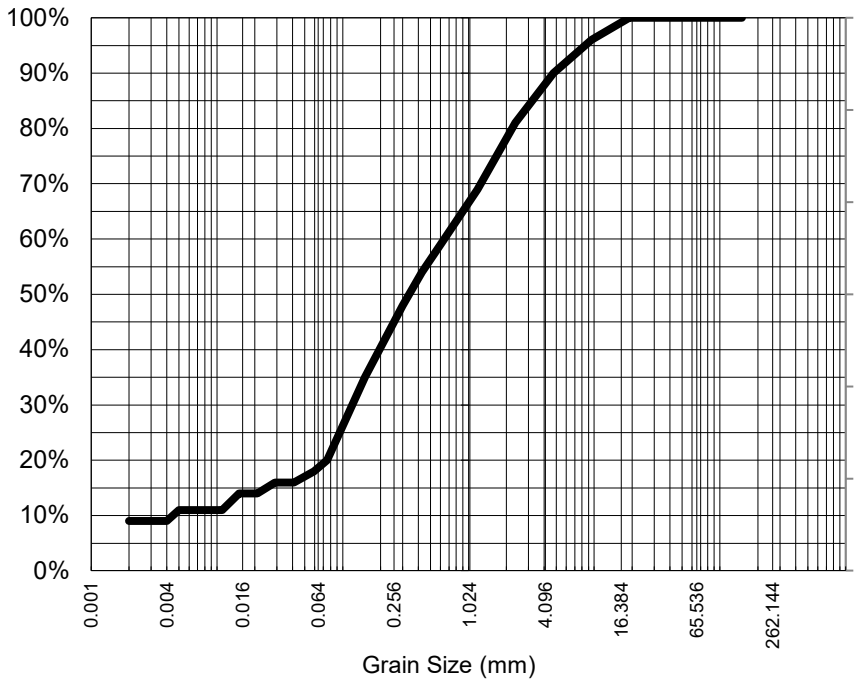
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-011 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A1-2

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	96%
4.75	90%
2.36	81%
1.18	69%
0.600	59%
0.425	54%
0.300	48%
0.150	35%
0.075	20%
Particle Size (microns)	
59	18%
41	16%
29	16%
21	14%
15	14%
11	11%
8	11%
5	11%
2	9%

Median Particle Size (mm)*	0.342

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.61

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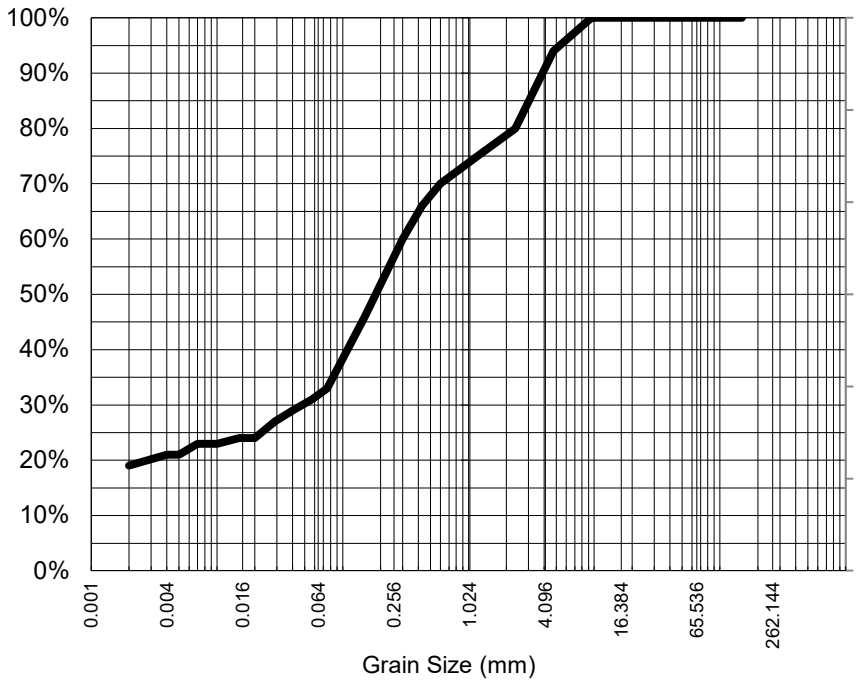
ALS Environmental

Brisbane QLD

CLIENT:	Matt Braimbridge	**DATE REPORTED:**	28-Aug-2024
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-012 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A2-1

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	94%
2.36	80%
1.18	75%
0.600	70%
0.425	66%
0.300	60%
0.150	46%
0.075	33%
Particle Size (microns)	
57	31%
40	29%
29	27%
20	24%
15	24%
10	23%
7	23%
5	21%
2	19%

Median Particle Size (mm)*	0.193

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.57

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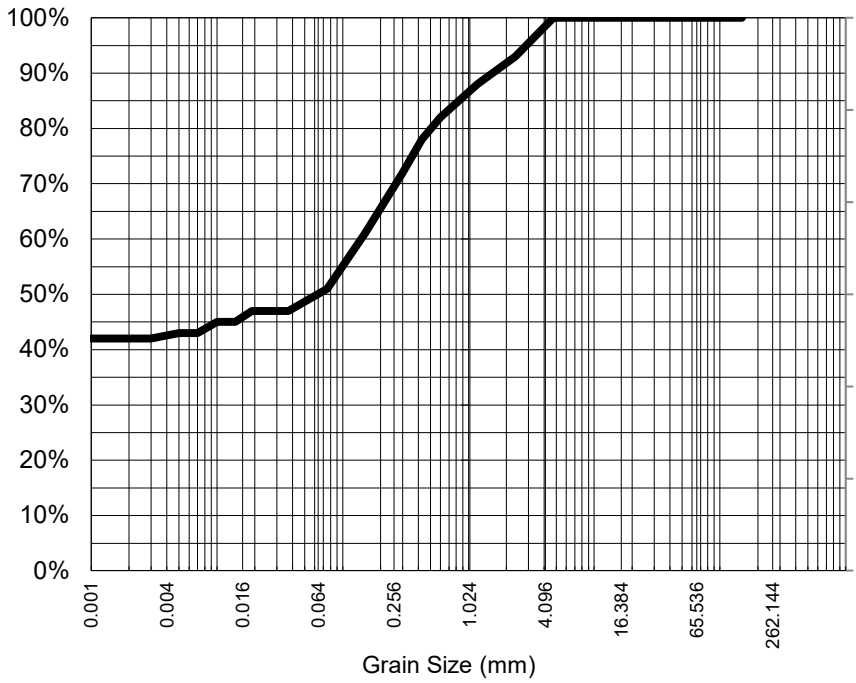
CLIENT:	Matt Braimbridge	**DATE REPORTED:**	28-Aug-2024
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-013 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A2-2

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	93%
1.18	88%
0.600	82%
0.425	78%
0.300	72%
0.150	61%
0.075	51%
Particle Size (microns)	
53	49%
37	47%
27	47%
19	47%
14	45%
10	45%
7	43%
5	43%
1	42%

Median Particle Size (mm)*	0.064

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.64

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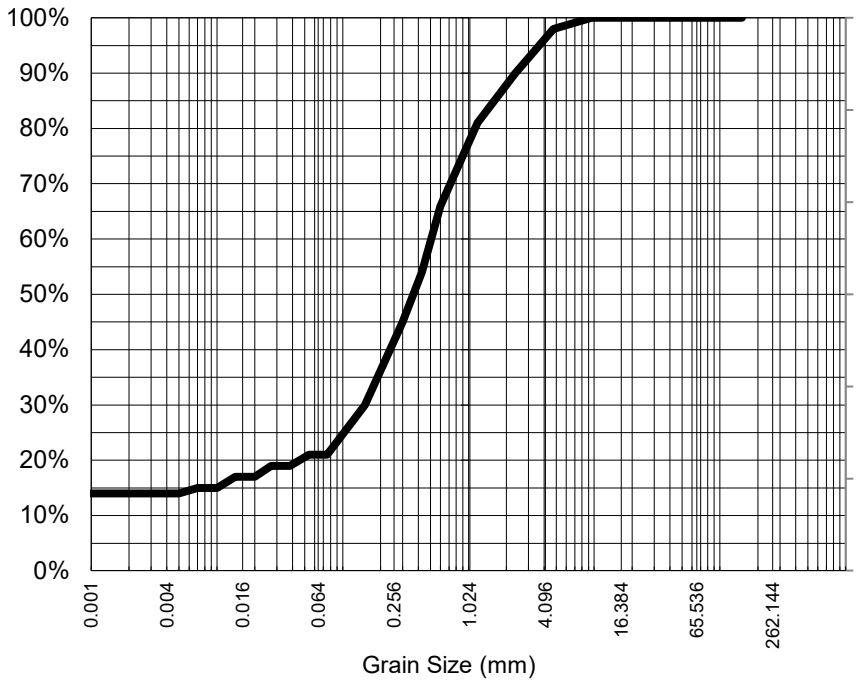
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-014 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A2-3

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	98%
2.36	90%
1.18	81%
0.600	66%
0.425	54%
0.300	45%
0.150	30%
0.075	21%
Particle Size (microns)	
54	21%
38	19%
27	19%
20	17%
14	17%
10	15%
7	15%
5	14%
1	14%

Median Particle Size (mm)*	0.369

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.75

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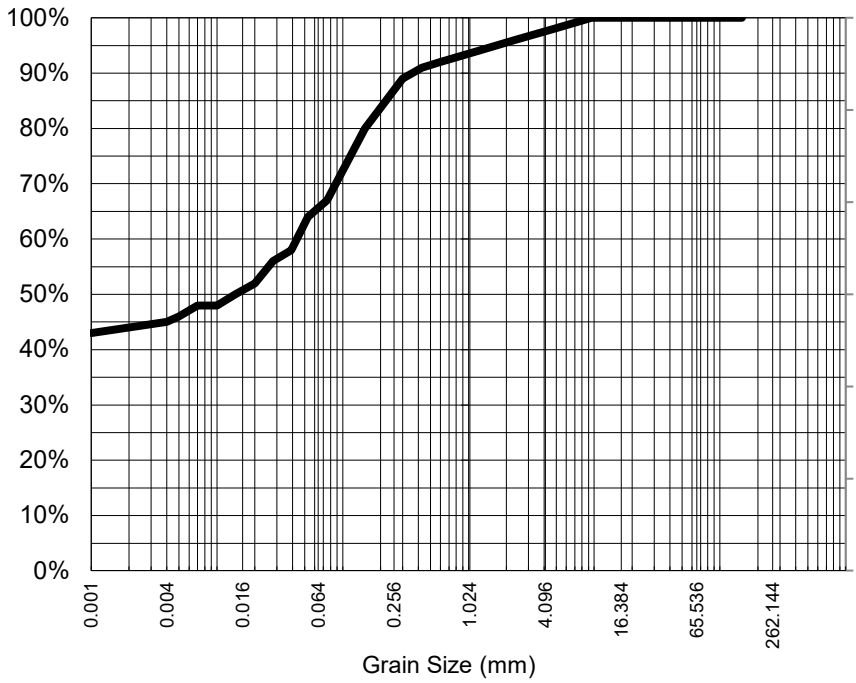
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-015 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A3-1

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	98%
2.36	96%
1.18	94%
0.600	92%
0.425	91%
0.300	89%
0.150	80%
0.075	67%
Particle Size (microns)	
53	64%
39	58%
28	56%
20	52%
14	50%
10	48%
7	48%
5	46%
1	43%

Median Particle Size (mm)*	0.014

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.54

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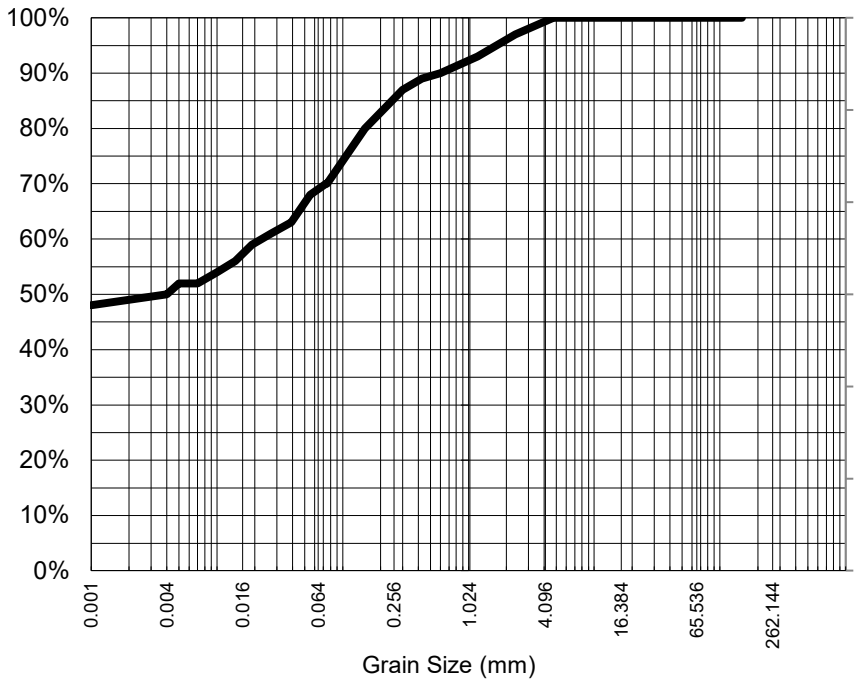
CLIENT:	Matt Braimbridge	**DATE REPORTED:**	28-Aug-2024
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-016 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A3-2

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	97%
1.18	93%
0.600	90%
0.425	89%
0.300	87%
0.150	80%
0.075	70%
Particle Size (microns)	
55	68%
39	63%
27	61%
19	59%
14	56%
10	54%
7	52%
5	52%
1	48%

Median Particle Size (mm)*	<0.007

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.59

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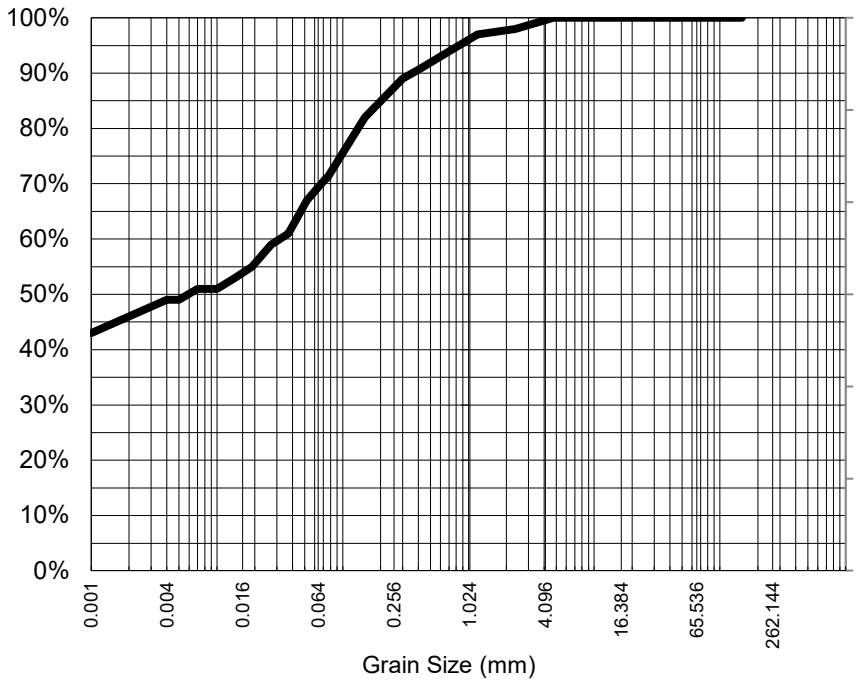
CLIENT:	Matt Braimbridge	**DATE REPORTED:**	28-Aug-2024
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-017 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A3-3

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	98%
1.18	97%
0.600	93%
0.425	91%
0.300	89%
0.150	82%
0.075	71%
Particle Size (microns)	
52	67%
37	61%
27	59%
19	55%
14	53%
10	51%
7	51%
5	49%
1	43%

Median Particle Size (mm)*	<0.007

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.57

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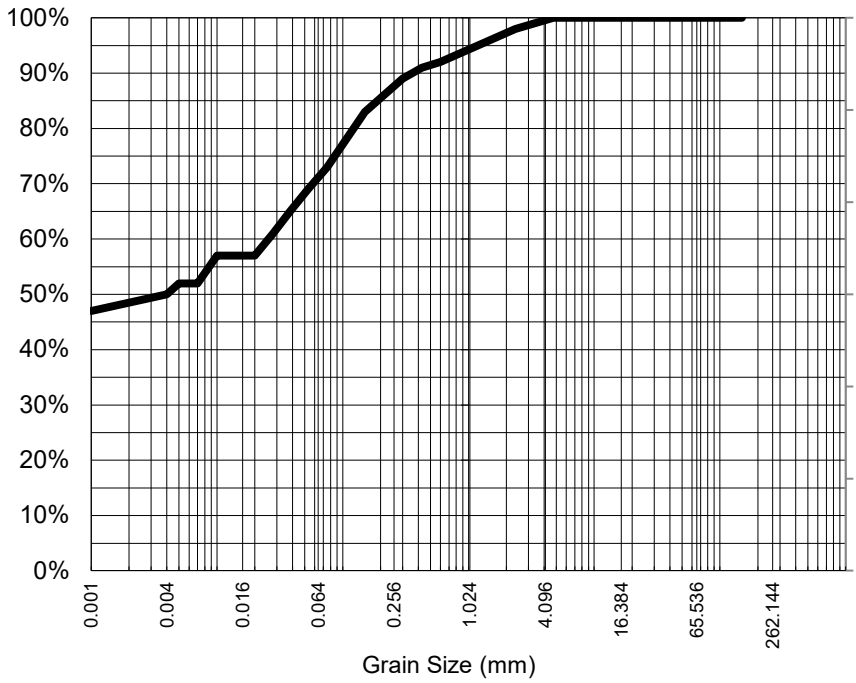
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-018 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A4-1

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	98%
1.18	95%
0.600	92%
0.425	91%
0.300	89%
0.150	83%
0.075	73%
Particle Size (microns)	
53	69%
38	65%
28	61%
20	57%
14	57%
10	57%
7	52%
5	52%
1	47%

Median Particle Size (mm)*	<0.007

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.5

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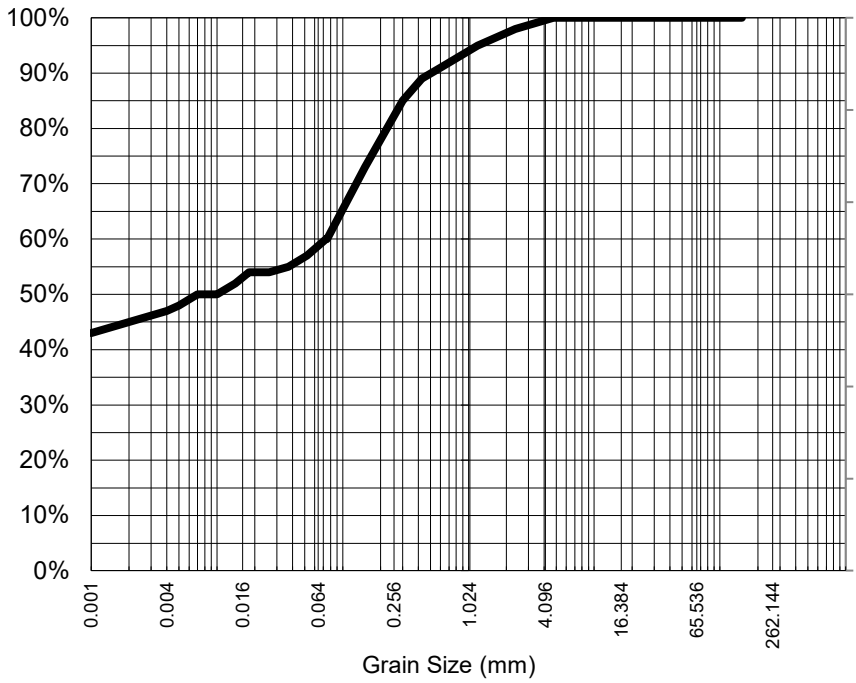
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-019 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A4-2

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	98%
1.18	95%
0.600	91%
0.425	89%
0.300	85%
0.150	73%
0.075	60%
Particle Size (microns)	
52	57%
37	55%
26	54%
18	54%
14	52%
10	50%
7	50%
5	48%
1	43%

Median Particle Size (mm)*	0.010

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.55

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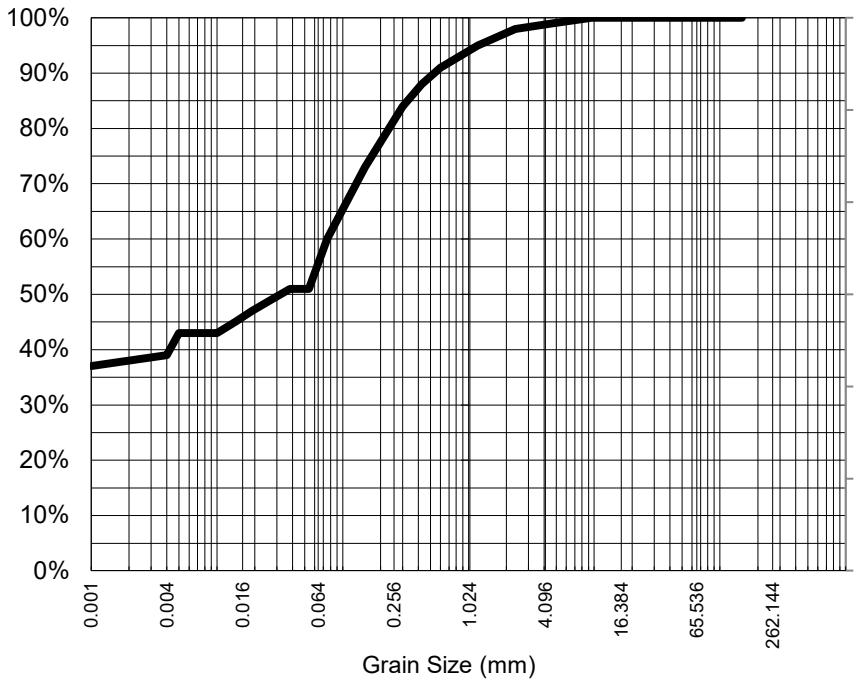
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-020 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A4-3

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	99%
2.36	98%
1.18	95%
0.600	91%
0.425	88%
0.300	84%
0.150	73%
0.075	60%
Particle Size (microns)	
54	51%
38	51%
27	49%
19	47%
14	45%
10	43%
7	43%
5	43%
1	37%

Median Particle Size (mm)*	0.033

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.6

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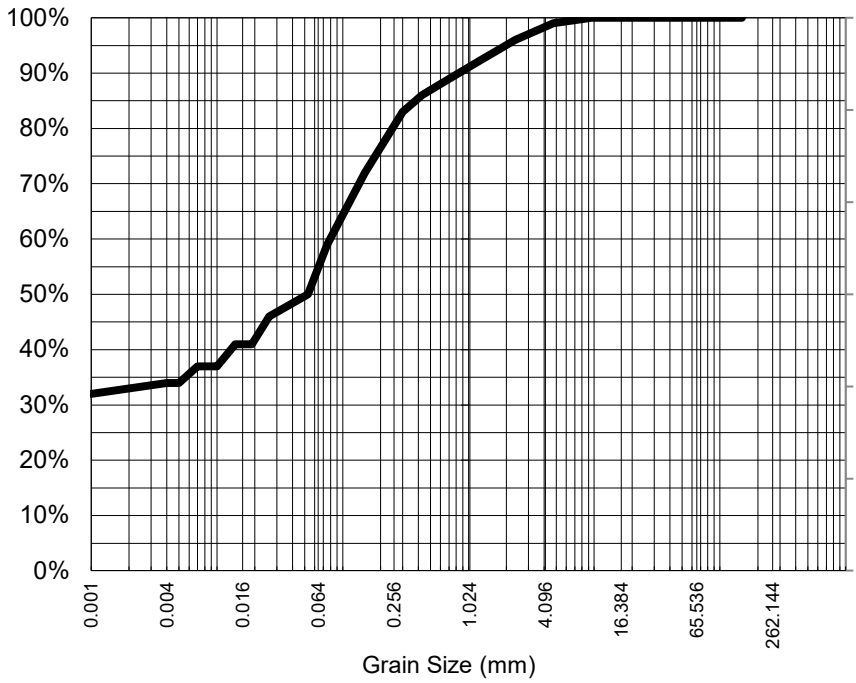
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-021 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A5-1

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	99%
2.36	96%
1.18	92%
0.600	88%
0.425	86%
0.300	83%
0.150	72%
0.075	59%
Particle Size (microns)	
53	50%
37	48%
26	46%
19	41%
14	41%
10	37%
7	37%
5	34%
1	32%

Median Particle Size (mm)*	0.053

Analysis Notes

Samples analysed as received.
** Soil Particle Density results fell outside the scope of AS 1289.3.6.3. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results*

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.44 (2.65)*

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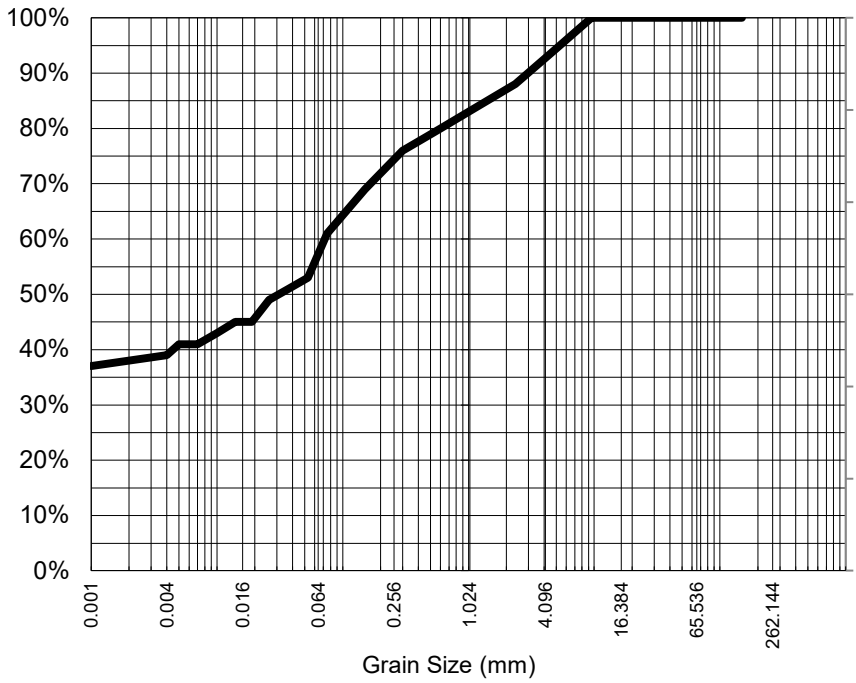
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-022 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A5-2

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	94%
2.36	88%
1.18	84%
0.600	80%
0.425	78%
0.300	76%
0.150	69%
0.075	61%
Particle Size (microns)	
53	53%
37	51%
26	49%
19	45%
14	45%
10	43%
7	41%
5	41%
1	37%

Median Particle Size (mm)*	0.032

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.6 (2.65)*

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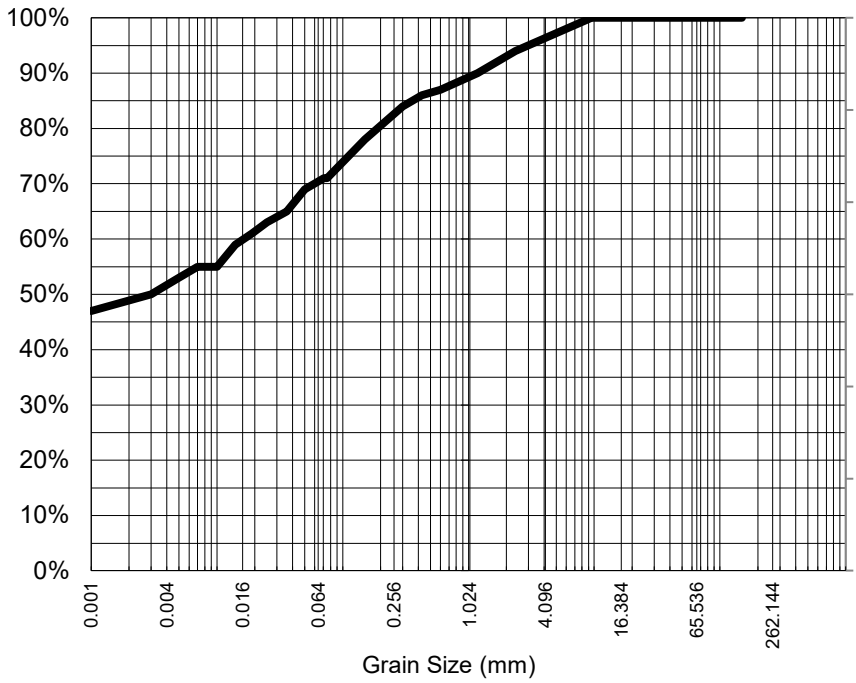
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-023 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	A5-3

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	97%
2.36	94%
1.18	90%
0.600	87%
0.425	86%
0.300	84%
0.150	78%
0.075	71%
Particle Size (microns)	
50	69%
36	65%
25	63%
19	61%
14	59%
10	55%
7	55%
5	53%
1	47%

Median Particle Size (mm)*	<0.007

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.6 (2.65)*

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Certificate of Analysis

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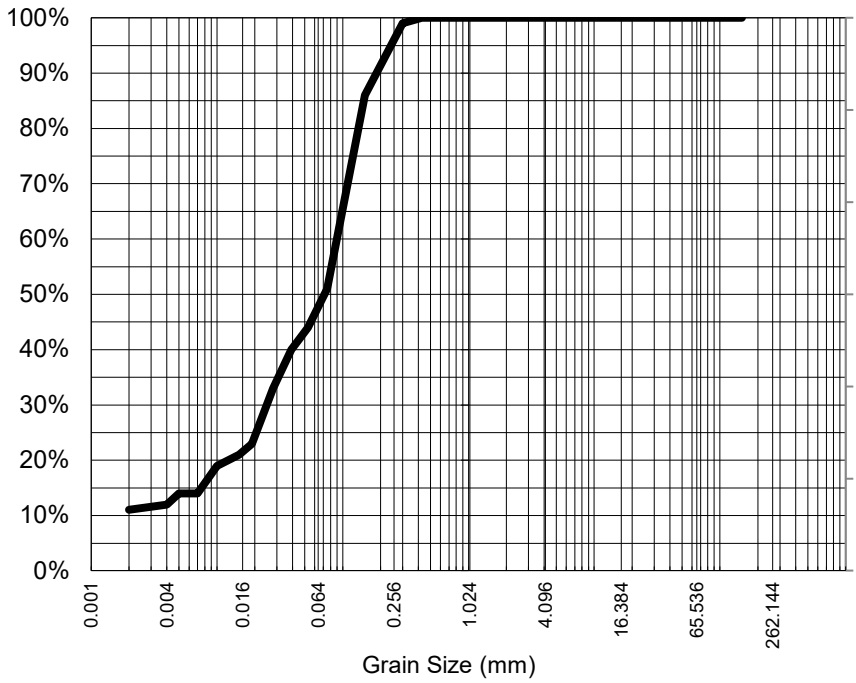
ALS Environmental

Brisbane QLD

CLIENT:	Matt Braimbridge	**DATE REPORTED:**	28-Aug-2024
COMPANY:	The Trustee for Mine Earth Unit Trust	**DATE RECEIVED:**	7-Aug-2024
ADDRESS:	1 Breakfast Creek Road Newstead	**REPORT NO:**	EB2428229-024 / PSD
PROJECT:	TCK-2405	**SAMPLE ID:**	T2

Particle Size Distribution



Particle Size (mm)	% Passing
0.425	100%
0.300	99%
0.150	86%
0.075	51%
Particle Size (microns)	
53	44%
39	40%
28	33%
19	23%
15	21%
10	19%
7	14%
5	14%
2	11%

Median Particle Size (mm)*	0.072

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Aug-24

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.82 (2.65)*

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Satish Trivedi
Soil Senior Chemist
Authorised Signatory

APPENDIX J EXCERPTS FROM PIT SHELL GEOTECHNICAL REPORT

Carnaby Resources Limited

Tick Hill Geotechnical Pre-Feasibility Study

PRJ008

July 2020

Final

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Document Reference: 200704_PRJ008_Carnaby_Tick Hill PFS

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Appendix A Basic Geotechnical Logs

Appendix B RQD and Fracture Frequency Logging

Appendix C Discontinuity Characteristic Logging

1 EXECUTIVE SUMMARY

WK Geotechnical (WKG) was requested by Carnaby Resources Limited (Carnaby) to undertake a geotechnical Pre-Feasibility Study (PFS) for the Tick Hill Mine.

The scope of work undertaken for the geotechnical PFS for the Tick Hill Mine comprised the following items:

- Part A – Site Visit
  - Pit wall inspections of accessible areas
  - Inspect potential failure zone on the north-west wall
  - Review core from three holes (TH023RD, TH075RD and TH077RD) and other holes if required.
- Part B – Design Study
  - Review Carnaby supplied electronic data, including a 3D lithological and structure model
  - Source any geotechnical records including core photos from the Diatreme Resources Brisbane office
  - Construct a geotechnical model
  - Undertake slope stability assessments
  - Develop pit wall design recommendations
  - Prepare report.

Key findings of the study are:

- Non electronic data sources or laboratory testing data constrained the detail of investigation.
- Discontinuity shape/roughness and alteration/infill was not logged in any of the boreholes by Carpentaria Gold loggers.
- RQD generally agreed with comments regarding shear zones or core loss, i.e. lower RQD was assigned to intervals with these features.
- It was noted that weathering varied down hole. It is possible that the loggers were confusing weathering with alteration.
- The geotechnical model calculated rock quality ranging from Poor to Good (GSI descriptions), which agreed with observations of the existing pit.

Limit Equilibrium Analyses

- [redacted]

[redacted]

- [redacted]

Finite Element Analyses

- [redacted]
  - [redacted]
  - [redacted]
  - [redacted]
- [redacted]
  - [redacted]
  - [redacted]
- [redacted]

The recommendations include:

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

- [redacted]

2 INTRODUCTION AND BACKGROUND

WK Geotechnical (WKG) was requested by Carnaby Resources Limited (Carnaby) to undertake a geotechnical Pre-Feasibility Study (PFS) for the Tick Hill Mine, in preparation for the resumption of mining.

The Tick Hill Mine is located 110 kilometres south of Mount Isa, and 16 kilometres north of The Monument township (Figure 1) which services the nearby Phosphate Hill Mine. The Tick Hill deposit was discovered in September 1989 by MIM Exploration and first gold poured on 31 December 1991 (MIM 1993).

The Tick Hill Gold Deposit was mined between 1991 and 1995 by MIM Holdings Limited subsidiary Carpentaria Gold Pty Ltd. Mining at Tick Hill was by an open pit with decline access to an underground mine beneath the open pit, with a ventilation shaft connecting the levels and also serving as an escape route. The decline and shaft were capped at the completion of mining but are expected to be recoverable if required for further mining. Mine workings are currently flooded (Diatreme 2015).

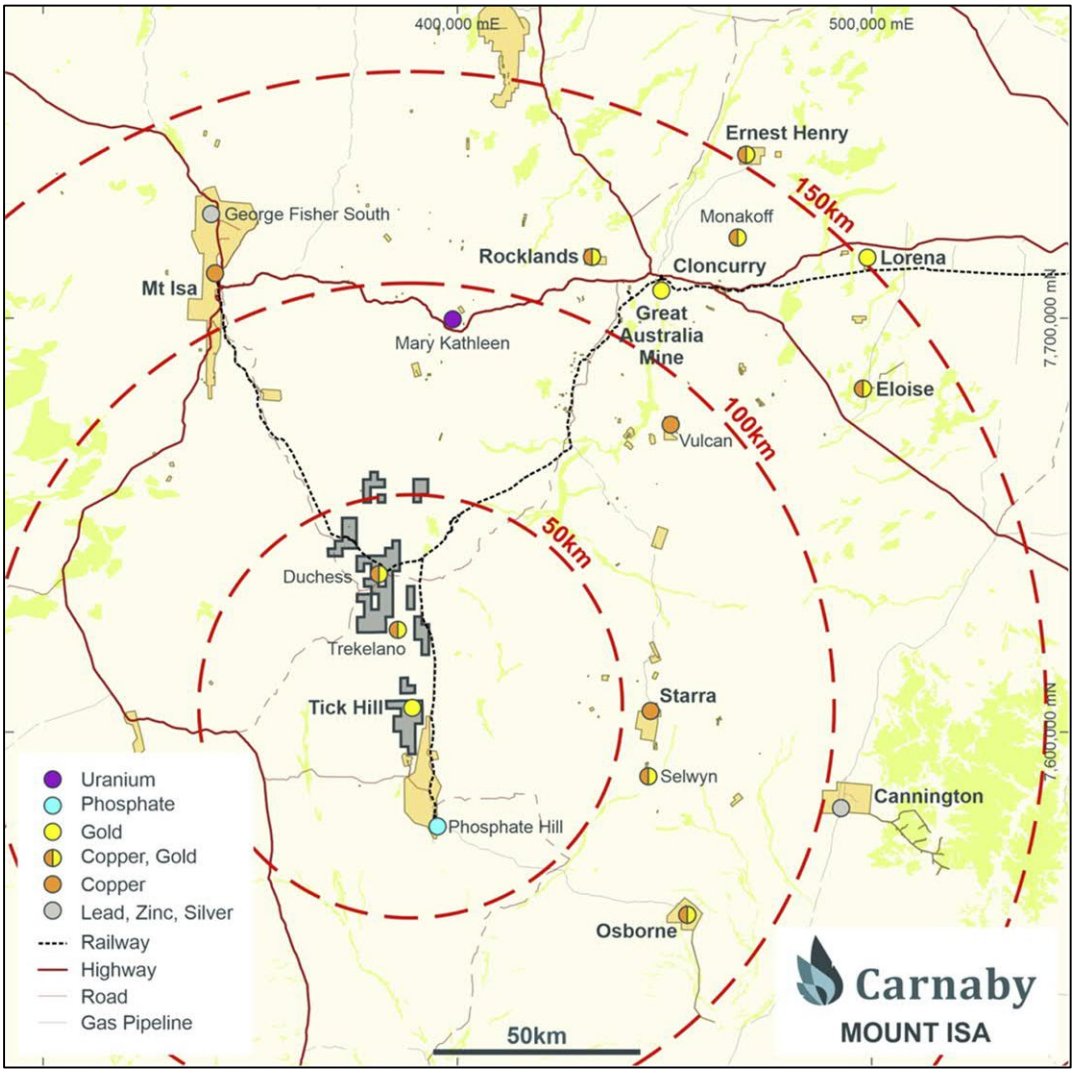

Figure 1: Tick Hill Mine location (Carnaby 2020)

A Scoping Study was completed by Carnaby with the results released in March 2020 (Carnaby 2020). [redacted]

The scope of work undertaken for the geotechnical PFS for the Tick Hill Mine comprised the following items:

- Part A – Site Visit
  - Pit wall inspections of accessible areas
  - Inspect potential failure zone on the north-west wall
  - Review core from three holes (TH023RD, TH075RD and TH077RD) and other holes if required.
- Part B – Design Study
  - [redacted]
    - [redacted]
    - [redacted]
    - [redacted]
    - [redacted]
    - [redacted]

3 INFORMATION SOURCES

3.1 Geotechnical Information

At Carnaby's request, WKG visited the Brisbane office of Diatreme Resources on 5th May 2020 to collect data of geotechnical relevance. The focus for data collection was geotechnical information from selected boreholes intersecting the western wall, preferably boreholes that existed in the on-site core yard so that the logs could be checked against the core.

No previous geotechnical reports (operational or design) or geomechanical laboratory test data could be located. Of the data that was available, none was electronic.

Table 1 summarises the 'Basic Geotechnical Logs' that were located. These are paper logs that were processed electronically for this assessment. Figure 2 illustrates the borehole locations and the existing pit.

Table 1: Basic geotechnical logs

Borehole	Logged Interval (m)
TH007RD	60.50 – 177.40
TH010RD	20.20 – 99.90
TH021RD	35.50 – 243.40
TH023RD	48.00 – 159.00
TH024D	6.00 – 76.00
TH025D	6.00 – 99.00
TH040RD	71.60 – 123.00
TH041RD	83.70 – 141.00
TH045RD	71.50 – 125.90
TH075RD	101.80 – 164.60
TH077RD	89.60 – 158.60

Figure 2: Boreholes containing basic geotechnical logs

Table 2 summarises the relevant core photographs that were located. Figure 3 illustrates the borehole locations and the existing pit.

Table 2: Boreholes with core photographs

Borehole	Interval (m)
TH063D	0.00 – 96.20
TH064D	3.05 – 51.10
TH065D	0.00 – 78.10
TH066D	0.00 – 46.00

Also collected were a joint analysis (Hood, date unknown) and a photo album with historical open pit photographs.

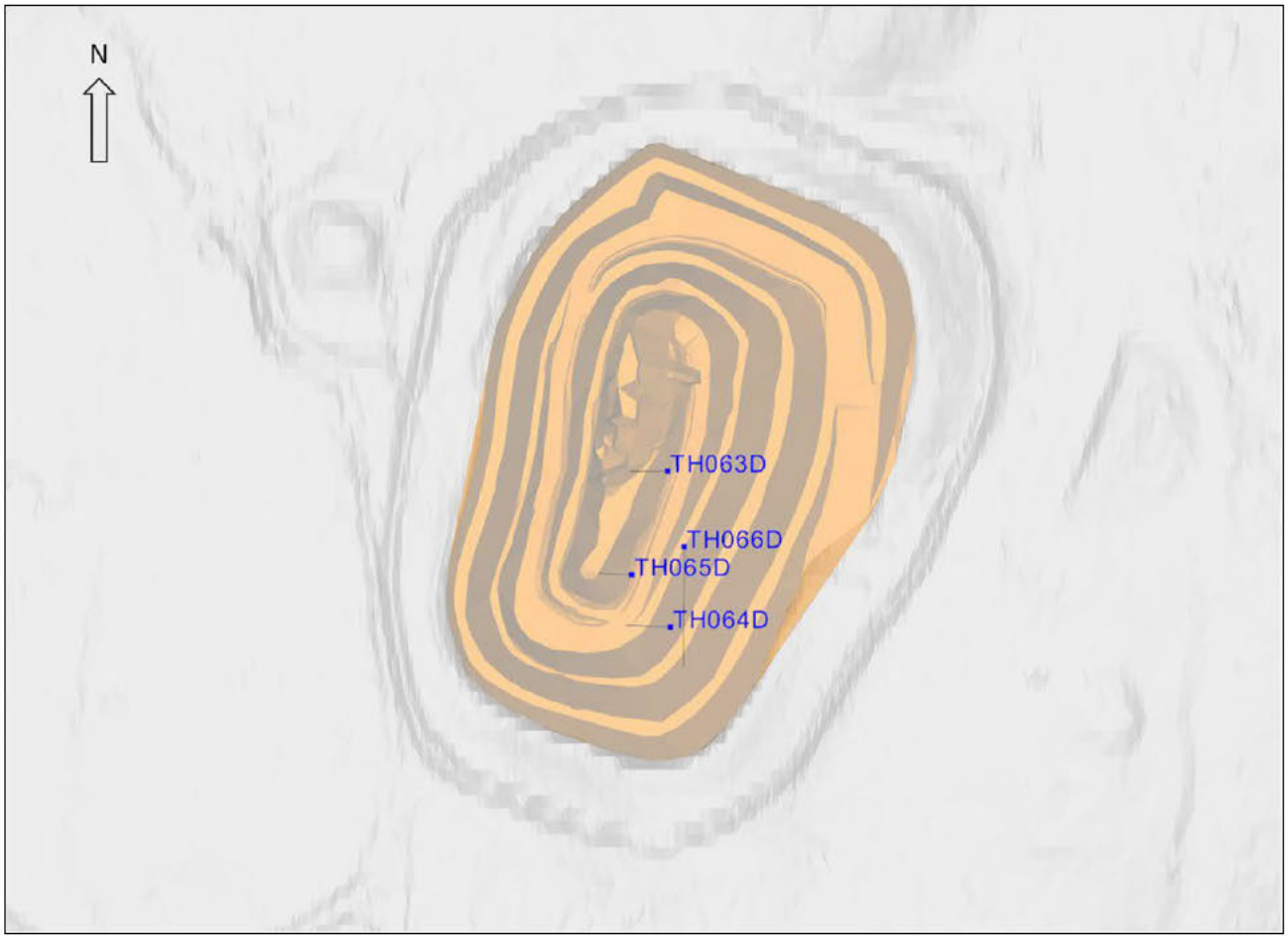

Figure 3: Boreholes containing core photography

3.2 Geological and Structural Model

Table 3 summarises the geological and structural model files supplied. No fault model was supplied.

Table 3: Geological and structure model files

File	Description
base_ox.dxf	Base of Oxidation/Weathering surface
fw_qtz_biotite_granofels_domain.dxf	Footwall Quartz-Biotite Granofels interlayered with Biotite Schists
fw_quartzite.dxf	Footwall Quartzite
hw_amphibolite_calcsilicate_domain.dxf	Hangingwall Amphibolite interlayered with calcsilicates
hw_quartzite.dxf	Hangingwall Quartzite
laminite.dxf	Laminite (host lithology of orebody)
Carnaby_Holes_Oriented_Structures.xlsx	Database of logged structures in eight Carnaby drilled boreholes

3.3 Current Topography, Mine Design and Other Items

Table 4 summarises the model files supplied for the current topography, existing pit (after crown pillar extraction), [redacted], water table, underground workings and west wall slip.

[redacted]

Table 4: Topography, mine design and other files

File	Description
final_topo_excluding_final_pit.dxf	Topography surrounding final pit
pit_floor_after_crown_removal.dxf	Open pit after crown pillar extraction
[redacted]	[redacted]
water_table.dxf	Water table surface
final_dev_solid.dxf	Solids of underground drill and extraction drives
final_full_workings_string_file.dxf	Strings of decline, all underground drives, ventilation shaft and stopes
final_hw_stope_solid.dxf	Hangingwall stope solid
final_main_lode_stope_solid	Main lode stope solid
solid_crown_pillar_remnant_resource.dxf	Orebody with the crown pillar that formed the hangingwall and main lode stope
potential_slip_zone.dxf	Potential slip zone caused by crown pillar extraction

[redacted]

[redacted]

4 GEOLOGY

The Tick Hill gold deposit is hosted in the Middle Proterozoic Corella Formation, locally made up of banded calc-silicates quartzites and amphibolites (Figure 5). Originally these were sediments of evaporitic, detrital and possibly igneous (tuffs) origin, that have now metamorphosed to mid-amphibolite facies.

The sequence has undergone regional deformation, leading to mylonitization, phases of silicification plus retrogressive and metasomatic alteration.

An estimated 90% of the gold mineralisation occurs in a highly strained quartz-feldspar laminite, with the remainder occurring in the surrounding quartzitic schists and amphibolites. The quartz-feldspar laminites vary in width from 1 cm to 150 cm and often carry visible grains of gold up to 2 mm in size. Individual bands show strong lateral continuity both along strike and up and down dip. The orebody contains virtually no accessory or pathfinder minerals, with only very minor pyrite and trace chalcopyrite.

The host rocks strike roughly north-south and dip to the west at about 55°. The orebody is situated on the eastern limb of a well-defined synformal structure, with the sub vertical fold axis striking north south and plunging gently to the north (MIM 1993).

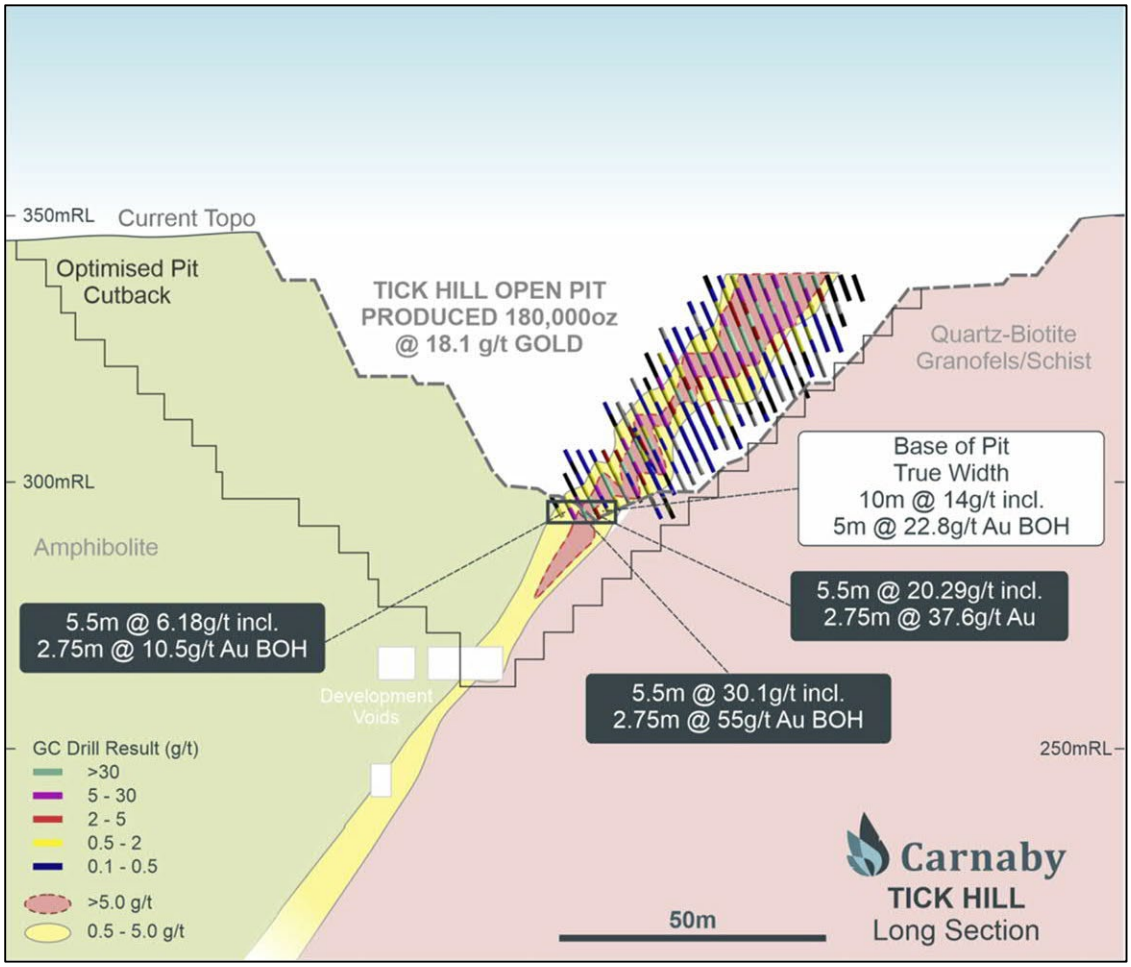

Figure 5: Tick Hill long section (Carnaby 2020)

5 GEOTECHNICAL MODEL

Table 1 and Table 2 summarise the historical geotechnical available to WKG.

On the 7th May 2020 WKG visited the Tick Hill Mine site to inspect core from available boreholes, conduct a site inspection of the existing pit, undertake structural mapping of accessible areas and a general inspection of the tailings dam.

5.1 Historical Paper Logs

The 11 boreholes in Table 1 were scanned and the data transcribed into an Excel spreadsheet.

The logs recorded information such as:

- Rock Type
- Weathering
- Rock Strength
- Bedding Foliation
- CBA
- Core Loss
- Rock Quality Designation (RQD)
- Remarks on shear zones, jointing etc.

In general, the logging was undertaken consistently with minor differences. Table 5 summarises the data collected for each hole.

Fracture frequency was logged with the following boreholes:

- TH040RD (detailed information in the remarks)
- TH045RD (the Rock Type field replaced with Fractures per Metre)
- TH075RD (fracture frequency noted in Remarks)
- TH077RD (dedicated Fractures per Metre field).

Discontinuity shape/roughness and alteration/infill was not logged in any of the boreholes.

RQD generally agreed with comments regarding shear zones or core loss, i.e. lower RQD was assigned to intervals with these features.

It was noted that weathering varied down hole. It is possible that the loggers were confusing weathering with alteration.

Codes and explanatory notes for bedding/foliation and CBA were not found so these parameters were not examined further.

Table 5: Information in historical paper logs

Borehole	Rock Type	Weathering	Rock Strength	Bedding/ Foliation	CBA	Coreloss	RQD
TH007RD	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TH010RD	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TH021RD	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TH023RD	No	Yes	Yes	Yes	Yes	Yes	Yes
TH024D	No	Yes	Yes	Yes	Yes	Yes	Yes
TH025D	No	Yes	Yes	Yes	Yes	Yes	Yes
TH040RD	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TH041RD	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TH045RD	No	Yes	Yes	Yes	Yes	Yes	Yes
TH075RD	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TH077RD	No	Yes	Yes	Yes	Yes	Yes	Yes

Due to the age of the paper logs, some sections were difficult to read and were not included in the geotechnical model.

The scanned logs can be found in Appendix A.

5.2 Core Photos

The four boreholes in Table 2 were logged by WKG visually for RQD and Fracture Frequency. The logs can be found in Appendix B.

5.3 Boreholes

From the 11 boreholes listed in Table 1, five were located in the core yard (Table 6) and structural characteristics (type, infill thickness, roughness, surface weathering and joint alteration/infill) re-logged.

Strength and RQD could not be logged as the cores were split.

The logs can be found in Appendix C.

Table 6: Boreholes re-logged for structure characteristics

Borehole	Interval (m)
TH002D	15.00 – 49.90
TH023RD	48.10 – 159.00
TH045RD	84.40 – 125.90
TH075RD	101.80 – 165.00
TH077RD	93.90 – 158.60

Figure 6 is an illustration of the boreholes that contain data used in the development of the geotechnical model.

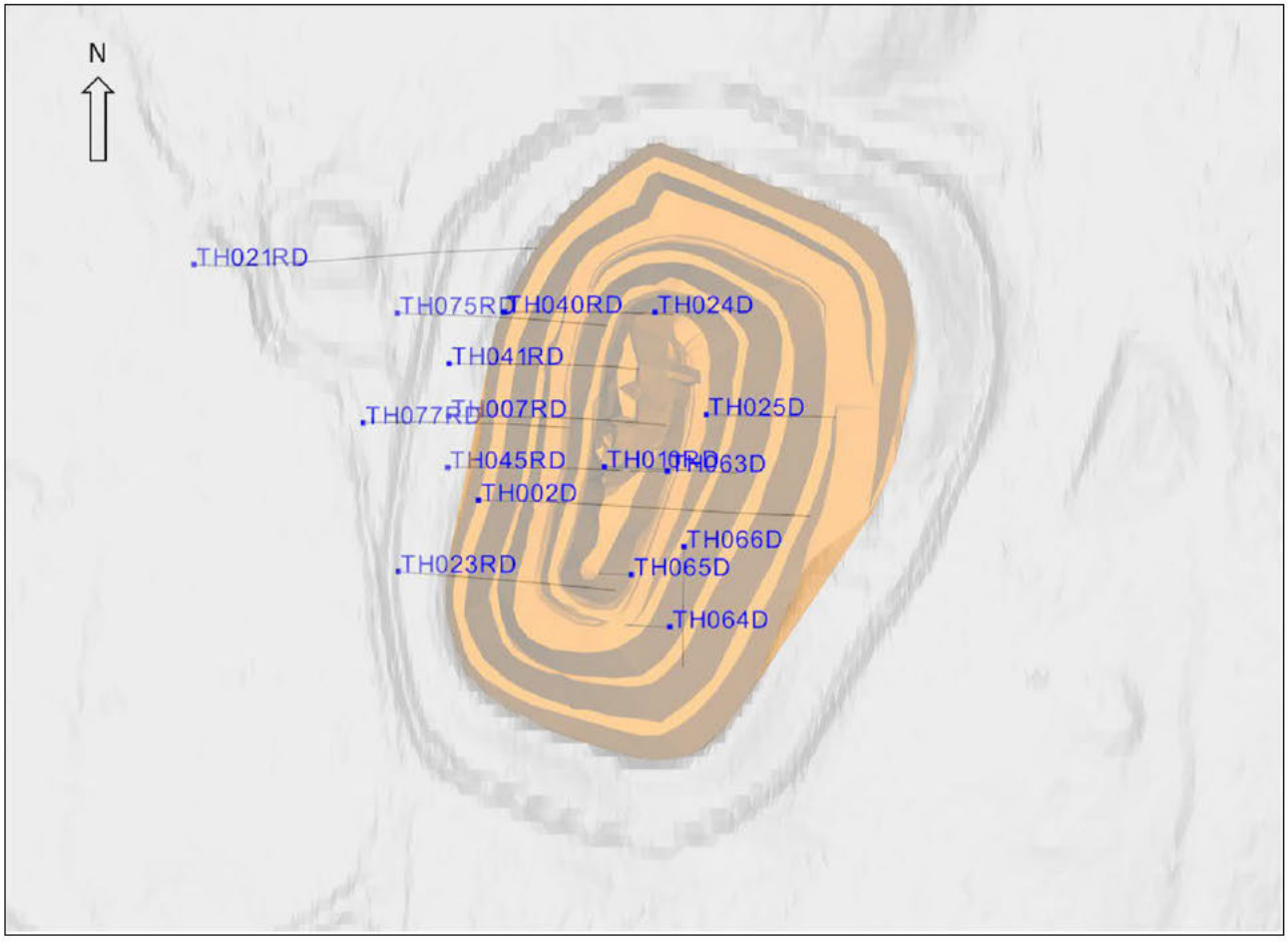

Figure 6: Boreholes used in geotechnical model development

The geotechnical data was compiled and domained using the supplied geological model (see Table 3).

[redacted]

[redacted]

5.4 Geotechnical Domains

The deposit has been divided into six geotechnical domains (Table 7) on the basis of the geology model and weathering state.

Table 7: Geotechnical domains

Domain	Code
[redacted] Amphibolite Calcsilicates Fresh	HW_AMP_CALC_F
[redacted] Amphibolite Calcsilicates Weathered	HW_AMP_CALC_W
[redacted] Quartzite Fresh	HW_QTZ_F
[redacted] Quartzite Biotite Granofels Fresh	FW_QTZ_BIO_GRAN_F
[redacted] Quartzite Fresh	FW_QTZ_F
Laminite Fresh	LAM_F

For the purpose of this assessment, WKG has assumed the unit weight of all domains to be 26 kN/m^3.

Rock mass classifications of the geotechnical domains has been determined using the Geological Strength Index (GSI), which is a function of:

- The degree of fracturing and "blockiness" of the rock mass
- The defect characteristics (surface roughness and infill material)
- The compressive strength of the intact rock material.

The GSI values for each geotechnical domain are presented in Table 8.

Table 8: Design GSI

Domain	UCS (MPa)	RQD (%)	GSI	GSI
HW_AMP_CALC_F	75	70	55	Fair rock
HW_AMP_CALC_W	75	44	53	Fair rock
HW_QTZ_F	75	60	58	Fair rock
FW_QTZ_BIO_GRAN_F	37.5	0	32	Poor rock
FW_QTZ_F	175	62	57	Fair rock
LAM_F	75	78	64	Good rock

5.5 Structural Mapping

A structural model for Tick Hill was provided to WKG. [redacted] Figure 8 is an example of the typical structure exposed in the northern wall. WKG's observations are in accordance with the structural model, a regional shear fabric dominates the rock mass and dips at moderate to steep angles to the west. A joint set steeply dipping to the south was also identified. The majority of defects observed by WKG were planar smooth to planar rough in shape.

Discontinuities are discussed in further detail in Section 6.3.

Figure 8: Typical north wall structure

5.6 Pit Inspection

WKG inspected the pit crest and accessible areas of the existing pit.

In general, the pit appears to be in good condition given the duration of exposure, with little erosional or weathering effects. This is a good indication of a reasonably high quality rock mass (Figure 9 and Figure 10).

The pit floor is under water, the level of which can be considered the regional water table level.

A section of the west wall ramp has failed into the pit and the west wall has slipped (Figure 11) however this was most likely due to the crown pillar extraction. The backscarp of the failure extends behind the west wall crest and has been cordoned off. A tell-tale has been established behind the crest. Movement of approximately 1 cm has been recorded (Figure 12) however it is unknown when the tell-tale was established.

A small section on the east wall has failed with a sliding/buckling slab mechanism (Figure 13) however no other major failures were noted.

Catch berms contain rilled material which is to be expected, however the amounts are not significant.

Figure 9: Tick Hill Pit looking north

Figure 10: Tick Hill Pit looking south

Figure 11: Western wall and ramp failure

Figure 12: Tell-tale established behind west wall crest

Figure 13: Sliding/buckling slab failure on East wall

6 GEOTECHNICAL DESIGN STUDIES

6.1 Pit Design

[redacted]

6.1.1 Current Pit

Approximate slope dimensions of the current pit are summarised in Table 9. Batter heights are <10 m for the initial batter in highly weathered material, 20 m in fresh rock materials.

Table 9: Current pit slope dimensions

Pit Wall	Batter Face Angle (°)	Berm Width (m)	Overall Slope Angle (°, including ramp)
West, North and South	65	4.0	52.5
East	56	5.0	44.0

6.1.2 [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

[redacted]

6.2 [redacted]

[redacted]

[1] *Recommended berm width based on minimum Ritchie-Call criteria.*

[redacted]

6.3 Geotechnical Analysis Model

6.3.1 Discontinuity Model

Structural discontinuity orientation data sets collected by MIM and by WKG during this study have been combined and reviewed to identify the principal structural sets within the Tick Hill units that will influence wall stability. The discontinuity model adopted for the kinematic stability analyses is summarised in Table 11.

Table 11: Tick Hill structural sets

Structural Set	Mean Orientation (Dip / Dip Direction,°)	Variability (°)	Persistence (m)
Bedding	55/280	± 10	> 50
Joint Set 1 (J1)	40/080	± 10	HW < 5 FW < 30
Joint Set 2 (J2)	90/170	± 10	< 10

Only one fault structure has been observed in the current pit walls; this feature daylights on the southern section of the west wall and is orientated approximately 80°/350°, near perpendicular in strike to the wall.

6.3.2 Discontinuity Strength Parameters

Shear strength parameters for in-situ bedding surfaces were developed using the Barton-Bandis methodology. Surface characteristic parameters for this process were derived from mapping data and from inspection of photographs of the pit walls. A "Basic Friction Angle" of 32° was assumed for the granofels and amphibolite units, based on literature values for similar rock types. Results are summarised in Table 12.

Table 12: Discontinuity strength parameters

Material	Surface Characteristics	JRC	Cohesion (kPa)	Friction Angle (°)
FW Granofels	Slightly Wavy; Undulating Smooth to Slightly Rough	11	21.5	56.2
HW Amphibolite	Slightly Wavy; Undulating Rough to Very Rough	14	136.0	59.6

6.3.3 Rock Mass Strength Parameters

Rock-mass strength and constitutive parameters were developed using the Hoek-Brown model. Equivalent Mohr-Coulomb strength parameters were derived from these for use with anisotropic strength models in the limit equilibrium analyses and where tensile stresses were likely to occur in the finite element models. The parameters are summarised in Table 13.

For the finite element analyses, the materials were assumed to be elastic-plastic with residual strength parameters equal to peak strengths.

Table 13: Rock mass strength parameters

Material	UCS (MPa)	GSI	mi	Unit Weight (kN/m³)	Cohesion (kPa)	Friction Angle (°)	E Rock Mass (GPa)	v	Rock Mass Tensile[2] (MPa)
Fresh FW Granofels	75	55	20	26	1151	56	13.0	0.3	-0.25
Fresh FW Quartzite	75	53	20	26	1092	56	10.3	0.3	-0.22
Fresh HW Amphibolite	75	58	26	26	1280	59	16.0	0.3	-0.25
Weathered Rock	37.5	32	26	26	572	47	1.6	0.3	-0.02
Fresh HW Quartzite	175	57	26	26	2025	61	29.7	0.3	-0.7
Fresh Laminite	75	64	26	26	1519	58	11.4	0.3	-0.5
Rockfill				20	10	35	0.1	0.3	0

6.3.4 In-Situ Stress Model

The in-situ stress model adopted for the finite element analyses is based on the Mt Isa regional model and is summarised in Table 14.

Table 14: In-situ stress model

Principal Stress	Magnitude (MPa)	Orientation
Major	1.6 x Depth x 0.026	Horizontal E-W
Intermediate	Depth x 0.026	Vertical
Minor	Depth x 0.026	Horizontal N-S

[2] *Rock Mass Tensile Strengths used in this work are 2x Hoek-Brown estimates, based on industry recognition that this underestimates rock mass strengths at very low confining stress.*

6.3.5 Groundwater Model

[redacted]

6.4 Stability Analyses

6.4.1 [redacted]

[redacted]

[redacted]

[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

[redacted]

[3] *DIPS 5.1 – Rocscience, 2013*

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

- [redacted]
  - [redacted]
  - [redacted]
- [redacted]
  - [redacted]
  - [redacted]
- [redacted]
  - [redacted]
  - [redacted]
- [redacted]
  - [redacted]
  - [redacted]

[redacted] [redacted]

[redacted]

- [redacted]
- [redacted]

[redacted].

[redacted]

[4] *SLIDE 5.0. Rocscience, 2010*

[redacted]

[redacted]

[redacted]

[5] *Phase2 v7. Rocscience, 2011.*

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

8 REFERENCES

Carnaby Resources 2020. Amended ASX Announcement – Tick Hill Gold Project Compelling Scoping Study Results. Dated 16 March 2020.

Diatreme Resources Limited 2015. ASX Announcement – Diatreme Pursues Immediate Gold Opportunities as Tick Hill Mining Lease Transfers Approved by Regulator. Dated 24 March 2015.

MIM Holdings Limited 1993. Tick Hill Gold Mine Visit by Asarco Directors. Internal Memorandum dated March 1993.

Rocscience 2010. SLIDE User's Manual. www.rocscience.com

Rocscience 2011. PHASE2 User's Manual. www.rocscience.com

Rocscience 2013. DIPS User's Manual. www.rocscience.com

Appendix A Basic Geotechnical Logs

CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

CA = Core axis
|| = parallel
Foln = foliation

Page 1 of 5 Logged by D. Lewis Borehole TH-007

FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	CORELOSS	R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
60.0	61.0	BIOT-CHL MAG-Hm Fsp SCHIST	SW	VS	4	65°	0%	70%	
61.0	62.0	"	"	VS	4			47	61-61.1 Alb-Mag-Q vein dips 20° E to CA 61.1-61.4 En echelon Alb-Q-Magn late veins @ 35° E
62.0	63.0	"	"	"	4	65-70°		53	62.2-.42 Alb-Q(Hm) vein w/ magn @ margins
63.0	64.0	"	"	"	4			40	63.25-.40 magn vein w/ Alb-Q @ low angle to CA
64.0	65.0	"	"	"	4			21	
65.0	66.0	"	"	"	4	65°		51	65-65.2 Q-Alb-?epid-magn vein - shatters rock
66.0	67.0	"	"	"	4			0	Joints @ 66.4m, shattered rock; magn lamina
67.0	68.0	"	"	"	4	70°		60	67.65-.7 Q-Alb-epid vein w/ magn along margins in fold closure, sub || to foln
68.0	69.0	"	"	"	4			45	68.6-.Hm(2cm) w/ slickenfibres & clay - minor shear
69.0	70.0	"	"	"	4	70°		75	69-69.5 Joint sub-|| to CA w/ slickenfibres @ 30° SW (rel to dip foln)
70.0	71.0	"	"	"	4			66	70.5-71.5 Joint sub-|| to CA, terminated by J @ 71.5m @ 30° E
71.0	72.0	"	"	"	4			39	70.95 Q-magn vein || foln
72.0	73.05	"	"	"	4	70°		34	72.6 Joint
73.05	74.0	BIOT-CHL Hm-HBL -?EPI SCHIST	"	"	3-4			66	73.5-.7 Joint fractures rock
74.0	75.0	"	"	"	3-4			54	74.48 J @ 50° to CA
75.0	76.0	"	"	"	3			53	75.1-.2 J shatters rock
76.0	77.0	QTZITE	"	"	3-4			87	76.0 J @ 45° E to CA
77.0	78.0	"	"	"	2-3			67	
78.0	79.0	"	"	"	2-3			72	
79.0	80.0	"	"		2-3			87	
80.0	81.0	"	MW	"	2-3			66	80.5-80.65 Qtz fractured by conjugate J w/ Hm staining
81.0	82.0	"	"	M-W	2			31	81.45-82.8 Rock shattered by Hm stained fracture zone
82.0	83.0	"	"	M-W	2			0	
83.0	84.0	"	FL	VS	2	55° W		66	
84.0	85.0	"	"	"	2			84	84.2-.45 Joint @ 10° to CA w/ chlor. concs
85.0	86.0	"	"	"	2			85	Joints @ 85.3 / 85.51 / 85.6 / 85.75 / 86.0 / 86.16 30° W / 30° W / 60° W / 55° W / 70° E parallel to foln w/ Hm concs on planes
86.0	87.0	"	"		2		V	62	

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CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

Page 2 of 5 Logged by D Lewis Borehole TH-007

FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	CORELOSS	R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
87.0	87.4	QTZITE	FL	VS	2	50°	0%	90	
87.4	88.0	PSAMMITE	FL	VS	2			94	
88.0	89.0	"	FL	"	2			82	
89.0	90.0	"	FL	"	2-3	60°		90	89.97m J @ 40° E to CA
90.0	91.0	"	SW	"	3	65-70°		90	90.68 J @ 45° E 90.8 J @ 40° E (chlor concs)
91.0	92.0	"	SW	"	4			95	91.4 J @ 50° E w/ chlor concs. Thin Hm wispy veins @ 30° E
92.0	93.0	"	"	"	4	60°		68	92.15 F/J @ 60° E w/ weak magn.
93.0	94.0	"	"	"	2			61	
94.0	94.55	"	"	"	3			65	
94.55	96.0	HGH-SILIC SCHIST @ CHL-ALBITE w/ PYRITE	"		2-3			60	94.55 – 95.2 Faints sub-// to CA w/ chlor concs.
96.0	97.0	"	"		3			100	95.4-.5 Chl-Hm Faults 95.8-.9 Hemon F w/ silic brecciation @ 10° W and Hm slickenfibres @ 55° N (to CA) on plane
97.0	98.0	"	"		3	70°		84	96.3 Q vein w/ chl/Hm on margins @ 45° E
98.0	99.0	"	"		3-4			75	98.2-.3 J1 @ 50° W 98.7 J @ 50° E 98.85 J // Foln
99.0	100.0	"	"		4	70°		91	99.75 J @ 40° W
100.0	101.0	"	"		4			94	100.1, 100.5, 100.28 } Faults @ 45-55° to CA
101.0	102.0	"	"		3	60°		79	101.4 Faint through alt. zone @ 30° E to CA
102.0	103.0	"	"		3-4			100	
103.0	104	Q-(BIOT)-CHL-(ALBITE) SILIC SCHIST	"		3-4	70°		100	
104	105	"	"		3-4			75	104m J @ 40° E 104.5-.6 @ 40° E 105.0 @ 40° E
105	106	"	"		3-4	70°		75	105-105.2 Faint, sub ⊥ to CA (>85°) 105.75 J @ 25-30° E 105.85 J @ 40°
106	107	"	"		4			84	106.1 J @ 35° E
107	108	"	"		4	70-75°		93	
108	109	"	SW		3-4	80°		67	108.45 Js @ 30° E, 45° W } Conjugates
109	110	"	"		3			50	109.0 – Conjugate J's @ 40° E & 40° W 109.5 J @ 35° S (\) w/ Chl-Hm concs.
110	111	"	"		3	65°		92	
111	112	"	"		3-4			77	
112	113.0	SE Hm-Q-B-CHL BANDED SCHIST	MW		4	70°	V	88	

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BASIC GEOTECHNICAL LOG

Page 5 of 5 Logged by [illegible] Borehole TH 007

FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	CORELOSS	R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
[illegible]	[illegible]	CSE Hm-Q-B-Chl BANDED Schist	SW-MW	[illegible]			0%	[illegible]	113-113.6m Joints sub-// to CA @ 10°
[illegible]	[illegible]	"	[illegible]		[illegible]	65°	[illegible]	[illegible]	114.1-114.55m Joints sub-// to CA & 114.35, cut out by J // foln @ 45°N 114.35-.55 J @ 20°E
[illegible]	[illegible]	"	"	[illegible]	[illegible]			[illegible]	
[illegible]	[illegible]	BANDED CSE Q-Hm-Chl-B, BANDED Schist	[illegible]		[illegible]	65°		[illegible]	116.5-116.6 Joint @ 30°E
[illegible]	[illegible]	"	SW		[illegible]			96	117.15-.3 Q vein boudinaged by Chl-Hm complex unit of weak lineation
[illegible]	[illegible]	"	"		[illegible]			63	118.5 J (Hm) @ 20°E
[illegible]	[illegible]	"	"		[illegible]			82	
[illegible]	[illegible]	"	[illegible]		[illegible]	65°		[illegible]	120-120.35 Conjugate Js @ 40°E & 65°W
[illegible]	[illegible]	"	MW		[illegible]			[illegible]	
[illegible]	[illegible]	"	SW	[illegible]	[illegible]			[illegible]	122.05-.2 ? F marked by intense Hm
[illegible]	[illegible]	"	"	[illegible]	[illegible]	65°		[illegible]	
[illegible]	[illegible]	CSE Qtz-Chl-B Hm-rich Schist	"	[illegible]	[illegible]			75	
125.0	[illegible]	"	[illegible]		[illegible]	45°		54	J @ 125.5 } 45°E W) Hm/Chl slickensides parallel & dip to J plane 125.8 }
126.0	127.0	"	"		[illegible]	65°		55	126.45 F // foln w/ Hm-Chl-Clay gouge
127.0	[illegible]	"	"		[illegible]			37	
128.0	129.0	"	"	[illegible]	[illegible]	70°		[illegible]	
[illegible]	130.0	"	"		[illegible]			80	
130.0	131.0	"	"		[illegible]			[illegible]	
131.0	132.0	"	"		[illegible]	75°		57	
132.0	133.0	Q-Chl-Hm & SILIC Schist "Zone"	"		[illegible]			66	132.35 Chl-musc on J plane @ 40°W 132.6 J @ 50°W
133.0	134.0	"	"		[illegible]			95	
134.0	135.0	"	"		[illegible]	70°		65	135.25-139.7 Qtz-Hm-Chl brecciated F-Zone
[illegible]	[illegible]	Q-Hm-Chl BRECCIA	MW	[illegible]	[illegible]			54	135.25-.45 Qtz vein-brecciation assoc. & Shattered Rock & fault breccias
[illegible]	[illegible]	w/ QTZ VEINING	MW	[illegible]	[illegible]			36	136.1-136.5 Fault Zone
137.0	138.0	"	MW-SW	[illegible]	[illegible]			[illegible]	137.25-.5 Small F w/ 1cm offset @ 15°E & CA
138.0	139.0	"	SW	[illegible]	[illegible]	75°		61	* Qtz veins throughout interval shattered by faults
139.0	140.0	"	"	[illegible]	[illegible]			[illegible]	139.7-140.3 Rock shot through w/ Qtz veins & shattered by faults - brecciated

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CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

Page 4 of 5 Logged by [illegible] Borehole [illegible]

FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	CORELOSS	R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
140.0	141.0	"	MW				0%	45	140.32-.7 Rock shattered by (Hm-Chl) stained fractures
141.0	142.0	Hm-Chl Qtz-Epid. Sch. with veining	MW					24	
142.0	143.0	"	MW-SW					52	142.4-.8 Hm-Chl-Epi-Q Qtz veining & assoc breccia vein sub // to CA
143.0	144.0	"	MW-SW			70°		40	143.5 Q-Chl (1cm) vein @ 70° to CA, // Foln
144.0	145.0	"	SW					22	
145.0	146.0	Qtz-Psammite w/ Chl-Hm & Q veins	"		3			64	145.04-145.5 Q+(Hm)-Chl breccia w/ assoc. Qtz vein stockwork 145.04-.15 multi-gen Q-Hm-Chl vein @ 45°W
146.0	147.0	"	"					48	
147.0	148	"	"					68	147-147.5 Conjugate J's @ 40°E & 60°W
148.0	149.0	"	"			60°		69	148.4 J @ 35°E w/ Chl slickenfibres
149.0	150.0	"	"					48	149.3-150.0 narrow fracture @ 10°E w/ Chl/Hm alts along plane
150.0	151.0	Hm-B Chl-Q Schist with veins broken rel. to veining	"					84	
151.0	152.0	"	"			65°		66	151.4 Q-Chl vein // foln
152.0	153.0	"	"		4			90	152.4 Q vein w/ brecc. of host 152.3-.5 Q vein complex & shearing
153.0	154.0	"	"			70°		80	Shear @ 40°E; Veins sub // to CA
154.0	155.0	"	"		4			62	
155.0	156.0	"	MW					44	155-156.45 Rock shattered by series of J's @ 45°W, spaced @ 5-10cm
156.0	157.0	"	SW					63	155.8-156.2 J sub // to CA - conjugate to J?
157.0	158.0	"	"		2-4			93	
158.0	159.0	"	"		4	60°		80	156.45-170.55 Intense brecciation of host rock
159.0	160.0	"	"		3			79	Rel to Qtz veining & faulting
160.0	161.0	Hm-Q Chl-Hm-Qtz F-breccia						65	Sub-rounded / angular clasts of Q-Chl-Hm in Qtz (vein) matrix
161.0	162.0	"			3			81	- generally clast supported
162.0	163.0	"	SW-MW		3			63	
163.0	164.0	"			2	70°		82	
164.0	165.0	"			2			84	
165.0	166.0	"	"		2-3	70°		90	
166.0	167.0	Banded F-Q-B Chl-Gr-Q Schist	"		4			54	166.23 Strong shearing on fault conjugate @ 65°W & 20°E

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CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

Page 5 of 5 Logged by D. Davis Borehole T.007

FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	CORELOSS	R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
167.0	168.0	BANDED F-Q-Bt CSE-Q-Hb CHL-SCHIST	SW-MW				0%	60	
168.0	169.0	"	MW					30	168.45 - 170.6 Rock Shattered in F-zone w/ 87mm thin slickensides
169.0	170.0	"	MW					10	
170.0	171.0	CHL-Amph-B ?Sericite-Q Schist	SW					25	
171.0	172.0	w/ Hbl thin	SW			65°		95	
172.0	173.0	"	"					93	
173.0	174.0	"	"					88	
174.0	175.0	"	"			60°		82	
175.0	176.0	"	"					59	175.5 - 176.75 'Box fold' in Chl-Hbl schist
176.0	177.0	MOTTLED CHL-SER-Q-Hbl SCHIST	"					[illegible]	Joints 176.15 @ 40°E, w/ yellow brown clay; 176.5 J @ 40°E to CA
177.0	177.40	"	"					100	
									EOH 177.40m

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CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

Page 1 of ..... Logged by Deirdre Lewis Borehole Tick Hill TH-010/23.0

FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	% CORELOSS	% R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
20.2	21.0	QTZ-CHLOR SCHIST	MW	M-S	3	70	0%	27.5	* See Drill log for
21.0	22.0	"	MW	M-S	3			0	details of structures
22.0	23.0	"	MW	M-S	3			0	
23.0	24.0	QTZ-CHLOR VEIN/R	MW	VS	3	75		10	
24.0	25.0	"	SW	"	3			10	
25.0	26.0	"	SW	"	3	65-70°		22	
26.0	27.0	"	SW	"	3			14	
27.0	28.0	"	SW	"	3			46	
28.0	29.0	"	SW	-	4	70°		22	
29.0	30.0	QTZ-CHLOR SHIC	SW	W/S	3-4			80	
30.0	31.0	SCHIST "	SW	VS	3-4			43	
31.0	32.0	"	SW	"	3-4	75°		15	
32.0	33.0	"	SW	"	3-4			0	
33.0	34.0	"	SW	"	3-4			26	
34.0	35.0	"	SW	"	3-4	70-75°		42	
35.0	36.0	"	FR	"	3-4			76	
36.0	37.0	" QCHL SCHIST	FR	"	4	80°		77	
37.0	38.0	BRA QCHL	"	"	4			76	
38.0	39.0	EPI-HM FSP PYR SCHIST	"	"	4	80°		56	
39.0	40.0	"	"	"	4			25	
40.0	41.0	"	"	"	4	75°		54	
41.0	42.0	"	"	"	4	80°		41	
42.0	43.0	"	"	"	4	75°		62	
43.0	44.0	"	"	"	4			55	
44.0	45.0	"	"	"	4			72	
45.0	46.0	"	"	"	4	80°		43	
46.0	47.0	"	"	"	4	70-75°	▽	54	

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CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

Page 2 of 3 Logged by D Lewis Borehole TH-010

FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	CORELOSS	R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
47	48	Felsic Sil Q-F-B Schist w Pyr Alun	FR	VS	4		0%	43	
48	49	"	"	"	4	80°		65	
49	50	"	"	"	4			51	
50	51	"	"	"	4			62	
51	52	"	"	"	4	75°		60	
52	53	"	"	"	4			85	
53	54	"	"	"	4	75°		85	
54	55	"	"	"	4			78	
55	56	"	"	"	4			79	
56	57	Q-F-B Sil Sch "	"	"	4	75°		31	
57	58	"	"	"	4	65-70°		40	
58	59	"	"	"	4			62	
59	60	Q-F-B Sil Sch w Pyr Alun	"	"	4			79	
60	61	"	"	"	4	80°		76	
61	62	"	"	"	4			80	
62	63	"	"	"	4	80°		66	
63	64	"	SW	"	4			24	
64	65	"	"	"	3	75°		60	
65	66	"	"	"	3			45	
66	67	"	FR	"	4	70°		75	
67	68	Q-Fm Schist "	"	"	4			66	
68	69	"	SW	"	4			58	
69	70	"	SW	"	4	65°		13	
70	71	QCA Carbonaceous Green	HW	W	5			41	
71	72	Carbs Scap-Qtz	HW	W-M	5	75°		50	
72	73	Fm Sil-F Q-Qz-F	FR	S	4	70°		68	
73	74	Calc-Silicate	"	VS	4			50	

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CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

Page 3 of 3 Logged by D Lewis Borehole T4-010

FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	CORELOSS	R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
74	75	Q-F-CH CALC-SILICATES	FR	VS	4		0%	60	
75	76	"	"	VS	4	70°		75	
76	77	"	"	VS	4			76	
77	78	"	"	"	4	70°		72	
78	79	"	SW	"	4			78	
79	80	F-Hm CH-Q SCHIST	"	"	4	75°		44	
80	81	w/ QTZ VEINS	"	"	4			20	
81	82	"	MW	"	4	80°		62	
82	83	"	"	W/M	4			41	
83	84	"	FR/M	VS	4	80°		63	
84	85	"	"	VS	4			70	
85	86	"	"	"	4	75°		53	
86	87	"	"	"	4			70	
87	88	"	"	"	4	70-75°		72	
88	89	"	HW	W	5			90	
89	90	"	MW	W/M	4	75°		60	
90	91	Hm-F-Q-CALC SCHIST	FR/M	S	4	75°		62	
91	92	w/ BRECC + CALC-SILICATES	MW	S(W)	4	65-70°		48	
92	93	"	FR/M	S	4			20	
93	94	"	"	S	4	70°		50	
94	95	"	SW	S	4			80	
95	96	" QTZITE	FR	S(M)	4	70°		21	
96	97	"	"	VS	4			52	
97	98	"	"	"	4			33	
98	98.9	"	"	"	4			24	

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CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

Page 1 of 8 Logged by C.T. Borehole TH021

FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	CORELOSS	R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
35.5	36	B-HB-F-Q SCHIST	FL	S	2	IRREG FOLDED -SUB// TO CA	NIL	0	- foliation irreg, & often sub // CA, with
36	37							50	partings // Fol^n, hem-carbonate
37	38							50	filled faint fracts ≈ 10°/CA
38	39							60	& 60-80°/CA.
39	40							50	
40	41			M				0	
41	42		FR	W		SPRG SHEARING		20	41-41.7 - ductile shear, strong hem-
42	43			S				30	(chl) alteration; crumbly, greasy, slickensides
43	44			S				10	42.4 - ductile shearing along Fol^n -
44	45	B-F-Q SCHIST		M	2			0	- 2nd fold, phases (F3?)
45	46			S		60°		60	
46	47					~65°		100	
47	48					IRREG FOLDED		80	48.2 faint ≈ 15°/CA.
48	49	F-Q-B(CHL) SCH			2-3			50	48.7-48.9 - sheared, ductile, hem/chl.
49	50							30	parting sub// Fol^n common.
50	51							40	
51	52							30	
52	53	B(CHL) F-Q SCHIST			3			80	
53	54							50	
54	55							90	
55	56	B(CHL) F Q SCHIST				65°		90	
56	57					70		20	
57	58					70°		90	
58	59	HB-B(CHL) F-Q-HEM DEMAGF			2-3	IRREG FADED		20	
59	60							20	
60	61							90	- brecciate, carbonate hem, cement. - 61.0-61.2.
61	62							80	
62	63							100	

Golder Associates

CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

Page 2 of 8 Logged by C.T Borehole TH 021

FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	CORELOSS	R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
63	64	QTZ VEIN	FR	M-W	2	↓	NIL	20	
64	65	SHEARED & BRECC		↑		60°		70	
65	66	ZONE				FAULT BRECCIA		10	-64.9 – 68.0 - strongly brecciate,
66	67							0	angular to sub angular clasts of red rock altd f-g chl-hem granofels
67	68			↓	↓			30	in hem-chl-carbonate matrix
68	69	↓		S-M	2			20	- weakly brecciate 68.0 – 70.0
69	70	F-CHL-Q MAGN (OP) HEM GRANOFELS				↓		20	↓ ↓
70	71					75°		50	
71	72					75°	↓	0	71.5 -73 – weakly brecciate
72	73			↓		75°	20cm CORELOSS	10	& finely fractured
73	74			S	↓	INTERFL	NIL	50	- strongly crenulate (F3?) 73.8 –
74	75					67°		70	
75	76					65		50	
76	77	↓				INTERFL & FOLDED		80	
77	78	MG-DARK GRY F-G HEM SCHIST			2			100	
78	79							100	
79	80					↓		100	
80	81					62°		90	
81	82	↓ BIO-F				68°		60	
82	83	Q. SCH.				60		80	
83	84					65		40	
84	85	↓			↓	65		50	
85	86	BRECC) Q-F SCHIST			3	60		60	
86	87					60		70	
87	88				↓	55		90	
88	89	↓			2-3	65		100	
89	90	AS ABOVE WITH	↓		↓	BRECC + FOLD		60	
90	91	QTZ VEINS		↓		↓	↓	90	

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CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

Page 3 of 8 Logged by Q-T Borehole TM021

FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	CORELOSS	R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
91	92		RR	S	2-3	IRREG FOLDED	NIL	100	
92	93							100	
93	94							100	
94	95					50		100	
95	96	F-MS(CH) Q-MAG.			1	60		100	
96	97					65		80	
97	98	B-F-G HSM			3	70		90	
98	99					65		50	
99	100					70		70	
100	101	F-Q-(CH) (MAG) (PR)			1-2	75		60	100.5, 101.5-7 - broken core
101	102	GRAPHITIC				66		40	102.8-103 - strong jointing 20°/CA
102	103					IRREG (FOLDED)		50	
103	104							100	
104	105	B(CH)F-Q SCHIST				70		100	
105	106					75		100	
106	107					77		100	
107	108					70		90	
108	109					72		60	
109	110					60		50	
110	111					62		70	
111	112	B(CH) Q-F SCHIST			3	FOLDED 30°		100	
112	113					70		100	
113	114					60		90	
114	115					60		90	
115	116					IRREG & FOLDED		70	
116	117	B-F(CH) Q-F SCH			1-2			100	
117	118	F Q(CH) GRANOF			1			90	
118	119	MB(CH) MAG Q GRANOF			1			60	

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CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

Page 4 of 8 Logged by C.T Borehole TH021

FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	CORELOSS	R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
119	120	F-MAG. HM (MHS) (CHL)	FR	S	1	↓	NIL	100	- very occasional joint throughout - wk parting
120	121	~~GRANOF~~ ~~SCHIST~~ HG F MAG GRANOF	|	|	|	60	|	80	
121	122	|	|	|	|	65	|	30	// foliation
122	123	|	|	|	|	65	|	50	- jo
123	124	↓	|	↓	↓	65	|	90	124.5 - joint sub// CA broken core
124	125	~~QVEIN~~	|	M-W	1	50	|	30	
125	126	F-CHL (HB) EP Q GRANOF	|	S	|	30-45 FOLIED	|	80	
126	127	|	|	|	|	60	|	80	
127	128	|	|	|	|	65	|	90	
128	129	|	|	|	|	70	|	70	
129	130	|	|	|	|	72	|	80	
130	131	↓	|	|	↓	66	|	40	- conjug. joints 42°/38° to CA
131	132	QTZITE ~~FELS~~ (MSH) (CHL)	|	|	1	65	|	60	
132	133	↓	|	|	|	66	|	20	132-133 - joints ≈ 10-20°/CA.
133	134	F-MAG. CHL (HB) Q GRANOF	|	|	|	66	|	80	
134	135	↓	|	|	|	65	|	40	- joint sub// CA
135	136	Q(F)(HM) (CHL) SCH SCH	|	|	|	65	|	20	- " "
136	137	F-Q (CHL) SCAP GRANOF	|	|	|	60	|	50	- joints sub// CA to 10°/CA
137	138	Q-F(CHL) SCAP GRANOF	|	|	|	65	|	30	
138	139	↓	|	|	↓	65	|	50	138.5 - hematite filled joint 20°/CA
139	140	~~QV~~	|	|	|	60	|	40	
140	141	~~QV~~	|	|	|	70	|	50	
141	142	~~QV~~	|	|	|		|	40	141.5 - joint ≈ 15°/CA
142	143		|	|	|	70	|	40	
143	144	F-MB(CHL) HM MAG (CHL)	|	|	↓	65	|	90	
144	145	GRANOF	|	|	|	65	|	60	
145	146	↓	|	|	↓	68	|	40	145.4 - joint ≈ 20°/CA.
146	147	QTZ VEIN	↓	↓	↓	72	↓	90	

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CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

Page 5 of 8 Logged by CT Borehole TH021

FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	CORELOSS	R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
147	148		FR	S		70	NIL	80	149-152 - core broken
148	149	F-HEM EP-CHL CHU Q		W S		60		100	
149	150	GRANODIORITE		M-W				60	149.5-150 - jointing with some
150	151			M				40	ductile shearing sub// CA
151	152			M				50	151.8 - 152.2 - broken core again
152	153	F-HEM CHL-CP Q GRANO		M				60	with jointing sub// CA
153	154			S		67		100	
154	155					65		20	154-155 - jointing sub//CA (≈ 10°) chl. filled
155	156					55		90	154.2 → 159.4 - brecciated zones
156	157					55		90	with pink feldspar annealing around
157	158					55		40	hematite chl. clasts. 157-158 - joint - sub//CA
158	159					50		50	
159	160	HB-BIOTITE F-Q-SER GRANOD			2-3	DEEPLY FADED		70	
160	161					45		90	
161	162					50		80	
162	163					60		90	
163	164					52		90	
164	165	~~GRANOD~~				60		70	
165	166					55		50	165.0 - 167 - jointing sub//CA
166	167					60		60	
167	168					56		80	
168	169					58		70	
169	170				2	56		100	
170	171			M		60		50	170.6 ≈ 177.0 - common fol^n parting
171	172			M		56		30	171.6 - 171.8 - jointing ≈ 20°/CA, sub// fol^n
172	173			M	3	64		60	
173	174			S		54		50	
174	175	HB-BIOTITE F-Q SCH			2-3	60		50	

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CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

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FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	CORELOSS	R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
175	176		FR	S	2-3	65	NIL	40	
176	177					68		90	
177	178					61		70	
178	179					61		80	
179	180					62		70	
180	181					58		80	
181	182					64		100	
182	183					64		90	
183	184					62		90	
184	185	F-HEM (HG-EPM) (MAG)				66		80	- brecciated fract, 10°/CA opp foli
185	186	GRANOF				52		90	
186	187					60		70	
187	188					60		50	
188	189					50		30	- mod jointing sub ∥ CA. (≤10°
189	190	RHL-MAG F-Q-HEM SILIC			1	50		80	
190	191	MAGN. GOTHITE)				62		80	
191	192	GOTHITE (HGB)				65		50	
192	193				2	64		30	192.8 - jointing 20°/CA
193	194				1	60		40	
194	195					66		60	194.3 jointing 10°/CA
195	196	HB/CHL FELD-HEMATITE				63		100	
196	197	SCHIST				65		90	
197	198	SIL. CHL/ SER. HEM (F) SCHIST				70		100	
198	199	+THIN BANDS FOLIA				68		60	
199	200	FELD-QTZ				70		90	
200	201	(HB)(ES)				76		90	
201	202					70		90	
202	203					73		90	

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CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

Page 7 of 8 Logged by..... Borehole.....

FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	CORELOSS	R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
203	204	↓	FR	S	1	68	NIL	80	
204	205	Q-CHL-HEM-F		S	2	72		60	- jointing 70°/CA
205	206	(CHL/SER) SILICIFIED SCHIST		M-W	1	68		100	
206	207	CHL/SER SH SCH F-Q				78		50	≈ 206m — 214 - strongly expansive
207	208					60		40	clays (chl/ser altn) → strong
208	209					60		40	cleavage parting & fracture
209	210	CHL/SER HM SH SCHIST		S	3-4	50		100	214 — 230 - mod-strong
210	211	CHL(BIO) F-Q HM SCHIST		M-W		72		60	parting, expansive clays
211	212			M		72		60	
212	213			W		70		30	212-214 - strongly broken core
213	214			W		65		0	(decay by exp. clays)
214	215	QTZ VEIN		S	1	65		70	
215	216	HM-CHL-F-Q SH		W	4	65		10	
216	217	WHITE Q-F VEIN		S	1	65		100	
217	218	(CHL/SER)		S		65		90	
218	219			S-W		65		90	
219	220	Q-F-W CHL/SER HEM SH SCHIST		S-W	3-4	70		40	
220	221			S-W		72		50	
221	222			S-W		72		70	
222	223	QTZ VEIN Q-F		S	1	70		90	
223	224	Q-CHL/SER HEM-F SH SCH		S	1	70		80	
224	225			M-W		70		50	
225	226			M		65		60	
226	227			M-W		72		60	
227	228	F-Q-BIO (CHL) HEM SCHIST		W	4	70		20	
228	229			M		55		40	
229	230			M		70		40	
230	231	QTZ VEIN (FLOG)		M-S	1	70		60	

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CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

Page 8 of 8 Logged by CT Borehole TH021

FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	CORELOSS	R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
231	232	BIO(CHL) HORN HTL SCHIST	FR	S-M	4	60°	NIL	40	
232	233			M-W				30	- strongly brecciated with
233	234							0	large partially melted
234	235							10	sub ang clast of chlorite
235	236							0	schist in hem-ch (fault)
236	237					65		90	matrix - fault zone.
237	238					50		100	
238	239					50		70	
239	240	QTZ (FWB)		S	1	70		80	
240	241			S-M	1	VARIABLE		80	
241	242	SCHIST AS ABOVE		S-M	4			60	
242	243	QTZ (FWB)		S	1	55-60		50	
243	243.4			S	1	"		-	

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CARPENTARIA GOLD PTY. LTD.

BASIC GEOTECHNICAL LOG

Page 1 of 4 Logged by: M. Sapp 14-7-90 Borehole : THO 23

FROM:	TO:	ROCK TYPE:	WEATHERING:	ROCK STRENGTH	BEDDING FOLIATION	C.B.A.	CORE LOSS	R.Q.D	REMARKS SHEAR ZONES, JOINTING ETC.
48	49		FR	S	3	590	—	76	x2 joint directions ≈ 25° sub-parallel & perpendicular to bedding.
49	50		FR	S	3	63°	—	60	
50	51		FR	VS-S	3	61°	—	64	3rd joint direction subparallel to core axis 2-3 every metre
51	52		FL*	VS	3-4	64°	—	88	* slight lim. staining at 51.9 m haem. in fractures.
52	53		FL SS Colour	S	3-4	66°	—	95	
53	54		FR	S	3	63°	—	92	
54	55		FR	S	3	65°	—	75	
55	56		FR	S*	3	66°	—	52	* VS at 55.6m
56	57		FR	S	3	64°	—	84	
57	58		FL	S	3	66°	—	68	58.2m 1cm band of chl/ser. clay crumbles when exposed to water x3 distinct joint directions 5° per metre
58	59		FL	S	3	67°	—	77.	
59	60		FR	S	3	67°	—	83	
60	61		FR	S	3	70°	—	92	
61	62		FL	S	3-2	69°	—	71	well fractured between 161.9 & 162m.
62	63		FR	S	3-2	70°	—	63	joining becomes more freq. - insipient fractures fine hairline fractures from 62m → 65m
63	64		FL	S	2-3	72°	—	82	
64	65		FR	S	2-3	71°	—	81	
65	66		FR	VS	2-3	73°	—	57	
66	67		FR	VS	2-3	72°	—	97	pockets of unsilicified material ~0.5cm throughout decreasing in size → 67m. x3 direction of joints as before 5° per metre
67	68		FR	VS	2-3	70°	—	91	
68	69		FR	VS	2	68°	—	88	fine fractures from 69 - 69.5m.
69	70		FR	VS	2	69°	—	91	
70	71		FR	VS	2	68°	—	68	
71	72		FR	VS	2	68°	—	85	
72	73		FR	VS	2	70°	—	89	
73	74		FR	VS	2	70°	—	99	
74	75		FR	VS	2	71°	—	86	
75	76		FL	VS	2-3	69°	—	69	smooth joint surfaces stained with lim / haem etc.
76	77		FL	VS	2-1	72°	—	92	
77	78		FL	VS	1	74°	—	57	
78	79		FL	VS	1	74°	—	64	
79	80		FL	VS	1	70°	—	36	
80	81		FL	VS	1	69°		41	

CARPENTARIA GOLD PTY. LTD.

BASIC GEOTECHNICAL LOG

Page 2 of 4 Logged by: J. Cooper 14-7-90 Borehole : TH023

FROM:	TO:	ROCK TYPE:	WEATHERING:	ROCK STRENGTH	BEDDING FOLIATION	C.B.A.	CORE LOSS	R.Q.D	REMARKS SHEAR ZONES, JOINTING ETC.
81	82		FR	VS	1	68°	—	93	
82	83		FL	VS	1	68°	—	86	slightly more joints per metre irregular stepped surfaces. sub-par. / perpendicular to bedding & sub-parallel to core axis
83	84		FR	VS	1-2	66°	—	94	
84	85		FR	VS	1	66°	—	77	
85	86		FL	VS	1	73°	—	98	
86	87		FR	VS	1	71°	—	37	broken core between 86.2 → 86.7M
87	88		FR	VS	1	65°	—	94	fine brittle fractures - insipient at 87.7m → 88M.
88	89		FR	VS	1	66°	—	65	not freq. joints → 91m strongly stained with wash.
89	90		FR	VS	1	61°	—	84	
90	91		FR	VS	1-2	63°	—	79	
91	92		FL	VS	1-2	62°	—	90	V3 joint directions 3 per metre
92	93		FR	VS	1-2	62°	—	92	
93	94		FR	VS	1-2	62°	—	94	
94	95		FR	VS	1-2	62°	—	94	
95	96		FL	VS	1-2	61°	—	94	
96	97		FR	VS	1-2	61°	—	87	insipient fractures at 96.8M.
97	98		FR	VS	2	66°	—	77	
98	99		FR	VS	2	68°	—	84	
99	100		FL	VS	2	67°	—	89	broken core at 99.75 for 10cm joints become less freq.
100	101		FL	VS	2	65°	—	84	
101	102		FL	VS	2	64°	—	98	
102	103		FL	VS	2	65°	—	100	
103	104		FL	VS	2-3	67°	—	89	
104	105		FR	VS	3	69°	—	58	Regular jointing.
105	106		FR	VS	3	71°	—	85	
106	107		FR	VS	3	68°	—	92	
107	108		FR	VS	3-2	67°	—	98	
108	109		FR	VS	3	71°	—	81	
109	110		FR	VS	3	72°	—	88	
110	111		FR	S	3	73°	—	83	insipient fractures & stained joints
111	112		FR	S	3	69°	—	97	
112	113		FR	S	2	71°	—	98	
113	114		FR	S	2	70	—	94	

CARPENTARIA GOLD PTY. LTD.

BASIC GEOTECHNICAL LOG

Page 3 of 4 Logged by: JLS 14-7-98 Borehole : TH023

FROM:	TO:	ROCK TYPE:	WEATHERING:	ROCK STRENGTH	BEDDING FOLIATION	C.B.A.	CORE LOSS	R.Q.D	REMARKS SHEAR ZONES, JOINTING ETC.
114	115		FR	S	3	74°	—	97	x3 direction of joints good surfaces
115	116		FR	S	3	74°	—	93	
116	117		FR	S	3	71°	—	80	
117	118		FL	S	3	73°	—	93	
118	119		FL	VS	2	71°	—	98	
119	120		FL	VS*	2	73°	—	97	* with bands of weak altered rock at 118.9 → 119.2 M
120	121		FL	VS	2-3	72°	—	90	
121	122		FL	VS	2-3	75°	—	72	
122	123		FL	VS	2-3	74°	—	81	
123	124		FR	VS*	2-3	73°	—	98	* weathered in places by alteration causing loss in strength.
124	125		FR	VS	2	74°	—	69	less jointing from 124.5M. 3 direction
125	126		FR	VS	2	74°	—	78	
126	127		FR	VS	2	71°	—	96	
127	128		FR	VS	2	70°	—	93	
128	129		FR	VS	2-3	73°	—	89	
129	130		FR	S	2-3	74°	—	92	
130	131		FR	S	2-3	73°	—	99	130.2 insig. fractures
131	132		FL	S	3	74°	—	92	
132	133		FR	S	3-4	68°	—	65	bands of clay 5-8mm crumbles when exposed to water. - bands of unsilicified material well developed joints
133	134		FR	S	3	72°	—	59	band of clay at 133.95 → 134 M.
134	135		FR	S	3	74°	—	99	
135	136		FR	S	3	73°	—	53	broken core at 135.75-135.85M.
136	137		FR	S	3	72°	—	83	
137	138		FR	S	3	73°	—	88	
138	139		FR	S	3	73°	—	77	broken core from 138.85 → 142 M. uneven fracture surfaces with kinks/chl. etc.
139	140		FR	S*	3	74°	—	26	* bands of clay 8cm at 139.5 & 139.6 VS material!
140	141		FR	S	3	78°	—	57	
141	142		FR	S	3	77°	—	36	
142	143		FR	S*	4	75°	—	22	* at 142.7-150m of VW clay crumbled when exposed to water
143	144		FR	S	3-4	74°	—	68	
144	145		FL	S	3	74°	—	67	144. → 144.2 v. broken core.
145	146		FL	S	2	76°	—	85	
146	147		FR	S*	3	75°	—	73	* VS at 146.9 → 147.1 - clay

CARPENTARIA GOLD PTY. LTD.

BASIC GEOTECHNICAL LOG

Page 4 of 4 Logged by: J. Cope 14-7-90 Borehole : TH023

FROM:	TO:	ROCK TYPE:	WEATHERING:	ROCK STRENGTH	BEDDING FOLIATION	C.B.A.	CORE LOSS	R.Q.D	REMARKS SHEAR ZONES, JOINTING ETC.
147	148		FL	S	3	77°	—	72	8 clusters of joints 35° as before stained with haem
148	149		FL	S*	3	78°	—	84	bands of clays crumble when exposed to water from 148.6 → 149.1 1-2mm wide. ch
149	150		FR	S*	3	75°	—	90	* mk 'N' clay bands - weakness also caused by unsh. normal.
150	151		FR	S	3-2	77°	—	95	
151	152		FR	S	3	76°	—	99	
152	153		FR	S	3	75°	—	95	clay band 1cm at 152.85 - dark green ch
153	154		FR	VS	3	74°	—	99	
154	155		FR	VS	3-2	79°	—	92	
155	156		FL	VS	3	76°	—	98	
156	157		FL	S	3	75°	—	98	light green ch. clay band 2cm at 157.2m & again 2cm at 157.8m
157	158		FL	S*	3-4	77°	—	81	* thin bands of clays weathering from 158.15m 1-2cm → 158.7m
158	159		FL	S*/g	3-4	78°	—	87	158.7m → 158.85 zone of extensive clays crumbled when exposed to water

CARPENTARIA GOLD PTY. LTD.

BASIC GEOTECHNICAL LOG

Page 1 of 3 Logged by: J. COPE 14-7-90 Borehole : THO24

FROM:	TO:	ROCK TYPE:	WEATHERING:	ROCK STRENGTH	BEDDING FOLIATION	C.B.A.	CORE LOSS	R.Q.D	REMARKS SHEAR ZONES, JOINTING ETC.
6	7		EW	VW	4*	–	–	0	* induced by weathering highly chlorinized & crumbly -
7	8		EW	VW		–	–	0	-
8	9		HW	VW		45°	–	0	
9	10			VW		47°	–	0	2 joint directions seen - sub-parallel & perpendicular to bedding - highly frequent. Thin bands of clays ≈ 10m
10	11			VW		49°	–	0	occur at ≈ 11.4 → 11.6m
11	12			W		52°	–	0	
12	13			W		54°	–	0	
13	14			W		55°	–	35	bands of clay from 14.85 - 15m
14	15			M		56°	–	26	W at 14m → 14.4m.
15	16			W		57°	–	0	occasional thin clay bands sub-parallel (?L) to foliation
16	17			M		56°	–	40	soft bands – highly weathered
17	18			M		58°	–	41	
18	19			M		56°	–	46	3 joint direction sub-parallel, perpendicular to foliation and sub-parallel to core axis very uneven, weathered surfaces
19	20			M*		58°	–	0	* very fractured – broken core between 19m → 19.25m Thin bands of chlorite to foliation
20	21			M		59°	–	47	Thin bands (mm's) of chlor/sericite clays at 20.9 → 21m
21	22			M		58°	–	57	very broken & weak end core at 21m – 21.2m.
22	23			M		59°	–	33	Thin clay bands
23	24			M		61°	–	37	
24	25			M*		59°	–	52	* weak bands especially at 24.5m
25	26		MW	M		60°	–	75	broken core – 25.85 → 26m – green chlorite occurs throughout fracturing
26	27			M-S	3	60°	–	40	with hearn Thin banded clay at 26.55m
27	28			M-S*	3-2	61°	–	0	* very broken – hearn. seen in fractures
28	29			M-S	2	61°	–	19	3 joint directions seen fractures weathered with hearn
29	30			M-S	2	62°	–	32	
30	31			S	2-3	64°	–	39	
31	32			S*	2	62°	–	0	* very broken up
32	33			S	3	64°	–	12	
33	34			S	2	66°	–	16	chlor. hearn. & ~~[illegible]~~ seen in fractures
34	35			S*	2-3	67°	–	14	* with weak bands v. broken
35	36			S	3	64°	–	0	v. broken
36	37			S	3	64°	–	11	v. broken 36.8 extensive clays
37	38			S	2-3	62°	–	18	v. broken
38	39			S	3	61°	–	0	v. broken

57 weak
FL

CARPENTARIA GOLD PTY. LTD.

BASIC GEOTECHNICAL LOG

Page 2 *of* 3 *Logged by :* J. COPE 14-7-90 *Borehole :* TH024

FROM:	TO:	ROCK TYPE:	WEATHERING:	ROCK STRENGTH	BEDDING FOLIATION	C.B.A.	CORE LOSS	R.Q.D	REMARKS SHEAR ZONES, JOINTING ETC.
39	40		MW	S	2	65°	–	0	v. broken, – haem, lim & chlorite weathering
40	41		↓	S	2-3	67°	–	10	v. broken – ↓
41	42		SW	S*	3	65°	–	25	* weak bands due to clays – highly foliated Thin bands (mm's) begin at 41.1 – continue at irregular intervals through to 48.
42	43			S*	2-3	67°	–	32	* w. bands – crumble on exposure to water end of clays at 42.64
43	44			S	3-2	66°	–	53	
44	45			S	2	64°	–	85	
45	46			S	3	66°	–	68	
46	47			S	2	65°	–	44	broken core at 46.1 → 46.5M highly chlor. joints
47	48			S	2	67°	–	82	fractures highly stained with haem.
48	49			S	2	67°	–	48	3 directions of jointing – sub-parallel, perpendicular to bedding & subpar to core axis stained (boudinaged) Qz. veins at 48.2
49	50			S	2	65°	–	53	Qz veins become stat freq.
50	51			S	2	62°	–	44	v. broken at 50.5 – 50.6M
51	52			S	3	64°	–	58	broken in places at beginning & end of metre – silicified Qz. veins
52	53			S*	2	64°	–	25	* few weak bands highly chlorinized clays
53	54			S	2	64°	–	29	v. broken from 53.5 → 54M
54	55			m-S	2	65°	–	75	* weak bands clays – crumbles when exposed to water at 54.5 ≈ 2cm wide & again (1cm) bands from 55.8M → 56M
55	56			S	3	67°	–	54	at regular intervals – containing chlor. & biotite
56	57			S	2-3	66°	–	95	↓
57	58		↓	m.s	2-3	68°	–	74	
58	59		↓	S	2*	69°	–	63	* Thin broken bands ≈ 2cm at 58.3 → 58.5 & thicker bands from 58.55 → 59.3M crumbles when exposed to water
59	60		↓	S	2	68°	–	88	59.9 fractures with haem
60	61		FL	S	2	65°	–	84	60.10M → 60.1 chlor. clays – 3 joint directions
61	62			S	2	67°	–	49	v. broken at 61.5 → 62.9 weathered with lim. & haem
62	63			S	2	68°	–	10	v. broken. regular clay bands ≈ 0.5cm wide
63	64			S*	2	64°	–	83	* Thin weak bands
64	65			S*	2-3 (1)	63°	–	87	* as above – causing foliation ↓ 65.9
65	66			S*	3	66°	–	95	* as above
66	67			S	2	67°	–	58	broken at 66.5 → 67.
67	68			S	2	66°	–	64	3 direction of joints 35° sub-parallel & perpendicular to bedding
68	69			S	2	67°	–	86	68.8 fractures ~~stained~~ with haem.
69	70			S*	2	65°	–	79	* Thin weak clay bands starting at 69.1 ≈ 0.5cm until 72.5 at 72.5 large band
70	71			S* ↑	2-3	69°	–	69	* as above ≈ 10cm wide of chlor clays & biotite
71	72		↓	S*	2-3	66°	–	63	↓

CARPENTARIA GOLD PTY. LTD.

BASIC GEOTECHNICAL LOG

Page 3 *of* 3 *Logged by:* J. COPE 14-7-90 *Borehole :* TH024

FROM:	TO:	ROCK TYPE:	WEATHERING:	ROCK STRENGTH	BEDDING FOLIATION	C.B.A.	CORE LOSS	R.Q.D	REMARKS SHEAR ZONES, JOINTING ETC.
72	73		FL	S*	2-3	70°	–	92	* weak rock bands of crumbly chlor. clays
73	74		↓	S-VS	1-2	68°	–	57	broken & well jointed (x3 directions) ↓
74	75		↓	S-VS	1-2	69°	–	12	v. broken ↓
75	76		↓	S-VS	2	70°	–	12	V. broken ↓

CARPENTARIA GOLD PTY. LTD.

BASIC GEOTECHNICAL LOG

Page 1 *of* 3 *Logged by :* F. COPE *Borehole :* TH025

FROM:	TO:	ROCK TYPE:	WEATHERING:	ROCK STRENGTH	BEDDING FOLIATION	C.B.A.	CORE LOSS	R.Q.D	REMARKS SHEAR ZONES, JOINTING ETC.
6	7		EW	VW		–	–	0	very broken & weathered core strongly stained with haem, WM ach
7	8		EW	VW		–	–	0	-
8	9		EW	W	3-4	–	–	0	jointing vaguely seen - still very broken
9	10		HW	M*	4	64°	–	15	* very broken & crumbly in places but strong material.
10	11		MW	M-S*	4	65°	–	0	x3 direction of joints ± 30-35° sub-parallel perpendicular to bedding x 1 direction sub-parallel to core axis
11	12		MW	M-S	4	62°	–	31	More core v. broken
12	13			M-S*	4	64°	–	0	
13	14			M-S	3-4	–	–	0	
14	15			S	3	–	–	0	
15	16			S	3	66°	–	26	
16	17			S	3	–	–	0	
17	18			S	3	65°	–	0	
18	19			M-S*	3	–	–	0	* as above very broken core
19	20			S*	3?	–	–	0	very broken core
20	21			S	?	–	–	0	very broken core
21	22			S*	4	64°	–	11	* strong but certainly crumbled altered bands at 20.85 - 21.7m * again at 21.8m very chl/ser joints - 3 directions as above
22	23			S	4	66°	–	12	occurring freq, sub-irregular joint surfaces
23	24			m	3	64°	–	10	
24	25		MW	S	3	67°	–	44	24.3 very crumbly haem stained mat. in joint perpendicular to bedding
25	26			M-S	3	66°	–	46	25.6 - 25.7 - zone with altered clays crumbled when exposed to water
26	27			S	3-4	67°	–	0	at 26.9 – 27.15 zone of clay mat. x3 joints > 5-6 per metre
27	28			S	3-4*	68°	–	26	* due to clay bands & [illegible] when exposed to water at 27.6 for 5cm
28	29			S	4	66°	–	32	well jointed from 28-28.4m clay at 28.5 - 28.6 occurring in thin bands
29	30		SW	S	4-3	68°	–	39	clay - crumbled chl/ser at 29.2m for 1cm. Very thin bands mat's until 29.7m.
30	31			S	3-4	69°	–	60	3 joint directions 4 per metre as above
31	32			S	3	64°	–	69	
32	33			S	2-3	68°	–	70	zone of clays at 32.7 - 32.8m.
33	34			S	2-3	69°	–	52	clays at 33.3m
34	35			S	3	69°	–	53	dark green clay band 1cm at 34.5m again at 34.75m
35	36		MW	S	3	70°	–	38	Slickensides in chl.
36	37			W	3	66°	–	17	* very disturbed bedding - very broken core very altered beginning at 35.9m
37	38			W	4	61°	–	37	sheared bands occur among clay alteration until 38.5m.
38	39		38.5 MW	W	4-3	62°	–	31	x3 joints stained with haem & [illegible]

CARPENTARIA GOLD PTY. LTD.

BASIC GEOTECHNICAL LOG

Page 2 *of* 3 *Logged by:* J. COPE *Borehole :* TH025

FROM:	TO:	ROCK TYPE:	WEATHERING:	ROCK STRENGTH	BEDDING FOLIATION	C.B.A.	CORE LOSS	R.Q.D	REMARKS SHEAR ZONES, JOINTING ETC.
39	40		MW	S	4	61°	—	50	Thin clay bands 1mm ± at 39.1 & 39.3 – 39.35
40	41		↓	S	4-3	63°	—	24	- clay very white + bio. at 40.1M
41	42		SW	S	4-3	62°	—	84	joints >5 per metre & orientation
42	43			S	3	—	—	0	v. broken core
43	44			M-S	3-4	64°	—	47	crumbly bands at 43.35M for 5cm stained with hacm.
44	45		↓	S	3	59°	—	47	bio./clay at 44.4 for 10cm
45	46		MW	S*	4	62°	—	87	less jointing & ~~weak~~ bands causes max. to be after 45.5 – 46.2 clay crumbles
46	47			M-W	4	63°	—	62	weakness due to crumbly clays occurring in bands ± 1cm throughout until 47.9
47	48			M*	4	64°	—	72	
48	49			S	3	65°	—	32	very broken 48.8 → 49.7 stained with hacm & bio.
49	50			S	3	66°	—	86	bands of crumbled clays at 49.9m → 50.1
50	51			W	4	64°	—	60	occur reg. 100's cm. Very altered at 50.9 51.1 → broken core until 51.8M
51	52		↓	S	3	63°	—	22	clay at 52.2 – 52.3 less joints in typical 3 directions.
52	53		SW	S	3-2	66°	—	57	* few chl/ser clay bands
53	54			S	3-2	67°	—	50	alteration of 53M → clays
54	55			S	2	69°	—	66	few MM's bands of clay until 55.7M
55	56		↓	S	2-3	64°	—	45	
56	57		FL	S	3	66°	—	38	
57	58		MW	W	4-5	65°	—	86	extensive crumbled clays until 59.1 59.1 → insignificant fracture
58	59		FL	W	2	68°	—	28	
59	60		FL	S	2-1	67°	—	72	
60	61		FL	S	1	68°	—	89	few insig. fractures few joints,
61	62		FL	S	1-2	68°	—	83	~~[illegible]~~
62	63			S	2	71°	—	65	
63	64			S	2*	71°	—	88	* clay bands at 63.3 → 63.75 MM's - crumble with water
64	65			S	3	69°	—	59	few crumbled bands at 64.8 – 65M.
65	66			S-VS	3	70°	—	29	broken silicified core
66	67			VS	3*	—	—	10	* v. broken core well jointed
67	68			VS	3	68°	—	37	
68	69			VS	3	71°	—	11	
69	70			VS	3	67°	—	30	
70	71			VS*	3	69°	—	51	* bands of weaker mottled rock
71	72		↓	VS	3-4	69°	—	42	insig. fractures for 69.4 → 72M.

CARPENTARIA GOLD PTY. LTD.

BASIC GEOTECHNICAL LOG

Page 3 *of* 3 *Logged by:* J. COPE *Borehole :* TH025

FROM:	TO:	ROCK TYPE:	WEATHERING:	ROCK STRENGTH	BEDDING POLIATION	C.B.A.	CORE LOSS	R.Q.D	REMARKS SHEAR ZONES, JOINTING ETC.
72	73		FL	VS	3-4	68°	—	15	very broken core x 3 joint direction
73	74			VS	3	-	—	0	v. broken
74	75			W	4	69°	—	24	74.2 – 75 altered w natural joints show good slickensides on surface. Stained with haem/chl. Min w- bands of unal. mar
75	76			S-W	4-3	71°	—	53	
76	77			N-S	3-2	67°	—	49	well jointed 76.6 - altered haem mar → 77.7m
77	78			S	3	68°	—	17	joint surfaces have small slickensides.
78	79			VS	3	69°	—	47	well jointed. - irreg surfaces
79	80			VS	2	72°	—	45	slickensides ~~up~~ on joint surfaces well jointed
80	81			VS	2	69°	—	18	
81	82			VS	3	64°	—	70	
82	83			VS	3	64°	—	15	82.8 soft altered mar.
83	84		FR	M	3-4	68°	—	54	
84	85			MS	4	64°	—	27	well jointed with slickensides
85	86			MS	4	66°	—	31	v. soft band at 84.3m.
86	87			VS	4	66°	—	30	
87	88			VS	4-3	69°	—	60	
88	89		FL	VS	2	72°	—	73	
89	90			VS	3	71°	—	34	Slight clays at 90m well jointed → 91.3m
90	91			VS	3	70°	—	20	
91	92		FR	VS	2	71°	—	80	
92	93			VS	1	66°	—	98	
93	94		FL	VS	1-2	67°	—	100	
94	95			S	3	71°	—	91	Thin clay at 95.4m -
95	96			S	3	71°	—	34	
96	97			S	3	73°	—	93	
97	98			S	3	75°	—	96	
98	99			S	3-2	74°	—	97	

CARPENTARIA GOLD PTY. LTD.

BASIC GEOTECHNICAL LOG

Page 1 *of* 2 *Logged by :* AR *Borehole :* THDH.0

FROM:	TO:	ROCK TYPE:	WEATHERING:	ROCK STRENGTH	BEDDING POLIATION	C.B.A.	CORE LOSS	R.Q.D	REMARKS SHEAR ZONES, JOINTING ETC.
71.6	72.0	2 Frag	Gr Clay mw	w m	4	60°	-	50/40	71.78 Gr Clay alt'n bond 71.80 - 71.90 Gr Clay alt'n & subsequent fracturing
72.0	73.0	3	Gr Clay mw	m w	3-4	65°	-	90	72.2 - 72.3 Rough conjugate Fracture @ 35° & 125° CA 72.65 Rough Fracture @ 65° CA
73.0	74.0	9 Frag	Gr Clay mw	m w	4	70°	-	58	73.06 Rough Fracture @ 70° CA 73.6 - 73.7 Gr Clay alt'n & Fracturing 70° CA 73.8 - 73.9 " "
74.0	75.0	4	Gr Clay mw	m w	3-4	60°	-	95	74.4 Hem & Gr Clay shear @ 60° CA
75.0	76.0	7	Gr Clay mw	m w	4	60°	-	86	75.0 - 76.0 all Fractures @ 60° CA.
76.0	77.0	4	Gr Clay mw	m	3	65°	-	90	76.0 - 77.0 all Fractures @ 65° CA except 76.8 low angle C.A.
77.0	78.0	11 Frag	Gr Clay Sw	m	3-4	60°	-	44	77.0 - 78.0 Fractures (Rough) @ 60° CA 77.40 Rough conjugate Fracture @ 60° & 135° CA 77.85 - 78.0 Brittle Fracture
78.0	79.0	4	Gr Clay Sw	m	3-4	65°	-	84	78.0 - 79.0 all Fractures @ 65° CA.
79.0	80.0	6	Gr Clay Sw	s	3-2	65°	-	80	79.4 - 79.5 Rough Fracture @ 180° CA 79.5 - 79.6 Gr Clay alt'n & Fracture(s) x 2 @ 65° CA
80.0	81.0	5	FR	Vs	2-3	65°	-	70	80.1 - 80.3 Fracture 170° CA & Hem Surfaces 80.9 - 81.0 Fracture @ 170° CA & Hem Surfaces
81.0	82.0	4	FR	Vs	2	65°	-	100	81.0 - 82.0 Rough Fracture @ 90° CA
82.0	83.0	5	Gr Clay Sw	Vs	2	65°	-	94	82.0 - 82.90 Rough Fracture @ 75° CA 82.95 - 83.0 Rough conjugate Fracture @ 150° & 60° CA
83.0	84.0	0	FR	Vs	2-3	70°	-	100	
84.0	85.0	0	FR	Vs s	2-3	70°	-	100	
85.0	86.0	6	FR	Vs	3-2	70°	-	78	85.0 - 85.1 Rough Fracture @ 130° & 40° CA 85.6 - 85.7 Rough Conjugate Fracture @ 15° & 85° CA 85.9 - 86.0 Rough Conjugate Fracture @ 130° & 45° CA
86.0	87.0	8	FL	Vs	3-2	70°	-	82	86.6 Rough Conjugate Fracture @ 130° & 70° CA 86.85 - 87.0 Rough Conjugate Fracture @ 160° & 80° CA & Limonised Surfaces
87.0	88.0	8 Frag	FL	Vs	3	65°	-	45	
88.0	89.0	2	Gr Clay Sw	Vs	3	60°	-	100	88.6 Fracture @ 60° CA
89.0	90.0	4	Gr Clay Sw	Vs	3	65°	-	100	89.0 - 90 Fractures @ 65° CA 90.0 Fracture @ 140° CA
90.0	91.0	4	Gr Clay Sw	Vs	3	70°	-	96	90.0 - 91.0 Fractures @ 70° CA
91.0	92.0	Frag	FL	Vs	4-5	75°	-	0	91.0 - 92.0 Fracture @ 80° CA & Limonised Surfaces
92.0	93.0	7	FL	s	4	65°	-	55	92.0 - 93.0 Fractures @ 60° CA
93.0	94.0	5	Gr Clay Sw	s	3	70°	-	80	93.0 - 93.9 Rough Fracture @ 70° CA 93.9 - 94.1 @ 160° CA
94.0	95.0	7	FL	s	3	65°	-	81	94.0 - 95.0 Fracture @ 130° 160° CA.
95.0	96.0	18	Gr Clay FL	s	4-5	70°	-	12	95.0 - 96.0 Fracture @ 70° CA.
96.0	97.0	15 Frag	Gr Clay Sw FL	m s	4-5	75°	-	0	96.0 - 97.0 Conjugate Fracture @ 130 & 70° CA.
97.0	98.0	7	Gr Clay Sw	m s	3-4	70°	-	51	97.0 - 98.0 Rough conjugate Fracture @ 70° & 160° CA & Gr Clay @ 97.6
98.0	99.0	9 Frag	Gr Clay mw	m s	3-4	70°	-	34	98.0 Gr Clay alt'n Fracture @ 160° & 70° CA 98.4 Hem & Gr Clay alt'n 98.8 - 99.0 Hem & Gr Clay alt'n Fracture 70° & 160° CA
99.0	100.0	Frag	FL	s	4	70°	-	0	99.0 - 100.0 Fractures @ 70° & 160° CA & Limonised Surfaces
101.0	102.0	Frag 5	Gr Clay Sw	m	3-4	65°	-	78	101.0 - 101.1 Intense Gr Clay (and) alt'n. Fracture 70° CA 101.0 - 102.0 Fracture 70° CA
102.0	104.0	18 Frag	Gr Clay Sw	m	4-5	65°	-	60	102.0 - 102.1 Fracture @ 65° CA 103.1 - 103.6 Brittle Fracture 103.3-4 Brittle Fracture 70° CA
104.0	105.0	9	FR	m	3-4	65°	-	84	104.0 - 105.0 Rough Fracture @ 65° CA
105.0	106.0	5	Gr Clay Sw	m	3	65°	-	95	105.0 - 106.0 Fracture @ 65° CA
100.0	101.0	Frag	Gr Clay Sw FL	m	4	75°	-	0	100.0 - 101.0 Brittle Fracture at 0° & 70° CA & Limonised Surfaces.

CARPENTARIA GOLD PTY. LTD.

BASIC GEOTECHNICAL LOG

Page 2 *of* 2 *Logged by :* JR *Borehole :* TH040

FROM:	TO:	ROCK TYPE:	WEATHERING:	ROCK STRENGTH	BEDDING FOLIATION	C.B.A.	CORE LOSS	R.Q.D	REMARKS SHEAR ZONES, JOINTING ETC.
106.0	107.0	1	Sw Gr	m	3	65°	–	100	106.6 Fracture @ 80° CA + Gr clay
107.0	108.0	4	FR	s Vs	3	65°	–	90	107.4 - 107.93 Fractures @ 60° CA 107.10 - 108.0 Fracture @ 170° CA
108.0	109.0	4	Sw Grcl	m s	3-2	65°	–	86	108.1, .2, .9 Rough Fracture @ 180° CA
109.0	110.0	5	Sw Grclay	s Vs	3-2	65°	–	100	109.1, .7, .8 Rough Fractures @ 130° CA 109.4 Rough Fracture @ 50° CA
110.0	111.0	1 Frag	Sw Grclay	s	3-2	66°	–	95	110.6 Conjugate Fracture @ 120° + 70° CA 110.9 - 111.0 Brittle Fracture @ 70° CA
111.0	112.0	3	Sw Grclay	m s	3	70°	–	90	111.1 Rough conjugate Fracture @ 130° CA + 140° CA 111.9 Fracture 100° CA
112.0	113.0	5	Sw Grclay	m s	3	70°	–	86	112.5 - 112.5 Fracture @ 140° CA 112.9 - 113.0 Fracture @ 70° CA & Gr clay
113.0	114.0	Frag	Mw Grclay	m w	5-4	69°	–	32	113.0 - 113.1 Disct Non Fracture & Gr clay @ 70° CA 113.8 - 114.0 Disct Non Fracture & Gr clay @ 70° CA
114.0	115.0	1 Frag	Mw Grclay	m w	4	70°	–	30	114.0 - 114.1 Gr clay Fracture @ 70° CA 114.2 - 114.4 " " 114.8 - 115.0 Brittle Fracture @ 0° CA & Limonite
115.0	116.0	4	Sw Grclay	m	3	70°	–	94	115.2 Rough Fracture @ 120° CA 115.4, 115.8 Fracture @ 70° CA
116.0	117.0	2	Sw Grclay	m	2-3	70°	–	100	116.2, .3 Fracture @ 80° CA
117.0	118.0	1	Sw Grclay	m s	2	70°	–	96	117.7 Limonised Rough Fracture @ 120° CA 117.96 - 118.0 Intense Gr clay alt'n
118.0	119.0	6	Mw Grclay	m s	2	70°	–	90	118.6 - 118.7 Conjugate Fractures in Gr clay @ 80° + 140° CA.
119.0	120.0	6 Frag	Hw Grclay	w	5	70°	–	16	119.1 - 119.4 Intense Gr clay alt'n + Fractures @ 70° CA 119.7 - 119.9 Conjugate Limonised Fracture @ 15° + 140° CA 119.9 - 120.0 Intense Gr clay alt'n + Fractures @ 70° CA
120.0	121.0	9 Frag	Hw Grclay	w	5	70°	–	0	120.0 - 120.7 Limonised Conjugate Fracture @ 0° CA + 70° CA 120.7 - 121.0 Intense Gr clay alt'n & Fractures @ 70° CA
121.0	122.0	4 Frag	Mw Grclay	m w	4-3	75°	–	50	121.2 - 121.3 Rough Fracture @ 160° CA. 121.45 - 121.55 Intense Gr clay alt'n
122.0	123.0	Frag	Mw Grclay FL	Vs	4	70	–	18	122.0 - 122.4 Gr clay & Limonised Fracture @ 70° CA 122.5 - 123.0 "

CARPENTARIA GOLD PTY. LTD.

BASIC GEOTECHNICAL LOG

Page 1 *of* 2 *Logged by:* R.A. CROOKES *Borehole :* TH 041

FROM:	TO:	ROCK TYPE:	WEATHERING:	ROCK STRENGTH	BEDDING FOLIATION	C.B.A.	CORE LOSS	R.Q.D	REMARKS SHEAR ZONES, JOINTING ETC.
83.7	84.0	QTZITE	FR	V.S.	1-2	MASSIVE & IRREG	—	100%	HW QTZITE, → 89.9m. OCC. BRITTLE FRACT. 75-90° TO C.A.
84.0	85.0	"	"	"	"	STREAKS	—	100	AS ABOVE.
85.0	86.0	"	"	"	"		10cm	73	LIMONITIC + HEM - CHLD CLAYS ON FRACTURES. BRITTLE FRACTURE - BROKEN RUBBLY CORE - MAJOR JT. SETS 70°C.A. //C.A. 20°C.A.
86.0	87.0	"	"	"	"		—	58	AS ABOVE. + PL. YELLOW FLECKS (CHL-LIM) CLAYS ON FRACTURES.
87.0	88.0	"	"	"	"		—	100	WH. THIN HAIRLINE FRACTS - CALCITE VEINS 45°C.A TWO CONJ. SETS.
88.0	89.0	"	"	"	"		—	100	MASSIVE QTZITE. OCC. BRITTLE FRACT. // HIGH ANGLE SET OF PINK FELD VEINLETS - ANNEALED ENECHELON TENSION GASHES
89.0	90.0	"	"	"	"		—	85	ANNEALED BRITTLE FRACT'D QTZITE. FRACTURES 90°C.A. + 40°C.A.
90.0	91.0	QTZ-BIO SCHIST	"	"	2-3	59°	—	100	SILIC.'D HIGHLY STRAINED QTZOSE SCHIST. FRACT. EVERY ~20cm 80°C.A. HIGH ANGLE ANNEALED. QTZ - CALCITE - FELDSPAR - HEMST'D VEINLETS. (IRREG. STRWK)
91.0	92.0	"	"	"	"	66°	—	100	AS ABOVE. SM. FSP./QTZ TENSION GASHES CONJ. TO FOLN.
92.0	93.0	"	"	"	"	70°	6cm	74	HIGH STRAIN ZONE. HEM-COATED FRACTURES SILIC. PLANAR CLAYS ~2mm THICK ~60-80°C.A.
93.0	94.0	"	"	"	"	66°	—	100	AS ABOVE.
94.0	95.0	"	"	"	"	70°	—	76	AS ABOVE. L.G. HEM. COATED FRACTURE 20°C.A. HEM-CHL-SERIC. SLICKENSIDED FRACT.
95.0	96.0	"	"	"	"	71°	—	100	MASSIVE CORE - OCC. FRACT. ALONG CONJ. HAIRLINE FRACTS. 90°C.A. + 45° + 45° C.A.
96.0	97.0	"	"	"	"	70°	—	100	MASSIVE CORE. OCC. FRACT AS ABOVE CROSS-CUTTING FOLN.
97.0	98.0	QTZ-FSP (ORE)		"	"	68°	—	100	AS ABOVE.
98.0	99.0	QTZ-FSP SCAP SCHIST		MOD. WK AT	3	72°	-	100	AS ABOVE.
99.0	100.0	"	FR E.G.C.A BANDS	CLAY BANDS	"	65°	-	90	AS ABOVE C. INCR. GN CLAY ALTN THROUGH CORE.
100.0	101.0	SCHIST	FRESH WITH GNCLAY ALTD. BANDS	"	"	66°	—	100	AS ABOVE. WELL DEVELOPED CONJ. FRACT. // FOLN + 65°to C.A. X-CUTTING FOLN
101.0	102.0	"	"	"	"	71°	—	95	(SM. BUT CLASSIC WEDGE FAILURE POTENTIAL) AS ABOVE + IRREG. GN CLAY + HEM VEINS
102.0	103.0	"	"	"	"	74°	—	100	AS ABOVE "
103.0	104.0	"	"	"	3-4	67°	—	92	AS ABOVE "
104.0	105.0	"	"	"	"	71°	—	54	AS ABOVE. "
105.0	106.0	"	"	"	"	70°	—	96	AS ABOVE ~
106.0	107.0	QTZ-FSP SCHIST (ORE)	"	STR. & WK CLAY BANDS	2-3	69°	—	64	BRITTLE FRACT'D ZONE ALONG STR. HEMATISED FRACTS. HEM-CHL SLICK'D CLAYS 1-5mm THICK ALONG NUMEROUS + IRREG. JT. SETS 20°C.A. + 60°C.A.
107.0	108.0	"	"	"	"	72°	—	45	AS ABOVE.
108.0	109.0	"	"	"	3-4	68°	—	77	OCC BROKEN CORE, BUT GENERALLY ANNEALED ALONG IRREG. CALCITE, QTZ-FSP-HEM-SCAP VEINLETS. INCR. GN CLAY ALTN BANDS.
109.0	110.0	"	"	MOD-WK & STR. BANDS	"	71°	—	92	AS ABOVE - HEM-CHL FRACTS + GN CLAY BANDS.
110.0	111.0	"	"	"	"	62°-73°	—	84	FRACT // FOLN TR. LIMONITE ON FRACT SURFACES ALNG. WISPY IRREG. VEINLETS NEAR //C.A. - SERICITE CLAYS.
111.0	112.0	"	"	"	4	71°	—	68	CORE BROKEN ALONG FOLN. + CONJ SET. 65°C.A. ALL IRREG. VEINLETS STR. HEMATISED.
112.0	113.0	"	"	"	4	69°	—	78	AS ABOVE - BRITTLE FRACT // FOLN + 15°C.A. THIN BRN/RED + GN CLAYS ON FRACTS - SILICIFIED + HARD.
113.0	114.0	"	"	"	4	67°	—	67	AS ABOVE.
114.0	115.0	SCHIST	STR. ALTD GNCLAY BANDS	MOD-WK W'D CLAY BANDS	4	70°	—	100	STR. GN CLAY ALTN. THROUGHOUT - GN CLAY BANDS // FOLN + //C.A. STR. CHL. STAINED FRACTS & SEAMS
115.0	116.0	"	"	"	3-4	71°	—	88	AS ABOVE - CHL + HEM VEINLETS + GN CLAY BANDS // FOLN

CARPENTARIA GOLD PTY. LTD.

BASIC GEOTECHNICAL LOG

Page 2 *of* 2 *Logged by :* RAC *Borehole :* TH 041

FROM:	TO:	ROCK TYPE:	WEATHERING:	ROCK STRENGTH	BEDDING FOLIATION	C.B.A.	CORE LOSS	R.Q.D	REMARKS SHEAR ZONES, JOINTING ETC.
116	117	GRANOF SCHIST.	FR – MOD ALTD	MOD – STR.	2-3	71°	—	60%	HEM-COATED BRITTLE FRACTURES - PLANAR, TR CLAYS. // FOLN + 10° → C.A.
117	118	SCHIST	FR + V.STR ALTD CLAY BANDS	MOD + WK CLAY BANDS	4	70°	—	80	AS ABOVE + INCREASING GN CLAY ALTN. - BANDS 1-2mm THICK // TO FOLN + SLIGHTLY CRENULATED
118	119	"	"	MOD – STR + WK. CLAY BANDS	4	71°	—	68	SCHIST C SCAP. GN. CLAY ALTD. BANDS // FOLN ANNEALED HEM - QTZ VEINS ~ // C.A. (OCC FRACTURED).
119	120	"	"	"	4	71°	—	81	AS ABOVE
120	121	"	"	"	4	66°	—	92	SCHIST C HEM + LIM STAINED FRACTURES
121	122	"	"	"	5	64°	—	72	SCHIST – INCR. DISCOIDAL FOLN // FRACTURE WITH INCR. COARSENESS OF MICAS
122	123	"	"	MOD + WK CLAY BANDS	5	66°	—	36	AS ABOVE LIM. + SERC CLAYS ON FOLN // FRACTS. DISCOIDAL FRACTURE // FOLN.
123	124	"	FR + ALTN CLAY BANDS + ON FRACTS.	"	4-5	67°	—	86	AS ABOVE.
124	125	"	"	"	4	65°	—	64	F.GR SCHIST, LESS FOLN FRACTURE. JT. SET 30° TO C.A - CONJUGATE TO FOLN. FILLED WITH GN-SCAP GN. CLAYS - SWELLING GN CLAY ALTN. FRACT. SPACING 5-15cm
125	126	"	"	MOD - STR + WK CLAYS	3-4	64°	—	64	INCREASING SCAP ∴ MORE GN CLAY ALTN
126	127	"	FR + V. SOFT CLAY BANDS (V. ALTD).	MOD - STR + SOFT CLAYS.	4	66°	—	61	126.5m STR. GN CLAY ALTN – SWELLING CLAYS 126.8 - 127.0
127	128	"	"	"	4	64°	—	68	STR. HEM ALTN + STR. G.C.A. – 10mm BANDS // TO FOLN EXPANING + BREAKING UP. IRREG. PINK FELD STRINK.
128	129	"	"	"	3	69°	—	100	IRREG SCAP. DISTRIBUTION IN SCHIST → GN CLAYS. Y-CUTTING PINK FELDSPAR VEINING
129	130	SILIC. SCHIST.	FR + STR G.C. ALTN	MOD – STR C WK CLAY BANDS	2-3	65-72°	—	99	QTZ - SCAP SCHIST. STR. GN CLAY ALTN ALONG MICACEOUS BANDS.
130	131	SCHIST	"	"	4	65°	—	99	AS ABOVE, CLOSE SPACED GN CLAY ALTD BANDS // FOLN WK. SWELLING CLAYS
131	132	"	MOD FR + GN CLAY BANDS	"	3	71°	—	100	OCC. WK. CLAY BAND.
132	133	"	ALTD STR. GN CLAY ALTN	MOD - WK SOFT CLAYS	5	73°	—	94	STRONG GN CLAY ALTD ZONE. FRACTS ALONG SWOLLEN CLAY BANDS 20cm SPACING.
133	134	" QTZ - SCHIST	" FR/OXID	" STR	5 / 1-2	68°	—	55	AS ABOVE TO 133.5m. 133.5m SILIC. QTZ - HEM - FELDSP. BRITTLE FRACTURE ZONE 133.5 - 134.1m
134	135	"	FR - OXIDISED	"	2-3	68°	—	72	SILIC. AS ABOVE. OCC. FRACT. 80° C.A. + 40° C.A. HEM HAIRLINE FRACTS // C.A. (ANNEALED)
135	136	SCHIST.	FR - OXID. + GN CLAY ALTN - BANDS	MOD – STR C SOFT CLAYS.	3	67°	—	64	FRACT // FOLN + HIGH ANGLE IRREG. QTZ - FELD VEINS HEM - STD C LIM - SER - HEM ON FRACT. SURFACES.
136	137	"	"	"	4	65°	—	87	GN. CLAY ALTD. SCHISTS. FRACTS 15cm SPACING - // FOLN + CONJUGATE SET 45° C.A.
137	138	QTZ - SCAP SCHIST.	FR C STR. GN CLAY ALTN.	STR. + WK GN CLAY BANDS	5/2	67°	—	78	137.4 - 137.5 BRITTLE FRACT. ZONE + STR. GN CLAY ALTN CONJ. JTS 30° C.A + 65° C.A (// FOLN) COINCIDENT C QTZ VEINING. SOFT GN CLAY BANDS 20CM APART
138	139	"	"	"	2-3	71°	—	87	QTZ - SCAP ROCK. STR. GN. CLAY ALTN THROUGHOUT ALTD SCAP VEINS // FOLN – FRACTURED (SWOLLEN CLAY). Y-CUTTING IRREG. PINK FSP. - QTZ STRINGER.
139	140	"	"	"	2-3	65°	—	100	HIGH ANGLE QTZ - FSP - SCAP VEINS. - ANNEALED. OCC. FRACT. ALONG SCAP CLAY VEINS.
140	141	SCHIST	FR + TR GN CLAY ALTN	STR → MOD - STR.	3-4	63°	—	88	OCC. FRACT. // FOLN + CONJ. JT SET 40° C.A C 2mm PINK SUCIFIED INFILL - PLANAR.

CARPENTARIA GOLD PTY. LTD.

BASIC GEOTECHNICAL LOG

Page 1 *of* 2 *Logged by :* JB *Borehole :* TH045

FROM:	TO:	Fractures Per Metre.	WEATHERING:	ROCK STRENGTH	BEDDING FOLIATION	C.B.A.	CORE LOSS	R.Q.D	REMARKS SHEAR ZONES, JOINTING ETC.
71.5	72.0	1/50cm	FR	Vs	2	70°	–	50/50	
72.0	73.0	5	Sw Gr Clay	SVs	2	70°	–	50	72.8-8 Rough Fracture @ 100° CA in Hem/Gr Clay 72.6-72.7 Fragmentation in Gr Clay @ 70° CA. 72.95 Fracture (Rough) 90° CA in chlorotic Silt?
73.0	74.0	7	Sw Hem	Vs	1-2	–	–	62	73.2 Rough Conjugate Fractures @ 80° + 120° CA.
74.0	75.0	2	Sw Hem	Vs	1-2	–	–	93	
75.0	76.0	2	Sw Hem	Vs	1-2	75°	–	100	
76.0	77.0	1	Sw Hem	Vs	1-2	–	–	100	76.7 Fracture in Hem @ 70° CA.
77.0	78.0	7	Sw Hem	Vs	1-2	65°	–	66	77.20 - Rough conjugate Fracture @ 100° + 140° CA 77.30 Rough Conjugate Fracture in Hem @ 100° + 140° CA. 77.80 Fracture + 140° CA & Hem Surfaces
78.0	79.0	12	Sw Hem	Vs	1-2	54°	–	24	78.1 Conjugate Fracture 150° + 60° CA. 78.7 Fragmentation @ " " 78.9 - 80.0 2 Rough Fractures @ 45° CA.
79.0	80.0	7	Sw Hem	Vs	1-2	50°	–	57	79.2-79.3 Conjugate Fracture @ 80° + 140° CA & Hem Surfaces 79.9 Rough Fracture @ 50° CA in Hem.
80.0	81.0	3	FR	Vs	1-2	55°	–	94	80.1 Conjugate Fracture @ 90° + 30° CA & Hem Surfaces
81.0	82.0	6	Sw Hem	Vs	1-2	80°	–	92	81.1 Fracture @ 120° CA. 81.3-81.6 Rough Fracture @ 100° + 180° CA
82.0	83.0	9	Sw Hem	Vs	1-2	–	–	81	82.4 - 82.5 Fragmentation @ 0° + 90° CA. 82.8 Rough Conjugate Fracture @ 100° + 50° CA.
83.0	84.0	11	FR	Vs	1-2	64°	–	62	83.45 - 83.7 Conjugate Fracture @ 70° + 160° CA
84.0	85.0	6	FR	Vs	2	70°	–	64	84.4 - 85.0 Rough Fractures @ 150° CA.
85.0	86.0	12	Sw Hem	Vs	2-1	72°	–	40	85.05 - 85.10 Rough Fracture @ 140° CA 85.40 - 85.50 Rough Fracture 170° CA 85.60 2 Rough Fractures @ 60° CA
86.0	87.0	4	Sw Hem	Vs	2	65°	–	90	86.0 Conjugate Fracture @ 30° + 120° CA 86.7 Rough Fracture 60° CA.
87.0	88.0	4	Sw Hem	SVs	3	70°	–	90	87.6 Rough Fracture @ 180° CA. 87.9 - 88.1 Fracture in incisal PPA @ 160° CA.
88.0	89.0	12	Sw Hem	SVs	3	75°	–	50	88.0 - 88.14 Rough conjugate fracture @ 15° + 120° CA (incl. Hem) 88.70 Fracture @ 140° CA 88.9 - 90.0 2 Fractures @ @ 130° CA.
89.0	90.0	8	FR	SVs	3	78°	–	71	89.50 Fracture @ 140° CA 89.75 Brittle Fracture (weak) @ 50° + 120° CA.
90.0	91.0	5	FR	SVs	3	70°	–	90	90.5 Rough Conjugate Fracture @ 40° + 140° CA. 90.85 Fracture @ 70° + 130° CA.
91.0	92.0	1	FR	SVs	3	70°	–	100	
92.0	93.0	3	FR	SVs	3	71°	–	95	
93.0	94.0	6	FR	SVs	3	65°	–	88	93.60 Fragmentation 93.66 Rough Fracture @ 60° CA in Hem 94.00 Fracture 65° CA in VW Gr Clay
94.0	95.0	5	FR	SVs	2-3	65°	–	94	94.80 Fracture 80° CA & bitumen Surface. 94.00 - 95.0 Fractures @ 70° CA (Rough)
95.0	96.0	6	FR	SVs	3	70°	–	96	95.80 Fragmentation @ 70° CA
96.0	97.0	2	FR	SVs	3	71°	–	100	96.9 Rough Fracture 130° CA
97.0	98.0	5	FR	SVs	3	70°	–	84	97.0 - 98.0 Fractures (Rough) @ 70° CA
98.0	99.0	Frag	Mw Hem Gr Clay	S	3.	70°	–	20	98.0 - 98.2 Hem/Mag inclps 0° CA 98.2 - 99.0 Intense Fracture @ 0° CA + 90° & Hem Surfaces
99.0	100.0	Frag.	Mw Hem Gr Clay	S	3	66°	–	0	99.0 - 99.9 Intense Fracture @ " "
100.0	101.0	8	FR	Vs	3-2	50°	–	42	100.1 Fracture @ 150° CA 100.3 - 100.5 Fracture + incipe 0° CA 100.7 - .8 Fracture 120° CA.
101.0	102.0	4	FR	Vs	2	70°	–	86	101.1 Rough Fracture @ 70° CA 101.66 Rough Fracture 130° CA.
102.0	103.0	11	Sw Gr Clay	SVs	2	60°	–	72	102.0 - 103.1 3 Fractures @ 70° + 110° CA 103.95 Rough Fracture @ 60° CA 102.50 Conjugate Fracture @ 60° + 70° CA 103.60 Gr Clay Fractures @ 70° CA
103.0	104.0	6	FR	SVs	3	60°	–	90	103.0 - 104.0 Fractures @ 60° CA.

CARPENTARIA GOLD PTY. LTD.

BASIC GEOTECHNICAL LOG

Page 2 *of* 2 *Logged by :* JR *Borehole :* TH045

FROM:	TO:	Fractures Per Metre	WEATHERING:	ROCK STRENGTH	BEDDING FOLIATION	C.B.A.	CORE LOSS	R.Q.D	REMARKS SHEAR ZONES, JOINTING ETC.
104.0	105.0	8	Grey m_w	m w	3	70°	–	76	104.0 - 104.1 Rough fracture in Hem clay @ 40° CA 104.0 °C 104.4 ° 104.95 Fracture @ 110° CA
105.0	106.0	5	Grey m_w	m w	3	75°	–	100	105.1 @ 105.4 Fracture @ 50° CA. 105.8 @ 106.0 Fracture @ 70° CA
106.0	107.0	7	Grey m_w	m w	3	70°	–	68	106.0 - 107.0 Fractures @ 70° CA
107.0	108.0	6	Grey m_w	m w	3	75°	–	74	107.1 @ 107.2 Fracture @ 70° CA 107.4 - 107.8 Strong Gr Clay All 1½ c Fractures @ 20° CA
108.0	109.0	19	Grey m_w	m w	4	60°	–	82	108.0 - 109.0 Fractures @ 20° CA cut by 0° CA @ 108.1 - 108.3 108.5 - 108.7 Grey @ 108.5 - 108.9 - 109.0
109.0	110.0	14	Hem S_w	m_s	3-4	70°	–	25	109.0 - 110.0 Fractures @ 70° 110° CA.
110.0	111.0	14	FR	m_s	4	65°	–	20	110.0 - 111.0 Percussive Fracture @ 60° CA 110.4 - 110.5 Brittle Fracture
111.0	112.0	6 Frag	FR	S	3	75°	–	22	111.0 - 111.3 Fractures @ 75° CA c Hem 111.3 - 112.0 Percussive Fracture 0° CA cut by 20° CA
112.0	113.0	7 Frag	FR	V_s	3	75°	–	29	112.0 - 112.6 Percussive Fracture @ 0° CA cut by 20° CA 112.6 - 113.0 S Fractures @ 75° CA.
113.0	114.0	5	FR	V_s	3-4	70°	–	76	113.0 - 113.1 Fracture @ 80° CA & Limonite Surface 113.1 - 114.0 Rough Fractures & Iron Surfaces @ 70° CA
114.0	115.0	11	FR	V_s	3-4	65°	–	76	114.0 - 115.0 Fractures @ 65° CA & Limonite Surfaces 114.70 Rough Fracture @ 130° CA in Rough Hem Clay.
115.0	116.0	7 Frag	FR	V_s	3	70°	–	50	115.0 - 116.0 Fractures @ 70° CA 115.3 - 115.4 Fracture @ 0° CA Frag @ 115.7 - 115.9.
116.0	117.0	10	FR	V_s	3	70°	–	46	116.0 - 117.0 Fracture @ 70° CA 116.7 @ 116.9 Rough Fracture @ 40° CA
117.0	118.0	11	FR	V_s	3	75°	–	42	117.0 - 118.0 Rough Fracture @ 110° CA
118.0	119.0	4	Grey Hem m_w	m	3-4	70°	–	100	118.1 Fracture in Gr Clay @ 70° CA 118.5 "
119.0	120.0	2	Grey Hem m_w	m	3-4	70°	–	100	119.1 @ 119.45 Fracture @ 70° in Gr Clay
120.0	121.0	0	Grey Hem m_w	m	3-4	70°	–	100	
121.0	122.0	2	Grey H_w	m_w	4	70°	–	60	121.6 - 122.0 Gr Clay which may have B/F 65 - 70° CA
122.0	123.0	7	Grey H_w	m_w	4	75°	–	30	122.0 - 123.0 Gr Clay " 123.9 Rough Fracture @ 120° CA
123.0	124.0	10	Grey S_w	m	4	70°	–	56	123.0 - 123.0 Percussive Fracture @ 70° CA 123.8 - 123.9 Rough Fracture @ 0° CA
124.0	125.0	6	Grey S_w	m	3	70°	–	90	124.5 @ 124.8 Rough conjugate Fracture @ 160° + 80° CA
125.0	125.90	9	FR	m	3	70°	–	28	125.4 - 125.5 Rough conjugate Fracture @ 120° + 10° CA 125.7 - 125.8 Rough Fracture @ 40° + 30° CA

CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

Page 1 of 3 Logged by C.J.S & GH Borehole TH075

FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	CORELOSS	R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
101.8	102.3	Schist	Mod	1-2	4	50°	Possible	10	>30 f/m Rubbley Core
102.3	104.3	Schist / clays	Mod	1	2	52°	Possible	107cm	>100 f/m 102.3-103.0 - fractures // CBA, - 103.0-103.5 - hematite breccia 103.5-105.0 - tectonized pebbles, hematite clays - Rubbley and strongly fractured core, - zone of shearing + hematite alteration "VERY WEAK ZONE" - hematite alt^n to 108m
104.3	105.0	hematite clays	Strong	<1	–	50°	Possible	0	>50 f/m
105.0	106.0	Schist	Wk	1-2	2	55°	–	72	>20 f/m irreg. fracts + breaks
106.0	107.0	Schist	Fr	1-2	2-3	55°	–	76	>20 f/m
107.0	108.0	Schist	"	2	2-3	58°	–	83	7 f/m
108.0	109.0	Schist	"	2-3	2	51°	–	97	2 f/m
109.0	110.0	Schist	"	2-3	2-3	72°	–	100	1 f/m
110.0	111.0	Silic Schist	"	2-3	3	60°	–	100	0 f/m
111.0	112.0	Silic Schist + trace C.A	"	2-3	2	63°	–	90	7 f/m 111.0-111.5 - weak to strong Green Clay Alt^n, and fracts // CBA
112.0	113.0	Ofite	"	2-3	2-3	60°	–	93	4 f/m
113.0	114.0	Ofite	"	3-4	1	70°	–	78	7 f/m 113.8 - hematite coated joint surface @ 30° to core axis
114.0	115.0	Ofite	"	3-4	1	61°	–	90	5 f/m
115.0	116.0	Ofite	"	4	1	57°	–	100	6 f/m
116.0	117.0	Ofite	"	4	2	63°	–	100	2 f/m
117.0	118.0	Silic Schist	"	3-4	2	63°	–	100	4 f/m
118.0	119.0	Silic Schist	"	3-4	2	69°	–	100	5 f/m
119.0	120.0	Silic Schist	"	3-4	3	62°	–	95	6 f/m 119.5-120.0 - zone of 4 // fractures (joints) at 45° to core axis
120.0	121.0	Silic Schist	"	3	3	60°	–	70	13 f/m 120.5-121.1 - strong hematite coated fracture running // to core axis
121.0	122.0	Silic Schist	"	3	3	62°	–	97	8 f/m
122.0	123.0	Silic Schist	"	3	3	69°	–	97	9 f/m
123.0	124.0	Silic Schist	"	3-4	2-3	66°	–	100	3 f/m
124.0	125.0	Silic Schist	"	4	2-3	70°	–	100	2 f/m
125.0	126.0	Silic Schist + QS	"	4	3	60°	–	100	4 f/m
126.0	127.0	Silic Schist	"	4	3	64°	–	83	4 f/m
127.0	128.0	Silic Schist + QS	"	4	3-4	61°	–	92	5 f/m 127.9 hematite clays coating fracture surface.
128.0	129.0	Silic Schist QS	"	5	4	65°	–	100	4 f/m

Golder Associates

CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

Page 2 of 3 Logged by CJS & GH Borehole TH075

FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	CORELOSS	R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
129.0	130.0	Silic Schist	FR	5	3	70°	-	100	2 f/m
130.0	131.0	Silic Schist	"	5	3	67°	-	68	17 f/m 130.0-130.1 - fracture running ≈20° to core axis - coated with calcite & hematite clays 130.4-130.6 as above
131.0	132.0	Silic Schist	"	4-5	3	59°	-	93	7 f/m 131.0-131.2 - Similar to above.
132.0	133.0	Silic Schist	"	4-5	2	62°	-	90	8 f/m
133.0	134.0	Silic Schist	"	3-4	2	65°	-	100	3 f/m
134.0	135.0	Silic Schist	"	4-5	2	62°	-	100	4 f/m 134.5 - Calcite covered joint or fracture surface.
135.0	136.0	Silic Schist	"	4-5	2	70°	-	100	1 f/m
136.0	137.0	Silic Schist	"	4-5	3	72°	-	100	4 f/m 136.1 - 4cm zone of rich hematite alteration - possible shear zone
137.0	138.0	Schist	"	1-4	4	70°	-	71	15 f/m 137.1 - 138.0 interval is rich with swelling clays - very soft, and weak
138.0	139.0	Schist	"	3	3	75°	-	36	>20 f/m 138.8 - tectonised pebbles and hematite clays in shear zone
139.0	140.0	Schist	"	3	3	56°	-	91	14 f/m 138.8 - 139.6 - 2mm Qtz-feld veinlet running sub // to core axis, plus fracture along contact
140.0	141.0	Schist	"	3	3	49°	-	100	4 f/m 140 - 142 - zone of Qtz-feld pegmatite veins with fractures on some contacts
141.0	142.0	Schist/ Peg	"	3-4	3	56°	-	100	3 f/m
142.0	143.0	Silic Schist	"	4	3	65°	-	100	2 f/m
143.0	144.0	Silic Schist	"	4	2	78°	-	100	4 f/m 143.25 - pair of calcite covered fractures (joints) approx 55° to core axis
144.0	145.0	Silic Schist	"	3-4	2-3	62°	-	92	4 f/m 144.5 - pair of calcite covered joints - as above - approx 40° to core axis
145.0	146.0	Silic Schist	"	4-5	2	68°	-	100	3 f/m
146.0	147.0	Silic Schist	"	5	2-3	71°	-	100	3 f/m
147.0	148.0	Silic Schist	"	4-5	2-3	68°	-	84	5 f/m
148.0	149.0	Silic Schist	"	3-5	3	70°	-	100	6 f/m 148.7 - 150.2 - Schist is rich with swelling clays and fractures are // CBA
149.0	150.0	Schist	"	3	3-4	67°	-	100	4 f/m
150.0	151.0	Schist	"	3	4	63°	-	100	3 f/m
151.0	152.0	Qtzite	"	5	1	63°	-	100	1 f/m
152.0	153.0	Silic Schist	"	4-5	1	68°	-	100	1 f/m
153.0	154.0	Silic Schist	"	4	1	54°	-	85	3 f/m
154.0	155.0	Schist	"	3-4	2-3	64°	-	100	1 f/m
155.0	156.0	Schist	"	3	4	70°	-	100	3 f/m 155-156 - Schist has traces of swelling clays and fractures are // CBA

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CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

Page 3 of 3 Logged by CJS GH Borehole TH075

FROM	TO	ROCK TYPE	WEATHER	ROCK STRENGTH	BEDDING/ FOLIATION	C.B.A.	CORELOSS	R.Q.D.	REMARKS SHEAR ZONES, JOINTING ETC.
156.0	157.0	Schist	FR	3-4	3	62°	–	66	8 f/m fractures are // to CBA - along biotite rich foliations.
157.0	158.0	Schist	"	3	4	72°	–	63	20 f/m 157.0-157.6 - Schist is rich with swelling clays + fracts // CBA. 157.8 contact of Dbite has been brecciated with soft chlorite + G.C.A fracture infill - "VERY WEAK ZONE"
158.0	159.0	Dbite	"	1-4	–	–	–	60	>30 f/m 158-161 - Dbite has been semi brecciated with chlorite fracture infill. The interval is also heavily fractured with irregular breaks
159.0	160.0	Dbite	"	4-5	–	62°	–	53	>20 f/m
160.0	161.0	Dbite	"	4-5	–	–	–	22	>20 f/m
161.0	162.0	Dbite	"	4-5	1	62°	–	100	5 f/m
162.0	163.0	Dbite	"	4-5	1	57°	–	100	1 f/m
163.0	164.0	Dbite	"	4-5	1	65°	–	78	6 f/m
164.0	164.6	Dbite	"	4-5	1	61°	–	30	6 f/m 164.0 - pair of // joints at 45° to core axis.

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8577N 9947E

CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

DRILLHOLE: TH 354/077 **LOGGED BY:** JWC **DATE:** 8/6/91 **PAGE:** 1 **OF** 2

FROM	TO	(m) Drilled	(m) Recov.	Core Loss	Weath.	Rock Strength	Foliation Intensity	CBA/DD	JOINTS/FRACT'S 1°	2°	3°	/m	RQD	% RQD	COMMENTS
0	89.6	PERCUSSION			PRE-COLLAR										
89.6	92.6	3.0m	2.95	0.05	FR	MOD	3	65°/015	65/160	65/015		4.5	2.7		
92.6	95.6	3.0	3.0	0	FR	M-S	3	65/015	65/015	55/180		3	2.7		
95.6	98.6	3.0	3.0	0	"	M-S	3	55/010	55/010	60/180	40/270	6	2.42		
98.6	101.6				"	ST	2-3	55/025	55/025	45/200		2.5	2.95		
101.6	104.6				"	V.ST	2-1	60/040	40/220	80/100		5	2.7		
104.6	107.6				"	VST	0-1	50/320 (ex. axial frac.)	60/190	15/200	30/170	3.5	2.72		
107.6	110.6				"	VST	0-1	60/330 (" ")	40/350	30/170		4	2.73		
110.6	113.6				"	VST	0-1	50/350	65/210	75/010		2	2.95		
113.6	116.6				"	V.ST	0-1	50/340	60/150	25/060	20/240	7	2.3		brittle fract assoc c̄ acute ∠ joints @ 114.9, 115.5, → 116m
116.6	119.6				"	V.ST	0-1	70/030 S_3?	60/235	50/180	50/025	2	3.0		S_2? 62/340
119.6	122.6				"	V.ST	1	70/040	50/190	45/015		3	3.0		
122.6	125.6				"	V.ST	1	65/060	65/060	40/270		3.5	3.0		sheet-like (late) feldspar (PRA) tension gashes ⊥ to c.l. @ strike 320 (170) → fract's
125.6	128.6				"	V.ST	1	60/040	60/200	20/150		2.5	2.77		
128.6	131.6				"	ST	0-1	70/050	20/160	30/300		~10	1.87		

CARPENTARIA GOLD PTY. LTD.
BASIC GEOTECHNICAL LOG

DRILLHOLE: TH354/077 **LOGGED BY:** JAC **DATE:** 10/6/91 **PAGE:** 2 **OF** 2

FROM	TO	(m) Drilled	(m) Recov.	Core Loss	Weath.	Rock Strength	Foliation Intensity	CBA/DD	JOINTS/FRACT'S 1°	2°	3°	/m	RQD	% RQD	COMMENTS
131.6	134.6	3.0	3.0	0	FR	ST	1-2	65/047 (50)	40/180	60/025	35/125	8	1.97		
134.6	137.6	3.0	3.0	0	"	ST	2	65/333	65/340	25/060		10	1.85		- questionable orientation
137.6	140.6	3.0	3.0	0	"	ST	2	70/013	70/010	45/060	70/295	5	2.58		
140.6	143.6				"	ST	2-3	75/305	75/290	70/035		6	2.12		Bio-scap. schist below 140.0m.
143.6	146.6				"	MOD-ST	2-3	77/320	75/320	25/100		10	1.47		Brittle fract 144.8 - 146.0m
146.6	149.6				"	M-ST	3-4	70/005	70/005	45/100		5	2.61		
149.6	152.6				"	M-ST	3-4	70/342	70/340	025/115		7.5	2.36		
152.6	155.6				"	MK-ST	3-4	70/345	70/345	020/105		3	2.67		clayey shear (wk) @ 152.6-152.8.
155.6	158.6				"	M-ST	3-4	70/341	70/340			4	2.78		
				END	OF	HOLE	158.6m.								

Appendix B RQD and Fracture Frequency Logging

DHID	From (m)	To (m)	Interval	RQD (m, estimated)	Fractures per Interval	RQD (%)	FF/m
TH063D	0.00	3.20	3.20	0.00	99	0	31
TH063D	3.20	4.20	1.00	0.60	9	60	9
TH063D	4.20	5.20	1.00	0.60	5	60	5
TH063D	5.20	6.20	1.00	0.30	12	30	12
TH063D	6.20	7.20	1.00	0.20	20	20	20
TH063D	7.20	8.20	1.00	0.00	99	0	99
TH063D	8.20	9.20	1.00	0.00	99	0	99
TH063D	9.20	10.00	0.80	0.00	99	0	124
TH063D	10.00	11.20	1.20	0.00	99	0	83
TH063D	11.20	12.20	1.00	0.00	99	0	99
TH063D	12.20	13.20	1.00	0.40	12	40	12
TH063D	13.20	14.20	1.00	0.40	8	40	8
TH063D	14.20	15.20	1.00	0.40	9	40	9
TH063D	15.20	16.00	0.80	0.30	8	38	10
TH063D	16.00	16.50	0.50	0.00	99	0	198
TH063D	16.50	17.20	0.70	0.00	99	0	141
TH063D	17.20	18.00	0.80	0.10	13	13	16
TH063D	18.00	18.60	0.60	0.00	99	0	165
TH063D	18.60	19.50	0.90	0.10	99	11	110
TH063D	19.50	20.00	0.50	0.30	10	60	20
TH063D	20.00	20.50	0.50	0.00	8	0	16
TH063D	20.50	21.20	0.70	0.20	9	29	13
TH063D	21.20	21.60	0.40	0.00	99	0	247
TH063D	21.60	22.60	1.00	0.40	11	40	11
TH063D	22.60	23.60	1.00	0.40	10	40	10
TH063D	23.60	24.20	0.60	0.10	11	17	18
TH063D	24.20	24.50	0.30	0.00	7	0	23
TH063D	24.50	25.50	1.00	0.20	15	20	15
TH063D	25.50	26.50	1.00	0.60	6	60	6
TH063D	26.50	26.90	0.40	0.10	6	25	15
TH063D	26.90	27.00	0.10	0.00	99	0	990
TH063D	27.00	28.00	1.00	0.70	10	70	10
TH063D	28.00	29.00	1.00	0.80	5	80	5
TH063D	29.00	30.00	1.00	0.50	9	50	9
TH063D	30.00	30.50	0.50	0.40	4	80	8
TH063D	30.50	31.20	0.70	0.70	1	100	1
TH063D	31.20	32.20	1.00	0.70	10	70	10
TH063D	32.20	33.20	1.00	0.90	5	90	5
TH063D	33.20	34.20	1.00	0.60	9	60	9
TH063D	34.20	35.20	1.00	1.00	5	100	5
TH063D	35.20	36.20	1.00	1.00	5	100	5
TH063D	36.20	37.20	1.00	0.70	10	70	10
TH063D	37.20	38.20	1.00	0.80	4	80	4
TH063D	38.20	39.20	1.00	0.60	8	60	8
TH063D	39.20	40.20	1.00	0.90	3	90	3

TH063D	40.20	40.90	0.70	0.10	14	14	20
TH063D	40.90	41.50	0.60	0.20	9	33	15
TH063D	41.50	42.20	0.70	0.60	4	86	6
TH063D	42.20	43.00	0.80	0.30	10	38	13
TH063D	43.00	44.00	1.00	0.80	7	80	7
TH063D	44.00	44.50	0.50	0.25	6	50	12
TH063D	44.50	45.50	1.00	0.00	14	0	14
TH063D	45.50	46.50	1.00	1.00	3	100	3
TH063D	46.50	47.50	1.00	0.90	4	90	4
TH063D	47.50	48.40	0.90	0.90	2	100	2
TH063D	48.40	49.40	1.00	1.00	5	100	5
TH063D	49.40	50.40	1.00	1.00	2	100	2
TH063D	50.40	51.20	0.80	0.00	12	0	15
TH063D	51.20	52.20	1.00	1.00	7	100	7
TH063D	52.20	53.20	1.00	0.90	5	90	5
TH063D	53.20	54.20	1.00	1.00	4	100	4
TH063D	54.20	55.20	1.00	0.80	9	80	9
TH063D	55.20	56.20	1.00	0.50	15	50	15
TH063D	56.20	57.20	1.00	0.60	16	60	16
TH063D	57.20	57.70	0.50	0.20	7	40	14
TH063D	57.70	58.35	0.65	0.20	9	31	14
TH063D	58.35	59.30	0.95	0.30	12	32	13
TH063D	59.30	60.20	0.90	0.40	8	44	9
TH063D	60.20	61.20	1.00	0.50	8	50	8
TH063D	61.20	62.20	1.00	1.00	1	100	1
TH063D	62.20	63.00	0.80	0.00	14	0	18
TH063D	63.00	63.80	0.80	0.60	4	75	5
TH063D	63.80	64.60	0.80	0.70	6	88	8
TH063D	64.60	65.25	0.65	0.50	3	77	5
TH063D	65.25	66.20	0.95	0.80	6	84	6
TH063D	66.20	67.20	1.00	0.50	8	50	8
TH063D	67.20	68.20	1.00	0.70	5	70	5
TH063D	68.20	69.20	1.00	0.00	99	0	99
TH063D	69.20	70.20	1.00	0.90	4	90	4
TH063D	70.20	71.20	1.00	0.60	8	60	8
TH063D	71.20	72.20	1.00	0.40	7	40	7
TH063D	72.20	73.20	1.00	0.90	5	90	5
TH063D	73.20	74.20	1.00	0.80	6	80	6
TH063D	74.20	75.20	1.00	1.00	4	100	4
TH063D	75.20	76.20	1.00	0.80	6	80	6
TH063D	76.20	77.20	1.00	0.90	4	90	4
TH063D	77.20	77.70	0.50	0.50	3	100	6
TH063D	77.70	78.50	0.80	0.70	5	88	6
TH063D	78.50	79.30	0.80	0.60	6	75	8
TH063D	79.30	80.10	0.80	0.20	9	25	11
TH063D	80.10	80.60	0.50	0.30	5	60	10

TH063D	80.60	81.20	0.60	0.40	4	67	7
TH063D	81.20	82.20	1.00	0.50	10	50	10
TH063D	82.20	83.25	1.05	0.40	12	38	11
TH063D	83.25	84.20	0.95	0.30	10	32	11
TH063D	84.20	84.65	0.45	0.00	12	0	27
TH063D	84.65	85.55	0.90	0.20	10	22	11
TH063D	85.55	86.45	0.90	0.50	6	56	7
TH063D	86.45	87.20	0.75	0.20	6	27	8
TH063D	87.20	88.20	1.00	1.00	4	100	4
TH063D	88.20	89.20	1.00	0.90	6	90	6
TH063D	89.20	90.20	1.00	0.80	5	80	5
TH063D	90.20	91.20	1.00	0.80	3	80	3
TH063D	91.20	92.20	1.00	1.00	2	100	2
TH063D	92.20	93.20	1.00	1.00	4	100	4
TH063D	93.20	94.20	1.00	0.90	5	90	5
TH063D	94.20	95.20	1.00	1.00	2	100	2
TH063D	95.20	96.20	1.00	0.90	6	90	6
TH064D	3.05	3.80	0.75	0.00	99	0	132
TH064D	3.80	3.90	0.10	0.00	99	0	990
TH064D	3.90	6.00	2.10	0.00	99	0	47
TH064D	6.00	6.70	0.70	0.00	99	0	141
TH064D	12.10	13.10	1.00	0.10	15	10	15
TH064D	13.10	15.10	2.00	0.20	8	10	4
TH064D	15.10	16.55	1.45	0.00	99	0	68
TH064D	16.55	17.35	0.80	0.00	15	0	19
TH064D	17.35	17.80	0.45	0.00	15	0	33
TH064D	17.80	18.11	0.31	0.00	6	0	19
TH064D	18.11	19.30	1.19	0.00	8	0	7
TH064D	19.30	19.60	0.30	0.00	99	0	330
TH064D	19.60	21.10	1.50	0.00	99	0	66
TH064D	21.10	21.60	0.50	0.00	99	0	198
TH064D	21.60	22.00	0.40	0.00	10	0	25
TH064D	22.00	22.60	0.60	0.30	15	50	25
TH064D	22.60	23.40	0.80	0.80	5	100	6
TH064D	23.40	24.10	0.70	0.60	6	86	9
TH064D	24.10	25.10	1.00	0.80	4	80	4
TH064D	25.10	26.05	0.95	0.85	6	89	6
TH064D	26.05	27.10	1.05	0.70	10	67	10
TH064D	27.10	28.05	0.95	0.40	15	42	16
TH064D	28.05	30.10	2.05	0.00	99	0	48
TH064D	30.10	31.00	0.90	0.10	11	11	12
TH064D	31.00	31.90	0.90	0.80	4	89	4
TH064D	31.90	32.50	0.60	0.40	5	67	8
TH064D	32.50	33.10	0.60	0.50	5	83	8
TH064D	33.10	34.10	1.00	0.90	8	90	8
TH064D	34.10	35.10	1.00	1.00	7	100	7

TH064D	35.10	36.10	1.00	1.00	4	100	4
TH064D	36.10	36.70	0.60	0.60	2	100	3
TH064D	36.90	37.90	1.00	0.90	3	90	3
TH064D	37.90	39.10	1.20	0.20	99	17	82
TH064D	39.10	40.10	1.00	0.90	7	90	7
TH064D	40.10	41.00	0.90	0.70	8	78	9
TH064D	41.00	42.10	1.10	1.00	2	91	2
TH064D	42.10	42.50	0.40	0.00	99	0	248
TH064D	42.50	43.00	0.50	0.00	7	0	14
TH064D	43.00	44.00	1.00	0.60	10	60	10
TH064D	44.00	44.65	0.65	0.55	4	85	6
TH064D	44.65	44.85	0.20	0.00	99	0	495
TH064D	44.85	45.25	0.40	0.00	99	0	248
TH064D	45.25	46.50	1.25	0.00	99	0	79
TH064D	46.50	47.50	1.00	0.90	8	90	8
TH064D	47.50	48.10	0.60	0.60	2	100	3
TH064D	48.10	49.10	1.00	1.00	4	100	4
TH064D	49.10	50.10	1.00	1.00	4	100	4
TH064D	50.10	51.10	1.00	1.00	4	100	4
TH065D	0.00	3.10	3.10	0.00	99	0	32
TH065D	3.10	4.10	1.00	0.30	5	30	5
TH065D	4.10	5.10	1.00	0.50	5	50	5
TH065D	5.10	6.10	1.00	1.00	0	100	0
TH065D	6.10	7.10	1.00	0.40	4	40	4
TH065D	7.10	9.10	2.00	0.00	99	0	50
TH065D	9.10	10.15	1.05	0.00	14	0	13
TH065D	10.15	10.40	0.25	0.00	99	0	396
TH065D	10.40	11.50	1.10	0.00	99	0	90
TH065D	11.50	12.25	0.75	0.00	17	0	23
TH065D	12.25	13.20	0.95	0.00	10	0	11
TH065D	13.20	14.10	0.90	0.00	99	0	110
TH065D	14.10	15.10	1.00	0.10	10	10	10
TH065D	15.10	15.50	0.40	0.00	99	0	248
TH065D	15.50	16.10	0.60	0.40	4	67	7
TH065D	16.10	16.80	0.70	0.00	99	0	141
TH065D	16.80	17.70	0.90	0.00	99	0	110
TH065D	17.70	18.55	0.85	0.00	16	0	19
TH065D	18.55	19.00	0.45	0.00	12	0	27
TH065D	19.00	20.15	1.15	0.00	99	0	86
TH065D	20.15	20.60	0.45	0.00	99	0	220
TH065D	20.60	21.10	0.50	0.00	99	0	198
TH065D	21.10	21.70	0.60	0.10	11	17	18
TH065D	21.70	22.20	0.50	0.00	12	0	24
TH065D	22.20	22.95	0.75	0.00	7	0	9
TH065D	22.95	23.80	0.85	0.20	12	24	14
TH065D	23.80	24.90	1.10	0.10	20	9	18

TH065D	24.90	25.50	0.60	0.00	99	0	165
TH065D	25.50	26.45	0.95	0.20	16	21	17
TH065D	26.45	27.10	0.65	0.20	13	31	20
TH065D	27.10	28.00	0.90	0.00	18	0	20
TH065D	28.00	28.45	0.45	0.00	15	0	33
TH065D	28.45	29.20	0.75	0.00	14	0	19
TH065D	29.20	30.10	0.90	0.15	15	17	17
TH065D	30.10	31.00	0.90	0.00	17	0	19
TH065D	31.00	32.15	1.15	0.20	13	17	11
TH065D	32.15	33.10	0.95	0.40	9	42	9
TH065D	33.10	33.90	0.80	0.20	15	25	19
TH065D	33.90	34.80	0.90	0.70	10	78	11
TH065D	34.80	35.65	0.85	0.00	20	0	24
TH065D	35.65	36.00	0.35	0.00	12	0	34
TH065D	36.00	37.00	1.00	0.50	11	50	11
TH065D	37.00	37.90	0.90	0.70	9	78	10
TH065D	37.90	39.00	1.10	0.50	9	45	8
TH065D	39.00	40.00	1.00	0.90	5	90	5
TH065D	40.00	41.00	1.00	0.85	6	85	6
TH065D	41.00	42.10	1.10	1.00	7	91	6
TH065D	42.10	43.10	1.00	0.90	5	90	5
TH065D	43.10	44.10	1.00	0.95	4	95	4
TH065D	44.10	45.10	1.00	1.00	3	100	3
TH065D	45.10	46.10	1.00	1.00	3	100	3
TH065D	46.10	47.10	1.00	0.90	3	90	3
TH065D	47.10	48.10	1.00	0.95	4	95	4
TH065D	48.10	49.10	1.00	1.00	2	100	2
TH065D	49.10	50.10	1.00	0.70	5	70	5
TH065D	50.10	51.10	1.00	0.70	5	70	5
TH065D	51.10	52.10	1.00	1.00	1	100	1
TH065D	52.10	53.10	1.00	1.00	1	100	1
TH065D	53.10	54.10	1.00	1.00	1	100	1
TH065D	54.10	55.10	1.00	0.95	4	95	4
TH065D	55.10	56.10	1.00	1.00	5	100	5
TH065D	56.10	57.10	1.00	0.90	5	90	5
TH065D	57.10	58.10	1.00	0.90	6	90	6
TH065D	58.10	59.10	1.00	0.90	7	90	7
TH065D	59.10	60.10	1.00	1.00	5	100	5
TH065D	60.10	61.00	0.90	0.85	3	94	3
TH065D	61.00	61.90	0.90	0.90	2	100	2
TH065D	61.90	63.05	1.15	1.10	7	96	6
TH065D	63.10	63.70	0.60	0.50	4	83	7
TH065D	63.70	64.45	0.75	0.60	8	80	11
TH065D	64.45	65.00	0.55	0.55	0	100	0
TH065D	65.00	65.60	0.60	0.50	2	83	3
TH065D	65.60	66.10	0.50	0.50	0	100	0

TH065D	66.10	66.70	0.60	0.60	0	100	0
TH065D	66.70	67.30	0.60	0.40	4	67	7
TH065D	67.30	68.20	0.90	0.85	3	94	3
TH065D	68.20	69.10	0.90	0.90	2	100	2
TH065D	69.10	70.10	1.00	1.00	1	100	1
TH065D	70.10	71.10	1.00	1.00	2	100	2
TH065D	71.10	72.10	1.00	0.45	8	45	8
TH065D	72.10	73.10	1.00	0.60	5	60	5
TH065D	73.10	74.10	1.00	0.95	3	95	3
TH065D	74.10	75.10	1.00	1.00	2	100	2
TH065D	75.10	76.10	1.00	0.95	5	95	5
TH065D	76.10	77.10	1.00	0.65	6	65	6
TH065D	77.10	78.10	1.00	0.95	3	95	3
TH066D	0.00	5.60	5.60	0.00	99	0	18
TH066D	5.60	6.10	0.50	0.00	99	0	198
TH066D	6.10	7.05	0.95	0.00	99	0	104
TH066D	7.05	8.60	1.55	0.00	99	99	64
TH066D	8.60	10.00	1.40	0.00	99	0	71
TH066D	10.00	11.30	1.30	0.00	99	0	76
TH066D	11.30	12.45	1.15	0.00	99	0	86
TH066D	12.45	13.10	0.65	0.00	99	0	152
TH066D	13.10	14.15	1.05	0.10	10	10	10
TH066D	14.15	14.60	0.45	0.00	99	0	220
TH066D	14.60	15.60	1.00	0.90	7	90	7
TH066D	15.60	16.50	0.90	0.00	15	0	17
TH066D	16.50	17.30	0.80	0.20	15	25	19
TH066D	17.30	17.60	0.30	0.00	5	0	17
TH066D	17.60	18.10	0.50	0.00	12	0	24
TH066D	18.10	18.70	0.60	0.00	15	0	25
TH066D	18.70	19.60	0.90	0.00	15	0	17
TH066D	19.60	20.60	1.00	0.00	15	0	15
TH066D	20.60	21.40	0.80	0.00	14	0	18
TH066D	21.40	22.20	0.80	0.00	15	0	19
TH066D	22.20	23.60	1.40	0.25	15	18	11
TH066D	23.60	24.10	0.50	0.15	9	30	18
TH066D	24.10	24.70	0.60	0.00	12	0	20
TH066D	24.70	25.20	0.50	0.15	4	30	8
TH066D	25.20	25.80	0.60	0.30	7	50	12
TH066D	25.80	26.40	0.60	0.15	8	25	13
TH066D	26.40	27.00	0.60	0.20	10	33	17
TH066D	27.00	27.70	0.70	0.20	12	29	17
TH066D	27.70	28.30	0.60	0.25	9	42	15
TH066D	28.30	28.90	0.60	0.10	10	17	17
TH066D	28.90	29.30	0.40	0.30	3	75	7
TH066D	29.30	29.60	0.30	0.00	11	0	37
TH066D	29.60	30.20	0.60	0.30	7	50	12

TH066D	30.20	30.90	0.70	0.20	8	29	11
TH066D	30.90	31.90	1.00	0.30	11	30	11
TH066D	31.90	32.60	0.70	0.30	8	43	11
TH066D	32.60	33.40	0.80	0.20	8	25	10
TH066D	33.40	33.70	0.30	0.10	8	33	27
TH066D	33.70	33.90	0.20	0.00	99	0	495
TH066D	33.90	34.10	0.20	0.10	1	50	5
TH066D	34.10	34.50	0.40	0.20	5	50	13
TH066D	34.50	35.10	0.60	0.15	13	25	22
TH066D	35.10	35.60	0.50	0.10	7	20	14
TH066D	35.60	36.10	0.50	0.20	7	40	14
TH066D	36.10	36.85	0.75	0.20	11	27	15
TH066D	36.85	37.70	0.85	0.25	12	29	14
TH066D	37.70	38.60	0.90	0.45	6	50	7
TH066D	38.60	39.60	1.00	0.40	13	40	13
TH066D	39.60	40.60	1.00	0.50	11	50	11
TH066D	40.60	41.00	0.40	0.00	99	0	248
TH066D	41.00	41.60	0.60	0.00	8	0	13
TH066D	41.60	42.10	0.50	0.20	8	40	16
TH066D	42.10	42.90	0.80	0.35	10	44	13
TH066D	42.90	43.70	0.80	0.55	10	69	12
TH066D	43.70	44.50	0.80	0.35	9	44	11
TH066D	44.50	45.20	0.70	0.20	11	29	16
TH066D	45.20	46.00	0.80	0.70	7	88	9

Appendix C Discontinuity Characteristic Logging

DHID	From (m)	To (m)	Structure Type	Infill Thickness	Micro Roughness	Surface Weathering	Joint Alteration/Infill
TH002D	15.00	26.80	BD	1	PR	HW	D
TH002D	26.80	29.80	BD	1	PR	SW	C
TH002D	29.80	31.30	BD	1	PR	SW	C
TH002D	31.30	35.00	BD	1	PR	SW	C
TH002D	35.00	37.60	BD	1	PR	SW	C
TH002D	37.60	42.10	BD	1	PR	SW	C
TH002D	42.10	45.59	BD	1	PR	F	B
TH002D	45.59	49.90	BD	1	PR	F	B
TH023RD	48.10	52.50	JT	0	UR	F	B
TH023RD	52.50	57.10	JT	0	UR	F	B
TH023RD	57.10	61.30	JT	0	UR	F	B
TH023RD	61.30	70.70	JT	0	PR	F	B
TH023RD	70.70	75.30	JT	0	PR	F	B
TH023RD	75.30	79.80	JT	0	UR	F	B
TH023RD	79.80	84.20	JT	0	PS	F	B
TH023RD	84.20	88.60	JT	0	UR	F	B
TH023RD	88.60	93.20	JT	1	PS	F	A
TH023RD	93.20	97.50	JT	0	UR	F	B
TH023RD	97.50	102.00	JT	1	PR	F	A
TH023RD	102.00	106.50	JT	0	PS	F	B
TH023RD	106.50	111.00	JT	0	PR	F	B
TH023RD	111.00	115.50	JT	1	PS	F	A
TH023RD	115.50	120.20	JT	1	US	F	A
TH023RD	120.20	124.70	JT	1	PS	F	A
TH023RD	124.70	129.00	JT	1	PS	F	A
TH023RD	129.00	133.40	JT	0	PS	F	B
TH023RD	133.40	137.90	JT	0	US	F	B
TH023RD	137.90	142.30	JT	0	PR	F	B
TH023RD	142.30	146.60	JT	0	PS	F	B
TH023RD	146.60	151.30	JT	1	PS	F	A
TH023RD	151.30	155.90	JT	0	PR	F	B
TH023RD	155.90	159.00	JT	0	PS	F	B
TH045RD	84.40	88.70	JT	0	UR	F	A
TH045RD	88.70	93.90	JT	0	UR	F	A
TH045RD	93.90	97.30	JT	0	UR	F	A
TH045RD	97.30	101.40	JT	0	UR	F	A
TH045RD	101.40	105.60	JT	0	PR	F	A
TH045RD	105.60	109.90	JT	0	PR	F	A
TH045RD	109.90	114.40	JT	0	PR	F	A

TH045RD	114.40	117.10	JT	0	PR	F	A
TH045RD	117.10	122.50	JT	0	PR	F	A
TH045RD	122.50	125.90	JT	0	PR	F	A
TH075RD	101.80	102.30	JT	0	PR	F	B
TH075RD	102.30	104.30	JT	0	UR	F	B
TH075RD	104.30	105.00	JT	0	UR	F	B
TH075RD	105.00	106.00	JT	0	UR	F	B
TH075RD	106.00	107.00	JT	0	UR	F	B
TH075RD	107.00	108.00	JT	0	UR	F	B
TH075RD	108.00	109.00	JT	0	UR	F	B
TH075RD	109.00	110.00	JT	0	UR	F	A
TH075RD	110.00	111.00	JT	1	PR	F	B
TH075RD	111.00	112.00	JT	1	PR	F	B
TH075RD	112.00	113.00	JT	1	PR	F	B
TH075RD	113.00	114.00	JT	1	PR	F	B
TH075RD	114.00	115.00	JT	1	PR	F	B
TH075RD	115.00	116.00	JT	1	PR	F	B
TH075RD	116.00	117.00	JT	1	PR	F	B
TH075RD	117.00	118.00	JT	0	PR	F	B
TH075RD	118.00	119.00	JT	0	PR	F	B
TH075RD	119.00	120.00	JT	0	PR	F	B
TH075RD	120.00	121.00	JT	0	PR	F	B
TH075RD	121.00	122.00	JT	0	PR	F	B
TH075RD	122.00	123.00	JT	0	UR	F	B
TH075RD	123.00	124.00	JT	0	UR	F	B
TH075RD	124.00	125.00	JT	0	UR	F	B
TH075RD	125.00	126.00	JT	0	UR	F	B
TH075RD	126.00	127.00	JT	0	UR	F	B
TH075RD	127.00	128.00	JT	0	UR	F	B
TH075RD	128.00	129.00	JT	0	UR	F	B
TH075RD	129.00	130.00	JT	0	UR	F	B
TH075RD	130.00	131.00	JT	1	UR	F	A
TH075RD	131.00	132.00	JT	1	UR	F	A
TH075RD	132.00	133.00	JT	1	UR	F	A
TH075RD	133.00	134.00	JT	1	UR	F	A
TH075RD	134.00	135.00	JT	1	UR	F	A
TH075RD	135.00	136.00	JT	1	PR	F	D
TH075RD	136.00	137.00	JT	1	PR	F	D
TH075RD	137.00	138.00	JT	1	UR	F	A
TH075RD	138.00	139.00	JT	1	UR	F	A
TH075RD	139.00	140.00	JT	1	UR	F	A

TH075RD	140.00	141.00	JT	1	UR	F	A
TH075RD	141.00	142.00	JT	1	UR	F	A
TH075RD	142.00	143.00	JT	1	UR	F	A
TH075RD	143.00	144.00	JT	1	PS	F	A
TH075RD	144.00	145.00	JT	1	PS	F	A
TH075RD	145.00	146.00	JT	1	PS	F	A
TH075RD	146.00	147.00	JT	1	PS	F	A
TH075RD	147.00	148.00	JT	1	PS	F	A
TH075RD	148.00	149.00	JT	1	PS	F	A
TH075RD	149.00	150.00	JT	1	PS	F	A
TH075RD	150.00	151.00	JT	1	PS	F	A
TH075RD	151.00	152.00	JT	1	PS	F	A
TH075RD	152.00	153.00	JT	1	PS	F	A
TH075RD	153.00	154.00	JT	1	PS	F	A
TH075RD	154.00	155.00	JT	1	PS	F	A
TH075RD	155.00	156.00	JT	1	PS	F	A
TH075RD	156.00	157.00	JT	1	PS	F	A
TH075RD	157.00	158.00	JT	1	PS	F	A
TH075RD	158.00	159.00	JT	1	PS	F	A
TH075RD	159.00	160.00	JT	1	PS	F	A
TH075RD	160.00	161.00	JT	1	UR	F	A
TH075RD	161.00	162.00	JT	1	UR	F	A
TH075RD	162.00	163.00	JT	1	UR	F	A
TH075RD	163.00	164.00	JT	1	UR	F	A
TH075RD	164.00	165.00	JT	1	UR	F	A
TH077RD	93.90	95.60	BD	0	PR	F	B
TH077RD	95.60	98.60	BD	0	PR	F	B
TH077RD	98.60	100.60	BD	0	PR	F	B
TH077RD	100.60	101.60	BD	0	PR	F	B
TH077RD	101.60	103.60	JT	0	UR	F	B
TH077RD	103.60	104.60	JT	0	UR	F	B
TH077RD	104.60	107.60	JT	0	UR	F	B
TH077RD	107.60	110.60	JT	1	PR	F	A
TH077RD	110.60	113.60	JT	0	UR	F	A
TH077RD	113.60	116.60	JT	1	PR	F	A
TH077RD	116.60	119.60	JT	1	PR	F	A
TH077RD	119.60	122.60	JT	0	UR	F	A
TH077RD	122.60	125.60	JT	0	UR	F	A
TH077RD	125.60	128.60	JT	0	UR	F	A
TH077RD	128.60	131.60	JT	0	PR	F	A
TH077RD	131.60	134.60	JT	0	PR	F	B

TH077RD	134.60	137.60	JT	0	PR	F	B
TH077RD	137.60	140.60	JT	0	PR	F	B
TH077RD	140.60	143.60	BD	0	PR	F	B
TH077RD	143.60	146.60	BD	0	PR	F	B
TH077RD	146.60	149.60	BD	1	PR	F	D
TH077RD	149.60	152.60	JT	0	PR	F	A
TH077RD	152.60	158.60	BD	5	PR	F	F1

Logging Codes

Micro Roughness

Code	Description
PP	Planar - Polished
PS	Planar - Smooth
PR	Planar - Rough
UP	Undulating - Polished
US	Undulating - Smooth
UR	Undulating - Rough
SP	Stepped - Polished
SS	Stepped - Smooth
SI	Stepped - Irregular

Infill Thickness

Code	Description
0	Tight, Zero
1	Less than 1mm
5	Between 1 and 5mm
6	Greater than 5mm

Surface Weathering

Code	Term	Description
CW	Completely Weathered	Rock exhibits soil like properties (i.e. can be remoulded).
HW	Highly Weathered	Limonite staining/bleaching and other signs of chemical decomposition evident. Porosity & strength may be increased or decreased. Colour & strength of original fresh rock no longer recognisable
MW	Moderately Weathered	Defect surface affected by weathering to extent that staining extends across complete surface and the original colour of the fresh rock is no longer recognisable.
SW	Slightly Weathered	Staining or discolouration of defect surface, usually limonite, colour & texture of fresh rock recognisable.
F	Fresh	Defect surface unaffected by weathering.

Joint Alteration/Infill

Code		Description	
A		Coatings only, rock contact	Tightly healed, hard, non softening, impermeable filling, e.g. quartz, carbonate, epidote.
B			Unaltered/Fresh joint walls, or surface staining only
C			Slightly altered joint walls (one grade higher than intact rock). Non softening mineral coatings, sandy particles, clay free disintegrated rock
D			Silty-clay or sandy-clay coatings, small clay fraction, non softening.
E			Altered joint walls (two grades higher than intact rock). Softening or low friction clay mineral coatings, i.e. kaolinite, mica, chlorite, talc, gypsum, graphite.
<5mm	>5mm	Filled joints, no wall contact	Friction materials. Sandy particles, clay free, disintegrated rock
F1	F2		
G1	G2		Hard cohesive materials. Strongly over-consolidated, non-softening clay
H1	H2		Soft cohesive materials. Medium to low over-consolidated, softening clay
J1	J2		Swelling clays, e.g. montmorillonite