TRANSITIONAL PROGRESSIVE REHABILITATION AND CLOSURE PLAN



MOORVALE SOUTH MINE

PREPARED FOR
PEABODY ENERGY AUSTRALIA PTY LTD

01 APRIL 2025

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Cover Page

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Table of Abbreviations

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
AMD	Acid Mine Drainage
ANC	Acid Neutralising Capacity
Bgl	Below Ground Level
BOM	Bureau of Meteorology
CHPP	Coal Handling and Processing Plant
CMJV	Coppabella-Moorvale Joint Venture
EA	Environmental Authority
EP Act	*Environmental Protection Act 1994*
EPBC Act	*Environment Protection and Biodiversity Act 1999*
EPC	Exploration Permit Coal
ERA	Environmentally relevant activity
FCCM	Fort Cooper Coal Measures
FoS	Factor of Safety
GLE	Global Limit Equilibrium
IA	Improvement Area
LEM	Landform Evolution Model
LOD	Land Outcome Document
ML / MLs	Mining Lease / Mining Leases
MM	Management Milestone
NAF	Non-Acid Forming
NC Act	*Nature Conservation Act 1992*
NUMA	Non-use Management Area
ODN	Olive Downs North
PMF	Probable Maximum Flood
PMLU	Post-mining land use
PoO	Plan of Operations
PRCP Guideline	Progressive Rehabilitation and Closure Plan Guideline
PRCP	Progressive Rehabilitation and Closure Plan
RA	Rehabilitation Area
RCM	Rangal Coal Measures
RM	Rehabilitation Milestone
ROM	Run-of-Mine
RUSLE	Revised Universal Soil Loss Equation
SILO	Scientific Information for Land Owners
VL	Vermont Lower
VU	Vermont Upper
WEPP	Water Erosion Prediction Project

1 Introduction

AARC Environmental Solutions Pty Ltd (AARC) has been commissioned by Peabody Energy Australia Pty Ltd (Peabody) to develop a Transitional Progressive Rehabilitation and Closure Plan (PRCP) for the Moorvale South Mine (the Project) in accordance with the requirements of the *Environmental Protection Act 1994* (EP Act).

This PRCP is applicable to Mining Lease (ML) 70354 and ML70355. The current Environmental Authority (EA) EPML00380113 for the Project took effect on 21 August 2023 as issued to the five EA holders being; Peabody Coppabella Pty Ltd, CITIC Australia Coppabella Pty Ltd, KC Resources Pty Ltd, Winchester Coal Operations Pty Ltd and NS Coal Pty Ltd.

The EA authorises the environmentally relevant activity (ERA) of mining black coal under Resource Activity Schedule 3 of the Environmental Protection Regulation 2019 (EP Regulation).

2 Scope and objective

The purpose of this PRCP is to describe how progressive rehabilitation and closure criteria will be implemented at the Project. The PRCP has been developed in accordance with the requirements of the Progressive Rehabilitation and Closure Plan Guideline (DES 2023) (PRCP Guideline) current at the time of preparing this document, which states that the PRCP must include the following two parts:

Rehabilitation Planning part:

The purpose of the rehabilitation planning part of the PRCP is to support and justify the development of the proposed PRCP schedule part. The planning part must detail how progressive rehabilitation and closure will be carried out over the entire life and extent of the Project. The key components of the rehabilitation planning part for the Project are:

- community consultation information (refer Section 3.2);
- post-mining land use (PMLU) and/or non-use management area (NUMA) determination (refer Section 4.2 and 4.3);
- rehabilitation and management methodology (refer Section 4.4.5);
- risk assessment (refer Section 6); and
- a monitoring and maintenance program (refer Section 7).

PRCP Schedule part:

The PRCP schedule defines the timing of progressive rehabilitation activities and must include:

- identification of either a PMLU or NUMA for all land within the relevant resource tenures, including land uses for land undisturbed by mining;
- identification of –
    - rehabilitation areas (RAs), defined as an area of land for which a PMLU applies and to which a rehabilitation milestone for the post-mining-use relates; and
    - improvement areas (IAs), defined as an area of land in a NUMA to which a management milestone for the NUMA relates.
- identification of when land becomes available for rehabilitation or improvement;
- development of rehabilitation or management milestones (RMs/MMs) to achieve a stable condition or sufficient improvement;
- development of site-specific milestone criteria that demonstrate when each RM/MM has been completed through SMART principles (specific, measurable, achievable, reasonable/relevant, time specific);
- determination of completion dates for each RM/MM to be achieved; and
- any conditions considered necessary or desirable.

Once approved, the schedule becomes a legally binding and enforceable instrument with which the Project must comply.

The administering authority may impose a condition on a draft PRCP schedule or a PRCP schedule if it considers the condition is necessary or desirable (section 4.2 of the PRCP Guideline). In accordance with section 206A of the EP Act there are two principal conditions deemed to be necessary in all PRCP:

1. when carrying out a relevant activity under the PRCP schedule, the holder must comply with a requirement stated in the EA relevant to carrying out the activity.
2. the EA holder must comply with the following matters stated in the schedule:
    - each rehabilitation milestone and management milestone, and
    - when each rehabilitation milestone and management milestone is to be achieved.

3 Project planning

3.1 Project description

The Project is an open-cut coal mine located 156 kilometres south-west of Mackay and approximately 30 km east of Moranbah in Central Queensland, east of the Daunia Mine. The Moorvale Mine, also owned by Peabody, is approximately 10 km to the north of the Project and is connected by a haul road corridor (Figure 1). The Project consists of two Mining Leases, ML70354 and ML70355, both granted in April 2009 for the Olive Downs North project as named at the time, which cover an area of 1,632 ha and 107 ha respectively (Figure 2).

ML70354 is located on the freehold property Olive Downs and was previously associated with the Olive Downs North (ODN) project. ML70355 has been granted as an infrastructure ML to connect the Project to the existing Moorvale Mine.

Located south-west of the Project are the existing mine operations of Peak Downs, Saraji and Lake Vermont. Located immediately to the north-west of the Project are the existing mining operations of Daunia, Poitrel and Millennium. Immediately to the south of the Project is the Olive Downs South project currently under construction/development.

The Project will consist of a series of open cut pits predominantly targeting the Rangal Coal Measures (targeting initially the Leichhardt and Vermont seams) and, where economically viable, also the Fort Cooper Coal Measures. The Project will extract between 1.5 and 2 million tonnes of coal per annum over a mine life of approximately 10 years. Based on the planned production rate, up to 20 million tonnes of product coal would be produced during the life of the Project. Operations commenced in 2021, and mining will be complete in 2030.



Figure 1: Project locality

3.1.1 Mining operations and site layout

The coal resource is mined by conventional open-cut mining (e.g. excavators, dozers, front end loaders and trucks) and strip mining methods. Mining operations commenced in Y Pit, then Z pit, progressing in a northerly direction (Figure 2). Coal is extracted from the pit and placed on the Run-of-Mine (ROM) pad, and subsequently hauled via road trains to Moorvale Mine's Coal Handling & Preparation Plant (CHPP) for processing. After processing, all coal is loaded into trains via the Moorvale Mine Train Load Out facility and railed approximately 140 km to the Dalrymple Bay Coal Terminal, just south of Mackay. Tailings from the CHPP is managed at Moorvale Mine.

Waste rock removal and placement is undertaken using strip mining methods. Waste rock from the first two mining strips was directed to construction of a flood levee to protect the future mining pits from potential flood inundation from the Isaac River in the south. Thereafter, waste rock is being removed and hauled to out-of-pit dumps strategically located in the vicinity of the active mining pits. Once sufficient space becomes available within the active mining pits, progressive backfilling of the pits will commence, forming in-pit dumps.

In addition to the flood levee, other water management structures have been developed to manage mine affected waters. This includes sediment dams, water storage dams, a clean water drainage channel drain, pumps and pipelines.

Minor infrastructure associated with mine operations has also been constructed within the "Flat Areas" mine domain, including site offices, crib facilities, bathhouse, stores/warehouse, workshops and re-fuelling facilities (including diesel storage), power lines and backup power generator, and communication facilities.

A map showing the conceptual location of the Project domains, open-cut pits, overburden dumps and associated infrastructure is presented in Figure 2.

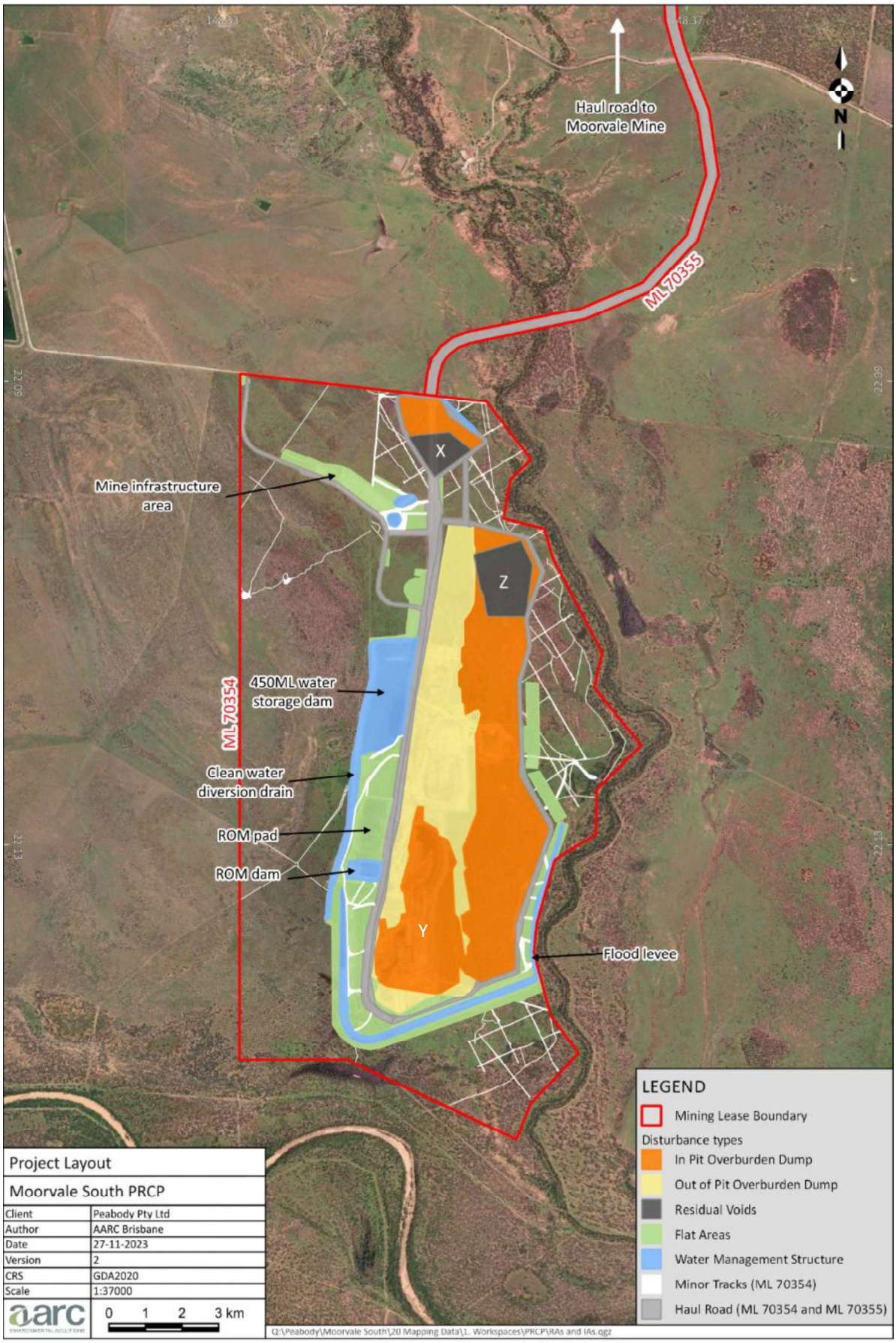


Figure 2: Project layout (operational)

3.1.2 Project ownership and history

The Moorvale South Mine forms part of the Coppabella-Moorvale Joint Venture (CMJV). The CMJV resource authorities were preceded by exploration permits (EPC's) that were granted to subsidiaries of Macarthur Coal Pty Ltd. The Coppabella mine leases were initially held under EPC 531 and EPC 646. The Moorvale mining leases were initially held under EPC 646, EPC 649, EPC 680 and EPC 749. The Moorvale South tenements were preceded by EPC 649. The tenements were amalgamated through a series of transfers and joint ventures from initial grant of EPC 531 in 1993 through to the current arrangements.

Macarthur Coal had established a majority interest in the exploration tenements by 1997 and were granted the first Mining Lease at Coppabella on 1st June 1998, with overburden removal commencing one month later and first coal being mined in October of the same year. The early production at Coppabella was undertaken by contractors (Roche – now BUMA Australia, and Peter Champion Mining) until Macarthur commenced converting to an 'Owner-Operate' model in 2006, with completion of the transition in June 2008.

The first Moorvale Mine leases were granted on 5th December 2002 with overburden removal commencing in the same month. First coal was mined in March of 2003 – all mining operations were done under a contract with Leighton Contracting. The CMJV was officially formed in December of 2003.

The Moorvale South Mining Lease (previously known as Olive Downs North) was granted in May of 2009, with development considered as a small-scale opencut satellite pit operation with a connecting haul road to the Moorvale CHPP. Plans to develop this operation were put on hold, with Macarthur focusing on developing other tenements within its portfolio.

Peabody acquired 100% of Macarthur Coal in December of 2011 and began managing the CMJV assets. In 2013, Peabody converted the CHPP operations on both sites to Owner-Operate, replacing the contractor Sedgman who had been there since the inception of both facilities. Coppabella and Moorvale have continued to operate in this manner, with production levels adjusting to market forces.

Studies into the development of Moorvale South Mine were progressed in 2018 and approval to commence the Project was granted by the CMJV in October of 2019. Construction of initial infrastructure was commenced in December 2019 before the Project was again put on hold in 2020 in response to a declining coal market. Construction activities re-commenced in late 2021.

3.1.3 Existing rehabilitation

No rehabilitation has been undertaken on the Project site to date.

3.1.4 Climate

Climate data for the Project has been sourced from the Scientific Information for Land Owners (SILO) climate database (Queensland Government) which interpolates point observations by the BoM into a national grid of synthesised data. Interpolated climate data for the Project is available from SILO database for the period between 1957 to 2023. The mean climate parameters estimated from SILO Grid point data (-22.10, 148.35) were referenced to describe baseline weather conditions.

The mean annual rainfall between 1968 and 2023 was interpolated at 587.5 mm. The mean annual evaporation estimated from the SILO grid is 2027.8 mm, approximately three times higher than the average annual rainfall, indicating a strongly negative simple water balance. The wettest months are November to March, with rainfall in this period comprising approximately 70% of the annual rainfall. The dry season generally occurs from June to September, with monthly rainfall generally less than 30 mm.

The SILO Moorvale South grid suggests mean temperatures of approximately 8.9 °C (minimum) and 33.2 °C (maximum). The warmest months are October to March, generally coinciding with the wet season. The coolest months are May to September, generally coinciding with the dry season.

Climate averages for rainfall, evaporation and temperature (maximum, minimum) for the Project are shown in Figure 3.

Long-term climate projections predict that conditions in the Project region will become warmer and drier, and the climate will become more variable (DES 2020). Maximum, minimum and average temperatures are projected to rise, with the projected range of warming between 1.1 and 3.6 °C by 2070, depending on future emissions. The temperature and frequency of hot days is also projected to increase, along with the duration of warm spells. Fire frequency is projected to remain the same, but when fires do occur, they are likely to be more extreme. High climate variability is likely to remain the major factor influencing rainfall changes in the next few decades; although the direction of change is likely to become drier, the intensity of heavy rainfall events is expected to increase. Tropical cyclones are predicted to become less frequent, but the proportion of the most intense storms will increase.

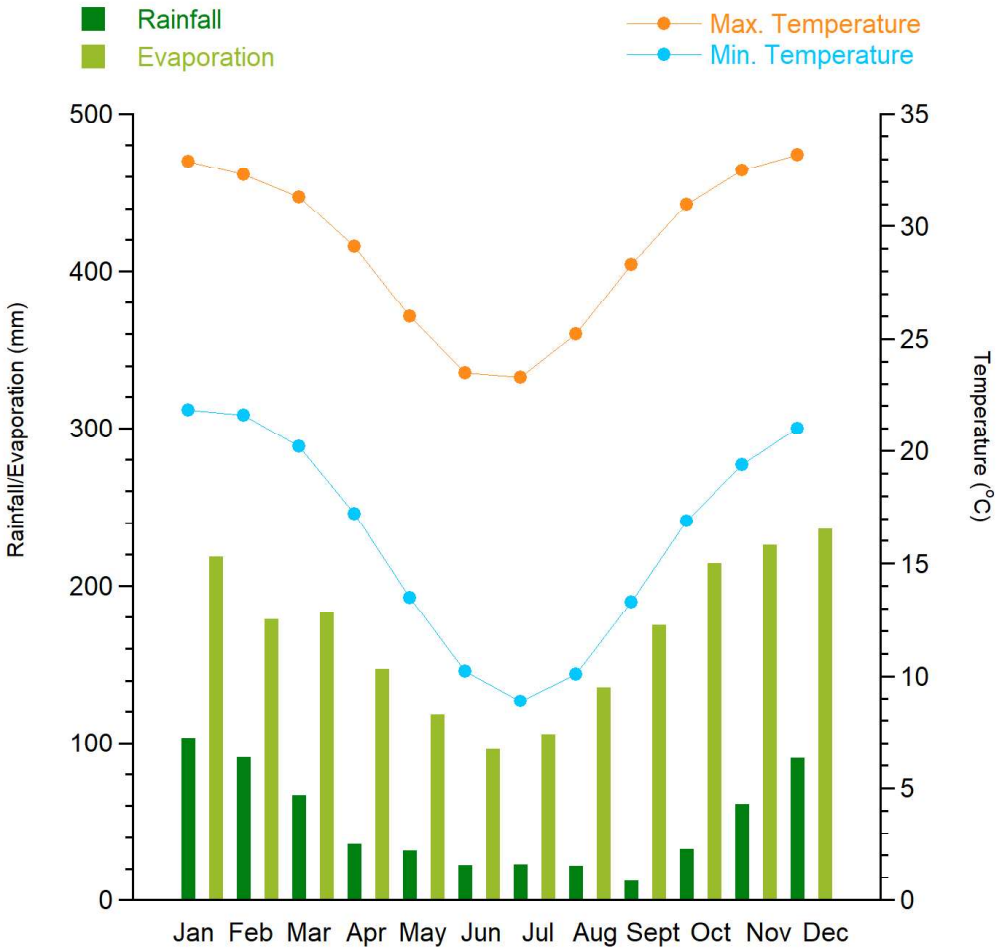


Figure 3: Average monthly climate data (1957-2023)

3.1.5 Topography and surface hydrology

Moorvale South Mine is located on relatively flat and gently undulating (2-4% gradient) topography, draining generally north to south towards the Isaac River, with elevations ranging between 180 m Australian Height Datum (AHD) south-east of the Project to 223 m AHD in the north and an average elevation of approximately 185 m AHD. Low mountain ranges of up to 400 m AHD, located to the north-east and south-west beyond the Project boundary, define the Isaac River valley, in which the Project is located.

The Project lies within the Isaac River sub-catchment, covering a total area of 22,364 km², within the greater Fitzroy River catchment. The Isaac River is defined as a watercourse under the *Water Act 2000* (Water Act) and is classified as a sixth order stream under the *Vegetation Management Act 1999* (VM Act). The southern boundary of the Project is adjacent to the Isaac River, which flows generally in a south-easterly direction to the Coral Sea *via* the Mackenzie River and Fitzroy River.

North Creek is a fourth order stream, flowing north to south along the eastern boundary of the Project, before its confluence with the Isaac River approximately 3 km downstream of the Project. The Project is traversed by three first order unnamed tributaries of North Creek. Both the Isaac River and North Creek are ephemeral and only flow after significant rainfall events, typically with surface flows in the wetter months from November to April. Significant rainfall may result in ponding, where it may be used as a water source for livestock.

The receiving waters up to 100km downstream do not include potable or irrigation water supply systems, and existing downstream water use is restricted to agricultural use for stock watering.

The extent and location of the waterways within and surrounding the Project are shown in Figure 4.

Environmental values (EVs) and Water Quality Objectives (WQOs) for the Project area are specified in the Isaac River Sub-basin Environmental Values and Water Quality Objectives, pursuant to the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP Water) (DEHP 2011). The Isaac River is located within the Isaac and lower Connors River main channel region of the Isaac River Sub-Basin water plan (WQ1301). The conditions of the Issac River and North Creek located in the vicinity of the Project are classified as slightly to moderately disturbed ecosystems under the Water Quality Guidelines (WQGs) (DEHP 2013). The legislated EVs for these watercourses are:

- Aquatic ecosystem protection (slightly to moderately disturbed ecosystems as described in the WQGs);
- Human use EVs:
    - Suitability of water supply for irrigation;
    - Farm water supply/use;
    - Stock watering;
    - Primary, secondary and visual recreation;
    - Drinking water supply;
    - Industrial use;
    - Cultural and spiritual values; and
    - Aquaculture (North Creek only).

Publicly available regional water quality data for the Isaac River at the Burton Gorge, Goonyella and Deverill gauging stations have been analysed and some water quality statistics at these stations along the Isaac River exceeded the ANZG (2018) default guideline values (DGVs). These include electrical conductivity (EC), total suspended solids (TSS), turbidity, nitrate and several dissolved metals i.e. aluminium, copper, iron and zinc. The Burton Gorge and Goonyella stations are located downstream of the Goonyella, North Goonyella, Broadlea and Burton mines and therefore measured water quality that may be affected by mine releases. Baseline water quality data for the Project collected from 2016 to 2023 show that a number of the samples are elevated above the regional DGVs. These include total suspended solids (TSS), dissolved aluminium and ammonia (WRM 2024, Appendix D).



Figure 4: Surface hydrology

3.1.6 Geological setting

The Moorvale South Mine primarily targets the Rangal Coal Measures (RCM) and Fort Cooper Coal Measures (FCCM), located within the Nebo Synclinorium. Both are major Permian coal-bearing sediments of the Blackwater Group.

At the Project, the RCM have an average thickness of 85 m with a maximum of 160 m thickness with a depth ranging from 16 m below ground level (bgl) to 193 m bgl. The RCM comprise light grey, cross-bedded, fine to medium grained labile and well cemented sandstones, grey siltstones, mudstones, shale and coal seams. The non-coal portions of the sequence being predominantly sandstones, siltstones, mudstone and shales are referred to as interburden in the mining context. The stratified sequences can be fractured and displaced through faulting. The coal seams in the RCM formation are laterally extensive, forming numerous thin seams that occasionally coalesce into thicker seams. The geological models are constructed from sub-units known as plies which may be individual seams in some areas, or parts of thicker seams in others.

The FCCM conformably underlie the RCM and occur as outcrops within the Project. FCCM are 258 m thick on average with a maximum thickness of 309 m within the Project and have a depth ranging from 78 m bgl to 494 m bgl. They are comprised of tuffaceous sandstones, siltstones, mudstones and coal seams.

Identified coal resources are predominantly hosted in the Leichhardt Seam package of the RCM with lesser contributions from the Vermont Seam in both the RCM and FCCM. Within ML70354, the Leichhardt Seam package occurs as 2 seams; the LL2 and LL3, and the Vermont Seam package comprises the VU of the RCM and the VL1 of the FCCM. A typical stratigraphic section at the Moorvale South Mine is presented in Figure 5.

In the Leichhardt Seam, LL2 is composed of the LL2T and LL2B plies, which together range from 2.8 to 4.8 m thick. The coal is generally banded with the proportion of bright to dull bands increasing towards the base. The LL3 comprises interbedded carbonaceous mudstone and bright coal bands, ranging from 1.0 to 1.6 m thick averaging 1.5 m.

The Vermont Seam occurs approximately 40 m below the LL3 and comprises the Vermont Upper (VU) and Vermont Lower (VL) separated by the Yarrabee Tuff. The VU is further divided into a dull, upper ply (VU1) and brighter lower plies (VU2 and VU3). The combined VU ranges from 2.5 to 3.7 m thick and is heavily intruded and cindered in the southern half of ML70354. The VL seam is also divided into 3 plies; an upper, banded coal (VL1) and 2 lower, stony coals (VL2 and VL3). The VL1 averages 1.3 m thick and is the only FCCM ply contributing to the Moorvale South resource in the Y-pit and Y-pit North areas only.

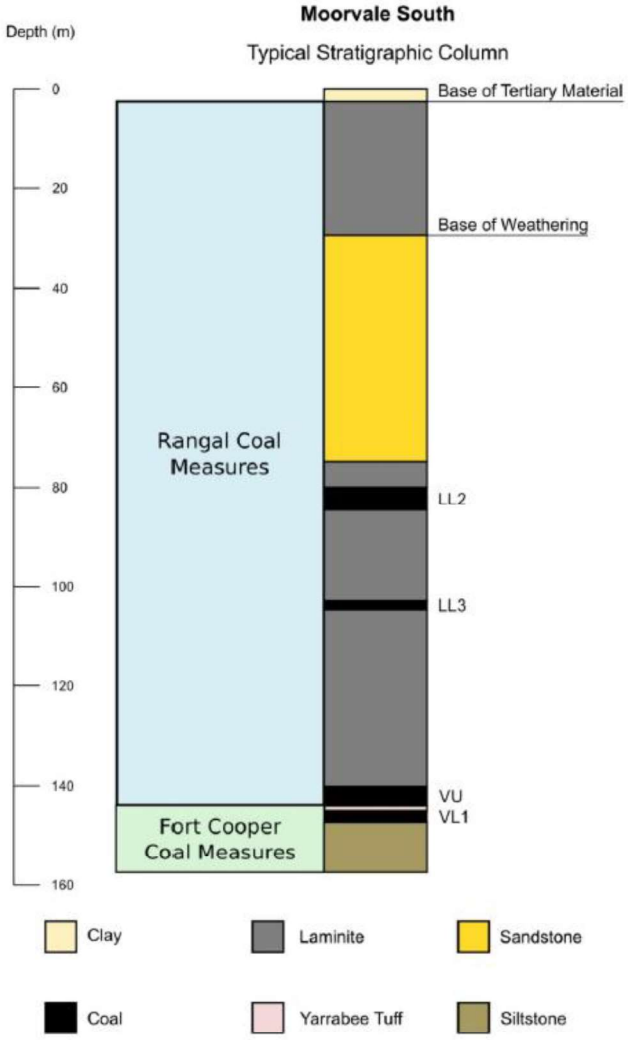


Figure 5: Typical stratigraphic section (RGS 2023)

3.1.7 Groundwater

The hydrogeological regimes underlying the Moorvale South Mine are characterised by hydrological features and geological settings, comprising of hydrogeological units described in Table 1. Faults and associated fracture zones have the potential to provide preferential flow pathways between aquifers. Aquifer connectivity may occur near structural features and may connect the alluvium with the RCM and/or FCCM.

Table 1: Hydrogeological units underlying Moorvale South Mine (SLR 2024)

Hydrogeological unit	Lithology	Aquifer type
Quaternary Alluvium (Isaac River and North Creek)	Clay, silt, sand and gravel	Unconfined
Rangal Coal Measures	Siltstone, sandstone, carbonaceous shale and coal	Mainly confined/ fractured
Fort Cooper Coal Measures	Siltstone, sandstone, carbonaceous shale and coal	Semi-confined to unconfined/fractured in the western part of the Project and confined/fractured in the eastern part of the Project

The characterisation of hydrogeological regimes at the Project has been compiled and described in the following section (SLR 2024).

The alluvium unit has been reported with variable hydraulic conductivity, reflecting the heterogenous nature of the alluvial sediments. The Isaac River is largely a losing system with stream-stage above that of the local groundwater levels, resulting in the water draining through the alluvial sediments to the water table. Occasional periods of baseflow to the river from the alluvium may occur after prolonged rainfall events or following flood events. Under these conditions, recharged alluvial sediments will drain to the river as the hydraulic gradient reverses and sustains streamflow for a short period after the rainfall event. As such, groundwater flow to the Isaac River is intermittent with an overall flow in a south-easterly direction in parallel with the flow direction of the Isaac River. Recharge to the alluvium unit is considered to be mostly from stream flow or flooding (losing streams), with direct infiltration of rainfall also occurring rapidly where there are no substantial clay barriers in the shallow sub-surface. Groundwater within the alluvium unit is likely discharged as evapotranspiration from riparian vegetation growing along the Isaac River and North Creek, potential baseflow contributions after significant rainfall and flood events, and landholder bore pumping near the Isaac River. Groundwater quality is described as fresh to moderately saline.

The coal seams of Permian coal measures are described as having high hydraulic conductivity due to the dual porosity of the coal seams, with a primary matric porosity and a secondary (dominant) porosity provided by fractures. Therefore, coal seams are regarded as dominant groundwater zones of the Permian hydrogeological units. Groundwater elevation is approximately 170 mAHD over the Project, with an overall south-easterly groundwater flow direction coinciding with the Isaac River. Groundwater within the Permian coal measures is confined and sub-artesian, which in some cases may result in a downward hydraulic gradient. Consequently, groundwater largely flows horizontally within the coal measures, along the bedding plane of the coal seams. Groundwater discharge occurs via evaporation and abstraction from active mine areas. Water within the Permian coal measures can range between fresh and highly saline, but is generally saline within the coal seams, and brackish to moderately saline within the interburden units.

The Project lies within the Isaac Connors Groundwater Management Area (GMA – Zone 34) of the Fitzroy Basin under the Water Plan (Fitzroy Basin) 2011. Within the GMA, alluvial groundwater is managed as Groundwater Unit 1 and water within the hard rock aquifers as Groundwater Unit 2 (sub-artesian aquifers).

Groundwater resources in the Project area are also scheduled under the EPP Water as Isaac Groundwaters of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1310). The legislated EVs for these groundwaters are:

- Biological integrity of aquatic ecosystems;
- Human use EVs:
    - Suitability of water supply for irrigation;
    - Farm water supply/use;
    - Stock watering;
    - Primary recreation;
    - Drinking water supply;
    - Cultural and spiritual values.

The EPP Water provides WQOs for the scheduled EVs in WQ1310. WQOs are long-term goals for water quality management and the purpose of the WQOs is to support and protect EVs. They are numerical concentration levels or narrative statements of indicators established for receiving waters to support and protect the designated EVs for those waters. They are based on scientific criteria or water quality guidelines but may be modified by other inputs (e.g. social, cultural, economic).

Baseline groundwater quality analysis includes initial baseline data collected from 2019 to early 2024 (SLR 2024, Appendix D). It is noted that the six completed sampling events at the Project monitoring bores between 2019 and the present 2024 is less than DES (2021) recommended minimum of eight samples, and preferably minimum 18 samples over 12 to 24 months, to assess site specific groundwater quality in a statistically robust manner.

Existing baseline groundwater quality data indicates a high degree of observed variability in groundwater quality between hydrostratigraphic units, and between individual bores within individual hydrostratigraphic units. There are bores within each aquifer that show some analyte concentration higher than all the relevant EVs specified in Isaac Groundwaters of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1310) and Isaac River Sub-basin Zone 34 (WQOs) (SLR 2024). Overall, the analysis concluded that groundwater at and surrounding the Project may only be suitable to support the scheduled EVs across some areas, but not across all parts of each hydrostratigraphic units.

3.1.8 Land and soil

3.1.8.1 Pre-mining land use and underlying landholders

Pre-mining, the Project area was used for low intensity grazing. As a result, there has been extensive tree clearing throughout the MLs, with much of the remnant vegetation only associated with the Isaac River and North Creek. Existing land use in the broader region comprises a combination of rangeland grazing, improved pasture grazing, resource exploration activities and coal mining.

Queensland Land Use Mapping (DES 2020) classifies the Project as 'Grazing Native Vegetation' which is defined as (ABARES 2016):

> *Land uses based on grazing domestic stock on native vegetation where there has been limited or no deliberate attempt at pasture modification.*

The real property descriptions and details of the registered owners of the land underlying the Project MLs are presented in Figure 6 and Table 2. It is noted that Lot 4 RP894192 was sub-divided as part of a compensation agreement, therefore, the current lot plan is more accurately Lot 1SP320981.

The Proponent own none of the freehold land within the MLs. Ownership of all the freehold land belong to various private owners (Table 2), with compensation agreements in place to enable mining and exploration activities to be conducted as allowed under the condition of the EA. Two road reserves are intersected by the haul road linking the Project with Moorvale Mine.

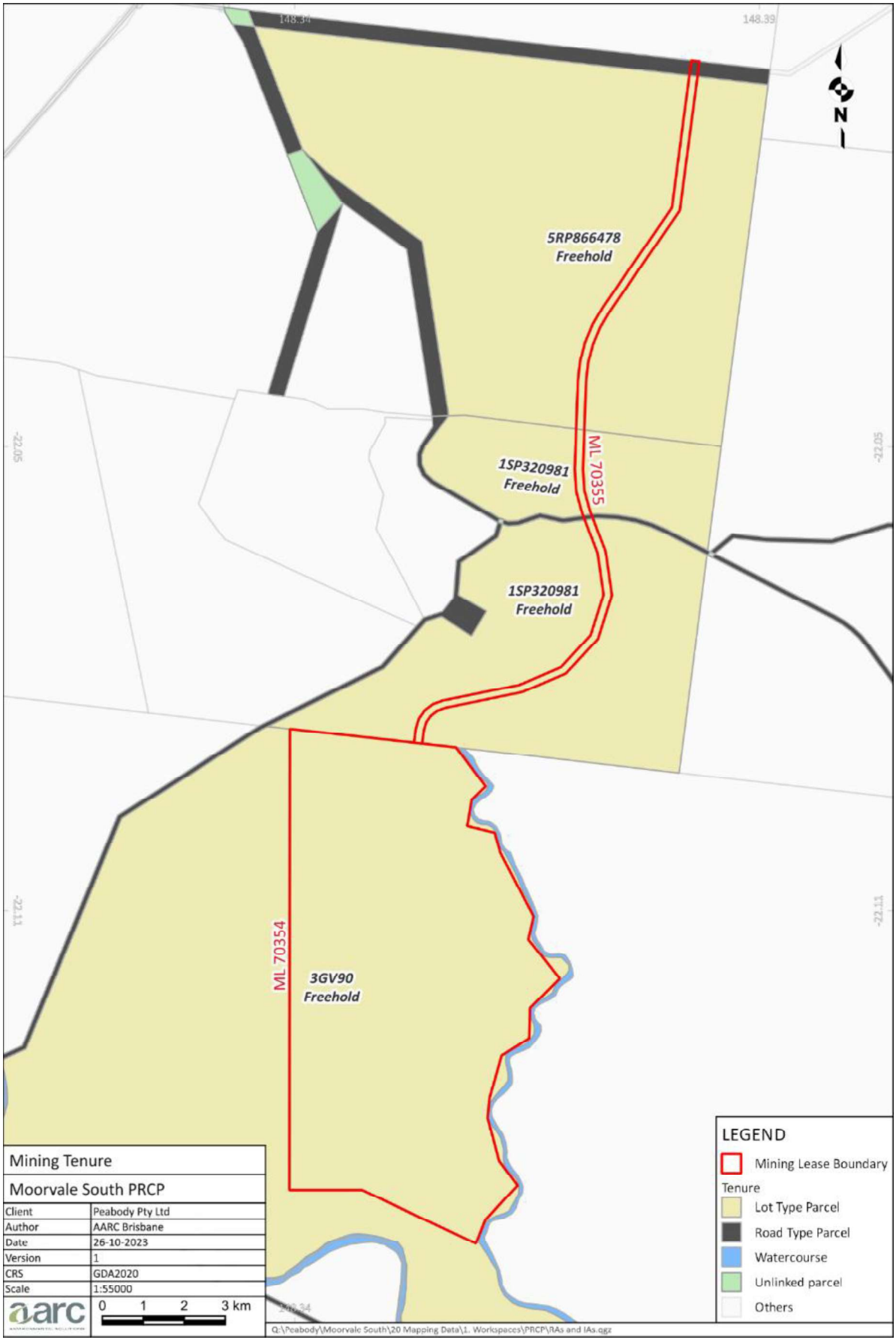


Figure 6: Mining tenure

Table 2: Underlying tenure

Tenement	Lot	Plan	Property Name	Tenure (underlying landholder)
70354	3	GV90	Olive Downs	Freehold (Williams)
70355	1	SP320981	Daunia	Freehold (Deguaras)
	4 (1)	RP894192 (SP320981)		
	5	RP866478	Mavis Downs	Freehold (Lloyd)
	-	-	Annandale Road	Road Reserve
	-	-	Unnamed Road Reserve	Road Reserve

3.1.8.2 Soil and land stability

A land resource survey of the Project identified the five soil management units (GSS Environmental 2005). The soil properties are summarised in Table 3.

Table 3: Moorvale South Mine soil units and characteristics

Soil unit	Properties
Brown duplex loam	• structurally stable with topsoil depth of 40 cm • sandy loam surface horizons grading to a heavier textured light clay subsoil • surface soil pH slightly acidic (pH 6.4 to 6.6) and non-saline • subsurface soil alkaline and non-saline
Grey gradational clay	• structurally stable with topsoil depth of 20 cm • sandy clay loam surface horizon grading to light clay subsoil layers • surface and subsoils non-saline • alkaline trend down the profile with surface soil slightly acidic to alkaline (pH 6.8 to 8.4) and alkaline subsoil (to pH 9.6)
Uniform sand	• structurally stable • coarse textured throughout the profile • slightly acidic and non-saline
Yellow brown gradational loam	• structurally stable with topsoil depth of 20 cm • brown clay loam surface horizon with sharp texture contrast to a clay subsoil • surface and subsoils non-saline • alkaline trend down the profile with pH recordings of 7.5 at the surface to 8.9 at depth
Yellow duplex loam	• structurally stable with topsoil depth of 30 cm • sandy loam surface horizon grading to a heavier textured medium clay subsoil • surface and subsoils non-saline • alkaline trend down the profile with pH recordings of 7.6 at the surface to 8.1 at depth

Erosion was recorded as present on the site, although generally associated with vehicle crossings on gullies, old cattle yards in the south-east of the Project, and some patches in the north-east of the Project (Wormington *et al.* 2004), the latter of which being the most severe, with erosion extending across the ML boundary near the bank of North Creek. Erosion is managed in accordance with the Project's Erosion and Sediment Control Plan.

3.1.8.3 Land suitability

A soil and land suitability assessment of the Project was undertaken in accordance with the *Technical Guideline for Environmental Management of Exploration and Mining in Queensland – Land Suitability Techniques* (QDME 1995).

All land within the MLs was determined to have a pre-mining land suitability of Class 2, defined as suitable land for beef cattle grazing with minor limitations.

The post-mining land suitability classification for the majority of the Project area subject to disturbance from mining operations will be Class 4, which is reflected in the land outcomes designated in the EA. Class 4 land is defined as unsuitable land for beef cattle grazing with severe limitations.

The exception is the residual voids, which will not be suitable for a post-mining land use. Therefore, defined as unsuitable land with extreme limitations.

3.1.9 Flora and fauna

The Project lies within the Northern Bowen Basin of the Brigalow Belt Bioregion, consisting of Quaternary alluvial systems (Land Zone 3), Cainozoic clay deposits (Land Zone 4), and Fine-grained sedimentary rocks (Land Zone 9). The individual land zones establish unique vegetation communities that are used to assess the conservation values of remnant vegetation. The nature conservation values within and surrounding the Moorvale South Mine have been assessed through a baseline flora and fauna survey (Wormington *et al.* 2004).

3.1.9.1 Flora

A total of 103 flora species were recorded during the survey, representing 39 families and 69 genera, across fourteen vegetation types. One (1) flora species listed as threatened under the *Nature Conservation Act 1992* (NC Act) or the *Environment Protection and Biodiversity Act 1999* (EPBC Act) was identified during the field surveys, specifically the Large-fruited Denhamia (*Denhamia megacarpa*) which is listed as vulnerable under the NC Act and Endangered under the EPBC Act.

Vegetation across at the site was associated with three main soil groupings based on geomorphology:

1) Course textured alluvium (massive earths, uniform sandy, texture-contrast and alluvial soils);

2) Argillaceous sediments (texture-contrast, dark brown and grey-brown and cracking clay soils); and

3) Tertiary weathered zone – mid catena (texture-contrast soils).

The majority of the Project prior to development was identified as having vegetation communities resulting from clearing of the original vegetation. The most significant stands of remnant vegetation are the woodlands and forests associated with the Isaac River and North Creek, and the narrow plains at the junction of the two watercourses. The woodlands are predominantly eucalypt-dominated with very little brigalow (*Acacia harpophylla*) remaining. *Eucalyptus populnea* dominates most of the higher forested areas and includes small patches of *E. orgadophila* and *E. cambageana*, while *E. tereticornis* and *E. camaldulensis* dominate on the Isaac River and North Creek.

A full description of vegetation communities present prior to commencement of the Project is provided in Table 4, along with an indication of regional ecosystems represented and their status. Vegetation mapping for the area, with the corresponding map units, is presented in Figure 7 and Figure 8. Twelve of the fourteen vegetation communities identified across the Project can be aligned with eight different regional ecosystems, of which, three are Endangered and four are Of Concern.

Four declared weed species were identified during the survey, with 12 additional weed species not declared but of environmental and/or biodiversity significance in the region. The declared weeds were Parthenium (*Parthenium hysterophorus*), Harrisia Cactus (*Harrisia sp.*), Prickly Pear (*Opuntia stricta)* and Lantana

(*Lantana camara* var *camara*). The impact from declared weeds within the Project was determined to be low in severity, although Parthenium was widespread and Lantana was thick in patches.

Desktop assessments identified a vegetation community a vegetation community occurring in an elevated area adjacent to the Project (Figure 8). The vegetation community is classified as RE 11.12.1a – *Eucalyptus crebra* woodland on igneous rocks (DoR 2023).

Table 4: Vegetation mapping units

Geology	Map unit	Vegetation description	Regional ecosystem	Vegetation Management Act/Biodiversity status	EPBC Act status
Course textured alluvium	1	*Eucalyptus camaldulensis* forest +/- *E. tereticornis* +/- *Corymbia tessellaris* with mid-storey of canopy species and *Acacia sp.* and dense grass cover on alluvial flats associated with the Isaac River	11.3.4	Of Concern / Of concern	-
	2	*Eucalyptus tereticornis* woodland +/- *E. populnea* +/- *Corymbia tessellaris* with no mid-storey and sparse grass cover on alluvial flats associated with the Isaac River	11.3.4	Of Concern / Of concern	-
	3	Mixed *Corymbia* woodland, with *Corymbia tessellaris*, *C. dallachiana* +/- *C. clarksoniana* +/- *Eucalyptus tereticornis* +/- *E. crebra* +/- *E. populnea* with very sparse mid-storey of Acacia sp. and mid-dense grass cover on alluvial soil associated mainly with the Isaac River	11.3.7	Least Concern / Of concern	-
	4	*Eucalyptus camaldulensis* and *E. tereticornis* woodland on alluvium associated with the Isaac River	11.3.25	Least Concern / Of concern	-
	5	*Eucalyptus tereticornis* woodland on alluvium associated with North Creek	11.3.25	Least Concern / Of concern	-
	6	*Eucalyptus tereticornis* on lowlands or swales with occasional *E. populnea* no mid-storey and mid-dense ground cover	11.3.4	Of Concern / Of concern	-
	7	*Eucalyptus populnea* forest / woodland +/- *Terminalia sp. Acacia harpophylla* +/- *Lysiphyllum sp*. with occasional *Corymbia spp*. very sparse mid-storey and sparse ground cover on clay soils (solid colour) and sandy soils represented by map unit 7a along North Creek	11.3.2 / 11.4.2	Of Concern / Of concern	Endangered

Geology	Map unit	Vegetation description	Regional ecosystem	Vegetation Management Act/Biodiversity status	EPBC Act status
Argillaceous sediments	8	*Eucalyptus cambageana*, *E. populnea* and *Acacia harpophylla* woodland with dense mid-storey of *Acacia spp.*, *Lysiphyllum sp*. and little or no grass cover	11.4.8	Endangered / Endangered	Endangered
	9	*Eucalyptus cambageana* and *E. populnea* +/- *Acacia sp.* +/- *Cassia brewsteri* +/- *Flindersia sp*. with sparse mid- storey and very sparse grass cover	11.4.8	Endangered / Endangered	Endangered
Tertiary weathered zone	10	*Acacia harpophylla* woodland with mid-storey of *Lysiphyllum sp*. +/- *Cassia brewsteri* +/- *Alectryon oleifolius* on clays with very sparse ground cover	11.9.5	Endangered / Endangered	Endangered
	11	*Eucalyptus orgadophila* woodland +/- *Corymbia dallachiana* +/- *Acacia harpophylla* with very sparse mid- storey of canopy species +/- *Lysiphyllum sp*. and very sparse grass cover	11.9.2	Least Concern / No concern at present	-
	12	*Eucalyptus cambageana* and *Acacia harpophylla* woodland with little to no mid-storey	11.9.1	Endangered / Endangered	Endangered
Cleared or regrowth vegetation	13	Grasslands with emergent *Eucalyptus tereticornis*, *Corymbia spp*. and *Acacia harpophylla* on sandy alluvial soils	Not applicable	Not applicable	-
	14	Sparse shrubland of *Acacia harpophylla* +/- *Lysiphyllum sp*. +/- *Flindersia sp*. +/- *Atalaya hemiglauca* on tertiary clay soils	Not applicable	Not applicable	-

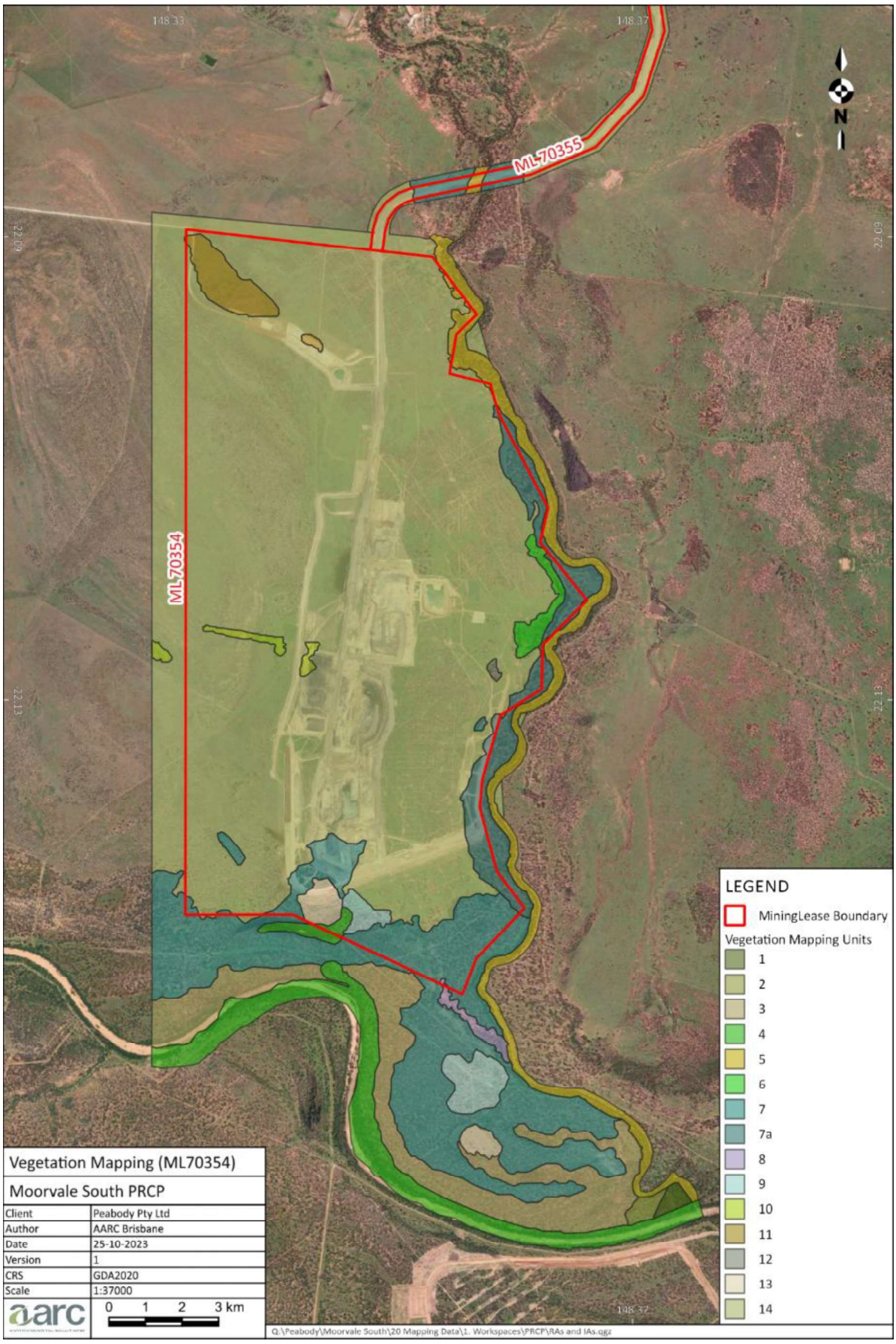


Figure 7: Vegetation mapping across ML 70354

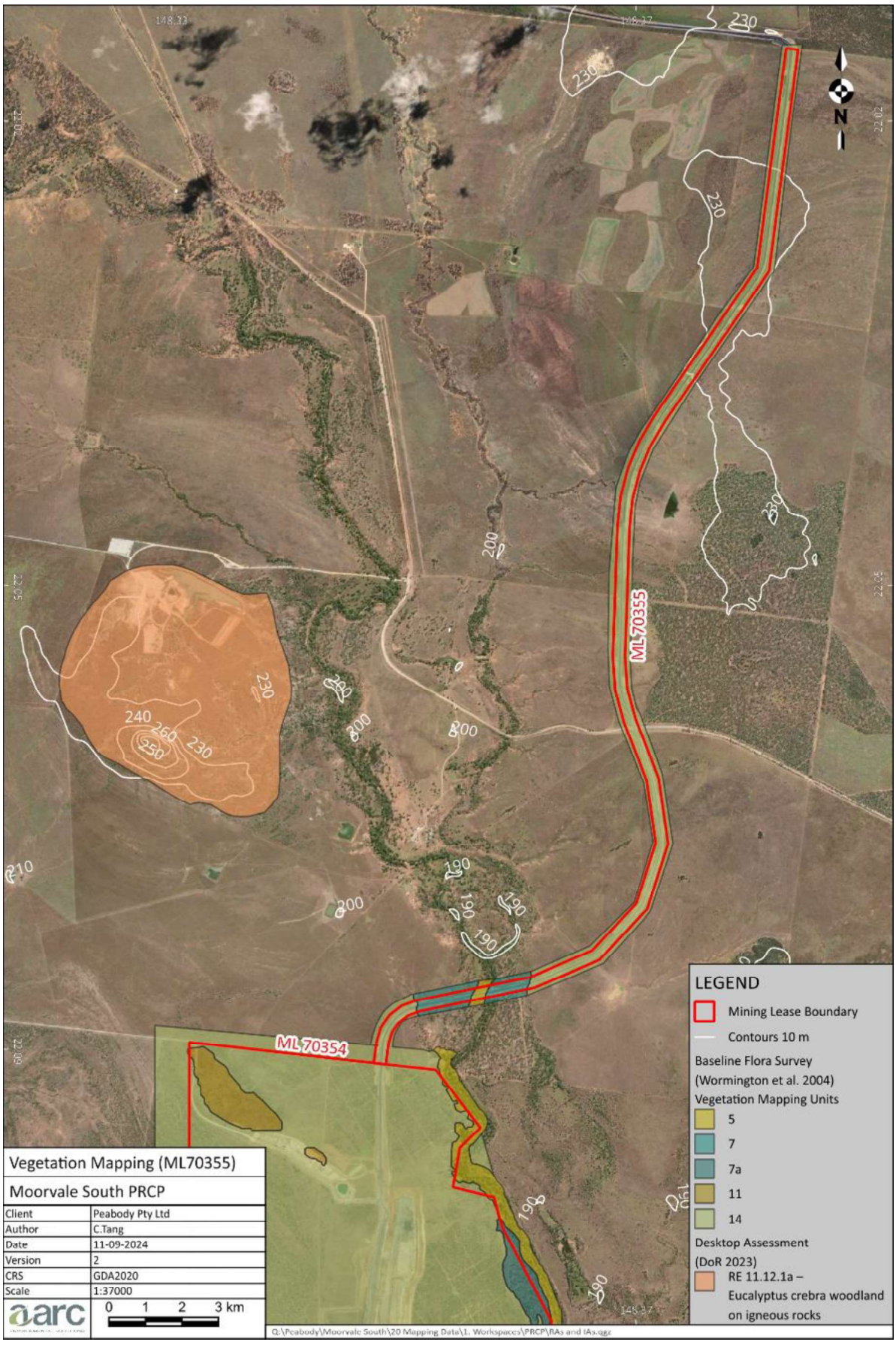


Figure 8: Vegetation mapping across ML70355 and adjacent elevated area

3.1.9.2 Fauna

Terrestrial fauna

Ninety-seven terrestrial vertebrate species were identified during the survey, comprising one (1) toad, 11 lizards, two snakes, 65 birds, 13 non-microchiropteran mammals and five microchiropteran bats. Three (3) fauna species listed as threatened under the NC Act and EPBC Act were identified during the field surveys, namely:

- the southern subspecies of the Squatter Pigeon (*Geophaps scripta scripta*) which is listed as Vulnerable under the NC Act and the EPBC Act;
- the Greater Glider (*Petauroides volans*) which is listed as Endangered under the NC Act and the EPBC Act; and
- the Koala (*Phascolarctos cinereus*) which is listed as Endangered under the NC Act and the EPBC Act.

The Short-beaked Echidna (*Tachyglossus aculeatus*), listed as a non-migratory Special Least Concern species under the NC Act, was also recorded during the survey.

The survey report noted several other species that were listed as threatened when the survey was undertaken that are no longer listed.

Pest species recorded during the survey include the Cane Toad, Feral Cat, Feral Pig, Rabbit and Wild Dog, with both Feral Cats and Rabbits noted as being common.

Aquatic fauna

One species of fish – Spangled Perch (*Leiotherapon unicolor*) – and one turtle – the eastern Snake-necked Tortoise (*Chelodina longicollis*) – were identified during the survey. Aquatic fauna can be found in ephemeral pools of Isaac River and North Creek; while the survey of the Project was only conducted during the dry season, an assessment of North Creek upstream of the Project in the post-wet season period identified five fish species.

Groundwater dependent ecosystems

Field verification has concluded that the majority of the terrestrial vegetation associated with the Isaac River, Phillips Creek, North Creek and Cherwell Creek is unlikely to be dependent on groundwater (SLR 2019). Given that the vegetation communities along these features are known to occur more widely across the landscape and are not restricted to areas where they could potentially access groundwater. On the basis that groundwater depth is greater than 10 m bgl and the ephemeral nature of the aquatic habitat associated with the watercourses, the habitats have a low likelihood of being dependent on groundwater. Terrestrial vegetation and aquatic habitat associated with the palustrine wetlands were also determined to have a low likelihood of being groundwater-dependent.

3.2 Community consultation

Stakeholder engagement is a critical component of successful mine closure planning. Through effective stakeholder engagement, organisational and community perspectives, goals and knowledge are gathered to inform closure processes. To provide context for the community consultation associated with the Project undertaken to date, the following provides a summary history of the development and ownership of the Moorvale South Mine.

3.2.1 Previous engagement activities

The Proponent's approach to community consultation is premised on early informative engagement and proactive response to landholder concerns. Consequently, the Proponent held a number of face-to-face meetings with the landholders of the land underlying ML70354 and ML70355 and the Isaac Regional Council during 2019, prior to commencement of mining. Details of the consultation undertaken at this stage in accordance with section 126C(1)(c)(iii) of the EP Act are shown in Table 5.

Table 5: Community consultation register

Consultation date	Stakeholders	Consultation type	Information provided	Issues raised/discussed	Response, outcomes and ongoing commitments
18 December 2018	Lloyd (Landholders)	Face-to-face meeting (informal)	Discussion of activities on Moorvale South.	Concerns about increased traffic speed and volume on Annandale Road due to its proposed upgrade.	Peabody provided brief clarifications on activities on Moorvale South and controls to be implemented.
22 January 2019	Williams (Landholders)	Face-to-face meeting	Greenfields exploration on EPC682; review of Moorvale South development; water monitoring activities on EPC649; mine progression design to enable backfilling of voids within the 1:1000 flood levels.	Discussed options for grazing access on western side and water monitoring activities.	Peabody agreed to undertake survey of existing fence network to allow ongoing grazing. Water of acceptable quality to be added to stock dams, water not suitable for stock use to be moved to a storage facility within ML.
31 January 2019	Deguara (Landholders)	Face-to-face meeting	Feedback on development plans and approval status for Moorvale South; seek feedback on conduct to date; discuss valuation of the land and mechanisms for granting of ML for Moorvale South Stage 2; timing and duration of activities on Landholders' land.	Various questions and issues raised, including concern about Peabody contractor driving too fast, haul road cattle crossing points and water supply, sealing the public access road, and the quality of grazing land pre-mining and post-rehab, as the limited research indicated that post rehab conditions were far inferior to pre mining environment. Indicated interest in maximising the land for cattle grazing.	Peabody to undertake a number of follow up actions by related to land valuation. Review haul road compensation agreement for undertakings to the landholders (specifically water supply).
19 February 2019	Lloyd (Landholders)	Face-to-face meeting	Project development plans and timing, particularly regarding haul road activities. Discussion of plans for expanding the operation, particularly in consideration of increased activity on the haul road and resources extending south onto the Lloyd's their property	Various questions and issues raised, including concerns about increased traffic and safety on Annandale Road, sealing the haul road, fencing along the haul road and crossing arrangements, and maintenance of water in isolated paddocks.	Peabody to provide suitable map focussed on activity on Lloyd's property for further discussions. Peabody to provide summary of obligations under the Compensations Agreement for subsequent discussions. Peabody to provide updates on coal haulage traffic and hours of operations. Fence line pick up and water sources. Peabody committed to discussing the implementation of measures in the Compensation Agreement as the level of design detail increases with regard to crossing points and water supply, and any residual issues

Consultation date	Stakeholders	Consultation type	Information provided	Issues raised/discussed	Response, outcomes and ongoing commitments
					not adequately covered by the Compensation Agreement.
19 February 2019	Small (Landholders)	Face-to-face meeting	Project development plans and timing, particularly regarding haul road activities. Discussion of plans for expanding the operation, particularly in consideration of increased activity on the haul road.	Various questions and issues raised, including discussion about upgrades to Annandale Road and the impact on the use of paddocks.	Ongoing engagement regarding Moorvale South Stage 2 project.
11 March 2019	Richard Madden (Isaac Regional Council)	Email	Request for consent to disclose the Annandale Road Construction and Maintenance Agreement.	Request for consent to disclose the Agreement to nominated third party for the purpose of discussing issues associated with its intended use and upgrade of Annandale Road.	Peabody provided a joint letter from all the parties and signed by each of the parties, and to address relevant questions from council to proceed with the request.
13 March 2019	Patrick Moore (Isaac Regional Council) Jeff Stewart-Harris (Isaac Regional Council) Manus Basson (Isaac Regional Council) Sean Robinson (Isaac Regional Council)	Face-to-face meeting	Overview of Peabody Projects in region. Moorvale South Project update	Various questions and issues raised, including coal haulage options and potential sealing of road, progressive rehabilitation, traffic volumes on Annandale Road, approval requirements for new access road planned through Daunia Station for heavy vehicles during construction.	Peabody confirmed that the haul road will be sealed in places, a noise assessment is underway, and rehabilitation will be undertaken progressively and residual voids will be minimised. Permits to be obtained to operate on council road.
18 March 2019	Deguara (Landholders)	Face-to-face meeting	Discussion of follow up actions related to land valuation.	Various questions and issues raised, including discussion of land valuation options and ongoing quarry operations. Quarry subdivision proposal and timeframe, and right of first	Peabody demonstrated what the full offer should include, such as commercial agistment arrangement, asset management plan, quarry rules and cost of business disruption.

Consultation date	Stakeholders	Consultation type	Information provided	Issues raised/discussed	Response, outcomes and ongoing commitments
				refusal for further agistment terms were requested by landholders.	
27 March 2019	Isaac Regional Council	Email	Email to council provided with Moorvale South Fact Sheet, Project Overview Infrastructure Plan, Intersection Design and Draft Construction Specification.	NA	NA
28 March 2019	Williams (Landholders)	Activity Notification	Notice to vacate ML 70354.	NA	NA
28 March 2019	Deguara (Landholders)	Activity Notification	Notice to vacate ML 70355.	NA	NA
9 April 2019	Robin Thekkekara (Isaac Regional Council) Richard Madden (Isaac Regional Council)	Email	Meeting request with council.	NA	NA
15 April 2019	Isaac Regional Council	Email	Council response to submission of draft plans and recommendations.	Submission was not approved by council.	NA
15 April 2019	Isaac Regional Council	Email	Request for further clarification regarding Land Court decision notice from council.	Copies of documents were provided, including Land Court decision notice, engineering details, vertical alignment, stormwater drainage design, traffic and pavement reports, bill of quantities and engineering reports used in developing proposal.	Peabody provided relevant copies.

Consultation date	Stakeholders	Consultation type	Information provided	Issues raised/discussed	Response, outcomes and ongoing commitments
18 April 2019	Isaac Regional Council	Email	Council response to submission of intersection design of Moorvale and Moorvale South.	NA	NA
3 May 2019	Robin Thekkekara (Isaac Regional Council)	Email	Request for follow up meeting on 21 May 2019 to discuss issues raised.	Confirmation of meeting arrangement and issues to be discussed with council.	Peabody provided a detailed design report with the technical information requested in council response to initial submission, and to give a presentation on what have been completed to address the requirements. Potential interaction with Annandale Road upgrade will also be a topic of discussion.
21 May 2019	Robin Thekkekara (Isaac Regional Council) Richard Madden (Isaac Regional Council) Sean Robinson (Isaac Regional Council) Manus Basson (Isaac Regional Council)	Face-to-face meeting	Overview of Project and background to haul road intersection progress	Various questions and issues raised including anticipated social impacts of infrastructure, use of Annandale Road, discussion of the intersection, potential to extend the sealed section, whether further public consultation was planned and whether the haul road would provide for fauna crossings.	Peabody confirmed that Project will be a continuation of Moorvale Mine, Annandale Road will be used for coal haulage (with relevant permits), extending the sealed section could be accommodated, no further public consultation is required but engagement with impacted stakeholders will continue, crossing points for cattle could be designed to accommodate wildlife.
22 May 2019	Lloyd (Landholders)	Face-to-face meeting	Updates on Project development timeline and coal haulage scenarios. Obligations with respect to haul road construction, pursuant to the Compensation Agreement. Discussion on noise modelling assessment and noise impacts.	Various questions and issues raised, including water supply to paddocks and the proposed underpass.	Ongoing consultation regarding preferred locations for road crossings and watering troughs. Obtain the Lloyd's input into a reconfiguration layout with the haul road in place. Obtain the Lloyd's input on locations of the infrastructure Peabody is to provide.

Consultation date	Stakeholders	Consultation type	Information provided	Issues raised/discussed	Response, outcomes and ongoing commitments
29 May 2019	Lloyd (Landholders)	Email	Email sent to landholder attaching Noise and Vibration Assessment Report for Mavis Downs homestead.	Review of noise and vibration impacts of the Project on Mavis Downs property as per discussion.	Peabody had further discussions of the road design to ensure impacts on the cattle station are best managed in accordance with the Compensation Agreement.
11 July 2019	Isaac Regional Council	Email	Letter of approval (Engineering Decision Notice) dated 27 June 2019 of Haul Road intersection.	NA	NA
30 August 2019	Deguara (Landholders)	Face-to-face meeting	Updates on acquisition progress of the Daunia Hill property.	Discussion around the expected timing of when Peabody might be ready to make an offer for the property.	Peabody had briefed the CMJV participants about the proposed acquisition to initiate the approval of authorised funds to support an offer. An inspection and valuation of the property has been commissioned which would inform its initial offer. Peabody had sought approval for an amount possible for securing an agreement and substantially less than the indicated asking price from the Deguaras.
14 October 2021	Williams (Landholders)	Email	Updates on drill site scouting activity commencing on ML70354, number of ground-truthed drill sites and drilling commencement date, Finalised drill site locations to be provided.	No issues raised/discussed.	NA
17 November 2021	Deguara (Landholders)	Phone call	Advised landholder that quarterly water bore monitoring had been postponed to later this week due to heavy rain last week, given with notice of entry into Daunia to bore MS0113 in ML70355.	Access to bore MS0113 was approved by landholder as the ground is sandy soil all the way to that bore.	Quarterly water bore monitoring proceeded on Thursday 18 Nov 2021 at Daunia's bore.
26 January 2022	Williams (Landholders)	Email	Email received from landholder containing a "Thank you" for the Christmas Hamper Peabody sent	No issues raised/discussed.	Peabody replied to the email.

Consultation date	Stakeholders	Consultation type	Information provided	Issues raised/discussed	Response, outcomes and ongoing commitments
			them and wishing everyone a Happy New Year.		
24 June 2022	Williams (Landholders)	Phone call	Notification to landholder of date of entry for second quarter water bore monitoring activity on EPC649 on Tuesday 28 June 2022.	No issues raised/discussed.	Moorvale South exploration activities were conducted.
31 October 2023	Deguara (Landholders)	Face-to-face meeting	A copy of the presentation shared with landholders was provided.	Discussion around the submission of the MVS PRCP and the MVSX project, and impacts from mining activities. Indicated potential to rehabilitate the haul road on Deguara's property to a post mining land use of light grazing, as nightworks along the haul road created traffic nuisance.	Requested to be informed throughout the process. Peabody confirmed that the haul road will be rehabilitated to a post mining land use of light grazing in the MVSX PRCP.
14 November 2023	Barada Barna (Indigenous communities)	Face-to-face meeting	A copy of the follow-up letter to the Traditional Owners (TO) group is provided.	Presentation of the MVS PRCP and discussion around the CMJV activities as a whole.	Requested to be informed throughout the process.
15 March 2024	Barada Barna (Indigenous communities)	Face-to-face meeting	Discussion of the opportunities to work with Peabody and any impacts from mining activities.	Various questions and issues raised, including opportunities presented to work with Peabody and direct contractors, reminder that Lot 2 SP113033 remains subject to acquisition for the Barada Barna.	Peabody reviewed and connected opportunities through to Barada Barna via regular meetings, and to progress employment opportunities in region with Compass Group management.

3.2.2 Community consultation plan

In order to comply with section 126C(1)(c)(iv) of the EP Act, the rehabilitation planning part must include a community consultation plan detailing how ongoing consultation will be carried out in relation to the rehabilitation to be carried out under the PRC plan. The following sections describe the objectives for community consultation, how the community will be engaged, the proposed consultation frequency, what information will be released for community consultation and how feedback and comments will be considered.

3.2.2.1 Objectives

The objectives for the community consultation plan include:

- keep identified stakeholders informed of relevant activities and progress at the mine;
- maintain and develop stakeholder relationships;
- record and respond to any complaints in a timely manner;
- identify stakeholder concerns about rehabilitation and closure of the mine;
- facilitate consultation feedback and input into mine rehabilitation and closure plans;
- consider and address broader stakeholder concerns where possible, as they are raised; and
- provide timely, accurate and credible information to the identified stakeholders until relinquishment is achieved.

3.2.2.2 Key stakeholders

The identification of all relevant stakeholders is important to ensure regional concerns and issues of the Project are adequately addressed during rehabilitation activities and relinquishment. The key stakeholders identified for ongoing consultation in relation to rehabilitation to be carried out under the PRCP area shown in Table 6.

Table 6: Key stakeholders

Affected	Interested
• Landholders underlying ML70355 and ML70354 • Indigenous communities – Barada Barna • Isaac Regional Council	• Dept of Environment and Science (DES) • Local businesses and suppliers • Elected officials

Ongoing community consultation will involve keeping stakeholders informed of the development and operation of the mine, and rehabilitation progress against the PRCP Schedule. Additionally, should any changes to the PRCP or schedule be required that affect the post mine land use, attempts to engage with the stakeholders will form part of the amendment process.

Table 7 provides an overview of the key engagement objectives, consultation methods and engagement frequency.

Table 7: Community consultation plan

Stakeholder	Communication method	Information to be provided	Frequency
Landholders underlying ML 70354	Formal meetings, email, letter or phone call	Advise in writing when PRCP is approved and provide copy of the PRCP for their information. Provide updates on development and operation of mine. Provide updates on rehabilitation and closure progress against the PRCP schedule. Where changes to the PRCP or schedule are proposed, provide fact sheet or summary document outlining the proposed changes and any additional information requested. Feedback will be considered in the context of the proposed changes and other relevant feedback and if technically viable and reasonably possible it will be incorporated in the final version of the PRCP amendment application. Continue to consult regarding land access.	Annually or as otherwise agreed with the stakeholder during operations and decommissioning/rehabilitation phases.
Landholders underlying ML 70355	Formal meetings, email, letter or phone call	Advise in writing when PRCP is approved and provide copy of the PRCP for their information. Provide updates on development and operation of mine. Provide updates on rehabilitation and closure progress against the PRCP schedule. Where changes to the PRCP or schedule are proposed, provide fact sheet or summary document outlining the proposed changes and any additional information requested. Feedback will be considered in the context of the proposed changes and other relevant feedback and if technically viable and reasonably possible it will be incorporated in the final version of the PRCP amendment application. Continue to consult regarding land access.	As needed during operations and decommissioning/rehabilitation phases.
Isaac Regional Council	Formal meetings, email or phone call	Provide updates on development and operation of mine. Provide updates on rehabilitation and closure progress against the PRCP schedule.	At Project milestones and as needed during operations and decommissioning/rehabilitation.

Stakeholder	Communication method	Information to be provided	Frequency
Indigenous communities – Barada Barna	Formal meetings	Provide updates on development and operation of mine. Provide updates on rehabilitation and closure progress.	As needed during operations and through Cultural Heritage process. Annually during decommissioning/rehabilitation phases.
Local businesses and suppliers	Through business networks and relevant tender processes	Provide updates on development and operation of mine. Provide updates on rehabilitation and closure progress.	As needed during operations and decommissioning/rehabilitation phases.
Elected representatives and Department personnel	Formal meetings, email or phone call	Provide updates on development and operation of mine. Provide updates on rehabilitation and closure progress against the PRCP schedule.	As agreed with individual elected representatives and Department personnel.
General Public	Website	Provide updates on rehabilitation and closure progress. Publish contact details on the facility page within Peabody's website (i.e. phone number and email address).	As required or as issues are raised.

3.2.2.3 Engagement record keeping and reporting

In accordance with Section 126C(1)(c)(iii) of the EP Act, and the PRCP Guideline, a community consultation register will be kept as part of the approval requirements for the PRCP (provided as Table 5). The register will be accessible to those with a consultation role responsibility and will be maintained throughout the life of the mine through to closure.

Following the approval of the PRCP, the register will used to document each stakeholder consultation event (including all meetings, presentations, feedback, phone calls and written submissions). Information recorded on the register will include consultation dates, engaged community member(s), communication type, the information provided, key issues raised, response actions and/or outcomes and any commitments made by the Proponent. The register will provide an efficient mechanism to track, respond to and report on any feedback received, as well as provide a mechanism to measure stakeholder perception and views.

Feedback from the consultation proves will be entered into the register and considered in the context of the proposed changes and other relevant feedback. If technically viable and reasonably possible, it will be incorporated in the final version of the PRCP amendment application.

4 Rehabilitation and improvement planning

4.1 Rehabilitation objectives

In Queensland, mine rehabilitation is required under the EP Act. Amendments to the EP Act in late 2018 implemented key elements of the State Government's Mined Land Rehabilitation Policy (Queensland Government 2018) which intends to ensure that, for land disturbed by mining activities:

- the land is safe and structurally stable;
- there is no environmental harm being caused by anything on or in the land; and
- the land can sustain a post-mining land use (section 111A of the EP Act).

These three objectives are the general rehabilitation goals for all areas disturbed by mining in Queensland.

4.2 Post-mining land use

This section of the PRCP describes and discusses the PMLUs proposed for the Project in accordance with section 126C(1)(d) of the EP Act and the performance outcomes required under Part 3 division 1 of the EP Regulation.

4.2.1 Land outcome documents

Schedule C – Table C1 of the EA identifies the various disturbance types, along with the projected disturbance areas, relevant post-mining land use and post-mining land suitability class for each disturbance type. The location of the various disturbance types is specified in *Schedule C – Table C1* and presented in *Attachment 1* of the EA.

Consequently, the EA is considered to define the transitional land outcomes and therefore satisfies the definition of a land outcome document (LOD) per section 750 of the EP Act. These land outcomes form the basis of the PMLUs of this PRCP. The PMLU relevant sections of *Schedule C – Table C1* has been reproduced as Table 8.

In accordance with *Schedule C – Condition C1* of the EA:

> *All areas significantly disturbed by mining activities must be rehabilitated to a stable landform with a self-sustaining vegetation cover in accordance with Table C1 (Final land use and rehabilitation approval schedule) and Attachment 2 – Conceptual Final Landform Contours, Attachment 5 – Final Land Uses, and Attachment 6 – Rehabilitation Completion Criteria.*

Table 8: Post-mine land uses

	Projective Disturbance area (ha)	**Disturbance Type**					
		Pre-mining Land Use	**Post-mining Land Use**	**Proposed Post-mining Land Use**	**Pre-mine land Agricultural Suitability Class**	**Post-mining Agricultural Suitability Class**	**Lot on Plan**
Overburden Dumps	**391** (subtotal)						
Out-of-Pit Overburden Dumps	141	Grazing	Light Grazing	Light Grazing	2	≤4	Lot 3 on GV90
In-Pit Overburden Dumps	250	Grazing	Light Grazing	Light Grazing	2	≤4	Lot 3 on GV90
Infrastructure	**426** (subtotal)						
Flat areas – Building areas, vehicle parking areas & ROM stockpile areas	129	Grazing	Light Grazing	Light Grazing	2	≤4	Lot 3 on GV90
Water Management Structures	77	Grazing	Light Grazing	Light Grazing	2	≤4	Lot 3 on GV90
Minor Tracks	29	Grazing	Light Grazing	Light Grazing	2	≤4	Lot 3 on GV90
Haul Road (ML70354)	84	Grazing	Light Grazing	Light Grazing	2	≤4	Lot 3 on GV90
Haul Road (ML70355) (includes topsoil stockpiles, water management and drainage facilities)	107	Grazing	Property access road	Light Grazing	2	≤4	Lot 5 on RP894192, Lot 4 on R89419 (Lot 1 on SP320981), 8/61489 (Annandale Road) and 16/37557 (Un-named road)

The LOD identifies the pre-approved PMLU as 'Light Grazing' in Table C1, with a variation of this PMLU pre-approved as 'Light Grazing (native vegetation)' in Attachment 5 of the LOD. The LOD also specifies the following requirements in accordance with Schedule C – Condition C4:

> *Where reasonable and practical, rehabilitation of the site should include native species endemic to the area.*

The variation in PMLUs reflects a difference in proposed rehabilitation strategy to achieve the rehabilitation objectives. The intent of the PMLU and its variation is clarified below.

Based on the pre-mining land resource assessment outcomes, areas to be considered suitable for grazing must provide and sustain a sufficient bulk of nutritious forage and be flood-free with relatively dry conditions (GSS Environmental 2005). This is considered achievable for land to be rehabilitated to elevations similar to pre-mining topography. While the PMLU is nominally pre-approved as 'Light Grazing', the revegetation strategy in this area will include local native species suitable for the new conditions. The proposed seed mix is designed with reference Map Unit 14 (refer Table 4) and contains less diversity of tree/shrub species to allow establishment of grass groundcover.

In areas subject to inundation during 1% AEP flood events (WRM 2023), the pre-approved PMLU is 'Light Grazing (native vegetation)'. The revegetation strategy will include endemic native wetland species suitable for the inundation frequency. The proposed seed mix is designed with reference to vegetation along North Creek and Isaac River (map unit 7, refer Table 4), containing greater diversity of tree, shrub and ground cover species to ensure greater vegetation cover. Greater vegetation cover supports stability and flood resistance of the post-mining landform.

Similarly, for elevated landforms, these landforms constitute a substantially different landform to that present pre-mining. The pre-approved PMLU of 'Light Grazing (native vegetation)' is nominated to include local native species suitable for the new conditions. Revegetation of elevated landforms is proposed to mimic existing surrounding elevated landforms (Figure 8). Government regional ecosystem and contours mapping identified a vegetation community occurring in an elevated area adjacent to the Project (DoR 2023). Slopes with rocky soils, similar to the proposed elevated landform, was identified as RE 11.12.1a – *Eucalyptus creba* woodland on igneous rocks (refer Section 3.1.9). The proposed RE is expected to provide a self-sustaining vegetation cover for the proposed PMLU. The selection of native species in accordance with the identified RE is detailed in Section 5.12.2.

In accordance with Condition C4, it is reasonable and practical to rehabilitate the site with native species endemic to the area as it will establish a self-sustaining final landform for both 'Light Grazing' and 'Light Grazing (native vegetation)' PMLUs.

The PMLU is consistent with the LOD and the pre-mining land use as the proposed rehabilitation methodology will include revegetation with native trees, shrub and pasture grass species, in accordance with pre-mining and existing surrounding vegetation communities.

Additionally, the PRCP Guideline specifies the requirement for a PMLU to be proposed for all land within the resource tenure, including land undisturbed by mining activities. Land undisturbed by mining activities will retain its existing land use.

Schedule C – Table C1 of the EA also specifies the targeted post-mining land suitability. With reference to the land suitability criteria for beef cattle grazing outlined in the *Regional Land Suitability Framework for Beef Cattle Grazing PMLU Rehabilitation in the Bowen Basin (Short 2023)*, the post-mining landscape is anticipated to be limited by coarse textured profiles, potential overlying rock at shallow depths, abundance of surface cobbles and rock outcrop, as well as steep slopes. These limitations to achieving a Light Grazing PMLU have been considered in the proposed rehabilitation management methodologies. This is including, but not limited to, the establishment of a suitable final landform design (refer Section 5). Therefore, the potential land limitations reflect the nature of disturbance and post-mining landscape and the rehabilitation requirement to return the land to a land suitability class of four (4) or less is considered suitable for the Project.

For built infrastructures within Flat Areas, *Schedule C – Condition C8* states:

> *All infrastructure constructed by or for the environmental authority holder during the mining activities, including water storage structures, must be removed from the site prior to mining lease surrender, except where agreed in writing by the post-mining land owner / holder.*

As Mine Infrastructure Area (MIA) becomes available for rehabilitation, all infrastructure will be removed from the MIA, and the area rehabilitated to a Light Grazing PMLU, with the exception of the haul road (ML 70355) connecting to Moorvale Mine, which will be retained at closure as a property access road, per *Schedule C – Table C1* of the EA. However, the underlying landholders of ML 70355 i.e. Deguaras have verbally confirmed that they are no longer interested to retain the haul road. Therefore, there is no agreement for the retention of the haul road in place. The haul road will be rehabilitated to a Light Grazing PMLU, instead of a retained infrastructure PMLU. The relevant landholder engagement activity occurred on 31 October 2023 and is detailed in the community consultation register shown in Table 5.

The proposed PMLU as part of this PRCP is outlined in Table 8.

The proposed rehabilitation methodologies have been developed in consideration of the rehabilitation goals, objectives and completion criteria outlined in *Attachment 6* of the EA. This is reflected in the rehabilitation milestone criteria detailed in Section 4.4.3.

4.2.2 Consistency with outcome of community consultation

A consultation register relating to the approvals stage of the Project, which occurred prior to the acquisition of the MLs by the Proponent, is no longer available; however, the granting of approval for the Project indicates that both the proposed PMLUs and the level of community consultation undertaken at the time were deemed to be sufficient by the administering authority.

4.2.3 Planning scheme conformance

The Project is located within the Isaac Regional Council planning area and is covered by the 'Isaac Regional Planning Scheme 2021', the strategic framework which sets the policy direction for development in the area. The Scheme advances the 'Mackay, Isaac and Whitsunday Regional Plan 2012' as it applies to the planning scheme area.

The 'Isaac Regional Planning Scheme' identifies the Project as being zoned for rural land use which has a purpose defined as to:

> *a) provide for rural uses and activities; and*
>
> *b) provide for other uses and activities that are compatible with:*
>
> *(i) existing and future rural uses and activities; and*
>
> *(ii) the character and environmental features of the zone; and*
>
> *c) maintain the capacity of land for rural uses and activities by protecting and managing significant natural resources and processes; and*
>
> *d) ensure sensitive land uses do not encroach into areas affected by hazardous levels of dust associated with mining activity*

The rural zone accommodates a wide range of rural uses, including cropping, intensive horticulture, aquiculture, grazing and intensive animal industries, and the Scheme encourages the retention of natural features such as creeks and bushland in this zone.

Therefore, the PMLU of Light Grazing is consistent with the local planning scheme and does not require State or Local Government approval prior to implementation. This land use is consistent with the land use of the surrounding area, which is predominantly a grazing land use.

4.2.4 PMLU summary

In summary, the PMLU defined in Table 8 conforms with the requirements under relevant legislation (EP Act and EP Regulation), where it:

- complies with the LOD;
- considers the use of land in the surrounding region;
- considers how the land was used before the mining activity was carried out on the land;
- consistent with the approval processes associated with the development of the Moorvale South Mine; and
- considers community views and the objectives of the local planning schemes.

4.3 Non-use management areas

This section of the PRCP relates solely to the disturbance areas that will remain as NUMAs post-closure.

4.3.1 Land outcome documents

Schedule C – Table C1 of the EA identifies the voids as remaining at closure as water filled voids, the relevant sections have been reproduced in Table 9. The design specifications of the residual voids are described in *Schedule C – Table C3* of the EA, and the location is presented in *Attachment 5* of the EA. Consequently, the EA is considered to define the transitional land outcomes and therefore satisfies the definition of a land outcome document (LOD) per section 750 of the EP Act.

As per Section 754(3) of the EP Act, water filled voids is authorised to remain at mine closure and will be rehabilitated to a NUMA. The NUMA as authorised by the LOD is considered to be pre-approved and therefore not required to comply with Section 126C(1)(g) and (h), and Section 126D(2) and (3). No further justification of the NUMA is required under legislation.

Table 9: Non-use management areas

	Disturbance Type					
	Projective Disturbance area (ha)	Pre-mining Land Use	Post-mining Land Use	Pre-mine land Agricultural Suitability Class	Post-mining Agricultural Suitability Class	Lot on Plan
Residual Voids	**36** (subtotal)					
Below Grade Mining Voids	36	Grazing	Water filled voids	2	NA	Lot 3 on GV90

Similarly stated in Section 213 of the EP Regulation, the following components of a PRCP objective and performance assessment in Schedule 8A, Part 3 do not apply:

- Table 1 – Final site design assessment;
- Table 2 – Post-mining land use assessment, entry for Rehabilitation milestones; and
- Table 3 – Non-use management area assessment, entry for Management milestones.

The NUMA has therefore been included within this PRCP as a IA that are subject to various management milestones. As such the following requirements in relation to the *Progressive Improvement* of NUMAs outlined in Schedule 8A, Part 3 of the EP Regulation, this PRCP will:

- describe how non-use areas will undergo improvement to a safe and stable condition post-closure;
- illustrate how improvement will commence;
- identify risks and discuss their incorporation within the improvement schedule; and
- detail the timeframe for improvement areas to progress through management milestones.

Schedule C – Condition C7 states the residual voids must comply with the following outcomes:

> *(a) residual voids must not cause any serious environmental harm to land, surface waters or any recognised groundwater aquifer, other than the environmental harm constituted by the existence of the residual void itself, and subject to any other condition within this environmental authority; and*
>
> *(b) residual voids must comply with Table C3 (Residual void design).*

These conditions are in line with the rehabilitation goals listed in *Attachment 6* of the EA to establish a geotechnically stable, safe and non-polluting final landform. The approved residual void design specifications are reproduced in Table 10. Various technical studies have been undertaken as part of the PRCP development process to support safe condition at surrender. Outcomes of the various assessments and relevant safety features for the water filled voids are reflected in the management milestones (refer Section 4.4.3) and described in Section 4.4.5.

Table 10: Residual void design specifications

Material	Residual Void highwall – competent rock maximum slope (%)	Residual Void lowwall – incompetent rock maximum slope (%)	Total void surface area (ha)
Intact pit slope	104 (46 degrees)	NA	36
Backfill spoil	NA	62 (32 degrees)	

4.3.2 Consistency with outcome of community consultation

With respect to the requirements of section 126C(d) of the EP Act, a compensation agreement between the EA holder and the landholder of Lot 3 GV9 has been agreed as part of EA approval processes. An agreement has been reached where a change in value of the underlying land and any fixed improvements on the land caused by the Project is recognized and agreed.

Consequently, the NUMAs authorised by the EA are determined to be consistent with relevant community consultation. Section 3.2 describes the community consultation undertaken to date and the ongoing engagement strategy.

The granting of approval for the Project indicates that the level of community consultation undertaken at the time were deemed to be sufficient by the administering authority and there are no significant changes to the pre-approved NUMA that forms part of the mine plan.

4.3.3 Planning scheme conformance

A total area of 36 ha is authorised to be rehabilitated to non-use management area under the EA. The NUMA proposed are therefore pre-approved under the EP Act and do not require any further State or Local Government approval.

4.3.4 Voids in flood plains

The mining sequence has been designed so that residual voids are located outside of flood plains. The mapped flood plain extent has been modelled to a 0.1% AEP, demonstrating that the residual voids are located outside of the flood plain and do not pose a risk to areas beyond the mining tenure. The findings of the flood assessment is provided in Section 5.1.

4.3.5 NUMA summary

The NUMA defined in Table 9 conforms with the requirements under relevant legislation (EP Act and EP Regulation), where it:

- complies with the LOD;
- is considered pre-approved and does not require any further State or Local Government approval;
- demonstrates a confined risk of environmental harm within the area of the mining tenure.

The PMLU and NUMA of the Project is illustrated in Figure 9.

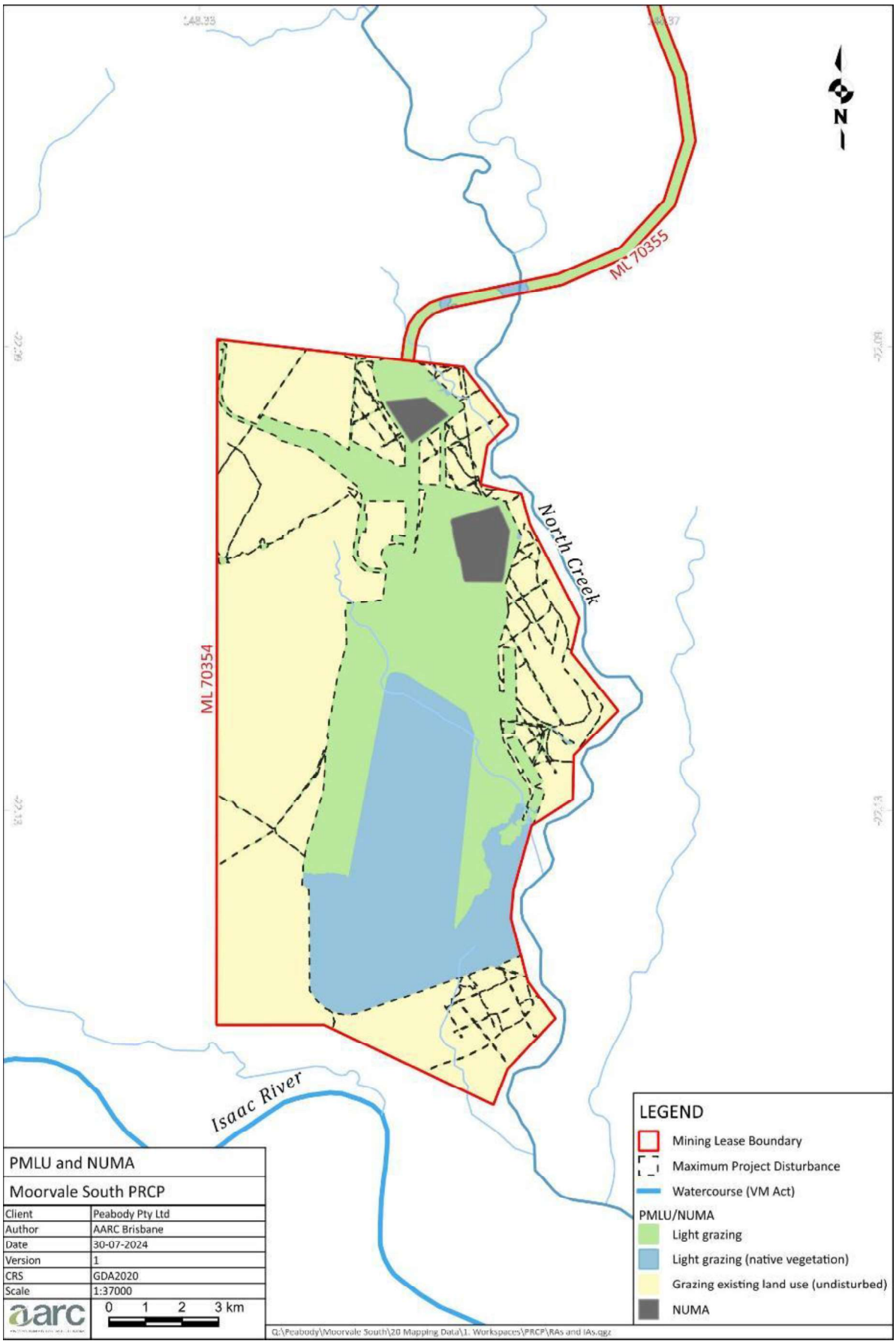


Figure 9: Post-mining land use and non-use management areas

4.4 Rehabilitation management overview

4.4.1 Rehabilitation areas and improvement areas

To allow the development of a PRCP schedule that satisfies the requirements of the PRCP Guideline, discrete rehabilitation areas (RAs) and improvement areas (IAs) have been defined for the Project. RAs have been nominated for each area of disturbance within the Project with consideration for the disturbance type, applicable rehabilitation activities and proposed PMLU. An IA is defined in the EP Regulation as, for a NUMA, an area of land in the NUMA to which a management milestone for the NUMA relates.

Both RAs and IAs have been nominated for areas of disturbance within the Project and are listed in Table 11 and presented in Figure 10. The remaining surface area within the Project MLs will not be subject to disturbance from mining activities and as such, no RA or IA is defined for this area and the existing land use will be retained post-closure.

Table 11: Identified rehabilitation areas and improvement areas

Rehabilitation or Improvement Area reference	Description	Area (ha)	Availability for progressive rehabilitation
RA1: Mine infrastructure	Flat areas – building areas, vehicle parking areas, ROM stockpile areas and topsoil stockpiles	129.4	2028
RA2: Elevated Landform	Elevated landform within a portion of out-of-pit and in pit waste rock emplacements	181	2026
RA3: Out-of-pit overburden dumps	Out-of-pit waste rock emplacements regraded to level topography	59	2026
RA4: In-pit overburden dumps	In pit waste rock emplacements regraded to level topography	152	2027
RA5: Clean water drainage channel	Clean water drainage channel retained as landform feature at closure	14	2026
RA6: Water management structures	Dams and levees	63	2036
RA7: Roads and tracks	Minor tracks and haul road (ML70354 and ML 70355)	220	2030
IA1: Residual void (X Pit)	Residual water filled void	11	2032
IA2: Residual void (Z Pit)	Residual water filled void	25	2032

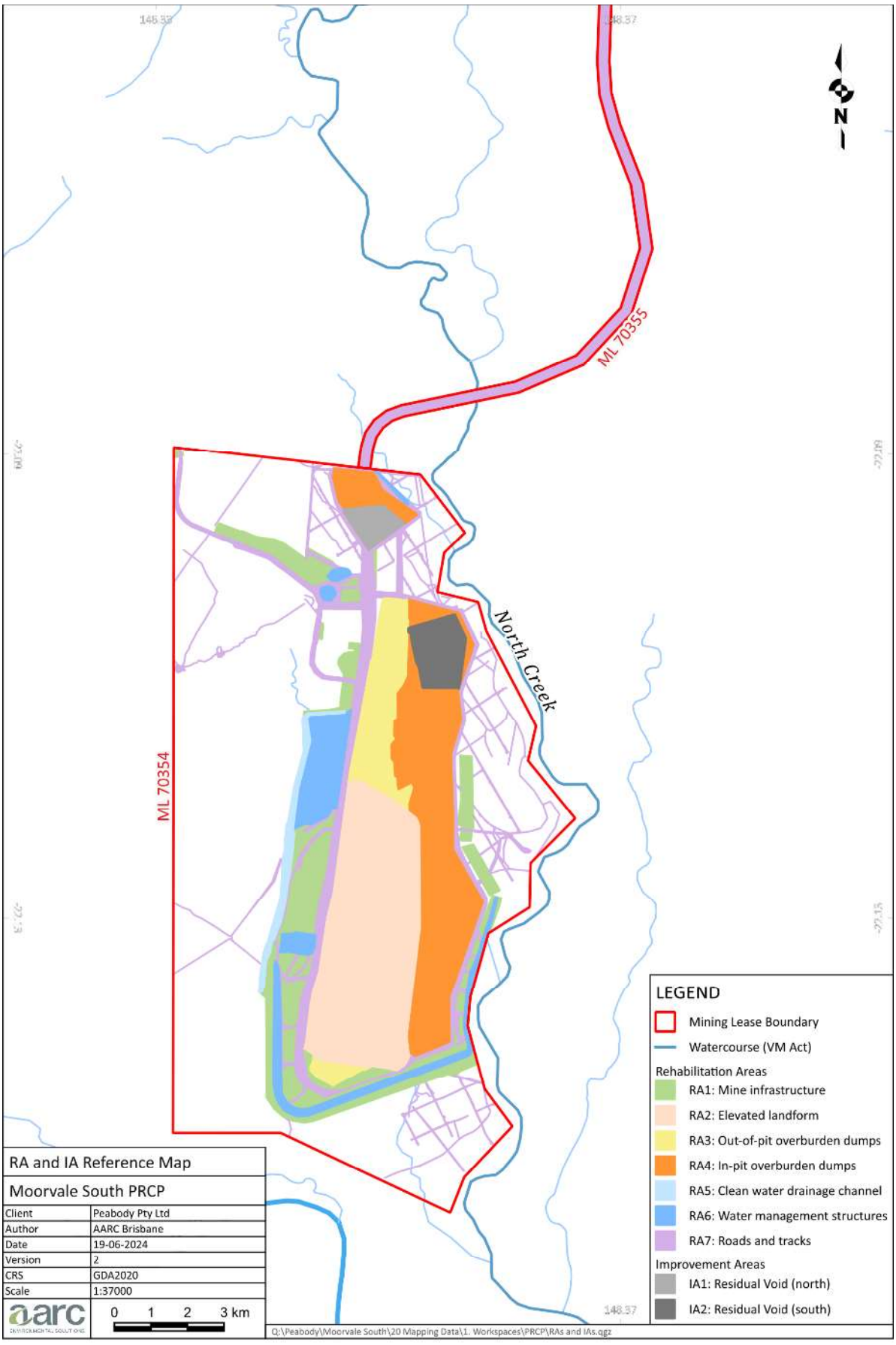


Figure 10: Rehabilitation areas and improvement areas

4.4.2 Justification for availability for progressive rehabilitation

The rehabilitation and management milestones described in the sections below must be achieved as soon as practicable after land becomes available for rehabilitation. Land is considered to become available for rehabilitation at the completion of mining and the ancillary activities, except where land is being used for operating infrastructure, placement of topsoil stockpiles, has been identified as being retained infrastructure post-closure, or is required for access to undertake rehabilitation activities elsewhere.

The clean water drainage channel (RA5) is currently operational in its final landform. The final landform is constructed, and relevant rehabilitation methodologies implemented in 2023. The RA is in its monitoring stages to demonstrate that it has achieved the rehabilitation objectives.

Mining operations are currently progressing from the south to north. According to the mining sequence, land will become progressively available in sections of the overburden dumps (RA2, RA3, RA4) from 2024 to 2027. Description of the mining sequence is provided in Section 5.4.

Subsequently, MIA (RA1) within the southern section of the Project will become progressively available as rehabilitation activities are completed in RA2. This is expected to be 4 years after land first becomes available in RA2, therefore, land in RA1 will become available from 2028.

Mine operations will be complete by 2030, and selected areas which have undergone rehabilitation activities prior to 2030 will have achieved the appropriate level of rehabilitation and access to those areas will no longer be required for mining purposes. Consequently, haul road (ML70355) and minor tracks within ML70354 (RA7) will become available from 2030. Subsequently, management of residual voids (IA1 and IA2) are expected to begin in 2032.

Water management structures (RA6), e.g. sediment dams, are expected to be required to capture runoff from rehabilitated areas until sufficient vegetative cover has established to provide erosion control, which is projected to be 2036 at which point RA6 will become available for rehabilitation.

4.4.3 Milestone criteria and completion criteria

Rehabilitation milestones (RMs) are required for all RAs and defined as each significant event or step necessary to rehabilitate an area of land to a stable condition (Section 112, EP Act).

Management milestones (MMs) are required for all IAs and defined as each significant event or step necessary to achieve best practice management of the area and minimise risk to the environment (Section 112, EP Act). The management milestones are applicable to the two residual voids nominated in the EA.

Key to assessing the success of rehabilitation and improvement is the definition of milestone criteria. Milestone criteria are preferably specific, measurable, achievable, realistic and timely. They should:

- be outcome-based (linked to the end land use);
- be flexible to adapt to changing circumstances;
- be able to evolve as the mine life progresses;
- include metrics suitable to demonstrate that rehabilitation is trending positively;
- undergo periodic review; and
- include a measurement approach that details how the criterion will have been met (CoA 2016; ANZMEC and MCA 2000).

A set of milestone criteria has been identified for the Project to provide a clear definition of milestone completion and successful rehabilitation for each rehabilitation area or sufficient improvement of each improvement area. The milestone criteria demonstrate the completion of progressive rehabilitation or improvement steps and events. The completion criteria for each PMLU (specified in the EA) is referred in the development of milestone criteria in the proposed schedule, which shows achievement of the PMLU to a stable condition for progressive certification and/or ML surrender. The completion criteria for the NUMA will be used as milestone criteria for the final milestone in the proposed schedule, which shows achievement of sufficient improvement.

Milestones and milestone criteria for each RA and IA and are provided in Table 12 and Table 14 respectively. It should be noted that not all RMs are applicable to all RAs; the applicability of RMs to the various areas are indicated in Table 12.

Table 12: Rehabilitation milestone criteria

Rehabilitation milestone	Applicable RAs	Milestone criteria
RM1: Infrastructure decommissioning and removal	RA1, RA5, RA6, RA7	1.1 A signed landholder agreement is in place for all retained infrastructure. 1.2 Except for any infrastructure to remain as part of the PMLU, and agreed to be retained by the landholder as evidenced by a signed landholder agreement, the following actions are complete for each Rehabilitation Area (RA): (a) All redundant services (such as water, electricity, and gas) disconnected and removed. (b) All buildings and associated infrastructure dismantled and removed from site. (c) All concrete slabs, hardstands, and footings removed from site. (d) All asphalt from sealed roads, carparks and hardstand areas removed from site. (e) All fencing removed from site. (f) All pipelines drained and removed from site. (g) All surface water drainage infrastructure, including watercourse crossings and culverts, removed from site. (h) All sediment ponds and sumps decommissioned. (i) All machinery and equipment removed from site. (j) All general waste removed from site to a **licensed**[1] facility for disposal or recycling.
RM2: Management of contaminated land	RA1, RA7	2.1 Preliminary site assessment and related assessment report by a **Suitably Qualified Person** (**SQP**)[2], meets the following requirements: (a) Site assessment identifies the presence of contamination or potential for contamination to exist in relevant rehabilitation areas (including the identification of potential sources of contamination, contaminants of concern, areas contaminated); and (b) Site assessment report Certification by the **SQP**: (i) verifies the contaminated land investigation document meets regulatory content requirements, including a statement of uses or activities for which the site is suitable; and (ii) confirms there is no contamination present that would undermine achievement of PMLU to stable conditions; and

[1] **Licensed** means, a waste transporter or waste facility holding an approval under the *Environmental Protection Act 1994* to transport, receive, store, recycle or dispose of the waste.

[2] Here, a **suitably qualified person (SQP)** means, a suitably qualified person for performing a regulatory function under chapter 7, part 8 (Contaminated Land) of the *Environmental Protection Act 1994* or another function prescribed under a regulation, defined as a person who—

(a) has qualifications and experience relevant to performing the function; and

(b) if a regulation prescribes an organisation for this paragraph—is a member of the organisation

Rehabilitation milestone	Applicable RAs	Milestone criteria
		(iii) recommends further investigation where there is: risk of contaminants migrating from site, causing environmental harm, undermining the achievement of the PMLU, required under the *Environmental Protection Act 1994*, or for another reason identified by the **SQP.** 2.2 For any area recommended for further investigation by the **SQP** under 2.1, the following actions are complete: (a) detailed site investigation report completed in accordance with requirements of the *Environmental Protection Act 1994* and subordinate legislation; and (b) contaminated and hazardous materials remediated on site or removed by a **licensed** waste transporter to a facility **licensed** to receive the waste; and (c) waste-tracking records retained, and waste-transaction information submitted to the administering authority in accordance with requirements of the *Environmental Protection Act 1994* and subordinate legislation; and (d) **SQP** Certified validation report, confirming contaminated materials removed or rehabilitated, completed in accordance with requirements of the *Environmental Protection Act 1994*.
RM3: Landform development (reshaping and reprofiling)	All RAs	3. 1 All major earthworks, including drainage works and land reshaping and recontouring, comply with the following requirements: (a) construction is under the supervision of, an **appropriately qualified person – engineering** (**AQP-Eng**)[3] in accordance with design specifications provided by an **AQP-Eng**; and (b) landforms are constructed such that: (i) there will be no runoff from landform tops onto batter slopes; and (ii) unless otherwise authorised under this schedule, the maximum slope is 1V:7H (~14 %); and (c) are consistent with the final site design in Appendix B; and (d) 'as constructed' Certification from an **AQP-Eng** , certifies that works have been completed in accordance with the design plans required under this schedule.. (e) geotechnical stability report(s) Certified by an **AQP-Eng**, confirms long-term geotechnical stability of constructed landforms and that a Factor of Safety (FoS) of ≥1.5 has been achieved for each landform. 3. 2 Temporary erosion and sediment control measures are in place.

[3] An **appropriately qualified person – engineering** (**AQP-Eng**) means a person who is a Registered Professional Engineer of Queensland (RPEQ) under the provisions of the *Professional Engineers Act 2002* and has demonstrated competency and relevant experience in the relevant area e.g. Mining (Civil), Mining (Geotechnical).

Rehabilitation milestone	Applicable RAs	Milestone criteria
		Additional final landform requirements: 3. 3 Final landforms of Mine Infrastructure (RA1), Out-of-Pit Overburden Dump (RA3), and In-pit Overburden Dump (RA4) meet the following design specifications: (a) Slope – Vertical: Horizontal ≤ 2-5%; (b) Vertical height from natural ground level ≤ 5 m; and (c) Maximum distance between contour banks ≤ 500 m. 3. 4 Final landform of elevated overburden dump (RA2) meets the following design specifications: (a) Slope – Vertical: Horizontal ≤ 15%; (b) Vertical height from natural ground level ≤ 30 m; and (c) Maximum distance between contour banks ≤ 88 m. 3. 5 Final landform of water management structures (RA5) meets the following design specifications: (a) Slope – Vertical: Horizontal ≤ 30%; (b) Vertical height from natural ground level ≤ 15 m; and (c) Maximum distance between contour banks ≤ 45 m. 3. 6 Final landform of roads and tracks (RA7) meets the following design specifications: (a) Slope – Vertical: Horizontal ≤ 3-5%; (b) Vertical height from natural ground level ≤ 5 m; and (c) Maximum distance between contour banks ≤ 500 m.
RM4: Surface preparation (topsoil application, soil amelioration, contour ripping) and revegetation (seeding and/or planting)	All RAs	4.1 Topsoil placed at the greater of the following depths: (a) minimum of 150mm of topsoil; or (b) minimum depth recommended by **AQP** to achieve the PMLU and target vegetation establishment. 4.2 Prior to each rehabilitation event: (a) soil health and suitability assessment of the in-situ soil/growth media characteristics is undertaken by an AQP, and endorsed as suitable to ensure achievement of the PMLU;

Rehabilitation milestone	Applicable RAs	Milestone criteria
		(b) Where soil health and suitability assessment identify that the in-situ soil/growth media is not suitable, a recommendation is made for ameliorants to ensure achievement of the PMLU. 4.3 Records demonstrate that ameliorants and appropriate mitigation measures have been undertaken as recommended by AQP. 4.4 Deep ripping at least 300mm into the soil/ subsoil profile along contour of slopes. 4.5 Seeding and planting completed using the species and at the planting/seeding rates detailed in Table 19: Pasture seed mix *and* Table 20: Native trees and shrub species; seed mix must include 3P (perennial, palatable and productive) species, with a minimum of 4 perennial grass species.
RM5: Achievement of surface requirements for PMLU	All RAs	5.1 **AQP** Certification that there is no presence of erosion classified as moderate or severe, as defined in Table 13: Erosion classification framework. 5.2 **AQP** Certification, for each rehabilitation area, that: (a) Seeded/planted vegetation is substantially consistent with Table 19: Pasture seed mix and Table 20: Native trees and shrub species; and includes 3P (perennial, palatable and productive) species, with a minimum of 4 perennial grass species. (b) Total percentage of vegetation groundcover to be >50 %. (c) Weed cover classified as prohibited or restricted matter (as defined under the *Biosecurity Act 2014)* is ≤10% (excluding exotic pasture grasses).

Rehabilitation milestone	Applicable RAs	Milestone criteria
RM6: Achievement of PMLU to stable condition (light grazing)	All RAs	6.1 A final rehabilitation assessment is completed by an appropriately qualified person[1] demonstrates that land has achieved long-term safe, stable, non-polluting and self-sustaining condition. **AQP** Certification that established pasture species, shrub species and tree species, where applicable, in each rehabilitation area are: (a) consistent with the target species in Table 19: Pasture seed mix and Table 20: Native trees and shrub species; and (b) include suitable 3P (perennial, palatable and productive) species, with a minimum of 4 perennial grass species; and (c) will support the proposed post-mining land use. 6.2 All temporary erosion and sediment control structures decommissioned. 6.3 **AQP** Certification that: (a) there is no presence, in any rehabilitation area, of erosion classified as moderate or severe, as defined in Table 13: Erosion classification framework; and (b) any erosion present will not compromise the achievement of PMLU to **stable condition**. 6.4 A hazard and safety assessment completed by an **AQP** Certifies: (a) the risks posed by hazards in rehabilitated areas are consistent with the post mining land use and regional land use, or are otherwise low; and (b) the risk to public safety, human health, and the environment, is not expected to increase over time. 6.5 **AQP** Certifies the following: (i) Have achieved grazing land suitability of Class 4 or better; and (ii) soil and subsoil/underlying spoil (0-60 cm) meet the following suitability criteria (derived from Land Class 4 land suitability parameters, Short 2023[4]): – Available Water Capacity (PAWC): 30 - <40 mm; – Bicarbonate P (at 0 -10cm depth): 4 - <8 mg/kg; – Electrical Conductivity (ECe, saturated): ≤ 16 dS/m; – Soil pH: 5.5 - 9.0. – Slope <10% achieves ESP (at 0 -10cm depth) of <14% – Slope >10% achieves ESP (at 0 -10cm depth) of <6%.

Rehabilitation milestone	Applicable RAs	Milestone criteria
RM7: Surface water and groundwater demonstrate non-polluting landform	All RAs	7.1 Surface water is non-polluting as demonstrated by compliance with the following for a minimum of the five (5) consecutive years prior to surrender of the EA: (a) Surface water quality monitored quarterly at the surface water monitoring locations specified in Table 27: Surface water monitoring locations, for the parameters specified in Table 28: Surface water quality trigger limits; and (b) Surface water quality results do not exceed the limits in Table 28: Surface water quality trigger limits, for 3 consecutive results within any five-year period. 7.2 Groundwater is non-polluting as demonstrated by compliance with the following for a minimum of the five (5) consecutive years prior to surrender: (a) Groundwater quality monitored quarterly at the groundwater monitoring bore locations specified in Table 29: Proposed closure groundwater monitoring locations, for the parameters specified in Table 30: Groundwater quality trigger limits; and (b) Groundwater quality results do not exceed the limits in Table 30: Groundwater quality trigger limits, for 3 consecutive results within any five-year period.

Table 13: Erosion classification framework

Erosion classification	Minor	Moderate	Severe
Sheet erosion	Shallow soil deposits downslope	Partial exposure of roots; moderate soil deposits downslope, etc.	Loss of surface horizon; subsoil exposure, root exposure, substantial soil deposits downslope.
Rill/gully erosion	<15 rills/transect* and <0.3m deep	15 – 30 rills/transect* and <0.3m deep	>30 rills/transect* and/or any >0.3m deep
Tunnel erosion	Absent	Absent	Present
Mass movement	Absent	Absent	Present

Source: NCST (2009) *Australian Soil and Land Survey Field Handbook, 3rd edition*. The National Committee on Soil and Terrain. CSIRO Publishing, Collingwood, Australia.
*Transect 100 m across the contour (Source: Tongway, D. J. and Hindley, N. L. 2005. Landscape Function Analysis: Procedures for Monitoring and Assessing Landscapes. CSIRO Publishing, Canberra, Australia.)

[4] Short TA. 2023. Rehabilitated mined land suitability for beef cattle grazing in the Bowen Basin: Technical Paper 1. Brisbane: Queensland Mine Rehabilitation Commissioner, Queensland Government

Table 14: Management milestone criteria

Management milestone	Applicable IAs	Milestone criteria
MM1: Achievement of final landform design	IA1, IA2	8.1 There are two residual voids, which comply with the relevant design specifications (for the specific void) in Table 10: Residual void design specifications. 8.2 Maximum combined area of residual voids is ≤36 ha. 8.3 Backfilling in relevant void areas is completed for flood mitigation. 8.4 Low walls are free draining into the residual void lake. 8.5 Highwall landforms: (a) prevent surface flow of floodwater into the void. (b) are geotechnically stable when floodwater is against the batter. (c) prevent seepage flow of floodwater into the void. 8.6 An **AQP-Eng[5]** has certified that: (a) highwall battered to a maximum slope of ≤104% (46°) (b) low wall battered to a maximum slope of ≤62% (32°) (c) highwalls and low walls achieve factor of safety ≥ 1.5 within the NUMA extents. (d) residual voids are not subjected to floodwaters up to and including the 0.1% AEP. (e) residual voids act as a groundwater sink within the tenure boundary as demonstrated by groundwater modelling. *(f)* Predictive modelling confirms that there is no risk of over topping

Management milestone	Applicable IAs	Milestone criteria
MM2: Achievement of surface and safety requirements	IA1, IA2	9.1 Safety infrastructure established around the void, including the following: (a) adequate bunding in place confirmed to be geotechnically stable by an AQP; and (b) perimeter fencing and signage erected around the outside of the safety bund to prevent access to fauna and humans to the residual void with five strand barbed stock fencing; and (c) warning signage designed in accordance with requirements of the *Coal Mining, Safety and Health Act 1999.* 9.2 Safety bund constructed at 2 m in height, 4 m in base width and 10 m beyond the area which may be affected by void edge instability. 9.3 Appropriate Seed mix applied to low walls above the maximum modelled water level, where practicable.

Management milestone	Applicable IAs	Milestone criteria
MM3: Achievement of sufficient improvement	IA1, IA2	10.1 **AQP**[5] Certification that: (a) low wall areas above maximum modelled water level, have a minimum 30% vegetation cover, where practicable. 10.2 Certification from an **AQP-Eng**[5] that the final NUMAs are in full compliance with items (a) to (i) below: (a) Predictive hydrological modelling and void water quality modelling re-run at end of mine life and calibrated against the final landform, demonstrates that the residual voids will continue to act as groundwater sinks and: (i) residual void water level will remain below 127 mAHD for Z pit; and (ii) residual void water level will remain below 148 mAHD for X pit; and (iii) each void will retain flood immunity in a probable maximum precipitation storm event; and (iv) water quality in the voids will not cause environmental harm to the surrounding environment; and (b) the highwall landform has designed by and **AQP-Eng**[5] and constructed in accordance with those design specifications; and (c) a geotechnical assessment demonstrates a negligible probability of wall failure, slippage, or rock fall. (d) each void meets requirements specified in Table 10: Residual void design specifications; and (e) security fencing installed at the voids is appropriately located, in good condition, fit for purpose, and meets requirements specified in criterion 8.1 of this schedule; and (f) safety signage is in place and secure and complies with requirements of condition 2.3 of this schedule; and (g) residual voids will not cause environmental harm outside of the relevant tenure boundary; and (h) residual voids are safe to humans and livestock; and (i) erosion occurring within the NUMAs will not adversely impact the stability of adjacent RA's.

[5] An **appropriately qualified person – engineering** (**AQP-Eng**) means a person who is a Registered Professional Engineer of Queensland (RPEQ) under the provisions of the *Professional Engineers Act 2002* and has demonstrated competency and relevant experience in the relevant area e.g. Mining (Civil), Mining (Geotechnical).

4.4.4 Rehabilitation and management timeframes

Rehabilitation and management milestone timeframes have been developed with consideration for the size of the rehabilitation area, the activities applicable to the milestone, the sequencing of activities on the mine and the risks of achieving the milestone criteria within the nominated timeframe. Controls were considered and proposed in milestone criteria to achieve a 'low' residual risk score, where possible. The Project risk assessment is detailed in Section 6 and provided in full in Appendix C.

Notably, milestones that involve revegetation activities, including monitoring of revegetation, make provision for unfavourable growing seasons and unforeseen extreme weather events such as droughts or storms that could negatively impact vegetation establishment, requiring longer timeframes for the milestone to be achieved. The nominated rehabilitation timeframes considered for scheduling the rehabilitation milestones are justified below. Each RM will be achieved within the timeframe nominated, with the activities associated with each RM commencing at the completion of the previous RM applicable to the RA.

Table 15: Typical timeframes for RMs associated with each RA

Rehabilitation Milestones (RM)	Summary rehabilitation methodology	Associated risks	Inherent Risk Score	Residual Risk Score	Typical timeframe (years)	Justification for assigned timeframe
RM1 Infrastructure decommissioning and removal	• All non-required services, equipment, machinery, infrastructure disconnected and removed.	• Mining infrastructure has not adequately decommissioned or removed. • Rehabilitation activities cannot progress until removal is complete.	Low – Moderate	Low	2	Mine infrastructure is assumed to remain operational for up to 1 year once mining is complete. Decommissioning activities are considered low residual risk, therefore a timeframe of 2 years is considered sufficient to ensure the moderate inherent risk to safety is managed.
RM2 Management of contaminated land status	• Contaminated and hazardous materials remediated. Contaminated land assessment and validation testing undertaken by an appropriately qualified person[1].	• Mobilisation of contaminated and hazardous materials from buildings/workshops and laydown areas.	Moderate	Low	2	A preliminary site investigation will be undertaken by an appropriately qualified person[1] to identify potential areas of contamination. A detailed site investigation report will be completed by an appropriately qualified person[1]. If contaminated land is identified, contaminated and hazardous materials will be removed and appropriately disposed or remediated. Following this, validation testing will be undertaken to confirm mitigation activities have been adequate. A site suitability statement from an appropriately qualified person[1] confirms the uses or activities for which the land is suitable, align to the approved PMLUs for the site. Given the moderate inherent risk classification associated with this activity and the activities required to achieve the milestone criteria the timeframe assigned is 2 years.

Rehabilitation Milestones (RM)	Summary rehabilitation methodology	Associated risks	Inherent Risk Score	Residual Risk Score	Typical timeframe (years)	Justification for assigned timeframe
RM3 Landform development (reshaping and reprofiling)	• All bulk earthworks and landform reshaping/reprofiling works completed to design specifications. • Geotechnical assessment of stability prior to construction. • Design certification by an appropriately qualified person[1].	• Significant slope failure. • Excessive gully, pipe and/or sheet erosion of rehabilitated areas. • Safety hazard due to surface roughness (rockiness, depressions) in excess of that expected for PMLU. • Safety hazard due to slope steepness in excess of that expected for the PMLU.	Low – Moderate	Low	2	As land becomes available, all bulk earthworks are to be completed according to rehabilitation design specifications and assessed as geotechnically stable by an appropriately qualified person[1]. Given that the size of areas becoming available at any one point in time is highly variable, and the need to coordinate works with favourable climatic conditions, the timeframe assigned is 2 years.
RM4 Surface preparation (topsoil application, soil amelioration, contour ripping) and revegetation (seeding and/or planting)	• Surface preparation (e.g., spreading of topsoil, contour ripping, soil amelioration activities as required). • Revegetation with seed and/or tube stock consistent with the PMLU.	• Failure to establish required surface conditions to achieve PMLU. • Poor establishment of required vegetation to achieve PMLU.	Low – Moderate	Low	3	Soil amelioration activities and prompt vegetation establishment are key processes to minimise the identified inherent risks. Seeding and/or planting of suitable target species must be timed to coincide with favourable climatic conditions. Therefore, a timeframe of 3 years has been allocated to allow activities to be undertaken at a suitable time of year following the completion of landform development.

Rehabilitation Milestones (RM)	Summary rehabilitation methodology	Associated risks	Inherent Risk Score	Residual Risk Score	Typical timeframe (years)	Justification for assigned timeframe
RM5 Achievement of surface requirements for Light Grazing PMLU (MIA, overburden dumps and water management infrastructure)	• Evidence of stabilised erosion[2]. • Vegetation monitoring and maintenance as required.	• Excessive gully, pipe and/or sheet erosion of rehabilitated areas. • Inadequate species density/diversity of vegetation for PMLU.	Low – Moderate	Low	10	As achievement of target surface requirements is dependent on good climatic conditions, poor growing seasons and extreme weather events can hinder vegetation establishment and may require maintenance actions such as reseeding or infill planting. A timeframe of 10 years is considered sufficient to achieve the target criteria while allowing some leeway for environmental factors that may hinder vegetation establishment.
RM6 Achievement of Light Grazing PMLU to stable condition	• Land suitability assessment. • Hazard and safety assessment. •	• Excessive gully, pipe and/or sheet erosion of rehabilitated areas. • Landform is unsuitable to sustain PMLU. • Potential acid and saline drainage impacts.	Low – Moderate	Low	2	A land suitability assessment and a hazard and safety assessment will be undertaken within 2 years.
RM7 Surface water and groundwater demonstrate non-polluting landform	• Receiving environment water quality monitoring of downstream environment.	• Potential downstream receiving environment water quality impacts.	Low – Moderate	Low	5	Receiving environment water quality monitoring/assessment will be undertaken for a minimum of 5 consecutive years after the achievement of final stable landform.

Rehabilitation Milestones (RM)	Summary rehabilitation methodology	Associated risks	Inherent Risk Score	Residual Risk Score	Typical timeframe (years)	Justification for assigned timeframe
MM1 Achievement of final landform design	• All bulk earthworks completed to design specification. • Geotechnical and erosional stability assessment.	• Residual void highwalls and lowwalls subject to significant slope failure. • Gully erosion on void walls.	Low – Moderate	Low – Moderate	5	Spoil will be used to partially backfill the pits at completion of mining, reducing the footprint of the residual voids. The process of creating a final landform design that meets the design parameters specified in the EA and erecting infrastructure that complies with safety requirements is estimated to be achieved within 5 years from completion of mining of the relevant pit.
MM2 Achievement of surface and safety requirements	• Safety infrastructure established around the void.	• Stock, wildlife or human access to the residual void.	Moderate	Low		
MM3 Achievement of sufficient improvement	• Geotechnical assessment to confirm FoS. • Groundwater modelling. • Void water balance assessment.	• Void overtopping, resulting in mine affected water entering the downstream environment. • Mine affected water seeping into the groundwater system.	Moderate	Low	2	Residual voids will be monitored for 2 years to assess slope stability and confirm that voids will function as groundwater sinks.

1 *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 relating to the subject matter using the relevant protocols, standards, methods, or literature.
2 As defined in the *Australian Soil and Land Survey – Field Handbook. 3rd ed (2009)*.

4.4.5 PRCP Schedule

The PRCP Schedule is a legally binding and enforceable instrument with which the holder must comply. The schedule outlines the reporting dates/years to report and demonstrate RMs that have been achieved for specified RAs. The PRCP Schedule is provided in Appendix A.

For practicality reasons, the reporting dates are planned for 3-year intervals from 2024. Therefore, the reporting date is the 10th December for the following years:

- 2028;
- 2031;
- 2034;
- 2037;
- 2040;
- 2043;
- 2046;
- 2049;
- 2052;
- 2055;
- 2058;
- 2061;
- 2064; and
- 2067.

In cases where the completion of a RM is between reporting years, the reporting of that RM will be captured in the subsequent reporting year.

5 Rehabilitation management methodology

5.1 General rehabilitation practice

The rehabilitation practices used at any mining site inevitably evolve as a result of increasing knowledge gained from experience in the following areas:

- early rehabilitation successes and failures;
- weather, subsoils, soils, local flora and fauna and revegetation species; and
- site preparation, seeding practices, the maintenance and repair of previously rehabilitated areas and/or local agricultural practices.

For this reason, the rehabilitation practices outlined in the following subsections should not be interpreted as the precise method that will be used from this point on, but rather as a record of the current rehabilitation knowledge and intent at the time of writing; and with the expectation that rehabilitation practices will further evolve and develop from this point on.

While rehabilitation and improvement objectives and milestone criteria for the Project are detailed at Section 4.4, from the perspective of operational rehabilitation planning and practice, the following overarching principles are considered key:

- Ensuring that reshaped areas proposed for rehabilitation meet the required landform design principles.
- Ensuring that prepared areas meet the rehabilitation design specification for the area, and that local site drainage has been considered.
- Ensuring surrounding areas are graded to mitigate any rainfall run-off from adjacent areas from depositing on prepared rehabilitation areas.
- Topdressing materials, final surface preparation methods and soil amelioration activities have the objective of supporting vegetative growth.
- Revegetation species selection, seeding and/or planting methods, and fertiliser applications target rapid vegetative ground cover effective at mitigating soil erosion, during the period of initial revegetation when areas are most at risk.
- Ongoing monitoring and maintenance are used both to assess rehabilitated area performance against completion criteria as well as to feedback to, and update rehabilitation practices; and to identify maintenance or modification requirements such that rehabilitation areas are proceeding along a trajectory towards the designated PMLU.
- Management of NUMAs to a degree where risk of environmental harm is confined to the area of the relevant resource tenure.

There will be circumstances when rehabilitation practices outside of those discussed within this PRCP are utilised. For example, discrete areas of steeper slopes, rehabilitation failures or other scenarios that may necessitate more intensive rehabilitation practices. These circumstances will be identified, assessed and rehabilitation activities planned for as required.

5.2 Built infrastructure

At the end of the Project life, all infrastructure will be decommissioned, demolished and removed from site, with the exception of infrastructure that is subject to an agreement with the post-mining landholder that they will accept ownership for that infrastructure. The haul road (including the creek crossing across North Creek) will be retained as per the EA.

All mine infrastructure is expected to be required at least until mine closure, with some facilities likely to be required to support rehabilitation activities beyond cessation of mining. All infrastructure not being retained will be decommissioned as soon as practicable once the service life of the infrastructure has passed. The general principles of waste management hierarchy will apply, with materials directed in priority to sources of:

- reuse;
- recycling;
- energy recovery, and
- disposal.

5.2.1 Buildings

Buildings will be deconstructed, removed from site and managed in accordance with the waste management hierarchy. Concrete footings will be broken and stripped of reinforced steel for recycling, with the concrete directed to a reuse source, where applicable. Materials such as non-ferrous scrap and heavy gauge may also be cut to size and trucked offsite for recycling, where applicable. The surface area will then be rehabilitated in accordance with the surface preparation and revegetation methods described in Section 5.12.2.

5.2.2 Access roads, car parks and hardstand areas

Sealed asphalt roads, car parks and hardstand areas will have the asphalt removed for reuse, where applicable. Unsealed roads, car parks and hardstands will be subject to a contaminated land assessment undertaken by an appropriately qualified person, and where applicable, any contamination will be removed for licensed disposal or on-site remediation. The surface area will then be rehabilitated in accordance with the surface preparation and revegetation methods described in Section 5.12.2.

5.2.3 Hydrocarbon and chemical storage areas

Bulk storage tanks will be emptied of contents and directed to reuse or appropriately cleaned and decontaminated prior to recycling or disposal of materials. Concrete footings and bunding will be broken down and depending on contamination status, either directed to a licensed disposal source, or broken down and stripped of reinforced steel for recycling, with the concrete either removed from site or directed to a reuse source. A contaminated land assessment will be undertaken by an appropriately qualified person, and, where applicable, any contamination will be removed for licensed disposal or on-site remediation in the case of hydrocarbons.

5.2.4 Haul road and tracks

As described in 4.2, the primary haul road (ML 70355) connecting the Project to the Moorvale Mine will no longer be retained, as the underlying landholders i.e. Deguaras have verbally confirmed that they are no longer interested to retain the haul road, resulting in no agreement for the retention of the haul road in place (refer Table 5). Topsoil stockpiles along the primary haul road will be removed and scarified. Water management and drainage facilities e.g. sediment dams and culverts will be removed, scarified and re-seeded. Further consultation with the relevant landholders will be undertaken prior to commencing rehabilitation to confirm landholder's intention to retain any water management or drainage facilities.

A final landform survey will be undertaken to confirm removal of all built structures or landforms. Further consultation with the relevant landholders will be undertaken prior to commencing rehabilitation to confirm that rehabilitation strategy is consistent with landholder expectations and post-mining land use.

Haul road (ML 70355) and minor tracks within ML70354 (RA7) are not planned to be retained post mining, however, further consultation will be undertaken with the relevant landholders prior to commencing rehabilitation. The haul road and minor tracks will be scarified and re-seeded.

5.2.5 ROM pad

Carbonaceous material within the ROM pad will be removed from site. The surface area will then be rehabilitated in accordance with the surface preparation and revegetation methods described in Section 5.12.2.

5.3 Final landform design

Transitional PRCPs are not required to demonstrate how aspects of the mine have been designed for closure; however, the following sections include a summary of design elements considered during the development of the proposed final landform.

5.3.1 3D design final landform

The final landform has been developed in 3-dimensional CAD packages, and the design outcomes are presented as a contour map in Figure 11.

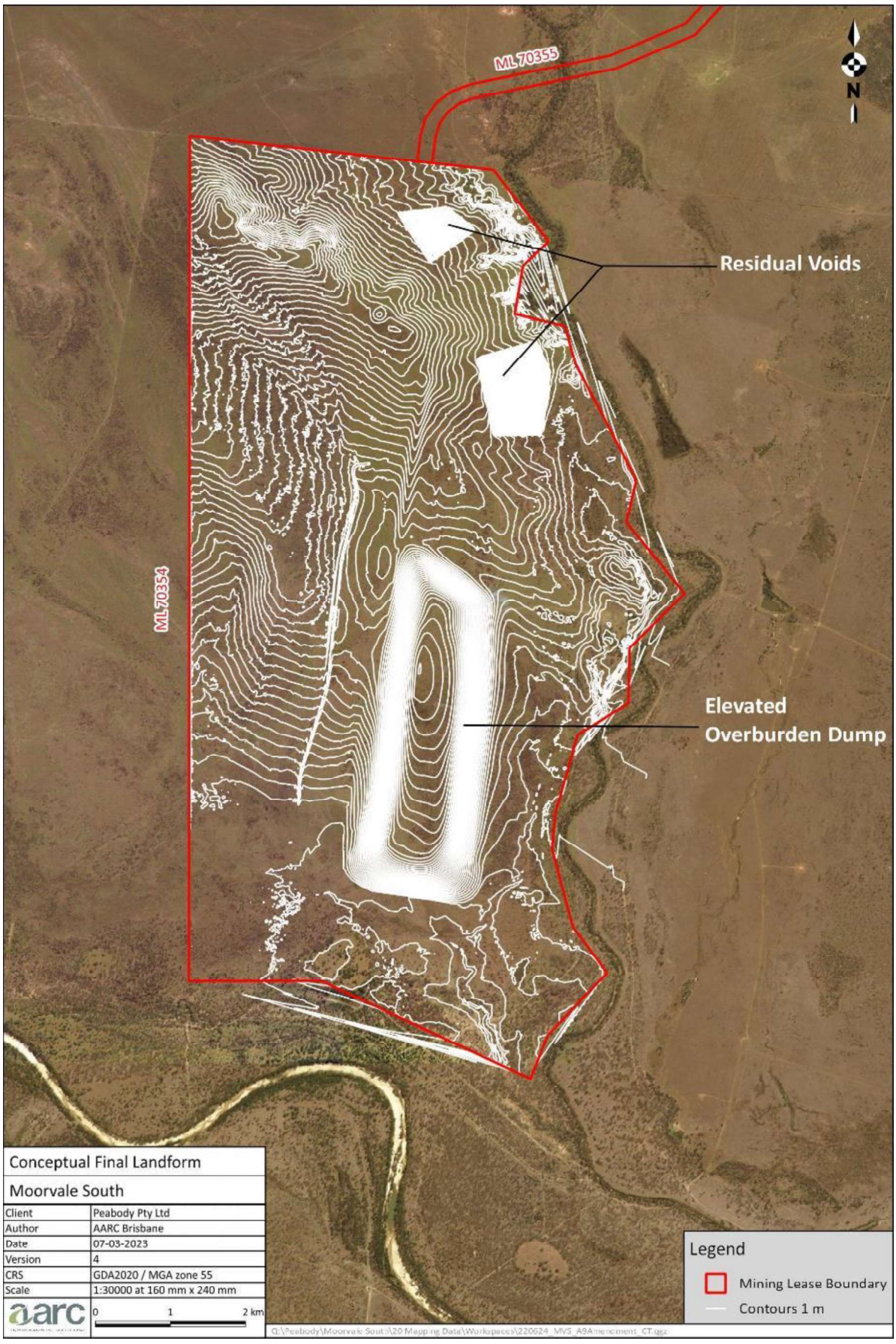


Figure 11: Proposed final landform design

5.3.2 Landform design method

To determine the final landform design, a mine schedule was first developed utilising the SPRY software package. The model used to develop this schedule includes 'Destination Scheduling', which enables the planner to place excavated material into logical 3-D dumping locations in a sequence relative to practical mining excavation sequence.

After the 'as-dumped' landform has been determined, a landform smoothing process has been undertaken using the 3D-Dig Reshape software tool to create 'convex-concave' surfaces that mimic 'natural' stable slope profiles, while staying within the maximum slope criteria specified in the EA. This surface is then inspected visually in 3-D to ensure the software has created an appropriate outcome, and final volumetric checks are performed to ensure that sufficient material is available to construct the overall landform.

5.3.3 Modelling of long-term stability

The current proposed landform has been designed within the approved requirements of the Project's EA, including limitations on overall dump height and maximum slope. The Water Erosion Prediction Project (WEPP) modelling was conducted to ensure slope stability of the proposed elevated landform. WEPP modelling considers four key data points: climate information, soil profile, land use management and slope design. Climate parameters were modelled from the area using CLIGEN 5.3, with input data sourced from SILO (daily rainfall, maximum and minimum temperature, solar radiation and maximum relative humidity) and BOM (pluviography data). Five (5) soil types were included for modelling. In creating the land use management parameters, soil cover classes were established at 5% intervals ranging from 5% - 100% across a 100-year simulation period without growth or decay. Slope design specifications were sourced from the Project EA, where the maximum slope was modelled.

The model results provide a maximum potential erosivity of landforms, expressed in tonnes per hectare per year (t/ha/yr). The predicted erosivity was assessed against a target erosion rate of 6 t/ha/yr (Landloch 2013; Howard and Loch 2019). Additionally, a maximum tolerable erosion rate of 10 t/ha/yr was adopted, as a rate that is considered acceptable for mining rehabilitation purposes (Lu et al. 2001).

The long-term stability of residual voids was assessed using a Global Limit Equilibrium (GLE) analysis to account for site-specific geotechnical conditions, and the pit geometry of the residual voids. The assessment adopted a minimum FoS of 1.5 for slope stability analysis. The analysis provided long-term stability requirements based on predicted time-dependent behaviour of the slope and in-pit and subsurface water conditions, however these requirements will need to be confirmed as mining approaches the residual void positions.

5.3.4 Proposed construction method

The elevated landforms will be constructed using the mine overburden, placed in lifts by haul trucks being loaded by excavator / shovel units. The final surface profile will generally be established utilising large earthmoving bulldozers (e.g. Caterpillar D10, D11, etc.) to regrade the 'as-dumped' lifts according to the final landform design. Environmentally, the method has advantages in providing for more controlled planning of overburden dump construction, maximising efficiency in landform development and rehabilitation. Additionally, the truck and excavator / shovel method offers advantages for selective encapsulation of potentially problematic materials that may be identified through operational material characterisation and monitoring programs.

5.3.5 Quality assurance / quality control (QA/QC)

Operator and supervisor training and supervision will be provided to personnel undertaking rehabilitation earthworks, including the importance of conforming to the design specifications. Works will be supervised to ensure compliance with design specifications and relevant procedures.

High-precision GPS tools may be used on-board construction equipment (or by surveyors) to assist in the development of the landform.

In addition, constructed landforms shall be inspected regularly during the construction phase and signed-off as constructed to design following completion of earthworks. Records shall be retained to demonstrate quality assurance and quality control processes have been met.

5.3.6 Limitations and assumptions

The results of the landform design work are heavily influenced by several assumptions, particularly the assumption relating to the swell factor of the excavated and dumped material. The mining process involves the removal of overburden and interburden materials from above the coal seams prior to coal extraction. This excavation process results in the 'loosening' of the material, which has been compacted *in situ* by geological processes over time. The 'loosening' results in an increase in the volume that a unit of overburden or interburden will occupy once excavated when compared to the un-excavated (*in situ*) volume. The increase in the overburden and interburden volume from the *in situ* to excavated state is known as the swell factor. The swell factor adopted for planning at the Project is 25%. This has been based on the material characteristics of the Project and experience at Coppabella and Moorvale Coal Mines.

Furthermore, the overburden and interburden removal and coal mining operations require sufficient room to safely undertake activities and minimise the risk of material encroaching into operational areas. Therefore, to account for the swell factor of excavated material and maintain adequate working room in the operating pit, out-of-pit overburden dumps are required in conjunction with progressive backfilling of the mined pits.

Small variations in this swell factor assumption can result in differences in the as-dumped profile, including the size and shape of the void. Additionally, mine sequence changes in response to market demands or operational challenges may result in similar differences. As the mine progresses, some variation in the current proposed landform can be expected and will be updated as required via a PRC Plan amendment process.

5.4 Overburden dumps

Overburden produced by the excavation of the open cut pits will be placed in an out-of-pit overburden dump adjacent to and immediately west and north of Y Pit, and in-pit as operations progress. Mining of Y Pit will commence in the south and progress north. Excavated waste rock will initially be placed in the out-of-pit dump, starting at the central western region of the overburden dump (commencing in 2024) and progressing to the north and then to the south. Waste rock will then be placed in-pit behind the advancing operation, including material from X Pit. Progressive backfilling of the pits will result in the final landform of the in-pit and out-of-pit overburden dumps (including elevated landforms) being consistent with the post-mining land use of Light Grazing.

The overburden dumps will be rehabilitated to meet the landform design criteria specified in the EA. The elevated landform will be shaped to achieve the following criteria, thereby complying with the EA:

- maximum height of 30 m from the natural ground level;
- maximum slope angle of 15%; and
- contour banks with a maximum distance between them of 88 m, where required.

The remaining in-pit and out-of-pit overburden dump will be shaped to achieve the following criteria that resembles the natural and adjacent level areas, thereby complying with the EA:

- maximum height of 5 m from the natural ground level;
- maximum slope angle of 2-5%; and
- contour banks with a maximum distance between them of 500 m.

Following bulk earthworks, the surface area will be rehabilitated in accordance with the surface preparation and revegetation methods described in Section 5.12.2.

The WEPP model outcomes indicate most model scenarios achieve potential erosion rates less than the 'target' rate (<6 t/ha/yr) at 50% vegetation cover. This is excluding areas with Yellow Brown Gradational Loam soil types, which require 75% vegetation cover. All model scenarios are below the maximum 'tolerable' erosion rate (<10 t/ha/yr) with 50% vegetation cover, excluding Yellow Brown Gradational Loam soil types. Model results are presented in Figure 12.

Post-closure erosion potential will be managed through a combination of soil ameliorants (where required) and vegetation and other groundcover such as organic litter. Based on WEPP modelling outcomes, the total percentage cover of ground foliage cover of >50% is considered sufficient for protecting the soil surface from erosion caused by rain drop impact and overland flow and reducing the risk of rill development on slopes <15% (So et al. 1998, Loch 2000).

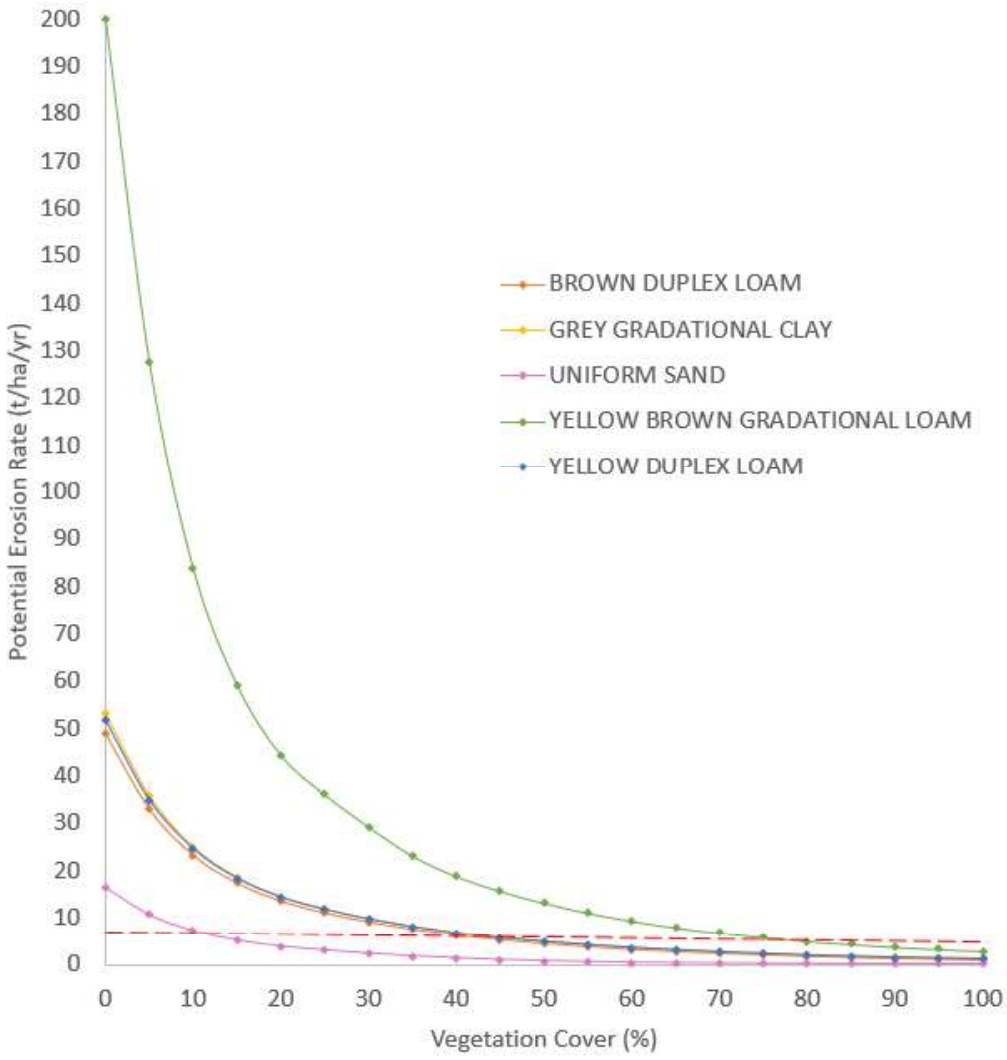


Figure 12: Potential erosion rates with vegetation cover on elevated landform

5.5 Waste characterisation

A geochemical assessment was undertaken for waste rock (i.e overburden/interburden) generated from the Project to determine potential post-closure risks to the environment (RGS 2023).

Waste rock, coal and coarse rejects are expected to be non-acid forming (NAF) with low sulphur content and excess acid neutralising capacity (ANC), suggesting a negligible risk to produce acid and metalliferous drainage (AMD). Both waste rock and coarse reject are not significantly enriched with metals and metalloids. Leachate generated from waste material is generally pH-neutral to alkaline and likely to be brackish, with low to moderate concentrations of major ions and low concentrations of dissolved trace metals/metalloids.

Tailings generally contain higher concentrations of sulphide relative to product coal and coarse reject but appear to have sufficient ANC to avoid acid generation for a period when exposed to idealised oxidising conditions. Nevertheless, there is a risk for tailings to produce AMD over time if the inherent ANC is consumed through neutralisation of any acid generated by oxidation of inherent sulphide. Long-term oxidising conditions may decrease pH and increase the content of trace metal/metalloid in pore water and potential leachate. It is noted that tailings generated from the Project will be managed at Moorvale Mine, no tailings will be handled at the Project.

Surface and groundwater quality monitoring will be undertaken post-closure for a period of time after rehabilitation methodologies have been implemented, as detailed in Section 7.

5.6 Residual void(s)

Two residual voids (X and Z voids) will remain as part of the post-closure final landform. The water filled voids do not support a beneficial PMLU and will be retained as NUMAs. Geotechnical stability analysis was undertaken on both residual voids (Cartledge 2023).

An assessment of the EA approved void design criteria (refer Table 10) indicates that short-term (i.e. at the end of mine-life) stability will be achieved for both residual voids. To achieve long-term geotechnical stability, the geotechnical assessment recommends reducing the spoil slopes from the natural angle of repose due to the influence of water inundation and time-dependent changes to the geotechnical behaviour of waste rock. Based on the assessment, a slope angle of 22 degrees is considered more suitable than that approved by the EA (i.e. 32 degrees), in order to obtain an adequate FoS of 1.5.

Therefore, the residual void design criteria is recommended as follows:

- Intact pit slope (highwall);
    - 46º cut slope within weathered over burden with 15 m wide berms every 20 m vertical;
    - 20 m wide berm at the base of weathering; and
    - 65º pre-split slope within fresh Permian with 20 m wide berms every 30 m vertically.
- Spoil slopes (lowwall);
    - 22° overall slope angle.

To limit the risk of human and/or livestock access, the following safety requirements will be implemented:

- Abandonment bund will be constructed of competent rock and to geometry specified with 2 m height , 1V:3H batters and 14 m width base. The bund will be revegetated to achieve a Light Grazing PMLU;
- Fencing will be located on the outside of the abandonment bund; and
- Safety signs will be erected at specified intervals along the fence line.

It is noted that the residual voids will be protected by abandonment bunds which limits the inflow of catchment runoff to the areas of the voids and further reduces the risk of impacts to the surrounding environment.

5.7 Flooding

Flood modelling was undertaken at Moorvale South Mine to assess the potential risks of storm events to the stability of the proposed final landform (WRM 2023).

The maximum extent of a 0.1% Annual Exceedance Probability (AEP) flood event along the northern section of the Project is presented in Figure 13. It is noted that an early configuration of the final landform observed a slight interaction between the Z pit and the 0.1% AEP floodplain. The final landform was since adjusted to move it outside the floodplain and has been adopted. Model results of the adopted final landform show the proposed NUMAs are both outside the floodplain of North Creek and are distant to the Isaac River floodplain. Additionally, both residual voids will be surrounded by 2m high and 14m wide abandonment bunds to further reduce the risk of any potential ingress of flood water.

The residual voids are surrounded by areas of backfilled overburden dumps to surface level. Modelling outcomes indicate flood ingress is limited to an insignificant 0.1 ha of backfilled overburden area in the eastern most corner adjacent to the Z pit during a 0.1% AEP flood event. It is noted that mining and backfilling may not occur in that area, considering on-ground operations may slightly differ from mapped mining plans. It is further emphasized that a 0.1% AEP event is extremely rare and unlikely, modelling outcomes may be subject to inaccuracies in reality, if this event were to occur. The risk of flood impacts on stability of the landform is low, however mitigation measures may be implemented in response to any identified potential of impact.

The elevated landform situated at the southern end of the Project has also undergone iterative adjustments to achieve the proposed long-term stable landform. Modelled flood depths immediately adjacent to the southern toe of the final landform are shallow and predicted peak velocity will not exceed the relevant guideline threshold value (Figure 14). Hydraulic properties adjacent to the southern toe of the elevated landform are unlikely to cause erosion.

The proposed rehabilitation methodology of the elevated landform at this southern toe will include the establishment of appropriate vegetation cover to improve erosion resistance and stability as part of the surface preparation milestone (RM4). In areas subject to inundation during 1% AEP flood events, the revegetation strategy will include local native species suitable for the inundation frequency, as approved in the EA. Revegetation of appropriate native vegetation within the 1% AEP floodplain is detailed in Section 5.12.2.

Under the highly infrequent Probable Maximum Flood (PMF) conditions, the proposed safety bunds around residual voids and establishment of adequate vegetation will minimise any potential impacts of inundation.

The proposed final landform will not be susceptible to ingress of floodwater or landform instability under 0.1% AEP and PMF conditions.

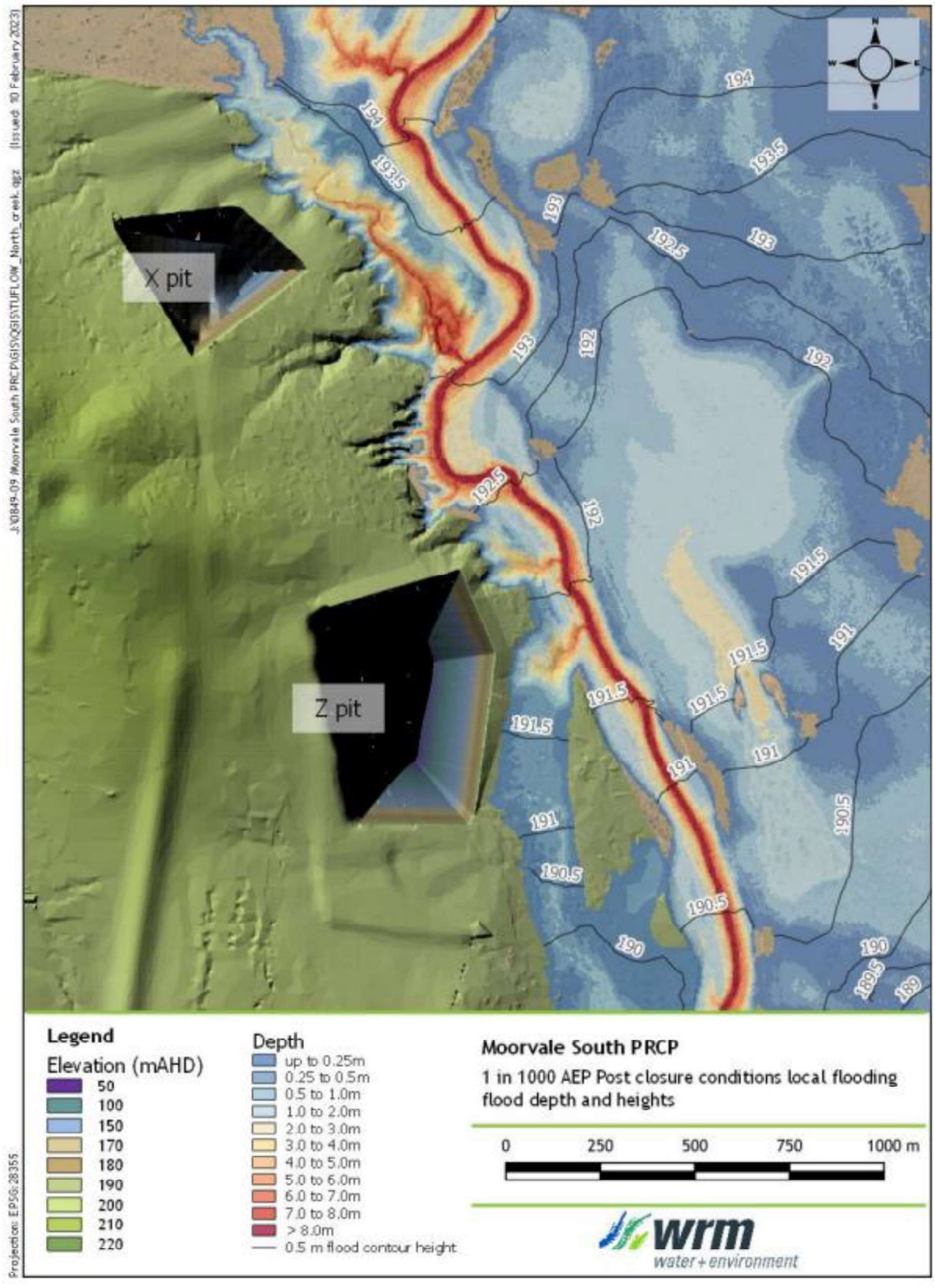


Figure 13: 0.1% AEP flood extents adjacent to residual voids (WRM 2023)

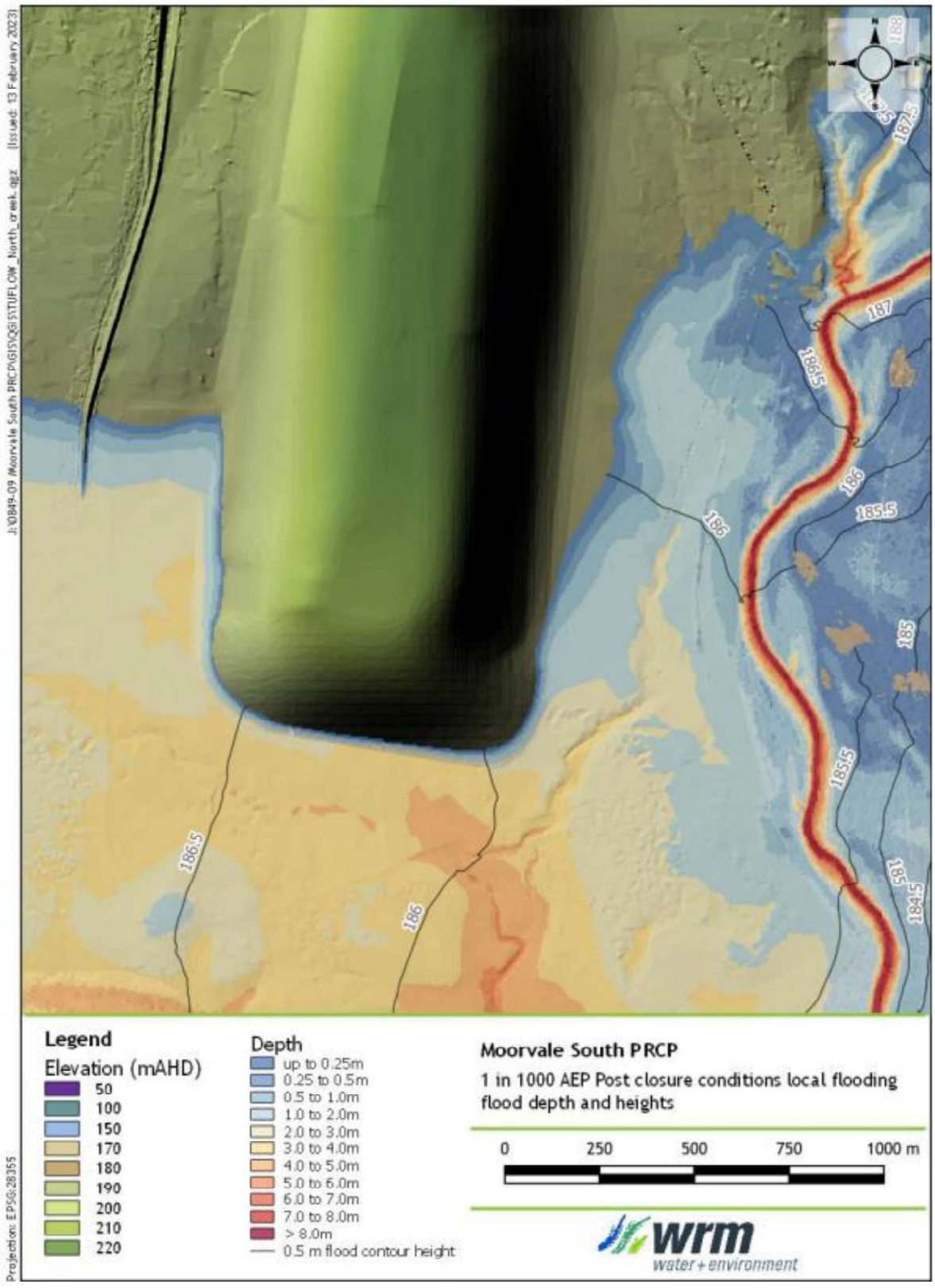


Figure 14: 0.1% AEP flood extents adjacent to southern toe of elevated landform (WRM 2023)

5.8 Residual void hydrology

A residual void hydrology assessment was undertaken at the Project to describe the long-term residual void water quality and void hydrology behaviour of the proposed NUMAs (WRM 2023).

Residual void lake elevations of X pit and Z pit will remain approximately 22 m (148 mAHD) and 43 m (127 mAHD) below the groundwater table level (170 mAHD), respectively. The residual void lake levels will also remain approximately 46 m for X pit and 62 m for Z pit below the void capacity. Additionally, the impacts of extreme storm events on the void lake levels were assessed. The model indicated slight increases in void water level. However, the maximum void lake levels will still remain at approximately 46 m and 62 m below the void capacity limits of X pit and Z pit, respectively.

The salinity of X pit and Z pit void lakes is predicted to increase progressively over time, as expected of a closed-loop system with no mechanism for salt removal.

Both residual voids are predicted to act as groundwater sinks in perpetuity and will not pose a risk of overflow to surrounding groundwater or spill to the environment. The assessment confirms the proposed NUMAs as non-polluting post-mining landforms.

5.9 Hydrogeology

A hydrogeological assessment was undertaken at Moorvale South Mine to assess the potential post-mining impacts to the groundwater system (SLR 2024).

Groundwater drawdown impacts in the immediate vicinity of the residual voids will be limited to the Permian coal measures. Groundwater elevations within the Permian coal measures are predicted to remain depressed post-closure, with long-term inwards groundwater flow gradients to the residual voids. The void lake levels will remain below groundwater elevations (groundwater sink) and there is no potential for impacts to the groundwater system.

Overburden dumps situated in higher groundwater elevations will be profiled to direct any potential seepage from south to north towards the residual voids in low groundwater elevations. Therefore, groundwater quality impacts associated with potential seepage from overburden dumps are unlikely.

Furthermore, minor groundwater drawdowns are predicted (up to 2.5 m) during the post-closure period, as they remain less than the ‘bore trigger threshold’ (5 m), as specified in the Water Act. Therefore, no significant impacts will be posed to surrounding groundwater bore receptors.

5.10 Water management

The Project operates a water management system based on the separation of clean water, surface water and ‘worked water’ catchments. Clean water is rainfall runoff from the surrounding catchment that is diverted around the mine to ensure no direct impact on the water quality by the mining operations. Surface water is rainfall runoff from disturbed areas, including active spoil areas, pre-strip operations, and haul roads under normal conditions. Rainfall runoff from disturbed areas typically collects and transports sediments but not environmental contaminants. Worked water (or mine-affected water) is water that is exposed to mining operations that are likely to contain transportable sediment and/or environmental contaminants that cannot be managed by erosion and sediment controls structures. Worked water is typically poor but is captured in designated storages for reuse onsite to support mining operations, providing all worked water returns to controlled storage available for reuse. Potential contaminants and the water management infrastructure and systems designed to reduce the risk of contaminants impacting EVs are described below.

5.10.1 Contaminant sources and pathways

A contaminant source assessment was undertaken (Peabody Energy 2022) to identify the Project activities that could potentially generate contaminants which may adversely impact the EVs of receiving waters.

The source of contaminants has been identified and evaluated based on water quality data collected on site at the Moorvale Mine since March 2004. Moorvale Mine is located 10 km north of the Project site, within a similar environmental setting, and it is therefore expected that the Project will have similar water quality to Moorvale Mine.

The major components of the operational activities with potential to adversely impact EVs and WQOs for the Project are:

- open cut pits;
- out-of-pit overburden dump;
- access roads, go-lines and haul roads;
- ROM coal stockpiles; and
- MIA including workshop, office building, re-fuelling facilities and wash-down area.

The potential erosion and sediment sources, as well as potential contaminants and impacts are presented in Table 16.

Table 16: Potential erosion and sediment sources

Disturbance category	Potential contaminant	Potential impacts
Overburden dump		
Re-contoured surface	Unconsolidated material with varying quantities of saline and sediment pre-disposition Acid mine drainage (AMD)	Sheet and rill erosion of potentially alkaline/ acidic/saline deposits leading to deposition of contaminants. Sheet, tunnel, rill and gully erosion leading to movement and deposition of sediments, deleteriously impacting on receiving waters.
Topsoiled (to be revegetated)	Sediment and turbidity	Sheet, tunnel, rill and gully erosion leading to movement and deposition of sediments, deleteriously impacting on receiving waters.
Established vegetation	Sediment and turbidity	Sheet, tunnel, rill and gully erosion leading to movement and deposition of sediments, deleteriously impacting on receiving waters.
Topsoil		
Topsoil stripping area	Unconsolidated materials	Sheet, tunnel, rill and gully erosion leading to movement and deposition of sediments, deleteriously impacting on receiving waters.
Topsoil stockpiles	Unconsolidated materials, sediment and turbidity	Sheet and rill erosion leading to movement and deposition of sediments, deleteriously impacting on receiving waters.
Peripheral lands		
Exploratory and access tracks	Disturbed materials, sediment and turbidity	Rill and gully erosion leading to movement and deposition of sediments, deleteriously impacting on receiving waters.

Disturbance category	Potential contaminant	Potential impacts
Haul Roads	Disturbed materials, sediment and turbidity	Sheet, tunnel, rill and gully erosion leading to movement and deposition of sediments, deleteriously impacting on receiving waters.
Industrial Areas	Hydrocarbons and hydrocarbon contaminated sediments	Sheet and rill erosion of potential hydrocarbon laden sediment leading to deposition of contaminants. Sheet, tunnel, rill and gully erosion leading to movement and deposition of sediments, deleteriously impacting on receiving waters.
Hardstand areas	Hydrocarbons and hydrocarbon contaminated sediments	Sheet, tunnel, rill and gully erosion leading to movement and deposition of sediments, deleteriously impacting on receiving waters.
Exploration Activity	Disturbed materials, sediment and turbidity	Sheet, tunnel, rill and gully erosion leading to movement and deposition of sediments, deleteriously impacting on receiving waters.
Land clearing (woody vegetation)	Disturbed materials, sediment and turbidity	Sheet, tunnel, rill and gully erosion leading to movement and deposition of sediments, deleteriously impacting on receiving waters.
Drainage channels	Disturbed materials, sediment and turbidity	Sheet, tunnel, rill and gully erosion leading to movement and deposition of sediments, deleteriously impacting on receiving waters.
Licenced stream diversions / Levees	Disturbed materials, sediment and turbidity	Sheet, tunnel, rill and gully erosion leading to movement and deposition of sediments, deleteriously impacting on receiving waters.

After closure the landform will comprise consolidated mine spoil overlain by revegetated topsoil. At that time, runoff will largely have come into contact only with the revegetated topsoil and the likelihood of contamination with potential mine spoil contaminants would be low. Geochemical assessment (RGS 2023) recommends monitoring of major ions and dissolved metals/metalloids for the overburden dumps and therefore, the recommendations were adopted as the Contaminants of Concern (CoCs) and considered in the development of the closure water monitoring programs.

Furthermore, an analysis of the water movement within the Project final landform was undertaken to simulate and assess the movement and fate of water particles through the groundwater system post-mining (SLR 2024). The model predicted a greater potential for shallow groundwater saturation in the western and southern side of the elevated final landform (overburden dump). This is further detailed in Section 7.5.

Overall, the particle movement simulation indicates that all groundwater within the Project, including that flowing through spoil of the final landform, would remain within the final landform (e.g. backfilled spoil and residual voids) in the long term with no groundwater predicted to flow to the receiving environment (Figure 15). The residual voids are predicted to remain groundwater sinks and groundwater would not flow from the residual voids off-site.

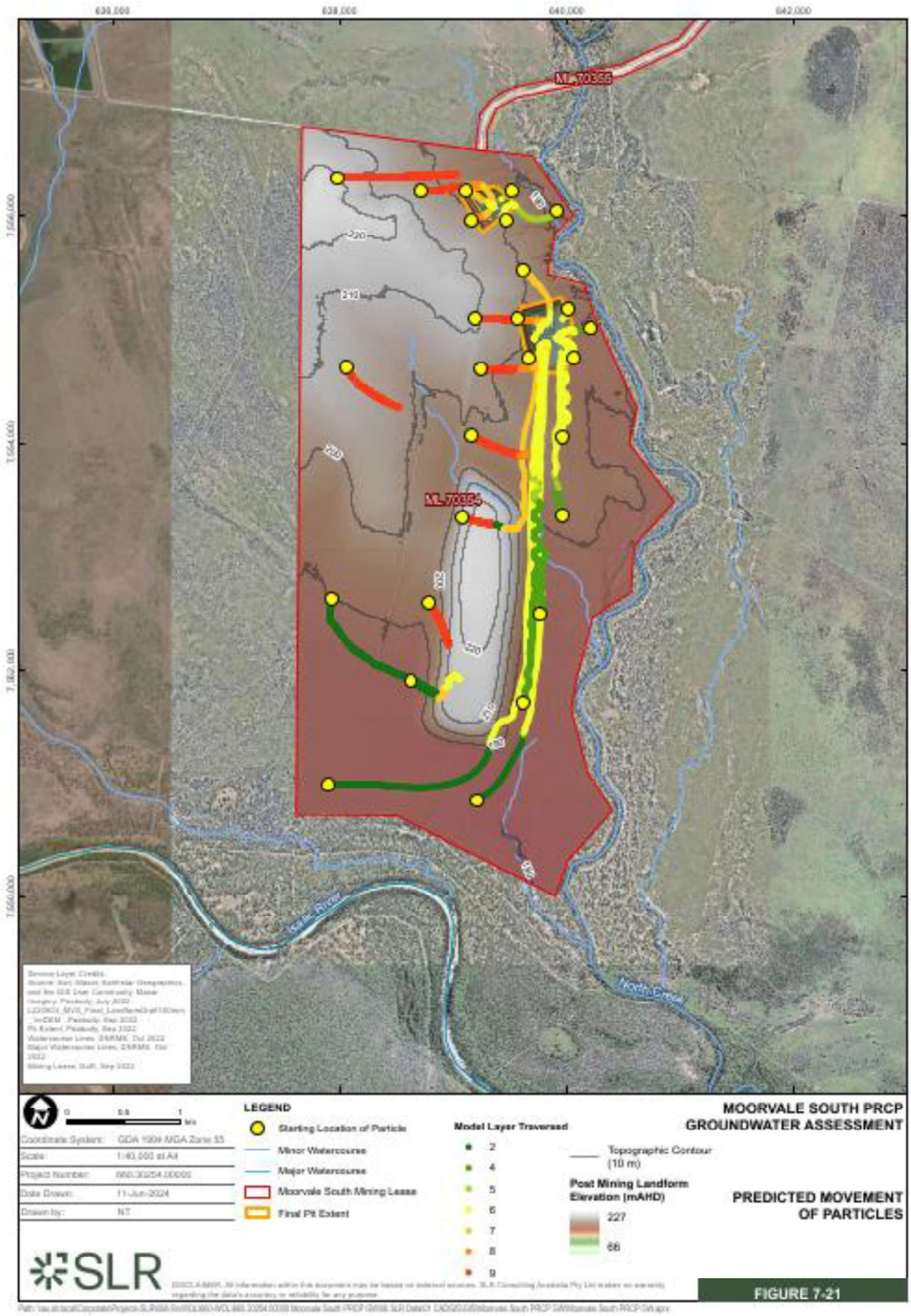


Figure 15 Predicted movement of particles (SLR 2024)

5.10.2 Water storages and clean water drainage channel

The proposed mine plan includes the construction of various water management structures for 'worked' waters. These include:

- 450 ML Dam;
- 300 ML Dam;
- 20 ML Dam;
- ROM Sediment Dam; and
- Sump West and Sump East.

Rainfall runoff from disturbed areas which is expected to contain sediment is collected in various dams and drainage facilities, including a series of sediment basins adjoining the haul road, sediment drains north, main and south, and the sediment dam surrounding the 300 ML dam. Worked water is captured in the ROM Sediment Dam, 20 ML Dam, 300 ML Dam and 450 ML Dam. The clean water drainage channel drain runs from north to south along the west edge of the ROM pad and the 450 ML Dam, and discharges to the south near the west arm of the flood levee (see Section 5.4). Key parameters of Project water storages that comprise the Project water management system are summarised in Table 17. A schematic diagram of the Project water management system is shown in Figure 16.

The outcome of a Consequence Category Assessment (Capital Consulting Engineers 2022a, 2022b) shows all proposed water management infrastructures are categorized with a 'Low' overall consequence category, hence are considered non-regulated structures.

For the purposes of the PRCP schedule, water management structures have been split into two rehabilitation areas, namely, the dams and flood levee that will be removed at closure and the clean water drainage channel that will be retained as part of the final landform.

Once no longer required, dams will be drained, the sediment allowed to dry and then removed for encapsulation within the final landform. Dams will then be filled-in by pushing the dam banks into the dam void, or alternatively the dam wall will be removed and the area recontoured to ensure that the site is free draining. The area will then be topsoiled and revegetated in accordance with the methods described in Section 5.12.2. The levee will be removed, and the area topsoiled and revegetated.

The 300 ML Dam will be constructed using appropriate overburden material excavated from the open cut pit and will be in use until 2035 when the dam is consumed by the advancing mining pit and replaced by the in-pit overburden dump. As the dam is located within the in-pit overburden dump (RA4) footprint, and the rehabilitation milestones applicable to RA4 apply, the dam area is not included in the rehabilitation schedule as a water management structure.

An unnamed first order tributary exists and begins in the centre of the ML (refer Figure 4), classified as the top of the catchment with headwater flow paths that would flow across disturbed areas of the Project. A clean water drainage channel is designed and implemented to function as an ephemeral drainage feature directing water around the western toe of the residual overburden dump. The clean water drainage channel is proposed to be retained at closure.

The design of this structure is in accordance with the International Erosion Control Association (IECA) guideline, described as a low gradient flow diversion technique. The channel comprises a gradient that is sufficiently low to maintain subcritical flow along its length.

The rehabilitation design of the drainage channel comprising a maximum 25% slopes, is consistent with the requirements of RM3 (and the LOD), which specifies a maximum of 30% slope for water management features (RA5). The approved rehabilitation slope is considered safe and stable long-term. The drainage channel is currently operational and constructed in accordance to design specifications by an appropriately qualified person.

The purpose of the clean water drainage channel is to deter rainfall runoff from surrounding catchments to avoid disturbed environments that may contaminate water quality. The landform is constructed of material that is free of soluble salts, organic matter and other deleterious matter. Additionally, sediment and erosion control measures are maintained until such time as the area has been rehabilitated and stabilised. Therefore, the structure design ensures a non-polluting final landform.

The drainage feature is not significant enough to create a riverine environment and due to the historical clearing for grazing, the tributary has been mapped as regrowth vegetation of sparse shrubland (Wormington et al. 2004, refer Table 4). Therefore, the drainage channel is revegetated to establish a self-sustaining Light Grazing PMLU in accordance pre-mining conditions (described in Section 5.12.2). Vegetation establishment and growth within RA5 will continue to be monitored until such time all rehabilitation objectives are achieved (as required in RM6).

Table 17: Project worked water storages

Water storage	Storage capacity (ML)	Maximum catchment area (ha)	FSL surface area (ha)	Overflows to	Design AEP	Retained post-closure
450 ML Dam	450	60	24.6	CWD/North Creek	10%	No
MIA Sediment Dam 1	13	7.5	0.72	Dirty water drain	10%	No
MIA Sediment Dam 2	25.6	13.3	1.4	Sediment Dam	10%	No
20 ML Dam	20	2.1	2.1	Dirty water drain	10%	No
ROM Sediment Dam	42.3	20	1.9	West sump	10%	No
300 ML Dam	300	5.3	4.94	North Creek	10%	No

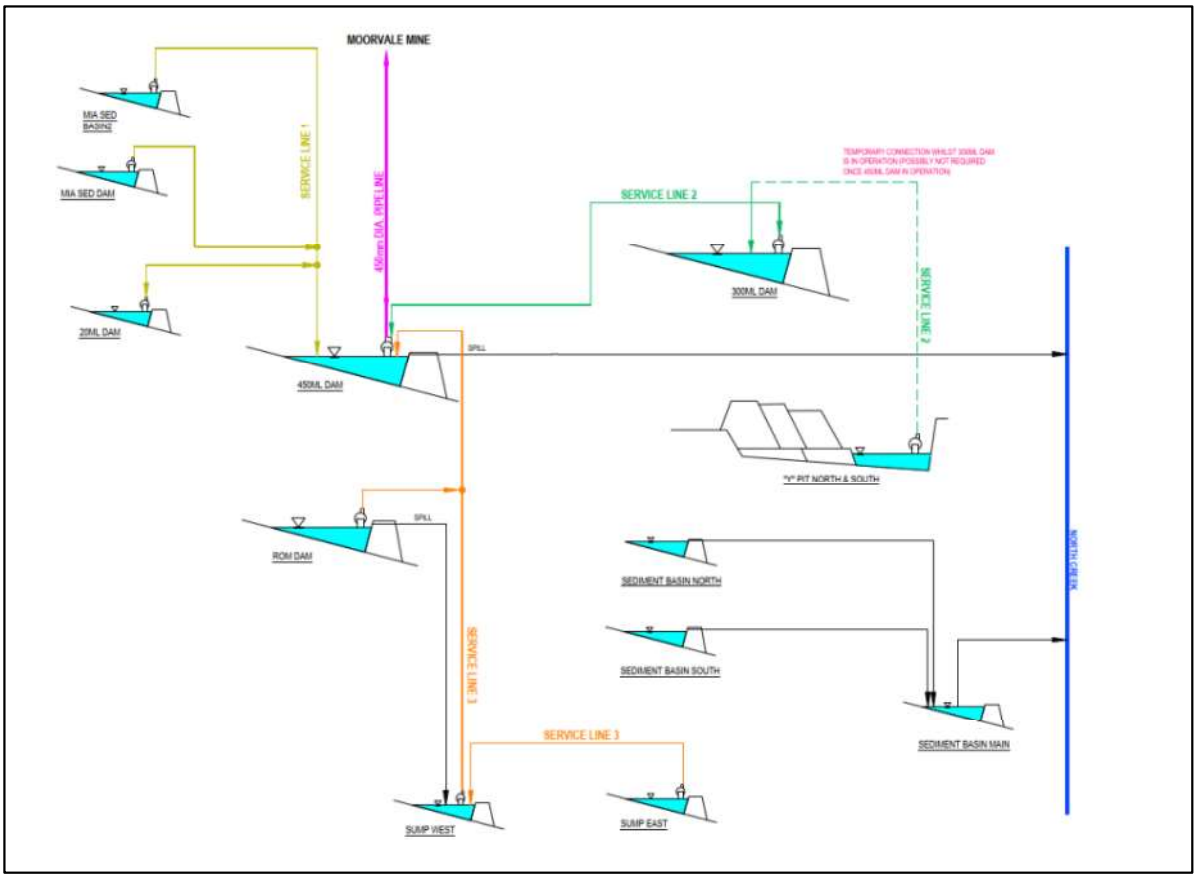


Figure 16: Water management system schematic

5.11 Tailings storage facility

ROM coal will be transferred to the Moorvale Mine for processing, and tailings will be managed on-site at Moorvale Mine. Consequently, there is no tailings storage facility located within the Project site and rehabilitation planning for tailings is not required for this PRCP.

5.12 Soil material assessment

5.12.1 Topsoil material

As discussed in Section 3.1.8.2, soils within the Project area are structurally competent in their natural setting, comprising sandy loam to light clay textured soils. Topsoils sourced from the Project are suitable for supporting plant growth, considering the following chemical characteristics described in the baseline survey–

- Soil pH in the Project is predominantly within ideal limits for plant growth (pH 5.5 – 9.0), and amelioration is not considered necessary (Hazelton and Murphy 2016). Although a small proportion of soil material sourced from the 'Grey gradational clay' soil unit may encounter strongly alkaline subsoil material (>pH 9.0, refer Table 3), requiring amelioration (e.g. application of elemental sulphur) to be applied prior to placement.
- Electric conductivity (EC) within all identified soil units are below 2 dS/m, indicating no limitations to vegetation growth in terms of salinity (Hazelton and Murphy 2016). All soil material are non-saline, no amelioration is necessary for this property.
- Exchangeable sodium percentage (ESP) was not measured in the baseline survey. Sodicity of soil material is inferred from the Emerson Aggregate Test (EAT), based on Hazelton and Murphy (2016). Soil material is predominantly unlikely to be sodic, indicating adequate structural stability and resistance to erosion.

Therefore, the material is suitable for vegetation establishment. ESP will be measured prior to placement of soil material to determine the requirement of gypsum (RM4).

The appropriateness of the proposed topsoil and revegetation methodology is demonstrated through its consistency with the Queensland Mine Rehabilitation Commissioners Technical Paper, *Rehabilitated mined land suitability for beef cattle grazing in the Bowen Basin* (Short 2023). The proposed milestone criteria in RM4 is consistent with the criteria specified in the technical guideline, including:

- Topsoil is spread to a minimum thickness of 150 mm;
- Soil pH is between 5.5 and 9.0, noting that the upper limit is applicable to the criteria to achieve Land Suitability Class 4;
- Soil salinity (Electrical conductivity, EC_e) ≤ 10 dS/m; and
- Soil sodicity (ESP) < 6%.

Prior to spreading of topsoil on a given rehabilitation area, composite soil sampling and agronomic laboratory analyses will be undertaken to ensure the relevant milestone criteria is achieved. The results of soil sampling and laboratory analyses will inform the type and quantity of ameliorants required that would be beneficial for the topsoil resource, if required.

An estimated topsoil balance was developed to investigate the volume of available resources required to complete the target rehabilitation methodology, as well as identify volume of material required for rehabilitation of existing and future disturbances. The overall material balance is presented in Table 18, it is anticipated that there are significant surplus volumes for soil materials required to complete the proposed rehabilitation.

Table 18: Estimated topsoil balance

Inventory	**Volume of Topsoil (m^3)**
Estimated material available at the end of mine	
Total topsoil available	**1,630,951**
Material requirements by rehabilitation and improvement areas	
RA1: Mine infrastructure	194,100
RA2: Elevated Landform	270,900
RA3: Out-of-pit overburden dumps	88,650
RA4: In-pit overburden dumps	227,550
RA5: Clean water drainage channel	21,000
RA6: Water management structures	93,900
RA7: Minor tracks	169,050
RA8: Haul road	-
IA1: Residual void (X Pit)	-
IA2: Residual void (Z Pit)	-
Total topsoil required	**1,065,150**
Deficit/Surplus	**+565,801**

5.12.2 Stockpile management

Topsoil at the Project is managed to support progressive rehabilitation methods in accordance with the Topsoil Management Plan. Land clearing and topsoil stripping is undertaken only in areas necessary to allow efficient mine operation, with stripping occurring ahead of mining and from infrastructure footprints. Clearing and topsoil stripping in front of the advancing highwall is limited to 100 m wherever possible. Preference is given to placing topsoil directly onto recontoured areas to avoid double handling and to prevent topsoil deterioration.

Where this is not possible, stockpiling will occur at suitable locations outside of active mine areas. To protect the integrity of stockpiled topsoil resources, the following procedures are adopted:

- stockpiles are located away from drainage lines and trafficable areas;
- stormwater runoff is diverted around stockpiles;
- the amount of time topsoil remains stockpiled is kept to a minimum;
- stockpiles are a maximum of 4 m in height; and
- stockpiles are seeded with suitable grass (cover crop) and legume species immediately after construction if topsoil is not planned for reuse in the immediate future.

Long-term soil stockpiles will be inspected every two years to ensure the following:

- clear demarcation of stockpile areas with signage;
- limited access to stockpile areas;
- vegetation cover of the stockpile is appropriate to reduce erosion; and
- minimal weed infestation of stockpile.

Stockpiling of soil material for extended periods is susceptible to physiochemical changes that can impact soil fertility. For an accurate interpretation of topsoil fertility and recommendation of amelioration, chemical analysis of soil material is to be undertaken prior to placement (as required by RM4). Recommended rates of ameliorants and/or fertilisers will be applied and incorporated via surface ripping.

5.13 Revegetation

5.13.1 Surface preparation

Following bulk earthworks, RA's will be graded to remove erosion scours (where necessary) and establish desired slopes.

Topsoil will be spread over the re-contoured landform to a depth of up to 150 mm. Following spreading, the topsoil will be ripped along the contour to protect against erosion and provide a suitable seedbed, conserve rainwater, reduce runoff velocity, and prevent soil loss. Where practicable, seeding is conducted concurrent with the ripping process. Seed mix is applied to the surface in the lead up to the wet season.

5.13.2 Species selection and application

The EA does not include a description of target species to be used in revegetation. Much of the land that will be disturbed for mining operations was historically cleared for grazing purposes, and given the changes in slopes and substrate expected in the post-mining landform, a species list has been developed with consideration for:

- the local soil conditions, including potential increased rockiness on overburden dumps;
- slopes and aspect of rehabilitated landforms;
- areas associated with North Creek and the Isaac River floodplain (1% AEP);
- the requirement to rapidly establish vegetation cover to stabilise the landform;
- being representative of native flora communities on comparative slopes and with similar aspect; and
- achieving a Light Grazing PMLU.

The post-mining landform slopes of the MIA, water management structures and in-pit overburden dump (RA1, RA3, RA4, RA6) will closely resemble the pre-mining landscape. The vegetation type documented across much of the Project during the baseline flora survey was identified as open shrubland of cleared or regrowth vegetation. As such, a selection of native trees, shrubs and groundcovers (predominantly grasses) have been selected that are known to occur in areas previously cleared for agriculture, being adapted to the soils, aspect and climate.

In areas subject to inundation during 1% AEP flood events (WRM 2023), the pre-approved PMLU is 'Light Grazing (native vegetation)'. The revegetation strategy will include endemic native wetland species suitable for the inundation frequency. The proposed seed mix is designed with reference to vegetation along North Creek and Isaac River (map unit 7, refer Table 4), containing greater diversity of tree, shrub and ground cover species to ensure greater vegetation cover. Greater vegetation cover supports stability and flood resistance of the post-mining landform.The clean water drainage channel (RA5) will be retained in the final landform to divert water around the western toe of the out-of-pit overburden dump and is expected to function as an ephemeral drainage feature post-mining. The drainage feature is not significant enough to create a riverine environment and due to the historical clearing for grazing, the tributary has been mapped as regrowth vegetation of sparse shrubland (Wormington et al. 2004, refer Table 4). Therefore, the drainage channel is revegetated to establish a self-sustaining Light Grazing PMLU in accordance pre-mining conditions.

The rehabilitated elevated landform (RA2) will not resemble the pre-mining landscape. Vegetation Management Regional Ecosystems mapping (VM Act) and contour mapping were referred to identify the vegetation community occurring in an elevated area adjacent to the Project (DoR 2023). Slopes with rocky soils, similar to the expected elevated landform, was identified as RE 11.12.1a – *Eucalyptus crebra* woodland on igneous rocks. A list of flora species to be seeded and/or planted on the elevated landform to facilitate a Light Grazing PMLU has been developed based on key species of the identified government mapped RE. The species proposed include a selection of native trees and shrub species. Additionally, a pasture mix including desirable 3P (perennial, productive and palatable) grass species has been developed with the aim to provide a good grazing pasture for Light Grazing PMLU.

Pasture seed mix and sowing rates is provided in Table 19. The native trees and shrub species list is provided in Table 20.

Table 19: Pasture seed mix

Common name	Scientific name	Indicative Sowing rate (kg/ha)
Gayndah Buffel Grass	*Cenchrus ciliaris*	3
Sabi Grass	*Urochloa mosambicensis*	2
Fine Cut Rhodes	*Chloris gayana*	3
Butteryfly Pea / Wynn Cassia	*Clitoria ternatea*	3
Seca Soran Stylo	*Stylosanthes scabra*	4
3P Species		
Queensland Bluegrass	*Dicanthium sericeum*	2
Curly Bluegrass	*Dicanthium fecundum*	2
Native Millet	*Panicum decompositum*	2
Brigalow grass	*Paspalidium* species	2
Minimum total sowing rate		**23**

Table 20: Native trees and shrub species

Genus	Scientific name	Properties
Acacia	*Acacia flavescens*	Leguminous species suitable for erosion management on slopes.
	A. shirleyi	
Corymbia	*Corymbia clarksonii*	Key canopy species for several REs.
	C. dallachiana	
	C. intermedia	
	C. erythrophloia	
	C. tessellaris	
Eucalyptus	*Eucalyptus crebra*	Key canopy species for several REs.
	E. platyphylla	
	E. persistens	
	E. populnea	
	E. melanophloia	
	E. tereticornis	

When sourcing native seed stock, the use of local provenance native seed will be prioritised, being better adapted to the Project's edaphoclimatic conditions. Species availability will be confirmed with suppliers, and locally sourced plant material used when available and practicable. Where seed for the selected species is not available, a non-endemic option may exist. Species selection will be planned sufficiently in advance (typically 1-2 years prior to planned rehabilitation) to improve the ability to obtain commercial quantities.

The preferred practice for revegetation is the direct machine seeding of a multi-species seed mix which includes a sterile, annual fast-growing cover crop together with the target mix of native perennial grasses and other native species. Seeding will be undertaken as soon as practicable following the completion of surface preparation activities.

Where local circumstances require, for example, localised steep slopes of overburden dumps, hydromulching is an option that may be utilised for delivering seeds to revegetation areas, and which has the advantage of providing early-stage erosion mitigation.

6 Risk assessment

6.1 Risk assessment requirements

Section 126C(1)(f) of the EP Act requires the PRCP to identify the risks, for each PMLU, of a stable condition not being achieved and how the applicant intends to manage or minimise the risk.

A risk assessment has been carried out in accordance with the following standards:

- Recognised Standard 02: Control of risk management practices; and
- AS/NZS ISO 31000:2018 Risk management – Guidelines.

6.2 Risk assessment process

Any risk assessment needs to be undertaken with consideration of the scope, context and criteria relevant to the assessment. For this risk assessment, the following scope and purpose was discussed and agreed to:

- Identify and define risks to land being safe and structurally stable;
- Identify and define risks which have the potential to adversely affect EVs; and
- Identify and define risks to land sustaining the nominated PMLU.

For this risk assessment, risk scenarios (or 'threats') were identified and considered for each RM and MM associated with the Project. The causes attributable to each risk scenario were documented as well as the potential impacts. Existing controls were noted, defined as those reasonably expected to be in place for a Project of this nature and having appropriate and contemporary management systems. Each risk scenario was then assessed with respect to safety, structural stability, environment and achievement of self-sustaining PMLU against the risk assessment schema outlined in section 6.3.

6.3 Risk assessment schema

Risks specific to the rehabilitation of the Project were classified using the risk classification schema which is described below. The risk assessment schema used is comparable to those used widely within the mining industry and comprises the following components:

- a likelihood classification descriptors table (Table 21); and
- a consequence classification descriptors table (Table 22).

Following a consensus determination of likelihood and consequence, the risk level was determined using the matrix shown in Table 23. For any inherent risks classified as 'moderate' or above, mitigation and management measures were identified and documented. Mitigation and management measures were also documented for some lower-level risks.

Table 21: Likelihood of exposure to the hazard

Level	Descriptor	Description
E	Very Likely	Likely to occur repeatedly — expected in the work team.
D	Likely	Probability will occur several times — expected at this location.
C	Possible	Could occur intermittently — expected within Peabody.
B	Unlikely	Could occur but hardly ever — expected within the mining industry.
A	Rare	Improbable or unrealistic — not expected in the mining industry.

Table 22: Consequence classification descriptors

Category	Consequence Severity Level					
	1. Low	*2. Minor*	*3. Moderate*	*4. Significant*	*5. Major*	*6. Catastrophic*
Safety	• Near miss, near hit, no medical treatment, report only (RO).	• Slightly injured, first aid treatment (FAI).	• Medical treatment (MTI), disabling reversible impairment, restricted work (RWI) or lost time (LTI).	• Serious bodily injury or disabling irreversible impairment, permanent partial disability (PPD).	• Single fatality incident. Total and permanent disability (TPD). Major irreversible health effects.	• Multiple fatality incident. Major injury/disease among multiple employees.
Structural Stability/Erosion	• The land surface will remain consistent with final design/construction and any minor changes reflect stabilisation and natural processes. • No intervention is required.	• The land surface will remain generally consistent with final design/construction. • Short-term (<5yrs) rill erosion will occur while natural ecological processes stabilise. • Any changes remain within footprint of land feature. • No intervention is required to achieve long-term stability.	• The land surface will remain generally consistent with final design/construction. • Rates or extent of soil movement are in excess of natural processes and gully erosion/minor subsidence. • The changes will self-stabilise within 10 years. • Impacts remain predominantly on the land feature but may extend beyond. • Monitoring is required to confirm trajectory towards long-term stability	• The land surface becomes moderately inconsistent with landform design. • The rates or extent of soil movement are significantly in excess of natural processes (i.e. rates of erosion) and are unlikely to self-rehabilitate or stabilise.	• The land surface is considered highly unstable with large scale slippage/subsidence or some other catastrophic failure expected. • Impacts extend beyond footprint of land feature • The land will not self-rehabilitate or stabilise to a form that is consistent with proposed closure land surface	

Environment	• Negligible or reversible environmental impact. • Nil to minor remediation (typically a shift). • No breach of regulations or requirement to report to regulators.	• Minor reversible environmental impact. • Minor remediation (typically <5 days). • Non-compliances and breaches of regulation that may result in a citation (NOV). • May require reporting to the regulators.	• Incident resulting in moderate reversible onsite and / or off-site impact causing short term effect. • Moderate remediation needed (typically a month). • Non-compliances and breaches of regulation that may result in prosecution or citation or punitive fine. • Requirement or obligation to report to the regulators.	• Incident resulting in significant on-site or off-site environmental impact causing medium to long-term environmental harm. • Significant remediation needed (typically less than 12 months). • Significant legal issues, non-compliances and breaches of regulation that results in prosecution or citation or fine. • Moderate litigation issues involving many weeks of senior management time.	• A major incident resulting in regional environmental impact causing long-term environmental harm. • Major long-term remediation needed (greater than 12 months). • Major litigation or prosecution resulting in long-term interruption to operations or loss of licence at a site.	• Incident resulting in catastrophic widespread regional environmental harm causing disastrous effect. • Major long-term remediation needed (over multiple years). • Major litigation or prosecution. • Loss of license to operate at multiple sites.
PMLU	• Selected PMLU achieved and is sustainable.	• Minor adjustment to selected PMLU is required to be sustainable. • No additional or ongoing intervention (beyond normal land management practices) is required.	• Moderate adjustment to selected PMLU is required to be sustainable, but intent of PMLU remains. • Moderate alteration in land management practices (scale, cost and/or duration) is required to achieve selected PMLU.	• Selected PMLU is not achievable or sustainable without significant adjustment. An alternative PMLU may be required. • Significant alteration in land management practices (scale, cost and/or duration) is required to achieve selected PMLU.	• Land cannot be of any use (i.e. NUMA).	

Table 23: Risk level classification matrix

Likelihood	Consequence					
	1. Minor	*2. Low*	*3. Medium*	*4. Major*	*5. Severe*	*6. Catastrophic*
E. Very Likely	Low (5)	Moderate (10)	Moderate (25)	High (50)	Extreme (125)	Extreme (250)
D. Likely	Low (4)	Moderate (8)	Moderate (20)	High (40)	High (100)	Extreme (200)
C. Possible	Low (3)	Low (6)	Moderate (15)	Moderate (30)	High (75)	Extreme (150)
B. Unlikely	Low (2)	Low (4)	Moderate (10)	Moderate (20)	High (50)	High (100)
A. Rare	Low (1)	Low (2)	Low (5)	Moderate (10)	Moderate (25)	High (50)

6.4 Risk assessment outcomes and management

In total, 38 risk scenarios were identified and assessed. The potential risks were further assessed to identify additional controls that could be proposed to lower the inherent risk score, forming the residual risks of the scenario.

One 'Moderate' residual risk was identified, and has been classified into geotechnical risk, relating to safety impacts from instability of residual void walls subject to significant slope failure.

The final outcomes of the risk assessment are detailed in Table 24 which provides a summary of the residual risk classifications made by the RMs and MMs. Risks associated with the Project have been considered in the rehabilitation management and monitoring methodology used to inform the completion criteria and PRCP schedule. The detailed risk outcomes are included in Appendix C.

A risk treatment plan was developed detailing the proposed controls to manage the identified risks (Appendix C). The treatment options responsible for the implementation of the PRCP are outlined below:

- Appropriate infrastructure and contaminated land management as described in Section 5.2. Remaining unsafe infrastructure removed, based on outcomes of final landform survey and hazard and safety assessment. Budget allowance and planning for potential contaminated soil disposal or treatment.
- Overburden dump and slope survey controls and reshaping as described in Section 5.4, to ensure landform is constructed according to design criteria.
- Slope moderation and engineered final landform to ensure the residual voids are constructed according to design criteria, as described in Section 5.6. Closure low wall slopes will be lowered to a long-term stable overall angle of 22 degrees.
- Adequate topsoil or subsoil amelioration as described in Section 5.12, and prompt revegetation establishment as described in Section 5.13.
- Adequate rehabilitation monitoring of site conditions and landform profile as described in Section 7.1. Monitoring of rehabilitation performance, undertake repairs and improvement works as required.
- Prompt remediation and causal feedback loop to water management system review as described in Section 7.1. Monitoring of drainage network performance, undertake repairs and maintenance as required.
- Geotechnical assessment at closure as described in Section 7.1. Certification by an appropriately qualified expert that the final landform is stable and constructed according to design criteria.
- Land suitability assessment at closure as described in Section 7.1. Certification by an appropriately qualified person that the land has achieved a minimum of land suitability Class 4.
- Statistical comparison or monitoring of receiving water quality to reference sites, as described in Section 7.1.
- Post-closure monitoring of the residual voids as described in Section 7.1. Certification of groundwater sink by an appropriately qualified person that the voids are safe to humans and livestock. Risk assessment of controls will be conducted when safety infrastructure is designed and placed around the voids, modify as required.

Table 24: Risk assessment outcomes by rehabilitation and management milestone

Milestones	Residual Risk Level				
	Low	**Moderate**	**High**	**Extreme**	**Total**
Rehabilitation milestones					
RM1 - Infrastructure decommissioning and removal	3	0	0	0	**3**
RM2 - Management of contaminated land status	1	0	0	0	**1**
RM3 - Landform development (reshaping and reprofiling)	6	0	0	0	**6**
RM4 - Surface preparation (topsoil application, soil amelioration, contour ripping) and revegetation (seeding/planting)	5	0	0	0	**5**
RM5 - Achievement of surface requirements for Light Grazing PMLU (MIA, overburden dumps and water management infrastructure)	3	0	0	0	**3**
RM6 - Achievement of Light Grazing PMLU to stable condition	5	0	0	0	**5**
RM7 – Surface water and groundwater demonstrate non-polluting landform	3	0	0	0	**3**
Management milestones					
MM1 - Achievement of final landform design	3	1	0	0	**4**
MM2 - Achievement of surface and safety requirements	2	0	0	0	**2**
MM3 - Achievement of sufficient improvement	6	0	0	0	**6**
Total	**37**	**1**	**0**	**0**	**38**

7 Monitoring and maintenance

7.1 Monitoring and maintenance program

To develop the PRCP schedule, seven (7) RMs have been proposed as being applicable for the Project. The PRCP Guideline (DES 2021) requires consideration of measures to be undertaken to demonstrate that milestones and milestone criteria have been achieved.

With respect to determining the achievement of RMs, a clear definition of milestone criteria have been developed for each RM. Assessment of RAs against completion criteria will be incorporated into the ongoing environmental management for the Project. Assessment of RAs against the milestone criteria that pertain to vegetation and achievement of PMLUs will be undertaken as part of an annual rehabilitation monitoring program. Monitoring of rehabilitation will commence following completion of activities of the first RM applicable to the relevant RA/IA.

The completion criteria for each PMLU will be used as the milestone criteria for the final milestone in the proposed schedule, which shows achievement of the PMLU to a stable condition for progressive certification and/or ML surrender. When the final RM applicable to the rehabilitation area is deemed to be satisfied, a final rehabilitation assessment will be undertaken before an application for progressive certification or ML surrender is made. Table 25 provides a summary of the measures to be undertaken to determine the achievement of each RM. Determination of the boundary of an area reaching a given RM at a given point in time will utilise standard survey techniques, including land-based survey and airborne survey at an appropriate frequency – nominally annually – to achieve satisfactory geolocation of areas.

Table 25: Milestone monitoring methods and frequency

Milestone	Monitoring measures	Monitoring validation method	Frequency
Rehabilitation milestones			
RM1: Infrastructure decommissioning and removal	Visual inspection(s) will be conducted to verify that no infrastructure remains that does not form part of a Landholder Agreement.	Visual monitoring	At completion of infrastructure decommissioning and removal activities
RM2: Management of contaminated land status	A completed Phase 1 contaminated land investigation report, as well as any consequent reports, where required. Visual inspection of potential sites or sources of contaminated and hazardous materials will be conducted, and samples collected as required. The contaminated land investigation will determine the presence of any contaminated and hazardous materials. Remediation activities will be undertaken if required following consultation on appropriate remediation activities.	Contaminated land assessment and validation testing	Single event, with follow up assessment as required

Milestone	Monitoring measures	Monitoring validation method	Frequency
	A validation report will detail the remediation of contaminated land and, if required, a site suitability statement prepared by an appropriately qualified person[1] that states that the land is suitable for use according to the nominated PMLU.		
RM3: Landform development (reshaping and reprofiling)	Landform stability and specifications on rehabilitated slopes will be confirmed using LIDAR, with particular attention paid to determining the post-mine landform stability by measuring: • year on year settlement / subsidence and / or sediment deposition; and • the extent and year on year progression of erosion features. Land based and/or remote sensing survey techniques will be employed to confirm that graded slopes meet design specifications. Additionally, visual inspections will be done to determine if any future maintenance/repair action is required. A geotechnical assessment will be conducted by an appropriately qualified person to confirm that long-term stability has been achieved for all relevant landforms.	LIDAR assessment/ Geotechnical monitoring	At completion of earthworks and surface reprofiling
		Rehabilitation (Erosion) monitoring	At 1, 2, 5, 7, 10 and 15 years post establishment of vegetation
RM4: Surface preparation (topsoiling/contouring/soil amelioration) and revegetation (seeding and/or planting)	A soil health assessment will be conducted by an appropriately qualified person[1] prior to each rehabilitation event to determine the chemical properties and soil nutrient status of the reconstructed topsoil profile, and recommendations made for ameliorants where required. Records of topsoil placement and depth indicating achievement of the target topsoil depth. Records to include any ameliorants applied, including types, rates and timing of applications. Visual inspections and documentation of surface scarification, including depth, spacing and machinery used.	Soil monitoring	At year 1 and 5-yearly intervals thereafter from commencement of rehabilitation
	Records of seeded and/or planted species consistent with the target species list. Records of noxious weeds and pests.	Written records/ Rehabilitation monitoring reports	At completion of seeding

Milestone	Monitoring measures	Monitoring validation method	Frequency
RM5: Achievement of surface requirements for Light Grazing PMLU (MIA, overburden dumps and water management infrastructure)	Undertake vegetation monitoring on all rehabilitated landform types. Measure percentage of weeds classified as Category 3 restricted invasive plant species under the *Biosecurity Act* 2014. Assess parameters related to vegetation establishment and success: • key plant species present; • evidence of recruitment of key plant species; • vegetation type; and • ground cover. Sufficient relevant data will be obtained to statistically indicate trends and demonstrate achievement of milestone criteria.	Rehabilitation (Vegetation) monitoring	At 1, 2, 5, 7, 10 and 15 years post establishment of vegetation
	Record the location of erosion as per the Australian Soil and Land Survey – Field Handbook. 3rd ed (2009) (e.g. active, stable, depth, type etc.). Recommendations for remedial works will be made where required, and remedial activities undertaken as soon as practicable.	Rehabilitation (Erosion)monitoring	At 1, 2, 5, 7, 10 and 15 years post establishment of vegetation
RM6: Achievement of Light Grazing PMLU to stable condition	Land based and/or remote sensing survey techniques confirms retained landforms (if any) are consistent with the intention of the PMLU. A visual inspection of rehabilitation areas will be undertaken by an appropriately qualified person[1] to identify any remaining hazards or safety concerns.	Landform survey/Hazard and safety assessment	Prior to completion of milestone
	A land suitability assessment will be undertaken by an appropriately qualified person[1] to certify that the land has achieved a minimum of Class 4.	Land suitability assessment	Prior to completion of milestone
	Undertake vegetation monitoring on all rehabilitated landform types. Measure percentage of weeds classified as Category 3 restricted	Rehabilitation (Vegetation) monitoring	At 1, 2, 5, 7, 10 and 15 years post establishment of vegetation

Milestone	Monitoring measures	Monitoring validation method	Frequency
	invasive plant species under the *Biosecurity Act* 2014. Assess parameters related to vegetation establishment and success: • key plant species present; • evidence of recruitment of key plant species; • vegetation type; and • ground cover. Sufficient relevant data will be obtained to statistically indicate trends and demonstrate achievement of milestone criteria.		
	Record the location of erosion as per the Australian Soil and Land Survey – Field Handbook. 3rd ed (2009) (e.g. active, stable, depth, type etc.). Recommendations for remedial works will be made where required, and remedial activities undertaken as soon as practicable.	Rehabilitation (Erosion) monitoring	At 1, 2, 5, 7, 10 and 15 years post establishment of vegetation
RM7: Surface water and groundwater demonstrate non-polluting landform	Surface water monitoring will be undertaken after the achievement of final stable landform. As creeks and drainage lines within the Project are ephemeral, surface water monitoring will only be undertaken opportunistically during periods of runoff where safe access to the site can be gained. Water samples will be collected from proposed upstream and receiving sites. Water quality in the receiving environment will be compared against specified limits and upstream water quality.	Surface water quality monitoring	Monthly during flow
	Groundwater monitoring will be undertaken after the achievement of final stable landform. Water samples will be collected from post-mining groundwater monitoring network. Water quality at monitoring bores will be compared against interim groundwater quality limits, developed based on Isaac River Sub-basin EV protection criteria.	Groundwater quality monitoring	Biannually

Milestone	Monitoring measures	Monitoring validation method	Frequency
Management milestones			
MM1: Achievement of final landform design	Landform stability and specifications on rehabilitated slopes will be confirmed using LIDAR. Land based and/or remote sensing survey techniques will be employed to confirm that landform meets design specifications. Visual inspections will be done to determine if any maintenance / repair action is required.	LIDAR assessment	At completion of landform development activities
		Geotechnical monitoring	
		Visual inspections	
MM2: Achievement of surface and safety requirements	Visual inspection(s) will be conducted to confirm that bunding, fencing and safety warning signage has been erected around the perimeter of each residual void.	Visual inspection	Once fencing and signage have been established
MM3: Achievement of sufficient improvement	A geotechnical assessment will be conducted by an appropriately qualified person[1] to confirm that long-term stability has been achieved.	Geotechnical monitoring	At completion of landform development activities
	Void water level monitoring will be undertaken to confirm that the residual voids are groundwater sinks and that the landform is not causing environmental harm.	Void water level monitoring	Before achievement of final stable landform

1 *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 relating to the subject matter using the relevant protocols, standards, methods, or literature.

7.2 Permanent vegetation monitoring transects

Permanent monitoring transects are to be located within each RA. RAs will be divided into blocks, and using a 10 ha grid, each monitoring block will be divided into plots. Within each rehabilitation monitoring plot, a randomly selected point will be located which will be the start of the cover transect (Figure 17). The cover transect will form the centre of the rehabilitation monitoring plot and will run diagonally across a slope/surface. Cover transects should be chosen with consideration for local differences in soil type, slope and aspect, and noting that the seed mix composition should align as closely as practicable with the species composition and density occurring in the reference site.

Reference transects are to be located adjacent to the existing mining operations on the ML or Peabody owned land where possible, but within an area that will not be impacted by future mining activities. The native vegetation reference transects should represent the vegetation communities similar to those the re-vegetation program is aiming to achieve e.g. Light Grazing (native vegetation). The reference sites should consider vegetation, slope, aspect and soil attributes similar to those in the rehabilitation. Multiple native vegetation reference sites should be established in each vegetation community to allow statistical analyses to be undertaken.

The start and finish of the cover transect will be permanently marked with steel or wooden pickets (50 m apart) and GPS coordinates taken.

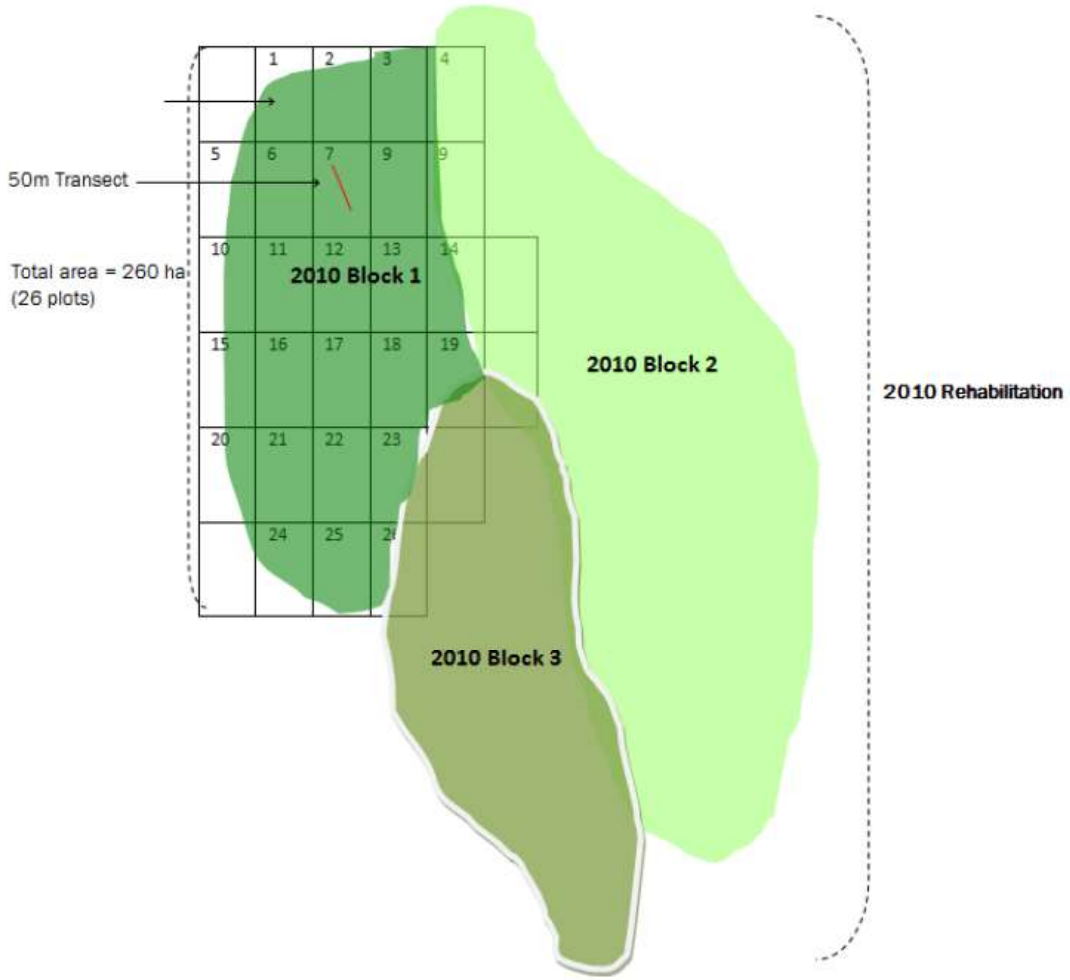


Figure 17: Rehabilitation plot randomisation design and transect location selection

The proposed rehabilitation monitoring methodology is described in Table 26.

Table 26: Summary of rehabilitation methodology

Monitoring methodology	Parameter measured	Description
General description and supplementary information	Transect characteristics	Record the slope, transect landform location (upper, middle, lower slope) and plot aspect.
	Erosion	Record the location of erosion within, or within the vicinity of the plot as per the *Australian Soil and Land Survey – Field Handbook. 3rd ed (2009)* (e.g. active, stable, depth, type etc).
	Visual record	Take one photograph at the start of the cover transect and a second at the finish, in both cases looking along the transect.
	Climatic variable	Recent rainfall events, intensity, duration, measurement in relation to time of seeding.
	Other variables	Note any other factors that have adversely affected rehabilitation areas, including fire, predation by insects, excessive grazing impact of herbivores, instances of vegetation die-back or soil disturbance caused by feral animals, e.g. pigs or rabbits.
2m x 2m Quadrats	Lower-storey density and richness	At 10 m intervals along the cover transect, record the number of all lower-storey species in each quadrat to obtain total lower-storey species density and richness.
	Lower-storey cover	Record total lower-storey cover (e.g. ground cover). The contribution of each of the lower-storey species to the live-standing ground cover assessment will be determined. The proportion of bare ground will be assessed by default.
	Topsoil Properties	Take five 0-15cm soil samples (i.e. one sample taken from each quadrat) and bulk, to produce one composite sample per transect.
50 m cover transect	Mid-storey and upper-story cover	Using the 50m cover transect, record the start and finish foliage intercepts. These intercepts are then added and divided by the total length (50 m), resulting in a percentage cover for the species along the transect.
	Basal	The contribution of groundcover species basal cover will be measured using the 'point frame method'. A 50 x 50 cm quadrats/frame will be located at 10 m intervals along, but adjacent to the cover transect. The contribution of competent rock (rock defined as >50mm in diameter) will also be assessed.
10 m either side of cover transect	Upper-storey & mid-storey density/richness	Record the total number of trees and shrubs for each species located 10m either side of the cover transect.
	Species Inventory	Separately record lower-storey species noted in the vicinity of the plot but not present within the 2m x 2m quadrats enabling a more comprehensive inventory of what species are present.

Monitoring methodology	Parameter measured	Description
	Recruitment	Within this plot, the proportion of dominant species found to be regenerating are counted. A regenerating individual is identified as a woody stem species at breast height, with a diameter of < 5 cm.
	Percentage weed cover	Recording weed species (classified as Category 3 – restrictive plant species from the Biosecurity Act 2014) within a 10 m x 50 m plot area (i.e. introduced species occurring within 5 m of either side of the transect centreline) and monitoring weed percentage foliage cover across ten 50 cm x 50 cm quadrats at each rehabilitation site.
LIDAR	Landform stability and specifications	Assess landform stability (settlement / subsidence), progression of erosion features and compliance of the 'as built' landform with the specifications (i.e. slopes, length) detailed within the EA.
Receiving environment water quality monitoring	pH, Dissolved Oxygen, Turbidity, EC, Temperature	Collect water samples from existing upstream and downstream locations in accordance with monitoring plans.

7.3 Soil monitoring

With regard to the rehabilitation monitoring program, soil monitoring will be undertaken in year 1 of monitoring and at 5-yearly intervals thereafter to assess any trends to inform amelioration requirements where required. At 10 m intervals along the cover transect (i.e. within the 2m x 2m quadrats resulting in total 5 sub-samples), a 0-15 cm soil sample will be taken and bulked to produce one composite soil sample per transect. The bulked samples will be prepared and analysed for various soil parameters, to allow recommendations for soil amelioration to achieve a self-sustaining PMLU. Consistent with RM4, parameters to be monitored and analysed will include, but not limited to:

- Electrical Conductivity (EC);
- pH; and
- Exchangeable Sodium Percentage (ESP) – calculated.

Soil texture is to be described. An appropriately qualified person will be required to assess the reconstructed topsoil profile and identify potential properties that may contribute to the rehabilitation not meeting the desired objectives and provide a recommendation for topsoil ameliorant and nutrient combination to achieve target vegetation growth.

7.4 Surface water monitoring

Water quality sampling is to be carried out in accordance with the *Queensland Monitoring and Sampling Manual 2009* (DES 2018) methodology. Surface water samples are to be collected from proposed upstream and downstream monitoring points, detailed in Table 27 and Figure 18. Surface water sampling will be undertaken monthly following the wet season and/or after significant rainfall events (e.g. an event greater than 50 mm in a 24-hour period) causing flow, for a minimum of five (5) consecutive years.

Field readings of pH, Dissolved Oxygen, Turbidity, Electrical Conductivity (EC) and Temperature are also to be recorded. *In-situ* measurements are to be collected using a multi-parameter water quality meter that is calibrated to the manufacturers' specifications.

Samples are to be collected in suitable sample collection bottles provided by the laboratory, with preservative added where required. All water samples are to be kept on ice or refrigerated during storage and transport to a National Association of Testing Authorities (NATA) accredited laboratory for analysis. RGS's geochemical assessment of mine waste at Moorvale South (RGS 2023) indicated the CoCs which could be at elevated concentrations and would require periodic monitoring. Surface water quality samples will be analysed under laboratory testing conditions for the parameters including the CoCs listed below:

- General water quality indicators;
    - pH;
    - Electrical conductivity (EC);
    - Total suspended solids (TSS);
    - Turbidity;
- Major Ions;
    - Calcium (Ca);
    - Magnesium (Mg);
    - Potassium (K);
    - Sodium (Na);
    - Sulfate (SO_4);
    - Chloride (Cl);
- Dissolved Metals and Metalloids;
    - Aluminium (Al);
    - Cadmium (Cd);
    - Copper (Cu);
    - Nickel (Ni);
    - Zinc (Zn); and
    - Selenium (Se).

After closure the landform will comprise consolidated mine spoil overlain by revegetated topsoil. At that time, runoff will largely have come into contact only with the revegetated topsoil and the likelihood of contamination with potential mine spoil contaminants would be low. The mine waste rock was also determined with neutral to alkaline pH levels which limits the potential of metals being liberated to a significant concentration. Nevertheless, the proposed surface water monitoring program will detect for exceedances above baseline levels in accordance with relevant guidelines.

The results of the analysis will be compared to the EPP (Water) WQO for the protection of aquatic ecosystems in the Isaac River Sub-basin. Where monitoring parameters have exceeded the aquatic ecosystem WQOs for the Isaac River Sub-basin, a comparison with water quality of upstream monitoring locations to demonstrate that exceedances are not a result of mine disturbance, that is water quality in downstream monitoring locations are statistically equivalent ($p<0.05$) to reference sites (upstream monitoring locations).

Monitoring triggers will be derived using site water quality data through methodologies outlined in the ANZG 2018 guideline. However, insufficient data is available to undertake statistical analysis. Therefore, interim monitoring values have been developed based on the default guideline values and appropriate levels of species protection. The interim values were derived by selecting the lowest WQO that is above the existing

range of local water monitoring data available. Table 28 outlines the proposed interim monitoring values for post-closure monitoring.

Table 27: Surface water monitoring locations

Monitoring Points	Receiving Waters Location Description	Easting (GDA94)	Northing (GDA94)
Upstream Background Monitoring Points			
Proposed Upstream North Creek (US)	450 m downstream of the connecting haul road	640010	7556760
Downstream Monitoring Points			
Proposed Downstream North Creek (DS)	2.5 km downstream of the final landform	640490	7549160

Table 28: Surface water quality trigger limits

Quality characteristic (units)	Limit	Source
pH	6.5-8.5	Upper Isaac River catchment waters WQO
Electrical Conductivity (µS/cm)	720 250	Baseflow - Upper Isaac River catchment waters WQO Highflow - Upper Isaac River catchment waters WQO
Turbidity (NTU)	50	Upper Isaac River catchment waters WQO
Sulphate (mg/L)	25	Upper Isaac River catchment waters WQO
Fluoride (mg/L)	1.7	ANZG 2018
Aluminium - dissolved (µg/L)	55	ANZG 2018
Arsenic - dissolved (µg/L)	13	ANZG 2018
Boron – dissolved (µg/L)	370	ANZG 2018
Cadmium - dissolved (µg/L)	0.2	ANZG 2018
Cobalt - dissolved (µg/L)	1.4	ANZG 2018
Chromium - dissolved (µg/L)	1	ANZG 2018
Copper - dissolved (µg/L)	1.4	ANZG 2018
Iron - dissolved (µg/L)	300	
Lead - dissolved (µg/L)	3.4	ANZG 2018
Manganese - dissolved (µg/L)	1,900	ANZG 2018
Mercury (inorganic) - dissolved (µg/L)	0.06	ANZG 2018
Molybdenum - dissolved (µg/L)	34	ANZG 2018
Nickel - dissolved (µg/L)	11	ANZG 2018
Selenium - dissolved (µg/L)	10	ANZG 2018

Silver - dissolved (µg/L)	0.05	ANZG 2018
Uranium - dissolved (µg/L)	0.5	ANZG 2018
Vanadium - dissolved (µg/L)	6	ANZG 2018
Zinc - dissolved (µg/L)	8	ANZG 2018
Nitrate (µg/L)	1100	
Total recoverable hydrocarbons (C6-C9) (µg/L)	20	
Total recoverable hydrocarbons (C10-C36) (µg/L)	100	
Major ions (mg/L) Calcium, chloride, potassium, magnesium, sodium, bicarbonate, carbonate	For interpretation purposes only	
Hardness (mg/L)	For interpretation purposes only	

Notes:

- All metals and metalloids must be measured as 'dissolved' (from analysis of a field filtered sample) and total (unfiltered).
- Limits for metals and metalloids apply to dissolved results.
- Upper Isaac River catchment water WQOs
- ANZG (2018) Aquatic ecosystem protection for moderately disturbed system (95% protection). https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/search

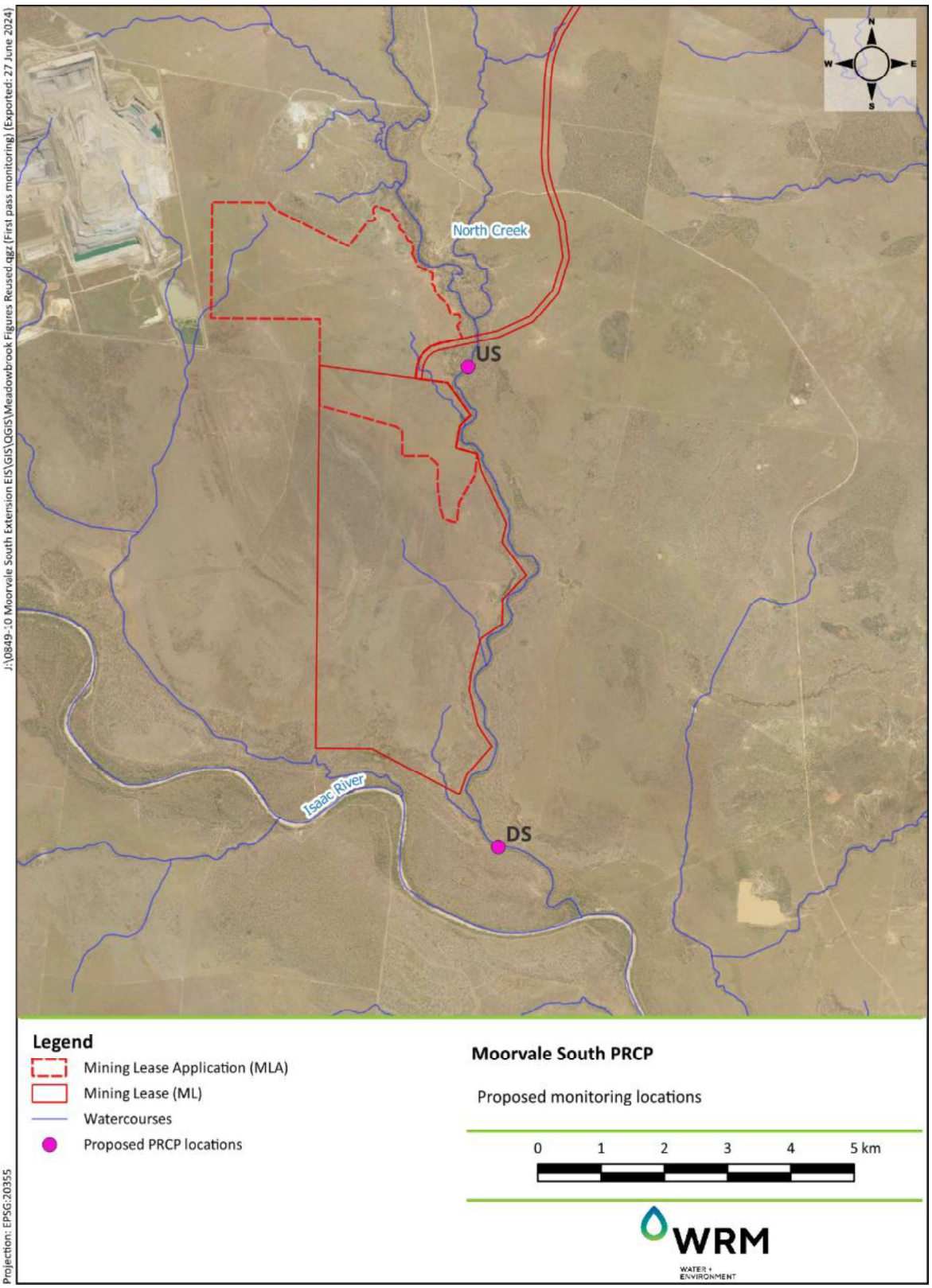


Figure 18: Proposed closure surface water monitoring locations

7.5 Groundwater monitoring

Groundwater monitoring and sampling will be conducted by an appropriately qualified person in accordance with the Groundwater Quality Assessment Guideline (DES 2021). Monitoring and sampling will also be undertaken in accordance with the Queensland Monitoring and Sampling Manual 2009 (DES 2018), or subsequent updated versions, *the Australian/New Zealand Standard (AS/NZS) 5667.11:1998 for Water Quality – Sampling Part 11 Guidance on sampling of groundwaters.*

7.5.1 Monitoring network

The closure groundwater monitoring network is established on the basis of the following key objectives:

1) Spatial coverage of all relevant aquifer units in the vicinity of the residual voids, such that any post-mining impacts to the groundwater system outside the final landform would be detected.

2) Provide for validation of model predictions for groundwater level changes post-mining, both generally within the groundwater system and at key potential environmental receptors.

3) Provide for validation of the results of this assessment that indicate no potential for release of contaminants to the groundwater environment.

The locations and details of the proposed monitoring bore network is shown in Table 29 and Figure 19.

Table 29: Proposed closure groundwater monitoring locations

Bore ID	Easting (GDA94)	Northing (GDA94)	Monitored unit
MS0128	639750	7551426	Leichhardt Seam
MS0135	640000	7551811	Alluvium
MS0163	639944	7551802	Vermont Upper Seam
MS0117	640310	7554734	Alluvium
MS0129	638921	7550183	Alluvium
MS0113	640089	7557236	Regolith / Rangal Overburden
MS0125	639451	7554580	Fort Cooper Coal Measures - Coal
MS0162	638599	7553465	Fort Cooper Coal Measures - Coal
MVSX2A	639820	7555922	Weathered Tertiary sediments
MVSX2P	639816	7555922	Leichhardt Seam
MVSX4P	640084	7557254	Leichhardt Seam
MVSX6P	638296	7556095	Fort Cooper Coal Measures

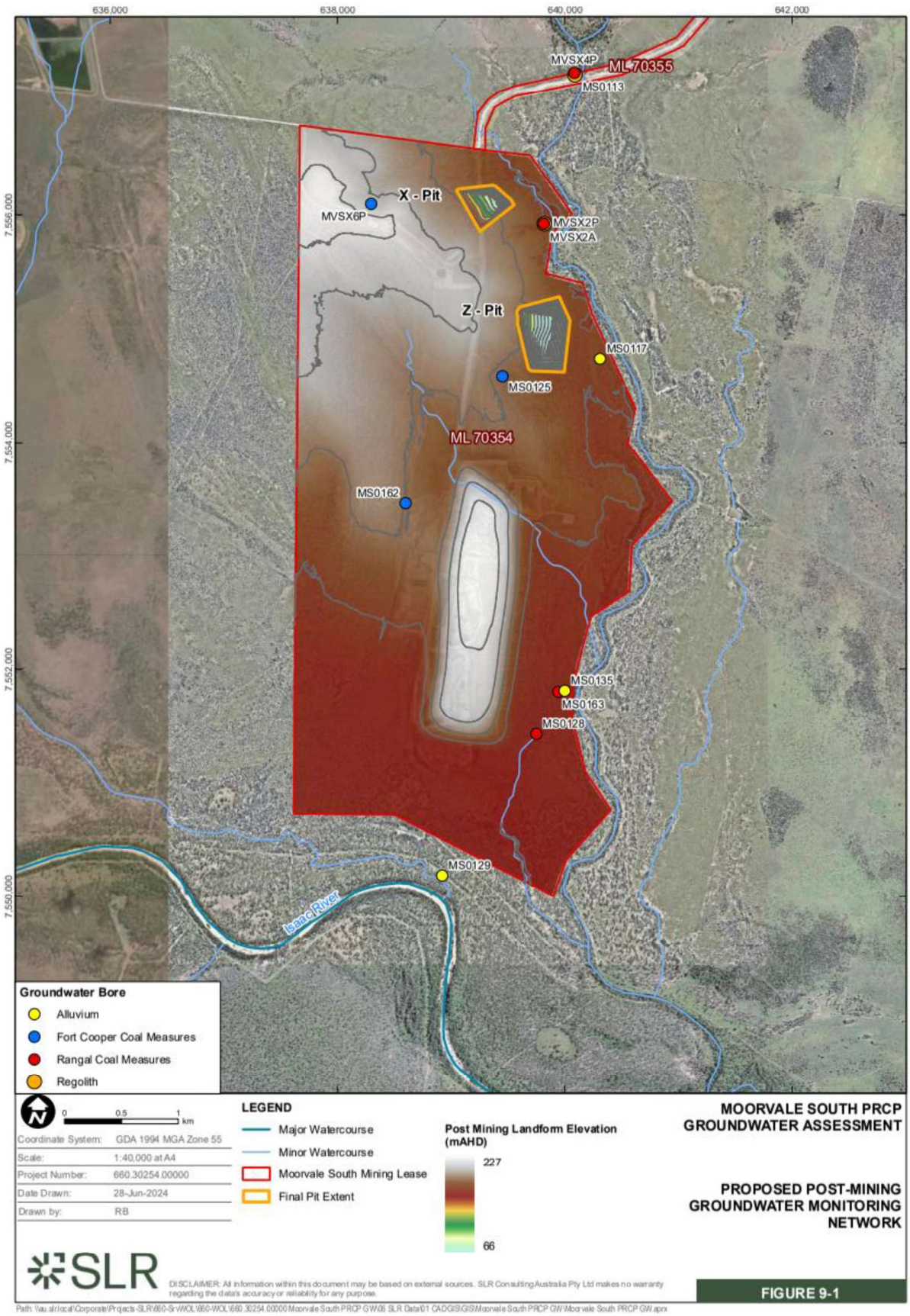


Figure 19: Proposed closure groundwater monitoring locations

7.5.2 Groundwater quality criteria

Groundwater quality criteria have been selected based on the mining-related CoCs identified in the RGS (2023) geochemical assessment's recommended post-mining water quality monitoring regime for the Project, and with respect to relevant Isaac River Sub-basin EV protection criteria (SLR 2024). The parameters that will be monitored are:

- General water quality indicators;
  - Electrical Conductivity (EC);
  - pH;
- Major Ions;
  - Calcium (Ca);
  - Magnesium (Mg);
  - Potassium (K);
  - Sodium (Na);
  - Sulfate (SO_4);
  - Chloride (Cl);
- Dissolved Metals and Metalloids;
  - Aluminium (Al);
  - Cadmium (Cd);
  - Copper (Cu);
  - Nickel (Ni);
  - Lead (Pb);
  - Zinc (Zn); and
  - Selenium (Se).

Impact triggers for closure groundwater quality will be established using the methodologies outlined in DES (2021), and incorporating site-specific (bore-specific) trigger derivation to take into account existing groundwater quality at each bore, once a sufficient quantum of data is available in accordance with the minimum data requirements stipulated by DES (2021). In the absence of sufficient monitoring data to derive bore-specific triggers at the present time in accordance with the methodologies prescribed by DES (2021), interim triggers have been developed based on Isaac River Sub-basin EV protection criteria relevant to groundwater (SLR 2024. Interim groundwater quality triggers is provided in Table 30. The approach to derive the interim groundwater quality triggers is to select the lowest EV guideline value (WQO) that is above the existing range of groundwater quality monitoring data for each individual bore proposed for the closure monitoring network.

Groundwater quality results must not exceed the trigger limits for three (3) consecutive results.

Table 30: Groundwater quality trigger limits

Quality characteristics (units)	Monitoring Bore	Limit
pH	All bores	6.5-8.5
Electrical Conductivity (µS/cm)	All bores	
Sulphate (mg/L)	All bores	25
Fluoride (mg/L)	All bores	1.7

Quality characteristics (units)	Monitoring Bore	Limit
Aluminium - dissolved (µg/L)	All bores	55
Arsenic - dissolved (µg/L)	All bores	13
Boron – dissolved (µg/L)	All bores	370
Cadmium - dissolved (µg/L)	All bores	0.2
Cobalt - dissolved (µg/L)	All bores	1.4
Chromium - dissolved (µg/L)	All bores	1
Copper - dissolved (µg/L)	All bores	1.4
Iron - dissolved (µg/L)	All bores	300
Lead - dissolved (µg/L)	All bores	3.4
Manganese - dissolved (µg/L)	All bores	1,900
Mercury (inorganic) - dissolved (µg/L)	All bores	0.06
Molybdenum - dissolved (µg/L)	All bores	34
Nickel - dissolved (µg/L)	All bores	11
Selenium - dissolved (µg/L)	All bores	10
Silver - dissolved (µg/L)	All bores	0.05
Uranium - dissolved (µg/L)	All bores	0.5
Vanadium - dissolved (µg/L)	All bores	6
Zinc - dissolved (µg/L)	All bores	8
Nitrate (µg/L)	All bores	1100
Major ions (mg/L) Calcium, chloride, potassium, magnesium, sodium, bicarbonate, carbonate	All bores	For interpretation purposes only
Hardness (mg/L)	All bores	For interpretation purposes only
Water Level (mAHD)	All bores	For interpretation purposes only

Notes:

- All metals and metalloids must be measured as 'dissolved' (from analysis of a field filtered sample) and total (unfiltered).
- Limits for metals and metalloids apply to dissolved results.

1. DEHP (2011) Isaac River Sub Basin WQO – surface water
2. ANZG (2018) Aquatic ecosystem protection for moderately disturbed system (95% protection). https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/search

7.5.3 Monitoring frequency

Prior to the establishment of the final landform, groundwater monitoring will be undertaken in accordance with operational groundwater monitoring requirements specified within the EA.

The proposed schedule for rehabilitation groundwater monitoring after the completion of final landform establishment and surface preparation (i.e. post-mining and completion of landform construction and topsoiling) is biannually for a minimum period of 5 years (final milestone, RM7).

After 5 years of rehabilitation monitoring, a review is to be undertaken to determine if there is a requirement for additional monitoring, or if post-mining groundwater system behaviour is sufficiently consistent with model predictions of minimal potential for groundwater environmental impact such that monitoring can be discontinued.

7.6 Hazard and safety monitoring

Hazard and safety risk assessment will be undertaken after achievement of surface requirements to consider the residual risk at a future point in time. The risk assessment will involve a visual inspection of rehabilitation areas to identify remaining hazards or safety concerns and evaluation of likelihood and consequence of rehabilitation failing in the future. If significant residual risks are identified, further remedial rehabilitation works and monitoring will be undertaken, and the PRCP risk assessment updated for submission to the assessing authority.

7.7 Sampling intensity

The sampling intensity proposed for the rehabilitation monitoring program takes into account:

- practicality and cost-effectiveness of monitoring techniques;
- separation of pit locations and therefore rehabilitated land which will allow for progressive certification or partial relinquishment opportunities;
- the need to capture different final landforms and disturbance types (e.g. elevation, out-of-pit overburden dumps, MIA) and end land uses;
- sampling in appropriate seasons to best capture all desired components, e.g the presence of annual species that germinate in response to summer rainfall events; and
- the need for broadscale monitoring, ensuring overall site rehabilitation performance is measured.

7.8 Maintenance

Maintenance activities will be undertaken as required. Detailed records of rehabilitation maintenance activities and the cost of carrying out such works will be compiled and maintained. These records may be used to refine the rehabilitation methodologies adopted at the site and provide accurate tracking of the cost of any rework.

Scheduled inspections will be undertaken to check that fencing, firebreaks, sediment dams, bunds, signage and any other related features are fit for purpose and maintained in good order. Where rehabilitation monitoring and / or routine site inspections determine that rehabilitated areas are impacted by a particular issue, maintenance works will be undertaken.

Table 31 provides indicative maintenance issues and treatments that would be undertaken.

Table 31: Indicative Maintenance issues and treatments

Issue	Maintenance treatment
Gully erosion	Review landform drainage/run on and modify as required. Fill gully and apply appropriate surface protection/armouring.
Erosion control device failure	Review design specifications and repair.

Issue	Maintenance treatment
Sedimentation	Where deemed necessary, excavate sediment built up and repair/reinstate structure.
Poor vegetation cover	Adjust fertiliser/soil ameliorant inputs and re-seed during appropriate seasonal conditions. If issue persists, conduct additional soil sampling and seek input from an appropriately qualified person.
Vegetation community developing inconsistent with PMLU	Review rehabilitation strategy and planting lists. Conduct a risk assessment for PMLU not being achieved and develop and implement a treatment response.

7.9 Identification of actual or emerging issues

The scope for rehabilitation monitoring includes provision to record actual or emerging issues and make recommendations on potential improvements to the rehabilitation process. This may include refinement to the species mix used in the rehabilitation process, recommendations for soil amelioration, weed control or pest management. The report may also make recommendations on potential improvements to the monitoring program. This may include adoption of emerging technologies.

7.10 Scheduled and event-based inspections

Field inspections may be undertaken in response to events that have the potential to adversely impact rehabilitation. This may include intense rainfall events occurring prior to establishment of a dense vegetation cover or impacts arising from the uncontrolled spread of fire within RAs.

7.11 Use of data to evaluate rehabilitation trends / trajectory

Data obtained from the rehabilitation monitoring program will be utilised to verify whether areas of rehabilitation are developing towards the desired targets described within the site's rehabilitation completion criteria. Where the desired trends are not observed, intervention via implementation of remedial actions may be required.

7.12 Reporting and identification of management requirements

The results of the monitoring program are analysed and as a minimum, the following documented in monitoring reports:

- trends in the vegetation and soil data (i.e. how rehabilitation is developing against expected growth patterns, trends towards reference communities, soil properties) including identification of any emerging issues that may compromise rehabilitation success;
- an appraisal of each monitoring location's alignment with the PMLU and associated vegetation communities;
- recommendations on potential improvements to rehabilitation practices;
- recommendations on improvements to the rehabilitation monitoring methodology; and
- recommendations for managing erosion and weeds.

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Appendix A. PRCP Schedule and stage plans

Post-mining land uses (PMLU)													
Rehabilitation area	RA1												
Relevant activities	Mine Infrastructure												
Total rehabilitation area size (ha)	129												
Commencement of first milestone: RM1	10/12/2028												
PMLU	Light Cattle Grazing												
Date area is available	10/12/28	10/12/31	10/12/32	10/12/33	10/12/34	10/12/35	10/12/36	10/12/37	10/12/38	10/12/39			
Cumulative area available (ha)	10	20	30	40	50	60	90	100	110	129			
Milestone completed by	10/12/2030	10/12/2033	10/12/36	10/12/39	10/12/42	10/12/45	10/12/48	10/12/51	10/12/54	10/12/57	10/12/60	10/12/63	10/12/66
Milestone Reference	**Cumulative area achieved (ha)**												
RM1	10	20	50	100	129								
RM2		10	30	60	110	129							
RM3			10	40	90	129							
RM4				30	50	100	129						
RM5							20	30	60	110	129		
RM6								20	40	90	129		
RM7									10	20	50	100	129

Post-mining land uses (PMLU)														
Rehabilitation area	RA2													
Relevant activities	Elevated Landform													
Total rehabilitation area size (ha)	181													
Commencement of first milestone: RM3	10/12/2026													
PMLU	Light Cattle Grazing													
Date area is available	10/12/25	10/12/26	10/12/27	10/12/28	10/12/29	10/12/30	10/12/31	10/12/35	10/12/36					
Cumulative area available (ha)	48	63	80	96	110	124	138	159	181					
Milestone completed by	10/12/2028	10/12/2031	10/12/2034	10/12/37	10/12/40	10/12/43	10/12/46	10/12/49	10/12/52	10/12/55	10/12/58	10/12/61		
Milestone Reference	**Cumulative area achieved (ha)**													
RM3	48	96	138	138	181									
RM4		48	96	138	138	181								
RM5					27	80	124	138	181					
RM6						48	96	138	138	181				
RM7								63	110	138	159	181		

Post-mining land uses (PMLU)														
Rehabilitation area	RA3													
Relevant activities	Out-of-Pit Overburden Dump													
Total rehabilitation area size (ha)	59													
Commencement of first milestone: RM3	10/12/2026													
PMLU	Light Cattle Grazing													
Date area is available	10/12/25	10/12/26	10/12/35											
Cumulative area available (ha)	4	7	59											
Milestone completed by	10/12/2028	10/12/2031	10/12/2034	10/12/37	10/12/40	10/12/43	10/12/46	10/12/49	10/12/52	10/12/55	10/12/58			
Milestone Reference	**Cumulative area achieved (ha)**													
RM3	4	7	7	7	59									
RM4		4	7	7	7	59								
RM5						7	7	7	59					
RM6						4	7	7	59					
RM7								7	7	7	59			

Post-mining land uses (PMLU)													
Rehabilitation area	RA4												
Relevant activities	In-pit Overburden Dump												
Total rehabilitation area size (ha)	152												
Commencement of first milestone: RM3	10/12/2027												
PMLU	Light Cattle Grazing												
Date area is available	10/12/27	10/12/28	10/12/29	10/12/30	10/12/31	10/12/35	10/12/36	10/12/37	10/12/38	10/12/39			
Cumulative area available (ha)	10	19	29	39	52	72	92	112	132	152			
Milestone completed by	10/12/2030	10/12/2033	10/12/36	10/12/39	10/12/42	10/12/45	10/12/48	10/12/51	10/12/54	10/12/57	10/12/60	10/12/63	10/12/66
Milestone Reference	**Cumulative area achieved (ha)**												
RM3	19	52	52	112	152								
RM4		19	52	52	112	152							
RM5					10	39	52	92	152				
RM6						19	52	52	112	152			
RM7								29	52	72	132	152	

Post-mining land uses (PMLU)														
Rehabilitation area	RA5													
Relevant activities	Clean Water Drainage Channel													
Total rehabilitation area size (ha)	14													
Commencement of first milestone: RM1	10/12/2026													
PMLU	Light Cattle Grazing													
Date area is available	12/12/25													
Cumulative area available (ha)	14													
Milestone completed by	10/12/2027	10/12/2030	10/12/2033	10/12/36	10/12/39	10/12/42								
Milestone Reference	**Cumulative area achieved (ha)**													
RM4	14	14	14											
RM5				14										
RM6					14									
RM7						14								

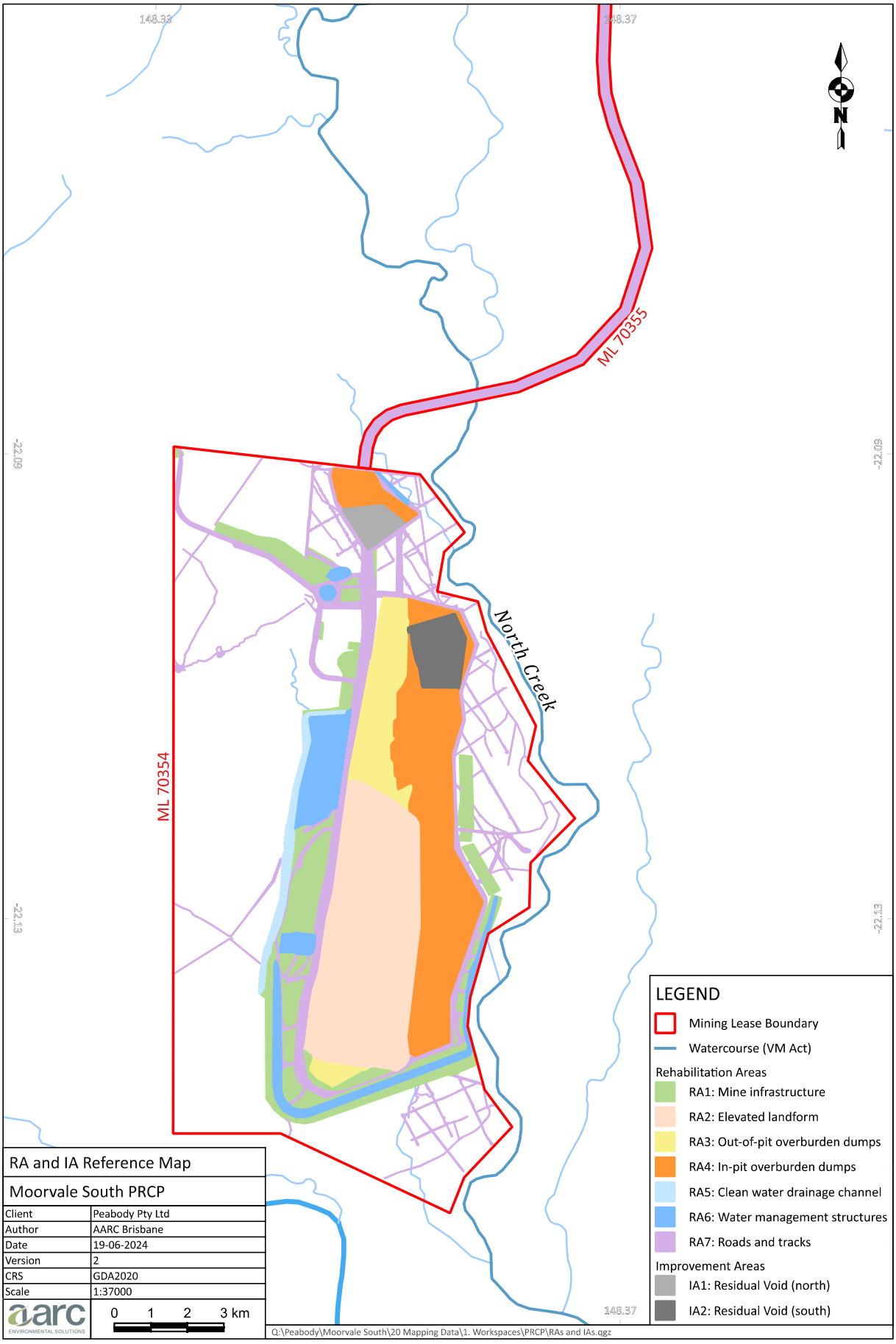
Post-mining land uses (PMLU)										
Rehabilitation area	RA6									
Relevant activities	Water Management Structures									
Total rehabilitation area size (ha)	63									
Commencement of first milestone: RM1	10/12/2036									
PMLU	Light Cattle Grazing									
Date area is available	10/12/36	10/12/37	10/12/38	10/12/39						
Cumulative area available (ha)	15	30	45	63						
Milestone completed by	10/12/39	10/12/42	10/12/45	10/12/48	10/12/51	10/12/54	10/12/57	10/12/60	10/12/63	10/12/66
Milestone Reference	**Cumulative area achieved (ha)**									
RM1	30	63								
RM3		45	63							
RM4			45	63						
RM5						30	63			
RM6							45	63		
RM7								15	63	

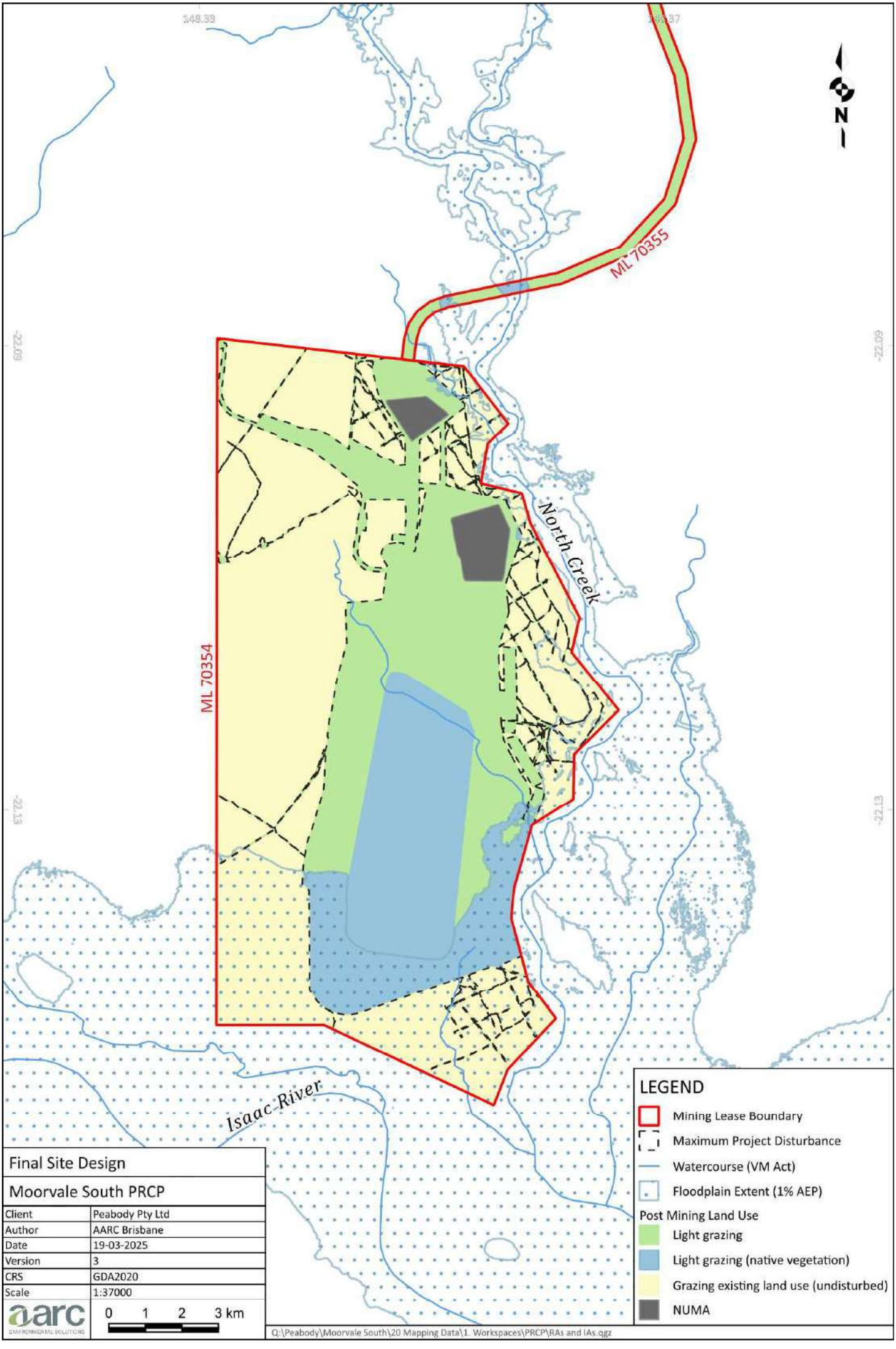
Post-mining land uses (PMLU)														
Rehabilitation area	RA7													
Relevant activities	Roads and Tracks													
Total rehabilitation area size (ha)	220													
Commencement of first milestone: RM1	10/12/2030													
PMLU	Cattle Grazing (ML70355) and Light Cattle Grazing (ML70354)													
Date area is available	10/12/30	10/12/34	10/12/35	10/12/36	10/12/37	10/12/38	10/12/44							
Cumulative area available (ha)	20	30	50	70	90	100	220							
Milestone completed by	10/12/2033	10/12/36	10/12/39	10/12/42	10/12/45	10/12/48	10/12/51	10/12/54	10/12/57	10/12/60	10/12/63	10/12/66	10/12/69	10/12/72
Milestone Reference	**Cumulative area achieved (ha)**													
RM1	20	30	90	100	100	220								
RM2		20	50	100	100	220								
RM3		20	20	70	100	100	220							
RM4			20	20	70	100	100	220						
RM5							20	50	100	100	220			
RM6							20	20	70	100	220			
RM7									20	30	90	100	100	220

Non-use management area (NUMA)												
Improvement area	IA1											
Relevant activities	Residual Void (X Pit)											
Total size (ha)	11											
Commencement of first milestone: MM1	10/12/2032											
NUMA	Final Void											
Date area is available	10/12/32											
Cumulative area available (ha)	11											
Milestone completed by	10/12/41											
Milestone Reference	**Cumulative area achieved (ha)**											
MM1	11											
MM2	11											
MM3	11											

Non-use management area (NUMA)												
Improvement area	IA2											
Relevant activities	Residual Void (Z Pit)											
Total size (ha)	25											
Commencement of first milestone: MM1	10/12/2032											
NUMA	Final Void											
Date area is available	10/12/32											
Cumulative area available (ha)	25											
Milestone completed by	10/12/41											
Milestone Reference	**Cumulative area achieved (ha)**											
MM1	25											
MM2	25											
MM3	25											

Appendix B. PRCP Reference Map and final site design


148.33
148.37
-22.09
-22.13
ML 70355
ML 70354
North Creek
N
LEGEND
Mining Lease Boundary
Watercourse (VM Act)
Rehabilitation Areas
RA1: Mine infrastructure
RA2: Elevated landform
RA3: Out-of-pit overburden dumps
RA4: In-pit overburden dumps
RA5: Clean water drainage channel
RA6: Water management structures
RA7: Roads and tracks
Improvement Areas
IA1: Residual Void (north)
IA2: Residual Void (south)
RA and IA Reference Map
Moorvale South PRCP
Client Peabody Pty Ltd
Author AARC Brisbane
Date 19-06-2024
Version 2
CRS GDA2020
Scale 1:37000
0 1 2 3 km
Q:\Peabody\Moorvale South\20 Mapping Data\1. Workspaces\PRCP\RAs and IAs.qgz



Final Site Design

Moorvale South PRCP

Client	Peabody Pty Ltd
Author	AARC Brisbane
Date	19-03-2025
Version	3
CRS	GDA2020
Scale	1:37000

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Appendix C. Rehabilitation risk assessment

Risk Scenario	Causes	Existing Controls	Impact Area	Likelihood	Consequence	Risk Score	Proposed Controls	Likelihood	Consequence	Residual Risk Score	Responsibility	Resource Requirements	Performance measures and constraints	Reporting and monitoring requirements	Timing and schedule
RM1 - Infrastructure decomissioning and removal															
Infrastructure not adequately decomissioned or removed, and is unsafe for persons.	• Infrastructure is used or interacted with post mining.	• Removal of all infrastructure other than those formally agreed.	Safety	C	3	15	• Undertake final landform survey e.g. LIDAR assessment. • Hazard and safety assessment to demonstrate remaining hazards are consistent with hazards typical of neighbouring equivalent land use. • Remaining unsafe infrastructure removed, based on outcomes of final landform survey and hazard and safety assessment.	B	2	4	Rehabilitation contractor/ Site management	Personnel and machinery to remove infrastructure	Visual monitoring and LIDAR	Visual assessment and Final Landform Survey	When land becomes available/ At completion of infrastructure decommissioning and removal activities
Infrastructure not adequately decomissioned or removed, and is unsafe for stock and wildlife.	• Infrastructure is interacted with post mining.	• Removal of all infrastructure other than those formally agreed.	Environment	C	2	6	• Undertake final landform survey e.g. LIDAR assessment. • Hazard and safety assessment to demonstrate remaining hazards are consistent with hazards typical of neighbouring equivalent land use. • Remaining unsafe infrastructure removed, based on outcomes of final landform survey and hazard and safety assessment.	B	2	4	Rehabilitation contractor/ Site management	Personnel and machinery to remove infrastructure	Visual monitoring and LIDAR	Visual assessment and Final Landform Survey	When land becomes available/ At completion of infrastructure decommissioning and removal activities
Rehabilitation activities cannot progress until removal is complete.	• Ongoing operation of some infrastructure may be required.	• Planning for progressive rehabilitation	PMLU	C	2	6	• Adherence to PRCP Schedule	B	1	2	Rehabilitation contractor/ Site management	Personnel and machinery to remove infrastructure	Visual monitoring and LIDAR	Visual assessment and Final Landform Survey	When land becomes available/ At completion of infrastructure decommissioning and removal activities
RM2 - Management of contaminated land status															
Mobilisation of contaminanted and hazardous materials from buildings/workshop areas and laydown areas to the receiving environment	• Hydrocarbon or heavy metal contamination from operational activities at infrastructure areas	• Procedure in place for identification, assessment and proper disposal of contaminated soil. • Monitor and record incidents through a contaminated site register e.g. hydroarbon or chemical spills. • Appropriate bunding around high risk areas.	Environment	E	3	25	• Appropriate infrastructure management. • Budget allowance and planning for potential contaminated soil disposal/treatment. • Undertake contaminated land assessment and validation testing. • Site investigation and remediation as required.	A	3	5	Rehabilitation contractor/ Site management	Personnel to assess land condition and field testing	Field assessments and laboratory testing	Contaminated land assessment report and validation testing	Single event, prior to landform development
RM3 - Landform development (reshaping and reprofiling)															
Safety hazard for personnel due to surface roughness (rockiness, depressions) in excess of that expected for PMLU	• Inadequate surface preparation • Localised settlement • Erosion gullies	• Surface preparation according to design. • Final landform is consistent with surrounding terrain.	Safety	B	3	10	• Undertake final landform survey e.g. LIDAR assessment. • Hazard and safety assessment to demonstrate remaining hazards are consistent with hazards typical of neighbouring equivalent land use. • Rehabilitation monitoring and assessment, undertake repairs and maintenance as required.	B	2	4	Rehabilitation contractor/ Site management	Personnel to assess surface condition	Rehabilitation and erosion monitoring	Rehabilitaiton monitoring reports	At completion of earthworks and surface reprofiling
Hazard for stock and wildlife due to surface roughness (rockiness, depressions) in excess of that expected for PMLU	• Inadequate surface preparation • Localised settlement • Erosion gullies	• Surface preparation according to design. • Final landform is consistent with surrounding terrain.	Environment	B	2	4	• Undertake final landform survey e.g. LIDAR assessment. • Hazard and safety assessment to demonstrate remaining hazards are consistent with hazards typical of neighbouring equivalent land use. • Rehabilitation monitoring and assessment, undertake repairs and maintenance as required.	B	2	4	Rehabilitation contractor/ Site management	Personnel to assess surface condition	Rehabilitation and erosion monitoring	Rehabilitaiton monitoring reports	At completion of earthworks and surface reprofiling
Safety hazard for personnel due to slope steepness in excess of that expected for the PMLU	• Landform not constructed to design	• Landform development according to design.	Safety	B	3	10	• Dump and slope survey controls. • Reshaping to design.	B	2	4	Rehabilitation contractor/ Site management	Personnel and machinery required to obtain final landform design	Design specifications assessed through site personnel or suitably qualified person (if required)	Internal report, Final lanform survey	At completion of earthworks and surface reprofiling
Hazard for stock and wildlife due to slope steepness in excess of that expected for the PMLU	• Landform not constructed to design	• Landform development according to design.	Environment	B	2	4	• Dump and slope survey controls. • Reshaping to design.	B	2	4	Rehabilitation contractor/ Site management	Personnel and machinery required to obtain final landform design	Design specifications assessed through site personnel or suitably qualified person (if required), LIDAR	Internal report, Final lanform survey	At completion of earthworks and surface reprofiling
Significant slope failure	• Landform not constructed to design • Excessive slope steepness • Unsuitable backfill materials • Inadequate drainage controls • Adverse rainfall event	• Landform design moderating slope. • Geotechnical assessment confirms long-term stability. • Drainage network design with acceptable design standards for drainage structures.	Structural Stability/ Erosion	A	2	2		A	2	2	Rehabilitation contractor/ Site management	Personnel and machinery required to obtain final landform criteria	Performance measured through site personnel or suitably qualified person (if required), LIDAR	Geotechnical stability report	Before the achievement of final stable landform
Excessive gully, pipe and/or sheet erosion of rehabilitated areas	• Erodible topsoils and subsoils • Poor soil cover • Rehabilitation failure/inadequacy • Inadequate drainage controls • Vegetation disease/loss • Adverse weather events • Others	• Slope moderation, max. slopes subject to engineered design. • Drainage network design with acceptable design standards for drainage structures. • Final landform is free-draining. • WEPP modelling indicates erosion rates along slopes are acceptable.	Structural Stability/ Erosion	B	3	10	• Adequate/effective topsoil/subsoil amelioration. • Prompt revegetation establishment. • Adequate rehabilitation monitoring of site conditions and landform profile. • Monitoring of drainage network performance, where applicable, undertake repairs and maintenance as required. • Prompt remediation and causal feedback loop to water management system review.	B	2	4	Site management/Environment Team	Personnel to assess surface condition	Rehabilitation and erosion monitoring	Rehabilitaiton monitoring reports	At 1, 2, 5, 7, 10 and 15 years post establishment of vegetation

RM4 - Surface preparation (topsoil application, soil amelioration, contour ripping) and revegetation (seeding/planting)																
Failure to establish required surface conditions to achieve Light Grazing PMLU	• Insufficient quality/quantity of topsoil resources onsite to complete rehabilitation activities	• Materials balance indicates sufficient material is available onsite.	PMLU	B	2	4		B	2	4	Rehabilitation contractor/ Site management	Personnel to survey stockpile quantity	Material balance estimation	Internal report	Before topsoil placement
	• Loss of topsoil cover during surface preparation • Erosion and increased runoff velocity	• WEPP modelling indicates erosion rates along slopes are acceptable. • Appropriate surface scarification. • Records or soil placement and depth indicating achievement of the target topsoil depth.	PMLU	B	2	4		B	2	4	Rehabilitation contractor/ Site management	Personnel to assess surface condition	Rehabilitation and erosion monitoring	Rehabilitaiton monitoring reports	At completion of earthworks and surface preparation activities, At year 1 and 5 yearly intervals thereafter/ At 1, 2, 5, 7, 10 and 15 years post establishment of vegetation
Poor establishment of required vegetation to achieve Light Grazing PMLU	• Poor soil characteristics and management practices impacting germination and vegetation establishment • Insufficient topsoil resource/ spreading	• Topsoil spread to achieve a minimum depth of 150 mm. • Application of ameliorants and/or fertilised at recommended rates and incorporated into surface, where required as a outcome of soil assessment.	PMLU	C	3	15	• Improving rehabilitation methodologies, management and maintenance activities. • Rehabilitation performance monitoring and assessment. • Undertake repairs and improvement works as required.	B	2	4	Rehabilitation contractor/ Site management	Personnel for soil field testing and to assess surface condition for species density	Soil monitoring/ Rehabilitation monitoring including groundcover percentage and diversity	Internal reports/ Rehabilitaiton monitoring reports	At year 1 and 5 yearly intervals thereafter/ At 1, 2, 5, 7, 10 and 15 years post establishment of vegetation
	• Poor seeding mix • Ineffective seeding rate and/or treatment • Adverse weather events	• Records demonstrate seeding/planting and establishment of target species.	PMLU	C	3	15	• Improving rehabilitation methodologies, management and maintenance activities. • Rehabilitation performance monitoring and assessment. • Undertake repairs and improvement works as required.	B	2	4	Rehabilitation contractor/ Site management	Personnel to assess surface condition for groundcover establishment	Rehabilitation monitoring including groundcover establishment	Written records/Rehabilitaiton monitoring reports	At completion of seeding
	• Presence of pest and noxious weeds, competing with native vegetation • Poor local, regional or site property management practices causing abundance of pest and noxious weeds.	• Pest and noxious weed management practices. • Monitoring programs to allow early detection and management. • Intensify monitoring and management measures as appropriate.	PMLU	B	2	4		B	2	4	All site personnel/ Rehabilitation contractor/ Site management	Personnel to assess surface condition for weeds and pests	Rehabilitation monitoring including percentage weed cover	Written records/Rehabilitaiton monitoring reports	At 1, 2, 5, 7, 10 and 15 years post establishment of vegetation
RM5 - Achievement of surface requirements for Light Grazing PMLU (MIA, overburden dumps and water management infrastructure)																
Excessive gully, pipe and/or sheet erosion of rehabilitated areas	• Inadequate groundcover/ vegetation establishment for surface stabilisation • Erodible topsoils and subsoils • Poor soil cover • Rehabilitation failure/inadequacy • Inadequate drainage controls • Vegetation disease/loss • Adverse weather events • Others	• Groundcover is statistically comparable to reference sites with similar landform parameters. • No records of active erosion gullies from rehabilitation monitoring data. • WEPP modelling indicates erosion rates along slopes are acceptable.	Structural Stability/ Erosion	C	3	15	• Adequate/effective topsoil/subsoil amelioration. • Prompt revegetation establishment. • Adequate rehabilitation monitoring of site conditions and landform profile. • Monitoring of drainage network performance, where applicable, undertake repairs and maintenance as required. • Prompt remediation and causal feedback loop to water management system review.	B	2	4	Rehabilitation contractor/ Site management	Personnel to assess surface condition	Rehabilitation and erosion monitoring	Rehabilitaiton monitoring reports	At 1, 2, 5, 7, 10 and 15 years post establishment of vegetation
Inadequate species density/diversity of vegetation for Light Grazing PMLU	• Adverse weather events • Poor soil characteristics and management practices impacting PMLU density/diversity metrics • Insufficient topsoil resource/spreading	• Evidence of species recruitment diversity and density is consistent with specified seed mix in PRCP.	PMLU	C	3	15	• Improving rehabilitation methodologies, management and maintenance activities. • Rehabilitation performance monitoring and assessment. • Undertake repairs and improvement works as required.	C	2	6	Rehabilitation contractor/ Site management	Personnel to assess surface condition for species density/diversity	Rehabilitation monitoring including groundcover establishment	Rehabilitaiton monitoring reports	At 1, 2, 5, 7, 10 and 15 years post establishment of vegetation
	• Presence of pest and noxious weeds, competing with native vegetation • Poor local, regional or site property management practices causing abundance of pest and noxious weeds.	• Pest and noxious weed management practices. • Monitoring programs to allow early detection and management. • Intensify monitoring and management measures as appropriate.	PMLU	C	2	6		C	2	6	All site personnel/ Rehabilitation contractor/ Site management	Personnel to assess surface condition for weeds and pests	Rehabilitation monitoring including percentage weed cover	Rehabilitaiton monitoring reports	At 1, 2, 5, 7, 10 and 15 years post establishment of vegetation
RM6 - Achievement of Light Grazing PMLU to stable condition																
Infrastructure not adequately decomissioned or removed, and is unsafe for stock and wildlife.	• Infrastructure is interacted with post mining.	• Removal of all infrastructure other than those formally agreed.	Environment	C	2	6	• Undertake final landform survey e.g. LIDAR assessment. • Hazard and safety assessment to demonstrate remaining hazards are consistent with hazards typical of neighbouring equivalent land use. • Remaining unsafe infrastructure removed, based on outcomes of final landform survey and hazard and safety assessment.	B	2	4	Rehabilitation contractor/ Site management	Personnel and machinery to remove infrastructure	Visual monitoring and LIDAR	Visual assessment and Final Landform Survey	Prior to completion of milestone
Excessive gully, pipe and/or sheet erosion of rehabilitated areas	• Inadequate groundcover/ vegetation establishment for surface stabilisation • Erodible topsoils and subsoils • Poor soil cover • Rehabilitation failure/inadequacy • Inadequate drainage controls • Vegetation disease/loss • Adverse weather events • Others	• Groundcover is statistically comparable to reference sites with similar landform parameters. • No records of active erosion gullies from rehabilitation monitoring data. • WEPP modelling indicates erosion rates along slopes are acceptable.	Structural Stability/ Erosion	C	3	15	• Adequate/effective topsoil/subsoil amelioration. • Prompt revegetation establishment. • Adequate rehabilitation monitoring of site conditions and landform profile. • Monitoring of drainage network performance, where applicable, undertake repairs and maintenance as required. • Prompt remediation and causal feedback loop to water management system review.	B	2	4	Rehabilitation contractor/ Site management	Personnel to assess surface condition	Rehabilitation and erosion monitoring	Rehabilitaiton monitoring reports	At 1, 2, 5, 7, 10 and 15 years post establishment of vegetation

Excessive gully, pipe and/or sheet erosion of rehabilitated areas **(medium-long term risk)**	• Inadequate groundcover/ vegetation establishment for surface stabilisation • Erodible topsoils and subsoils • Poor soil cover • Rehabilitation failure/inadequacy • Inadequate drainage controls • Vegetation disease/loss • Adverse weather events • Others	• Drainage network design with acceptable design standards for drainage structures and engineered flow channels. • Groundcover is statistically comparable to reference sites with similar landform parameters. • No records of active erosion gullies from rehabilitation monitoring data.	Structural Stability/ Erosion	C	3	15	• Monitoring of drainage network performance, where applicable, undertake repairs and maintenance as required. • Prompt remediation and causal feedback loop to water management system review.	B	2	4	Rehabilitation contractor/ Site management	Personnel to assess surface condition including drainange network performance	Rehabilitation and erosion monitoring	Rehabilitaiton monitoring reports/ internal report	At 1, 2, 5, 7, 10 and 15 years post establishment of vegetation
Landform is unsuitable to sustain a Light Grazing PMLU	• Unfavourable soil and land characteristics • Landform not constructed to design • Excessive slope steepness	• Appropriate surface preparation e.g. topsoil spreading to adquate depth and scarification. • Landform development according to design.	PMLU	B	3	10	• Adequate/effective topsoil/subsoil amelioration, where required. • Adequate rehabilitation monitoring of site conditions and landform profile. • Land suitability assessment indicates land has achieved a minimum land suitability class of 4.	B	2	4	Rehabilitation contractor/ Site management	Personnel to assess land condition and field testing	Field assessments and laboratory testing	Land suitability assessment report/ Rehabilitation monitoring report	Prior to completion of milestone
Acid and saline drainage generation impacts revegetation performace, downstream receiving environment water quality and dependant ecosystems	• Adverse waste rock geochemistry	• Confirmed NAF materials and low risk of saline drainage.	Environment	B	2	4		B	2	4	Site management	Personnel for material characterisation and field testing	Geochemical reports and characterisation	Geochemical assessment report	As required
RM7 - Surface water and groundwater demonstrate non-polluting landform																
Downstream water quality impacts due to transport of sediments, as a result of excessive gully, pipe and/or sheet erosion of rehabilitated areas	• Land gradient and slope length • Erodible topsoils and subsoils • Adverse weather events	• Slope moderation, max. slopes subject to engineered design. • Drainage network design with acceptable design standards for drainage structures. • Final landform is free-draining. • WEPP modelling indicates erosion rates along slopes are acceptable. • The final landform will be primarily designed to drain mine affected water towards the pit.	Environment	B	3	10	• Monitoring of receiving water quality to specified limits and reference sites. • Adequate/effective topsoil/subsoil amelioration. • Prompt revegetation establishment. • Adequate rehabilitation monitoring of site conditions and landform profile.	A	3	5	Rehabilitation contractor/ Site management	Personnel and equipment to assess downstream water quality and field testing	Post-closure surface water and groundwater monitoring monitoring/ erosion monitoring	Post-closure surface water and groundwater monitoring report/ Rehabilitation monitoring report	Monthly during flow for surface water and biannually for groundwater for a minimum of 5 consecutive years after the achievement of final stable landform
Downstream water quality impacts due to transport of sediments, as a result of excessive gully, pipe and/or sheet erosion of rehabilitated areas **(medium-long term risk)**	• Inadequate groundcover/ vegetation establishment for surface stabilisation • Erodible topsoils and subsoils • Poor soil cover • Rehabilitation failure/inadequacy • Inadequate drainage controls • Vegetation disease/loss • Adverse weather events • Others	• Drainage network design with acceptable design standards for drainage structures and engineered flow channels. • Groundcover is statistically comparable to reference sites with similar landform parameters. • No records of active erosion gullies from rehabilitation monitoring data. • The final landform will be primarily designed to drain mine affected water towards the pit.	Environment	B	3	10	• Monitoring of receiving water quality to specified limits and reference sites. • Adequate/effective topsoil/subsoil amelioration. • Prompt revegetation establishment. • Adequate rehabilitation monitoring of site conditions and landform profile.	A	3	5	Rehabilitation contractor/ Site management	Personnel and equipment to assess downstream water quality and field testing	Post-closure surface water and groundwater monitoring/ erosion monitoring	Post-closure surface water and groundwater monitoring report/ Rehabilitation monitoring report	Monthly during flow for surface water and biannually for groundwater for a minimum of 5 consecutive years after the achievement of final stable landform
Downstream water quality impacts, as a result of significant slope failure	• Landform not constructed to design • Excessive slope steepness • Unsuitable soil materials e.g. materials properties • Inadequate drainage controls • Adverse rainfall event	• Slope moderation, max. slopes subject to engineered design. • Geotechnical assessment confirms long-term stability.	Environment	A	3	5	• Monitoring of receiving water quality to specified limits and reference sites. • Adequate/effective topsoil/subsoil amelioration. • Prompt revegetation establishment. • Adequate rehabilitation monitoring of site conditions and landform profile.	A	3	5	Rehabilitation contractor/ Site management	Personnel and equipment to assess downstream water quality and field testing	Post-closure surface water and groundwater monitoring/ erosion monitoring	Post-closure surface water and groundwater monitoring report/ Rehabilitation monitoring report	Monthly during flow for surface water and biannually for groundwater for a minimum of 5 consecutive years after the achievement of final stable landform
END OF RECORD																

Risk Scenario	Causes	Existing Controls	Impact Area	Likelihood	Consequence	Risk Score	Proposed Controls	Likelihood	Consequence	Residual Risk Score	Responsibility	Resource Requirements	Performance measures and constraints	Reporting and monitoring requirements	Timing and schedule
MM1 - Achievement of final landform design															
Final void high walls and low walls subject to significant slope failure	• Excessive slopes • Inadequate design • Inadequate drainage controls • Adverse weather event	• Void constructed to design criteria. • Void designed to achieve a FoS >1.5 for the highwalls.	Safety	C	4	30	• Slope moderation. • Engineered final landform design. • Assessment of construction materials by a appropriately qualified person. • Provision of adequate drainage infrastructure. • Geotechnical assessment undertaken at closure. Certification by an appropriately qualified expert that the final landform is stable and constructed according to design criteria.	B	3	10	Rehabilitation contractor/ Site management	Personnel and machinery required to obtain final landform criteria	Final geotechnical assessment to validate landform stability	Geotechnical stability report	At completion of landform development activities, before the achievement of final stable landform
Gully erosion on void walls	• Faults and fractures in the underlying geology • Adverse weather events	• Landform design in accordance with geotechnical assessment of the site. • Monitoring and management as required.	Structural Stability/ Erosion	C	2	6		C	2	6	Site management/ Environment Team	Personnel and machinery required to obtain final landform design	Visual monitoring and LIDAR	Visual assessment and Final Landform Survey	Before the achievement of final stable landform
	• Inadequate design • Erodible topsoil and subsoils	• Landform including highwalls (FoS > 1.5) and site drainage network to be constructed as designed. • Monitoring of drainage network performance, prompt remediation. • Certification by an appropriately qualified person that the final landform is stable and constructed according to design criteria.	Structural Stability/ Erosion	C	2	6		C	2	6	Site management/ Environment Team	Personnel and machinery required to obtain final landform design	Design specifications assessed through site personnel or suitably qualified person (if required)	Internal report, Final lanform survey	Before the achievement of final stable landform
	• Unsuitable material used on low wall slopes subject to submersion	• Final void walls constructed as per design criteria. • Closure low wall slopes will be lowered to overall angle of 22 degrees	Structural Stability/ Erosion	C	2	6		C	2	6	Site management/ Environment Team	Personnel and machinery required to obtain final landform design	Design specifications assessed through site personnel or suitably qualified person (if required)	Internal report, Final lanform survey	Before the achievement of final stable landform
MM2 - Achievement of surface and safety requirements															
Safety hazard for personnel, including falls, slips, trips impacting humans having access to the final void	• Insufficient warnings/ barriers preventing access to hazardous areas • Faulty fencing/bunding • Unauthorised access	• Safety infrastructure established around void (bunding and signage).	Safety	C	4	30	• Slope moderation. • Conduct a risk assessment of controls when designed and placed and modify as required. • Post closure monitoring.	C	2	6	Site management/ Environment Team	Personnel to install bunding, fencing and safety warning signage	Routine visual inspection of perimetrical signage and physical barriers	Internal report	Once barriers and signage have been established, As required
Safety hazard for stock and wildlife, including falls, slips, trips impacting livestock and wildlife having access to the final void. Livestock and wildlife accessing void water for drinking.	• Insufficient warnings/ barriers preventing access to hazardous areas • Faulty fencing/bunding • Unauthorised access	• Safety infrastructure established around void (bunding and signage).	Environment	C	2	6	• Slope moderation • Conduct a risk assessment of controls when designed and placed and modify as required • Post closure monitoring.	C	2	6	Site management/ Environment Team	Personnel to install bunding, fencing and safety warning signage	Routine visual inspection of perimetrical signage and physical barriers	Internal report	Once barriers and signage have been established, As required
MM3 - Achievement of sufficient improvement															
Safety hazard for personnel due to void overtopping	• Extreme rainfall events beyond design capacity • Climate change influencing evaporation and rainfall rates • Excess groundwater accumulation • Insufficient water level monitoring	• Void constructed to design criteria. • Storage curve indicate there is sufficient capacity in final voids. • Predictive modelling confirming voids remain as groundwater sinks.	Safety	B	3	10	• Certification of groundwater sink by appropriately qualitified person that the final void is safe to humans and lifestock.	A	2	2	Rehabilitation contractor/ Site management	Monitoring personel/ climate data	Monitoring of climatic conditions and groundwater inflows to voids	Internal void water level reports	As required
Safety hazard for stock and wildlife due to void overtopping	• Extreme rainfall events beyond design capacity • Climate change influencing evaporation and rainfall rates • Excess groundwater accumulation • Insufficient water level monitoring	• Void constructed to design criteria. • Storage curve indicate there is sufficient capacity in final voids. • Predictive modelling confirming voids remain as groundwater sinks.	Environment	B	2	4	• Certification of groundwater sink by appropriately qualitified person that the final void is safe to humans and lifestock.	A	2	2	Rehabilitation contractor/ Site management	Monitoring personel/ climate data	Monitoring of climatic conditions and groundwater inflows to voids	Internal void water level reports	As required
Release of contaminants contained within the void to receiving environment due to void overtopping	• Extreme rainfall events beyond design capacity • Climate change influencing evaporation and rainfall rates • Excess groundwater accumulation • Insufficient water level monitoring	• Void constructed to design criteria. • Storage curve indicate there is sufficient capacity in final voids. • Predictive modelling confirming voids remain as groundwater sinks.	Environment	B	3	10	• Certification of groundwater sink by appropriately qualitified person that the final void is safe to humans and lifestock.	A	2	2	Rehabilitation contractor/ Site management	Monitoring personel/ climate data	Monitoring of climatic conditions and groundwater inflows to voids	Internal void water level reports	As required

Pit water quality impacts as a result of gully erosion on void walls	• Faults and fractures in the underlaying geology • Adverse weather events	• Landform design in accordance with geotechnical assessment of the site. • Monitoring and management as required.	Environment	B	3	10	• Certification of groundwater sink by appropriately qualitified person that the final void is safe to humans and lifestock.	B	2	4	Site management/ Environment Team	Personnel and machinery required to obtain final landform design	Visual monitoring and LIDAR	Visual assessment and Final Landform Survey, internal groundwater level reports	Before the achievement of final stable landform
	• Inadequate design • Erodible topsoil and subsoils	• Landform including highwalls (FoS > 1.5) and site drainage network to be constructed as designed. • Monitoring of drainage network performance, prompt remediation. • Certification by an appropriately qualified person that the final landform is stable and constructed according to design criteria.	Environment	B	3	10	• Certification of groundwater sink by appropriately qualitified person that the final void is safe to humans and lifestock.	B	2	4	Site management/ Environment Team	Personnel and machinery required to obtain final landform design	Design specifications assessed through site personnel or suitably qualified person (if required)	Internal report, Final lanform survey, void water level reports	Before the achievement of final stable landform
	• Unsuitable material used on low wall slopes subject to submersion	• Final void walls constructed as per design criteria.	Environment	B	3	10	• Closure low wall slopes will be lowered to a long-term stable overall angle of 22 degrees	B	2	4	Rehabilitation contractor/ Site management	Personnel and machinery required to obtain final landform criteria	Final geotechnical assessment to validate landform stability	Geotechnical stability report	At completion of landform development activities, before the achievement of final stable landform
END OF RECORD																

Appendix D. Provided technical studies

- SLR 2024, *Moorvale South PRCP – Groundwater Assessment*, SLR Consulting Australia Pty Ltd, Brisbane, 29 July 2024, report prepared for Peabody Energy Australia.
- GSS Environmental 2005, *Olive Downs Coal Project – Land Resource Assessment Report*, report prepared for McCollum Environmental Management Services Pty Ltd, February 2005.
- Wormington, K, Tucker, G, Lowry, R & Houston, W, Fauna and flora of the Olive Downs Mining Lease, Adjacent Southern Area and associated haul road near Moranbah, Central Queensland, report prepared for McCollum Environmental Management Services, Terrestrial Ecology Programme, Centre for Environmental Management, Central Queensland University, Rockhampton.
- RGM 2023, *Moorvale South – Geochemical Assessment of Mine Waste,* RGS Environmental Consultants Pty Ltd, May 2023, report prepared for Peabody Energy Australia.
- Cartledge 2023, *Moorvale South Project – PRCP Final Void Assessment*, Cartledge Mining and Geotechnics, March 2023, report prepared for Peabody Energy Australia.
- WRM 2023, *Moorvale South Mine PRCP – Flood Risk Assessment*, WRM Water & Environment Pty Ltd, Brisbane, May 2023, report prepared for AARC Environmental Solutions Pty Ltd.
- WRM 2023, *Moorvale South Mine RRCP – Final Void Hydrology Report*, WRM Water & Environment Pty Ltd, Brisbane, March 2023, report prepared for AARC Environmental Solutions Pty Ltd.
- Peabody Energy Australia 2022, *Moorvale South Mine Water Management Plan*, Peabody Energy Australia.
- WRM 2024, Moorvale South PRCP response to RFI, WRM Water & Environment Pty Ltd, Brisbane, 2 September 2024, memorandum prepared for AARC Environmental Solutions Pty Ltd.

Moorvale South PRCP

Groundwater Assessment

Peabody Energy Australia

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Prepared by:

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SLR Project No.: 660.30254.00000

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Revision: 3.0

Making Sustainability Happen

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
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2.0	15 March 2023	Daniel Ashton	Derwin Lyons	Derwin Lyons
1.0	10 March 2023	Corinna De Castro	Derwin Lyons	Derwin Lyons
	Click to enter a date.			
	Click to enter a date.			

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Peabody Energy Australia (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

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Appendices

Appendix A **80th Percentile Summary Statistics Compared to EV Guideline Values**

Appendix B **80th Percentile Summary Statistics Compared WQO Guideline Values**

Appendix C **Predictive Model Starting Heads**

Appendix D **Recovery Model Starting Heads**

1.0 Introduction

1.1 Background

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Peabody Energy Australia PCI (C&M Management) Pty Ltd (Peabody) to undertake a groundwater assessment supporting the Moorvale South Project (the Project) Progressive Rehabilitation and Closure Plan (PRCP). The Project is owned by the Coppabella and Moorvale Joint Venture (CMJV). Peabody owns a majority 73 percent share and is the operator of the CMJV assets.

This groundwater assessment is undertaken in accordance with the relevant requirements of the Queensland Government Department of Environment and Science (DES) Guideline: Progressive Rehabilitation and Closure Plans (DES reference: ESR/2019/4964, version 2.00, effective 17 March 2021) - "the Guideline" and will be integrated into the design of the rehabilitation strategies and selection of post mining land uses (PMLUs) and Non-use Management Areas (NUMAs) within the Project PRCP.

Mining activities commenced at the Project in FY 2022. The Project is operated as an open cut satellite pit of the Moorvale Mine in the northern Bowen Basin, Central Queensland; located approximately 23 kilometres (km) south of Coppabella, 35 km southeast of the township of Moranbah and 55 km north of Dysart (**Figure 1-1**). A hydrogeological assessment was undertaken for the Project in 2019 (SLR, 2019a), prior to mining commencement. However, the mine plan has since been revised to optimise resource recovery, which includes changes to the location and size of the residual voids, necessitating an updated groundwater assessment. This groundwater assessment will also support an EA amendment (EAA).

Existing operations at the Project are undertaken under the conditions of EA EPML00380113 (in effect as of 11 October 2021). The Project is located within the Isaac Regional Council Local Government Area, within the freehold property Olive Downs and was previously known as the Olive Downs North (ODN) project. The Project consists of two Mining Leases (MLs) ML70354 and ML70355 both granted in April 2009, which cover an area of 1,632 ha and 107 ha respectively. ML70355 has been granted as an infrastructure ML to connect the Project to the existing Moorvale Mine to the north. The Project is operated by the Moorvale Mine under the control of the Moorvale management team. The coal from the Project is washed at the Moorvale Mine Coal Processing Plant using existing infrastructure.

Located immediately to the north-west of the Project is Daunia Mine and Poitrel Mine. Moorvale Mine is located to the north. Located south-west of the Project is the proposed Winchester South Project. Immediately to the south of the Project is the Olive Downs project (**Figure 1-2**).

The most recent hydrogeological study relevant to this PRCP and EAA is that undertaken for the Project in 2019 (SLR, 2019a), which included a post-mining assessment. That body of work has been drawn upon as directly relevant to this groundwater assessment, including the development of conceptual and numerical groundwater models as documented within SLR (2019a and 2019b).

Throughout this report, the terms "the Project" and "Study Area" are used as defined by:

- The Project is defined as areas covered by EA EPML00380113 within ML70354 and ML70355.
- The Study Area is the regional area surrounding the Project considered in detail within this assessment, as shown in **Figure 1-1**, and is synonymous with the groundwater model boundary.

1.2 Final landform

The post-mining final landform relevant to this groundwater assessment was provided by Peabody (denoted 230125 MVS Final Landform Draft 100mm_OOP_mods) and is shown in **Figure 1-3**. The final landform is updated from that previously assessed in SLR (2019a) and has been designed for the PRCP and EAA to provide suitability for the intended Post Mining Land Use (PMLU). The final landform contains two residual voids, denoted X Pit Void and Z Pit Void, both located at the northern end of ML70354.

1.3 Objectives

The main objective of the groundwater assessment is to assess the potential groundwater related impacts at completion of mining and until conditions stabilise post rehabilitation (i.e. groundwater equilibrium). A focus of the groundwater assessment is demonstrating suitability of the landform for the intended PMLU with respect to the Project groundwater system. As such, the key specific objectives adopted in this assessment from which to demonstrate this suitability are:

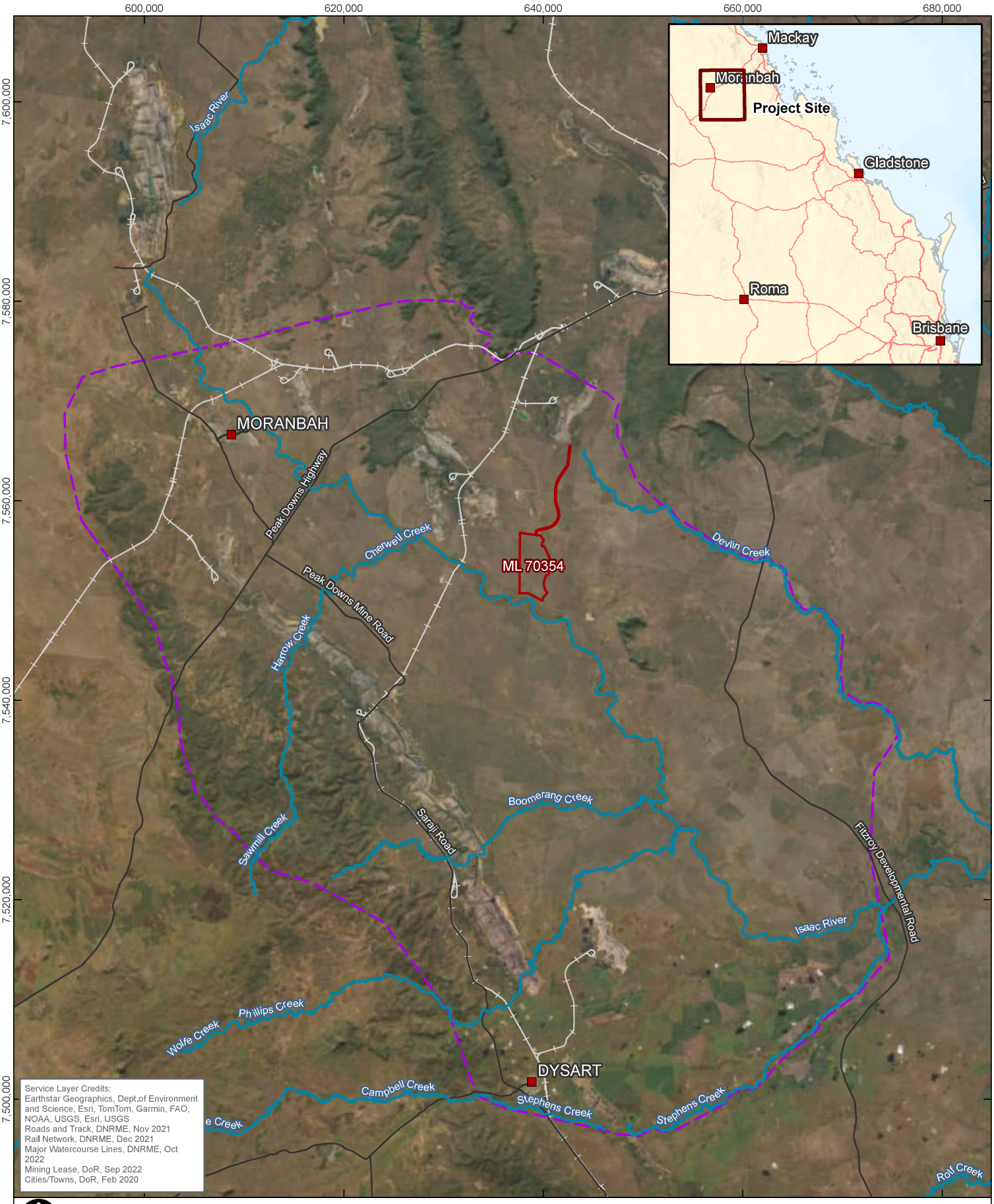
- That the final landform is non-polluting with respect to groundwater:
  - Final voids are demonstrated to be sinks for groundwater, including groundwater contained within spoil.
  - Final void lake levels remain below shallow groundwater bearing units, i.e. there is sufficient freeboard to negate risk of void water discharge to any shallow groundwater system.
- That there are minimal additional impacts to groundwater receptors post-closure that have not already occurred during approved mining:
  - Little to no additional groundwater drawdown at potential groundwater dependant ecosystem (GDE) locations caused by the final landform.
  - Little to no additional groundwater drawdown at anthropogenic bore users caused by the final landform.

1.4 Guideline criteria

As discussed in **Section 1.1**, this groundwater assessment is undertaken consistent with the Guideline: Progressive Rehabilitation and Closure Plans (DES, 2021). A cross reference between the relevant Guideline requirements with respect to groundwater and specific components of this assessment is provided in **Table 1-1**.

Table 1-1 Guideline requirements

Guideline requirement	Section of this report
Section 3.6.1 General rehabilitation practices – Hydrogeology	
Determining the groundwater occurrence including the existence of, and depth to, aquifers and aquitards	Section 4.3
Locating groundwater recharge and discharge locations locally and regionally	Section 4.3
Groundwater quality within each of the aquifers and from surface expressions (i.e. seeps and springs)	Section 4.4
Current and potential future uses of groundwater including existing groundwater extraction bores	Section 4.5
Groundwater flow direction and velocity, including field tests to determine hydraulic conductivity	Section 4.2
The development of potentiometric mapping and hydrostratigraphic cross sections	Section 2.3, Section 4.3
Groundwater modelling to determine contaminant transport and potential changes to groundwater level from dewatering or waste storage.	Section 7.0



Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:500,000 at A4
Project Number:	660.30254.00000
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MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

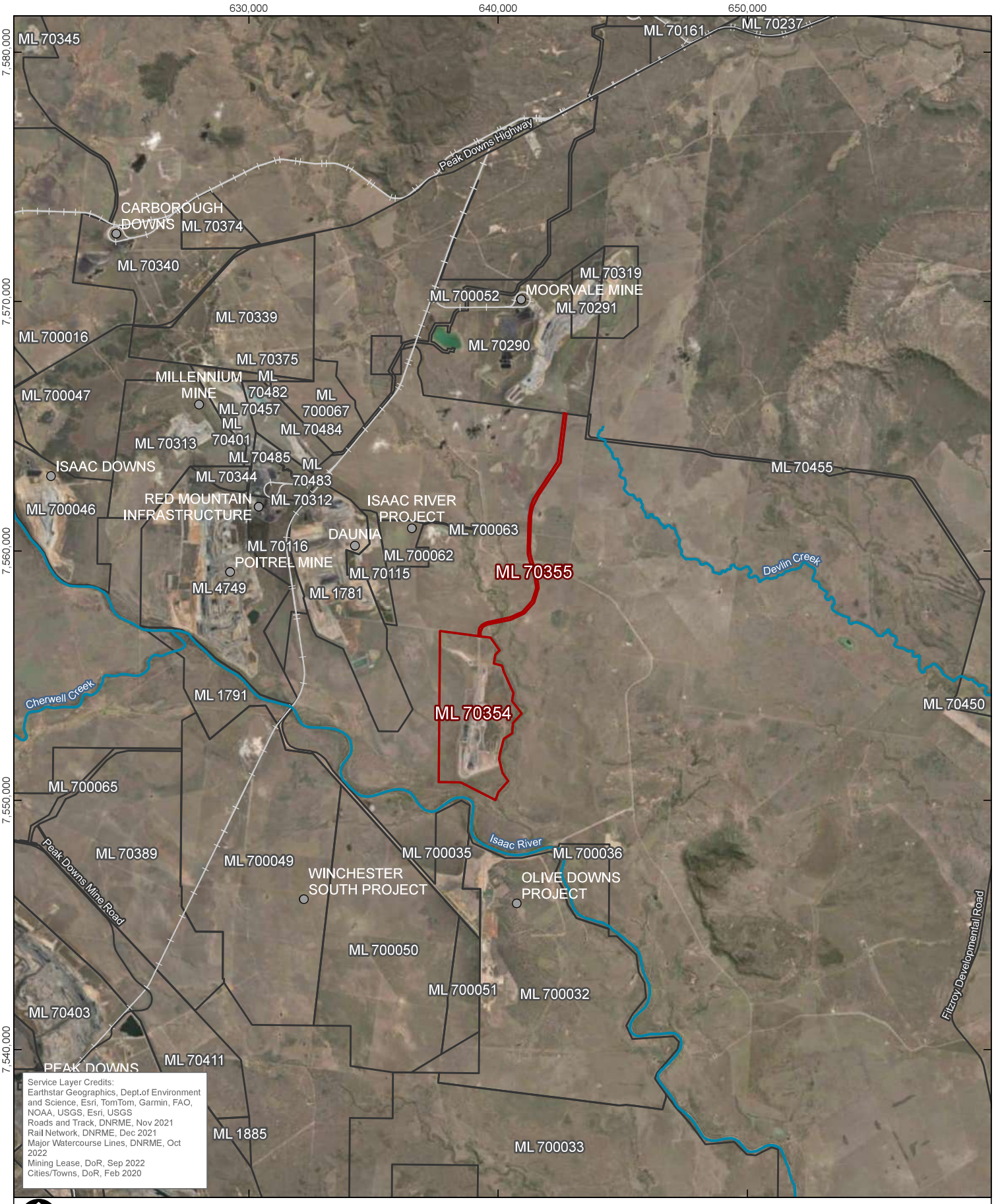
PROJECT LOCATION AND STUDY AREA

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FIGURE 1-1

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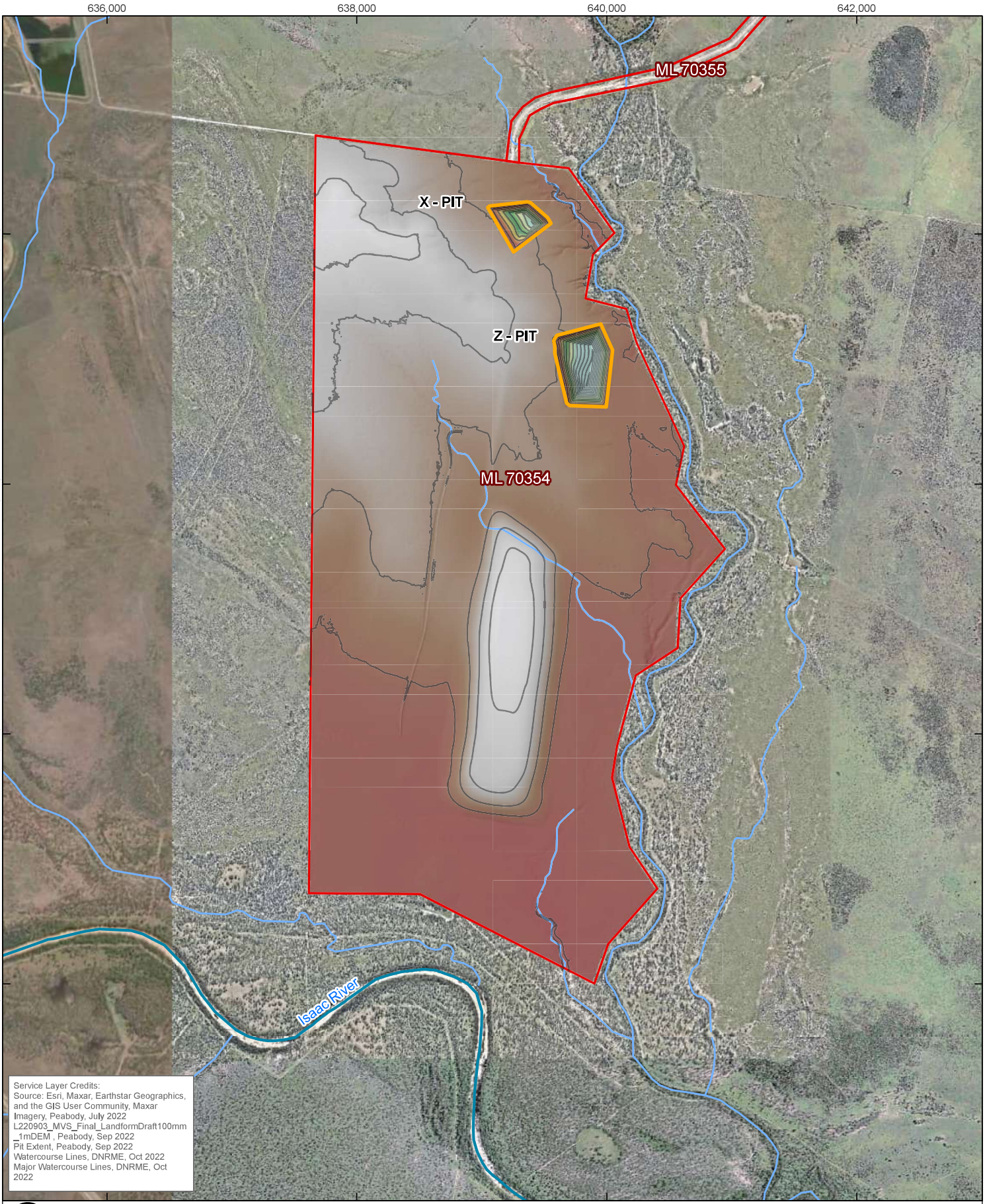
PROJECT AND SURROUNDING MINE TENEMENTS

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FIGURE 1-2

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Service Layer Credits:
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community, Maxar Imagery, Peabody, July 2022
L220903_MVS_Final_LandformDraft100mm_1mDEM , Peabody, Sep 2022
Pit Extent, Peabody, Sep 2022
Watercourse Lines, DNRME, Oct 2022
Major Watercourse Lines, DNRME, Oct 2022

0 0.5 1 km

Coordinate System:	GDA 1994 MGA Zone 55
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Drawn by:	NT

LEGEND

- Minor Watercourse
- Major Watercourse
- Moorvale South Mining Lease
- Final Pit Extent

Post Mining Landform Elevation (mAHD)

227

66

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

POST MINING LANDFORM

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FIGURE 1-3

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2.0 Physical Setting

2.1 Climate

The climate in the study area is sub-tropical with higher temperatures, higher rainfall and higher evaporation occurring over the summer months (December to February). The closest Bureau of Meteorology (BoM) weather station is located at Iffley (station 34100), 16 km southeast of the Project. This weather station has available data between 1998 and 2022, however, there are several instances of missing data. Approximately 55 km southeast of the Project at Carfax (station 34016), a weather station has available data between 1962 and 2021. This station has a continuous record with only a few occasional months of missing data. A more recent station at Moranbah Airport (station 34035, 30 km northwest of the Project) has been open since 2012 and has current data (to May 2024). The Moorvale Mine weather station is located approximately 16 km north of the Project and data is available between 2013 and 2022. **Table 2-1** provides the details of the nearby operational weather stations and locations are shown on **Figure 2-3**.

Table 2-1 Weather stations with recent data near the Project

Name	BoM Station Number	Date Commenced	Easting (GDA94)	Northing (GDA94)	Elevation (mAHD)	Data Available to	Distance from Project
Moorvale Mine	-	2013	642201	7569861	280	October 2022	16 km N
Iffley	34100	1998	647356	7539801	173	March 2022	16 km SE
Moranbah Airport	34035	2012	610999	7559653	232	May 2024	30 km NW
Carfax	34016	1962	673063	7515595	128	April 2021	55 km SE

The weather station at Carfax has the most complete long-term data set and is therefore is useful for assessing long term rainfall trends in the vicinity of the Project. The average annual rainfall recorded at Carfax (station 34016) from 1962 to 2021 is 615 millimetres (mm). The highest annual rainfall for this period was recorded for the year 2010 with an annual rainfall of 1251 mm, while the lowest was 262 mm recorded in 1992. Additionally, the weather station Moranbah Airport has a complete monthly rainfall dataset covering the timeframe that groundwater levels in Project monitoring bores have been recorded, and therefore is useful for assessing the relationship between rainfall and groundwater levels (refer **Sections 4.3.1** to **4.3.4**). Monthly averages for available data at the three BoM stations are listed in **Table 2-2**.

Table 2-2 Average monthly rainfall (mm)

BoM Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Carfax	110	94	62	31	36	28	22	22	19	36	55	96	615
Iffley	97	84	58	37	17	40	22	36	15	34	57	87	545
Moranbah Airport	103	83	77	26	31	17	39	12	14	23	66	64	554

Source: http://www.bom.gov.au/climate/data/index.shtml

Long term rainfall trends for Carfax (1962 to 2021) and Iffley (1998 to 2022) and Moranbah Airport (2012 to 2024) are illustrated by analysis of the residual mass curve or cumulative

rainfall departure (CRD) (**Figure 2-1**). Positive gradients on the curve (rising limbs) indicate wetter conditions than normal, while negative gradients (falling limbs) indicate dry conditions. Average rainfall conditions are inferred during periods of stable residual mass. **Figure 2-1**shows that, over the past 60 years, the wettest periods occurred during 1973-1979, 2007-2008 and in 2010. The driest periods were 1963-1970, 1991-1998 and 2001-2006. From 2011 to 2019 rainfall has generally been consistent with the long-term average. From 2019 to 2022 negative gradients indicate dry conditions, while over the most recent period of the record (November 2022 to May 2024) rainfall volumes have more or less been consistent with the long term average.

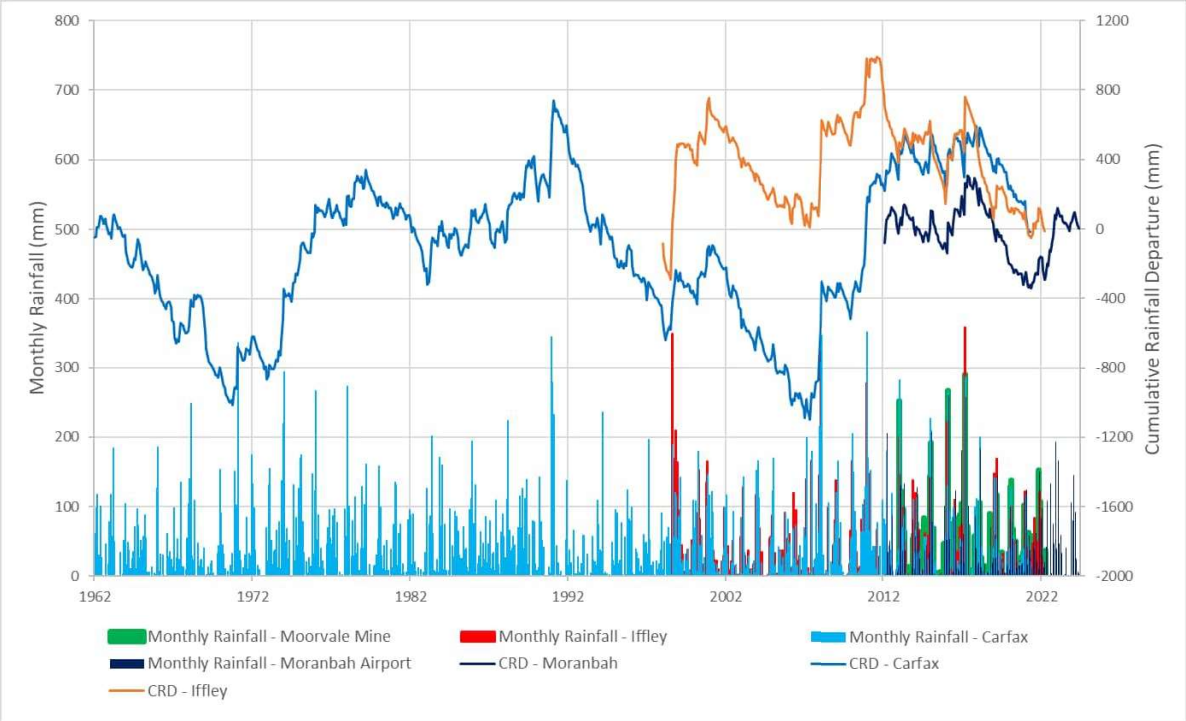


Figure 2-1 Long term cumulative rainfall departure and monthly rainfall

If rainfall recharge is a significant source of groundwater, the temporal variability in recorded groundwater levels can be expected to mimic the pattern of the RMC. Natural fluctuations in the water table result from temporal changes in rainfall recharge to groundwater systems. Typically, changes in groundwater elevation reflect the deviation between the long term monthly (or yearly) average rainfall, and the actual rainfall, illustrated by the rainfall RMC. Groundwater hydrographs showing the relationship between rainfall and groundwater levels are assessed in **Section 4.3**.

Actual and potential evapotranspiration (ET) were sourced from BoM's Australia wide interpolation dataset at the locations of the weather stations (SLR, 2019a). The potential ET in the district is about 1600 mm/year according to BoM (**Table 2-3**). The definition of potential ET is: "… *the ET that would take place, under the condition of unlimited water supply, from an area so large that the effects of any upwind boundary transitions are negligible and local variations are integrated to an areal average. For example, this represents the evapotranspiration which would occur over a very large wetland or large irrigated area, with a never-ending water inflow".* Further to this, where the water table approaches the ground surface, ET can also approach the potential ET value.

Table 2-3 Average monthly potential evapotranspiration (mm)

BoM Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Carfax	187	155	170	124	96	80	81	100	126	172	189	188	1668
Iffley	181	151	167	122	96	80	81	99	125	172	188	184	1646
Moranbah Airport	175	147	163	120	95	80	81	98	124	171	186	179	1619

The actual ET in the district is about 600 mm/year according to BoM (**Table 2-4**). The definition for actual ET is: "... *the ET that actually takes place, under the condition of existing water supply, from an area so large that the effects of any upwind boundary transitions are negligible and local variations are integrated to an areal average*". For example, this represents the predicted ET that is occurring over a large area of land under the existing (mean) rainfall conditions.

Table 2-4 Average monthly actual evapotranspiration (mm)

BoM Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Carfax	72	64	70	45	33	29	29	29	34	55	67	67	594
Iffley	70	65	71	46	35	31	30	29	33	54	67	66	597
Moranbah Airport	63	62	65	43	33	29	27	25	28	47	62	60	544

Figure 2-2 shows that the average potential monthly ET exceeds the average monthly rainfall over the entire year, often by more than double. Average actual ET is equal to or slightly less than average rainfall for all months except during the "wet" season between December and March, when the average rainfall exceeds the average actual ET.

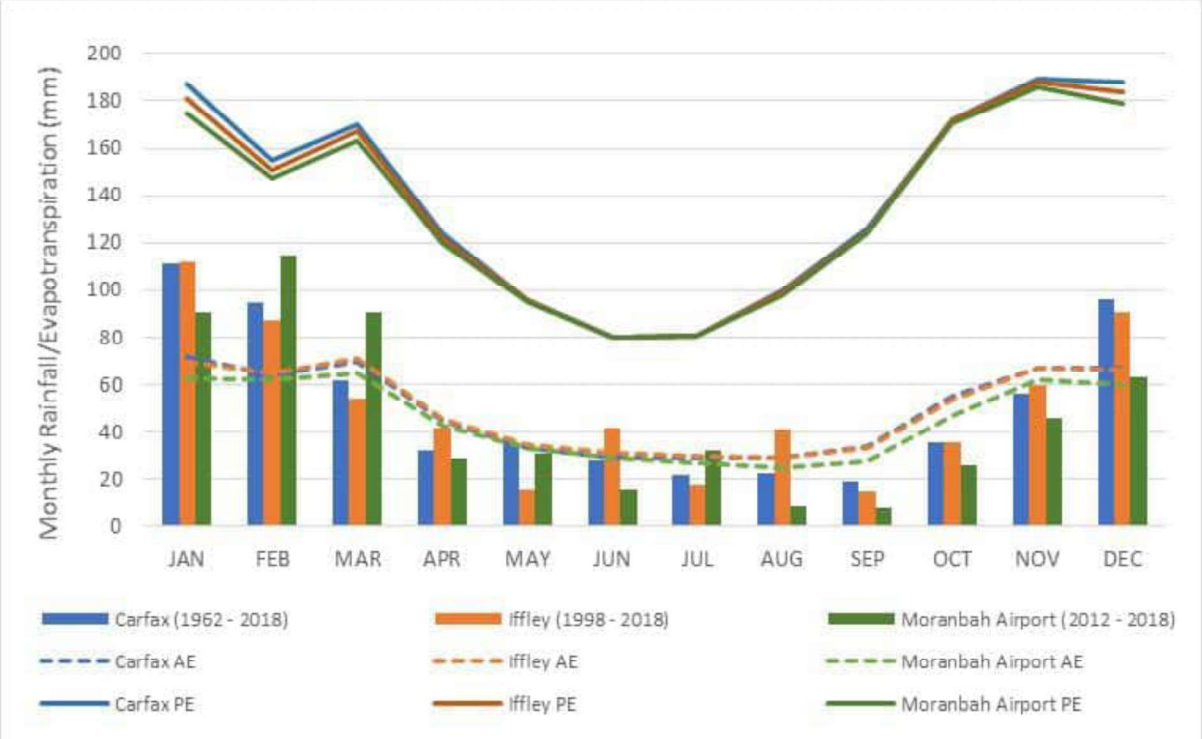
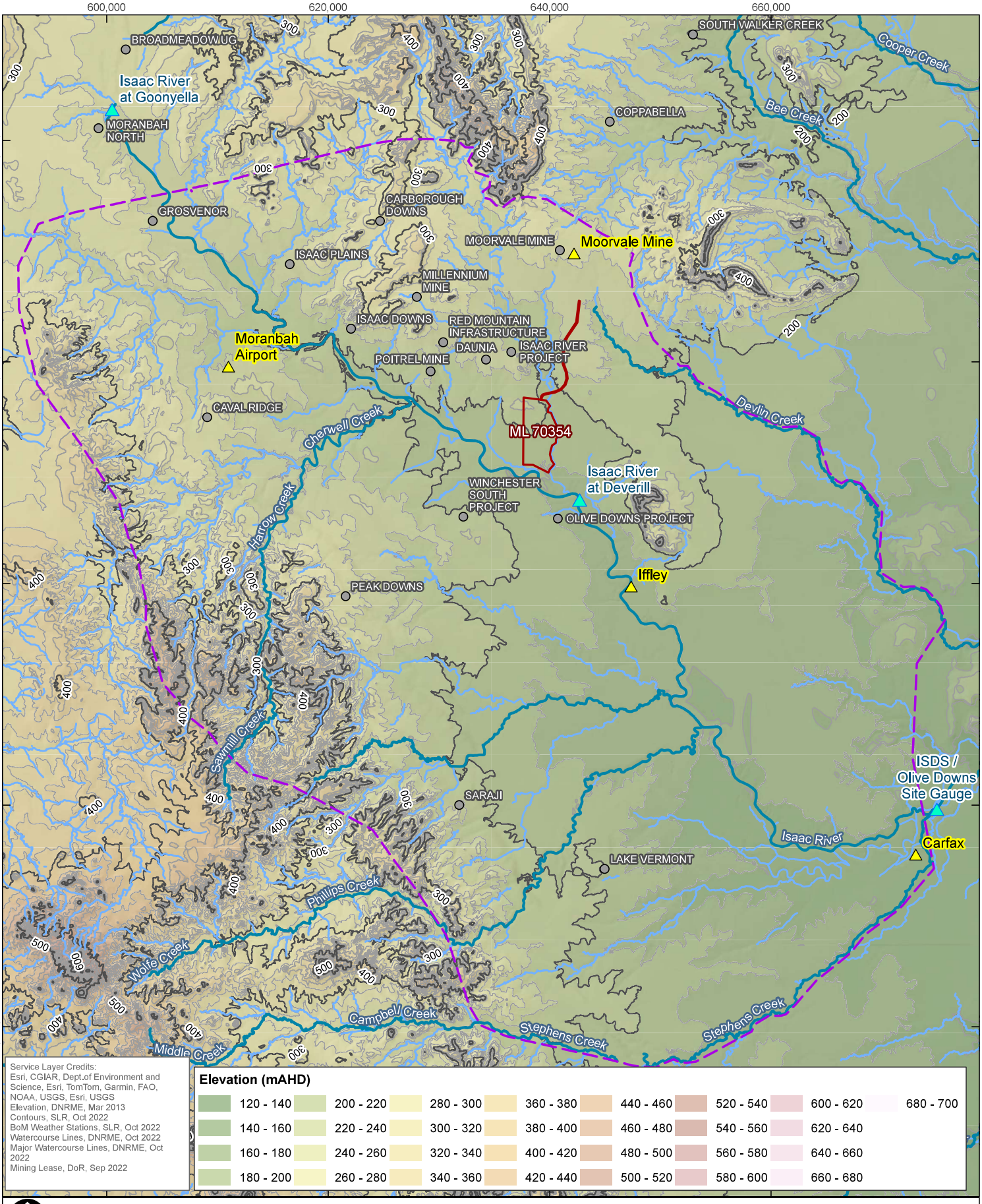


Figure 2-2 Average monthly rainfall and evapotranspiration at nearby weather stations (SLR, 2019a)

2.2 Topography and Drainage

The Project is located in the Isaac Connors catchment, a sub-catchment of the upper Fitzroy Basin. The topography of the Project Area is relatively flat with gentle undulation and average elevations of approximately 185 m AHD (**Figure 2-3**). Elevations range between approximately 180 m AHD southeast of the Project to 220 m AHD in the north. Low mountain ranges up to 400 m AHD border the Project to the northeast and southwest.

The Isaac River and contributing streams are the major surface water systems draining the Study Area (**Figure 2-3**). Northeast of the Project Area, the upper reaches of the Devlin Creek are within the groundwater model boundary, and northeast boundary of the model is aligned with Devlin Creek.



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TOPOGRAPHY AND DRAINAGE

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FIGURE 2-3

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The Isaac River flows from the northwest to the southeast. The Project Area lies directly west of the north to south flowing North Creek (a minor tributary of the Isaac River), and north of the Isaac River (**Figure 2-4**). The confluence of North Creek to the Isaac River is approximately 3 km south of the Project at an elevation of 186 m AHD. Both the Isaac River and North Creek are ephemeral and only persist for a relatively short time after rainfall (1-3 months). After significant rainfall, water remains in ponds that are used as livestock water sources.

There is a Department of Regional Development, Manufacturing and Water (DRDMW) gauging station located at Isaac River at Deverill (station 130410A), located approximately 1.5 km downstream of the Isaac River and North Creek confluence (**Figure 2-5**). A gauging station referred to as both 'ISDS' and 'Olive Downs Site Gauge' has also been installed downstream of the Study Area in the Isaac River at the bridge on Fitzroy Developmental Road, just downstream of the confluence with Stephens Creek. Data records are logged at 10 minute intervals commencing on 22 December 2016. As of 22 April 2018, five flow events (peak flow greater than 1 m^3/s) have been recorded at this gauge. The greatest discharge was recorded in March 2018 at 804 m^3/s.

Table 2-5 presents a summary of stream gauge stations along the Isaac River near the Project, derived from the DRDMW Water Monitoring Information Portal (WMIP). There are no stream gauging stations on North Creek. **Figure 2-3** shows the locations of the gauging stations.

Table 2-5 Stream gauging stations

Station Location	Number	Easting (GDA94)	Northing (GDA94)	Distance from Project	Zero-gauge Elevation (m AHD)	Mean Flow (ML/day)	Max Flow (GL/day)	Max Flow Date
Isaac River at Deverill	130410A	642717	7547618	4 km downstream (east)	169.30	615	228	Mar 1988
ISDS / Olive Downs Site Gauge	-	674973	7519695	50 km downstream (east)	136.93	-	-	-

Figure 2-4 presents daily mean stream discharge at the Isaac River at Deverill station (130410A) from 1968 to 2019, compared against daily rainfall. The graphs show that flows within the Isaac River are typically ephemeral, with short-duration flows generally occurring over the summer months.

Based on daily flow data since 1968, **Figure 2-5** shows that the Isaac River flows only 27 % of the time, with less than 11 % probability of flows exceeding 100 ML/day. Less than 1 % of readings exceed 10,000 ML/day, which includes high flow/flood events in 2008 (January and February), 2010 (December), 2012 (March), 2016 (February), 2017 (March) and 2021 (January) (SLR, 2021a).

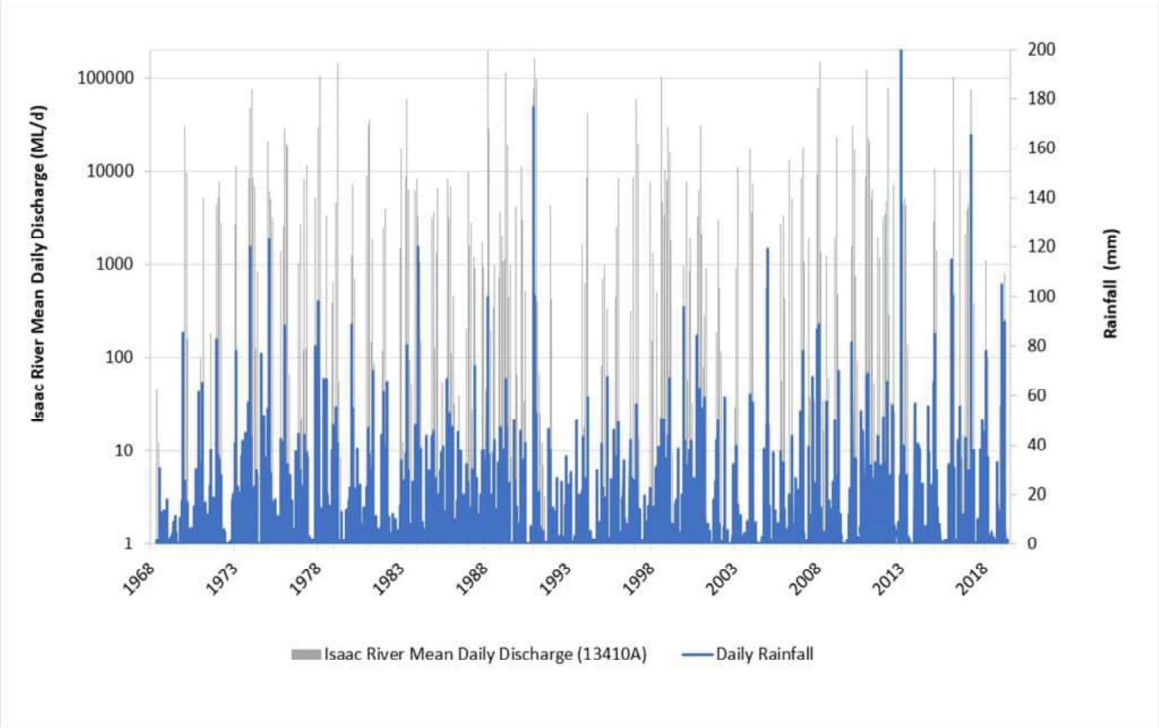


Figure 2-4 Isaac River station 130410A stream flow and Carfax station 34016 rainfall (SLR, 2019a)

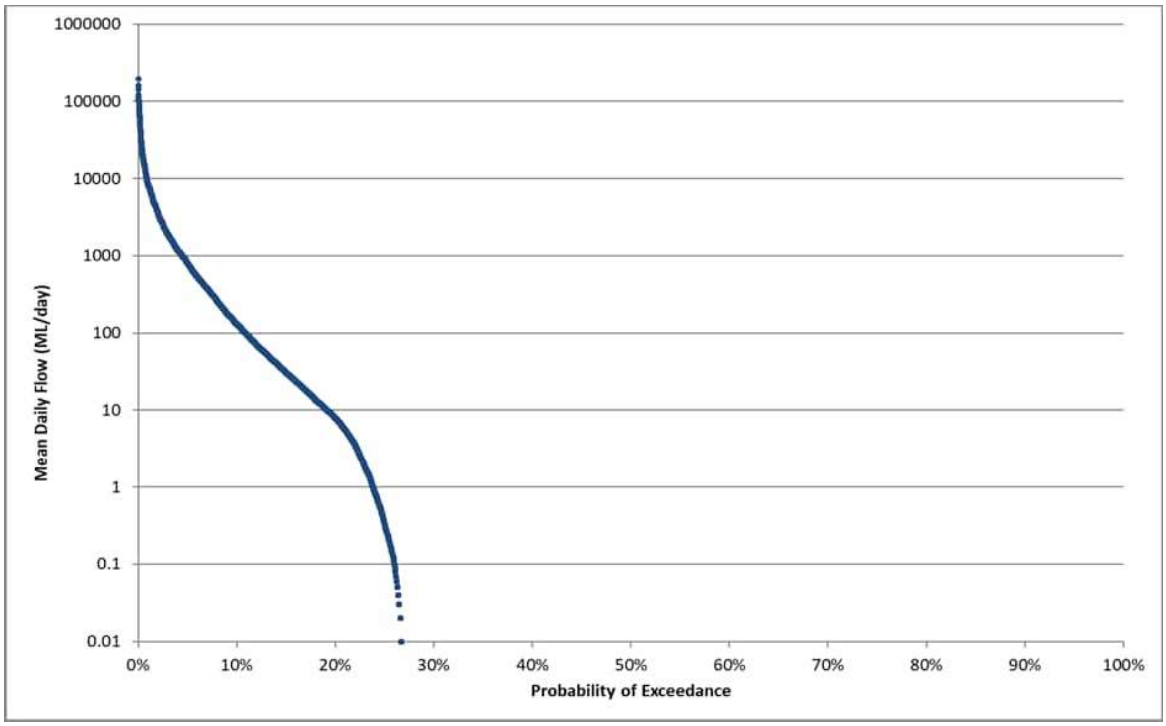
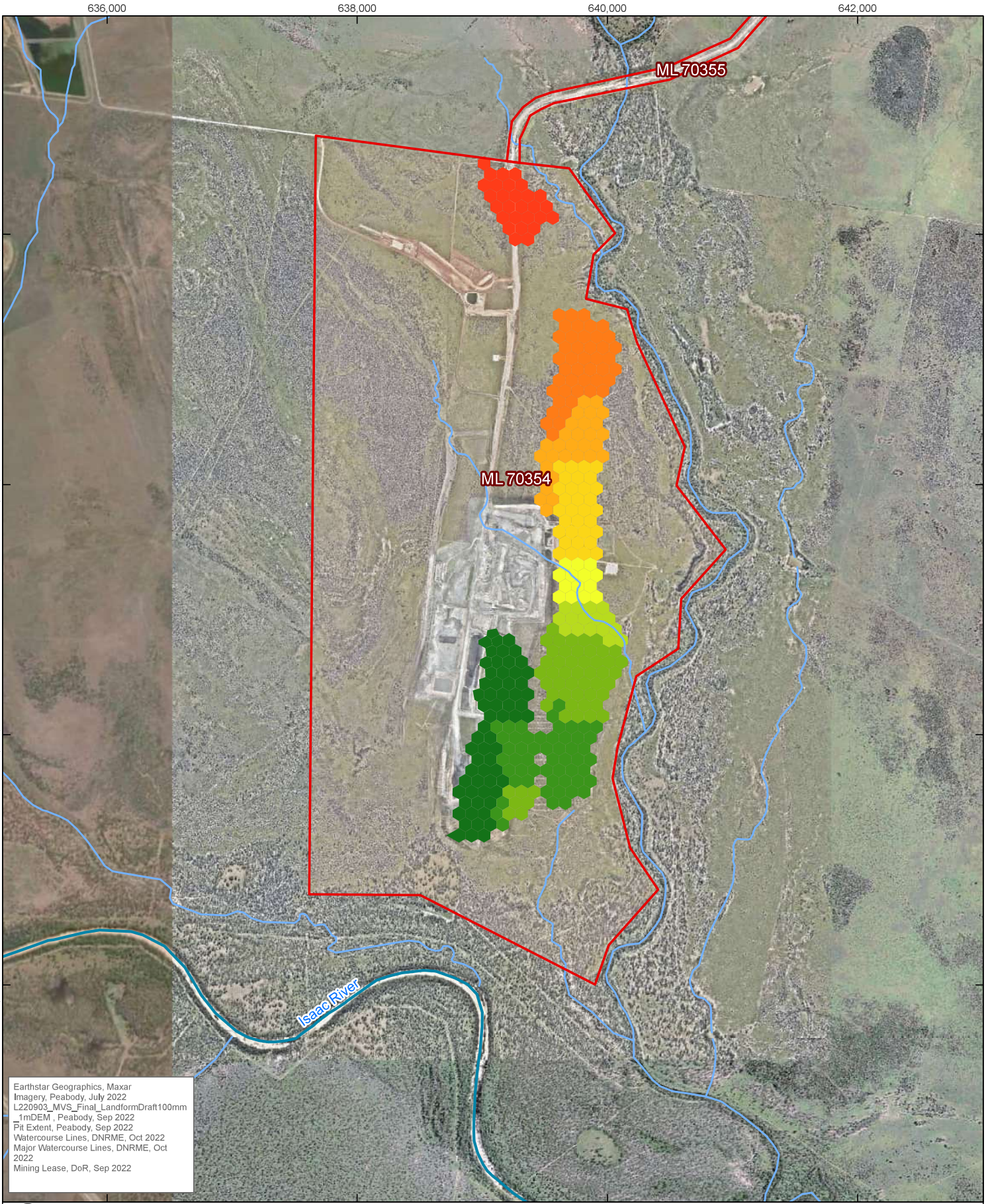


Figure 2-5 Isaac River station 130410A mean daily flow duration curve 1968 to 2021 (SLR,2021)

2.3 Moorvale South Project Mining Activities

The Project is located within the Isaac Regional Council Local Government Area, within the freehold property Olive Downs and was previously known as the Olive Downs North (ODN) project. Project mining activities commenced in FY 2022, with open pit mining progressing in a general south to north direction. The Project consists of a series of open cut pits mostly targeting the Rangal Coal Measures (targeting initially the Leichhardt and Vermont seams) and where economically viable also the underlying Fort Cooper Coal Measures. The Project will extract between 1.5 and 2 million tonnes per annum of coal over a mine life of approximately 10 years. Based on the planned production rate, approximately 10 million tonnes of product coal would be produced during the life of the Project. The mine progression for the Project is shown on **Figure 2-6**.



Earthstar Geographics, Maxar
Imagery, Peabody, July 2022
L220903_MVS_Final_LandformDraft100mm_1mDEM , Peabody, Sep 2022
Pit Extent, Peabody, Sep 2022
Watercourse Lines, DNRME, Oct 2022
Major Watercourse Lines, DNRME, Oct 2022
Mining Lease, DoR, Sep 2022

0 0.5 1 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	660.30254.00000
Date Drawn:	20-Jun-2024
Drawn by:	RB

LEGEND

- Minor Watercourse
- Major Watercourse
- Moorvale South Mining Lease

Mining Progression

- 2022
- 2023
- 2024
- 2025
- 2026
- 2027
- 2028
- 2029
- 2031

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

MINE PROGRESSION

SLR

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FIGURE 2-6

Path: \\au.slr.local\Corporate\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx

3.0 Geology

3.1 Regional Geology

The Project coal deposit is in the northern part of the Bowen Basin, a foreland sedimentary basin of approximately 200,000 km2 (**Figure 3-1**). The Bowen Basin is a north-northwest to south-southeast oriented basin and contains the largest coal reserves in Australia. The southern half of the Bowen Basin is covered by the Surat Basin, and the Galilee Basin exists to the west (Geoscience Australia, 2017).

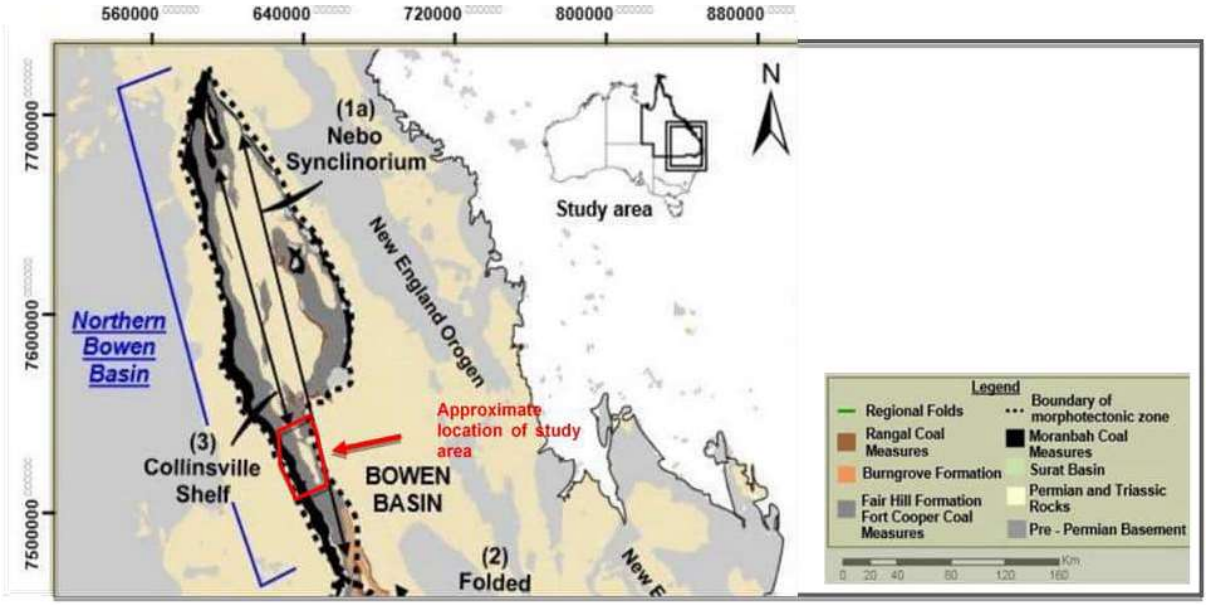


Figure 3-1 Structural setting of the Bowen Basin (after Dickins and Malone, 1973)

Basin geology within the Collinsville Shelf includes the basal Permian aged Back Creek Group, which generally comprises of generally fine-grained clastic sedimentary rocks deposited in a fluvial to shallow marine environment. The Back Creek Group is conformably overlain by the Blackwater Group, which includes the Moranbah Coal Measures, Fort Cooper Coal Measures and Rangal Coal Measures. The economic seams of the Project are contained in the Late Permian Rangal Coal Measures. The Permian sediments occur at outcrop on the eastern and western edges of the Basin and are unconformably overlain by the Triassic aged terrestrial sediments of the Rewan Group. While not present at the Project, isolated pockets of remnant quartzose sandstones of the Middle Triassic Clematis Group are also mapped within the Study Area, on the eastern side of the Isaac River.

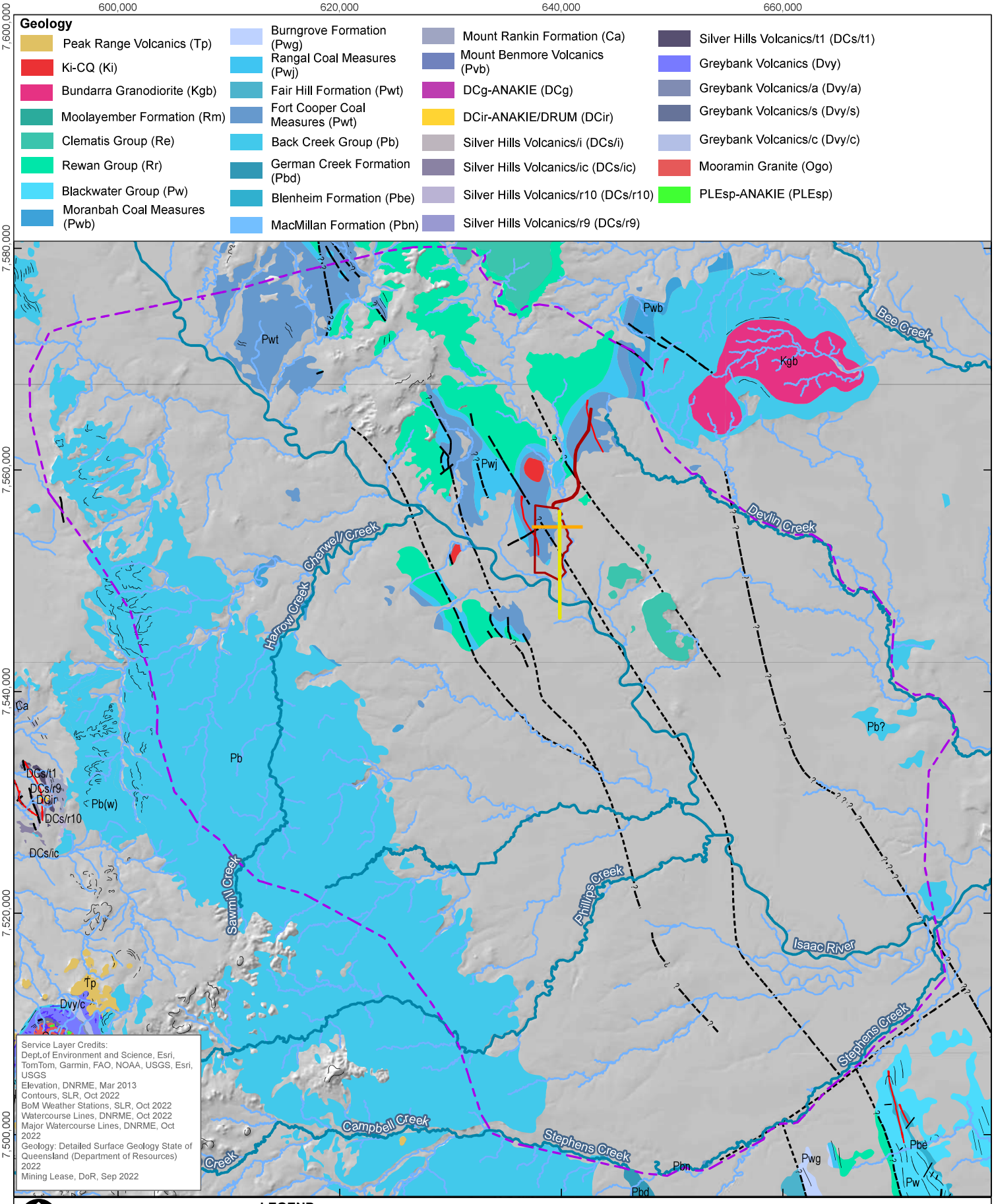
The Permian and Triassic sediments are covered by a thin veneer of unconsolidated to semi-consolidated Cainozoic sediments (Tertiary to Quaternary alluvium and colluvium). The alluvial sediments are localised along rivers and creeks (i.e. Isaac River and North Creek). Volcanic intrusions and extrusions (i.e. basalt) are also present within the region.

The generalised regional stratigraphy is summarised in **Table 3-1**.

The outcrop geology is presented in **Figure 3-2**, based on the 1:500k solid geology outcrop mapping of the Bowen Basin. The surficial geology is shown in **Figure 3-3**, and is based on the Clermont (SF5511) and St Lawrence (SF5512) 1:250k geological maps, as compiled within the Queensland Geology Detailed Surface Mapping (DNRME, 2017).

Table 3-1 Regional stratigraphy

Period		Stratigraphic Unit		Description	Distribution
Cainozoic		Isaac River Quaternary alluvium (Qa)		Flood plain alluvium comprising clay, silt, sand and gravel.	Surficial cover localised along Isaac River and North Creek.
		'Regolith': colluvium, weathered bedrock strata and other sediments in floodplains, alluvial fans, and high terraces (Qr, Qr\b and TQa)		Colluvial and residual deposits comprising poorly sorted clay, silt, sand, gravel and black soils, silts and muds derived from weathered basalts.	Surficial cover other than Qa at and surrounding the Project.
		Duaringa Formation (Tu)		Mudstone, sandstone, conglomerate, siltstone, oil shale, lignite and basalt.	Present to south and east of Study Area.
Triassic		Mimosa Group	Clematis Group (Re)	Cross-bedded quartz sandstone, some quartz conglomerate and minor red-brown mudstone.	Isolated outcrop to the southeast of the Project.
			Rewan Group (Rr) (Rewan Formation and Sagittarius Sandstone)	Rewan Formation: green lithic sandstone, pebbly lithic sandstone, green to reddish brown mudstone and minor volcanolithic pebble conglomerate (at base). Sagittarius Sandstone: lithic sandstone interbedded with mudstones and siltstones with scattered carbonaceous plant material.	Outcrops or subcrops within the Study Area, and to the northeast and southwest of the Project.
Permian	Late	Blackwater Group	Rangal Coal Measures (Pwj)	Coal seams, carbonaceous shale and mudstone, tuff, siltstone and mudstone.	Within Project Site; isolated outcrops in the east and south of the Project.
			Fort Cooper Coal Measures (Pwt) (Fair Hill Formation)	Coal, brown and green sandstone, conglomerate, carbonaceous shale, tuff.	Within Project Site; Outcrops or subcrops in the majority of the Project.
			Moranbah Coal Measures (Pwb)	Quartzose to sublabile locally argillaceous sandstone, siltstone, mudstone, carbonaceous mudstone and coal.	Within/underlies the Project; Outcrops or subcrops in the west of the Study Area.
	Early to Middle	Back Creek Group (Pb)		Quartzose to lithic sandstone, siltstone, carbonaceous shale, minor coal and sandy coquinite.	Within/underlies Project; Outcrops west of mines and extends under mined areas to the east.



Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:450,000 at A4
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Drawn by:	AS

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

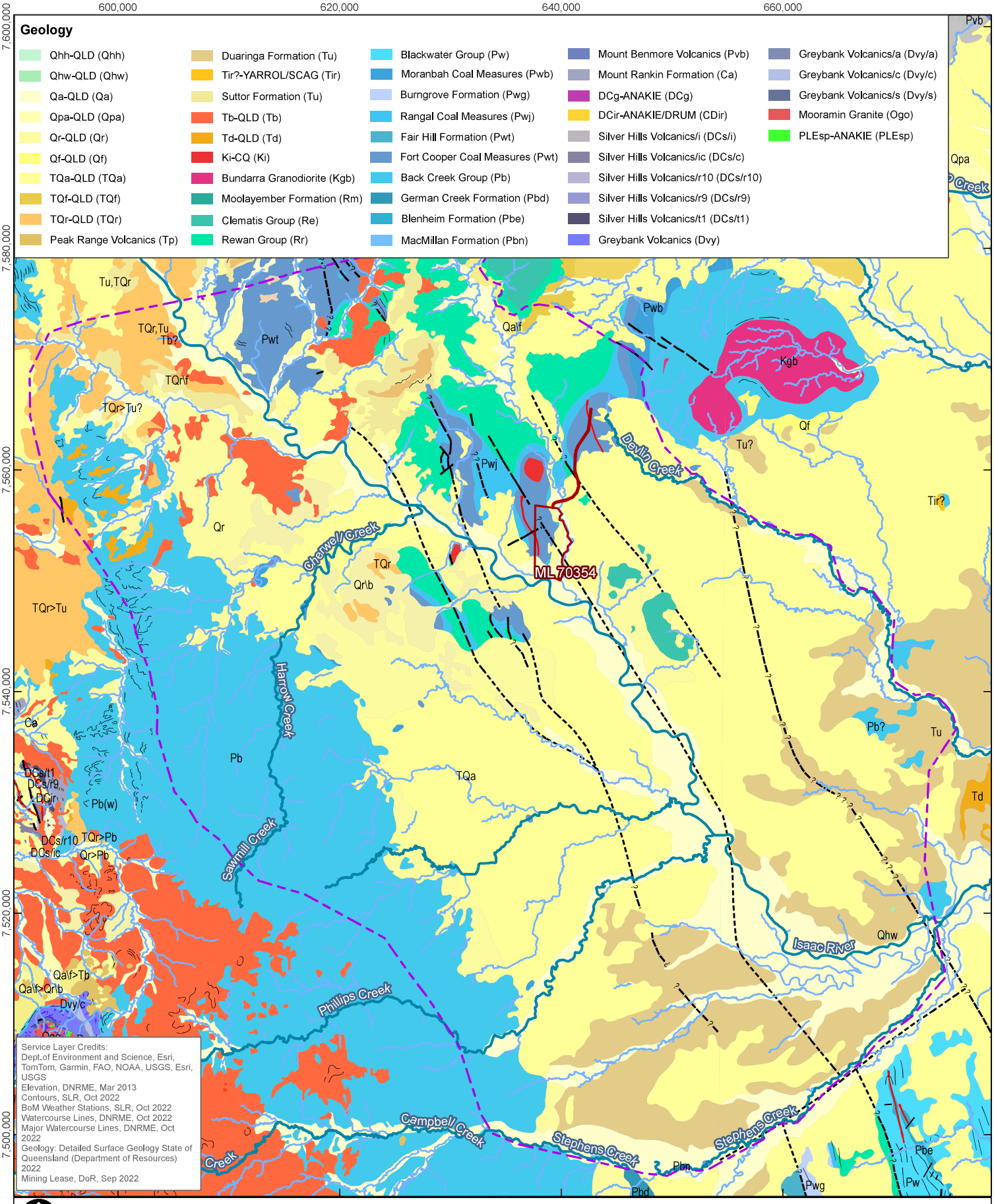
OUTCROP GEOLOGY

SLR

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FIGURE 3-2

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MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

SURFACE GEOLOGY

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:450,000 at A4
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FIGURE 3-3

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3.2 Local Geology

The stratigraphic profile within the Study Area comprises three distinct units:

- Cainozoic sediments (alluvium and regolith);
- Early Triassic Rewan Group; and
- Permian aged coal measures.

Each of the main stratigraphic units is discussed in further detail below. The structural geology of the Study Area is also discussed in Section 3.2.4.

3.2.1 Cainozoic Sediments

Alluvium

Queensland Government Detailed Surface Geology mapping (**Figure 3-3**) shows that alluvium is localised along the Isaac River. At the Project, the alluvium is present in the southern and eastern areas. A thin veneer of sediments unconformably overlie the Permian and Triassic units. There is a small area of thicker alluvium in the vicinity of the confluence of the Isaac River and North Creek that can be up to 25 m thick.

The extent and thickness of the unconsolidated sediments was assessed in the southern area of the Project. In November 2018 Golder Associates Pty Ltd (Golder) undertook a geophysical survey which entailed five seismic refraction (SR) and five electrical resistivity imaging (ERI) lines adjacent to the Isaac River to test the resistivity of ground cover to a depth of approximately 40 m below ground level (mBGL). Data and location of the geophysical surveys are contained in Golder (2019a).

The purpose of the geophysical survey (Golder, 2019a) was to assess:

- Lateral extent, thickness and composition of Isaac River deposits;
- Potential connectivity between shallow groundwater and the Isaac River;
- Possible presence of palaeochannels; and
- Occurrence and approximate thickness of a clay layer at the interface between the Isaac River deposits and underlying Permian rock.

The results of the surveys identified five units (Golder, 2019a):

- Unit 1 – dry alluvium, thickest near the river (maximum thickness 12 m) and thins north;
- Unit 2 – discontinuous, low resistivity alluvium with a high clay/moisture content, 6 m maximum thickness;
- Unit 3 – high and variable resistivity indicating alluvium with a higher sand and gravel content, with some clay/moisture content, 15 m maximum thickness;
- Unit 4 – a change in resistivity is interpreted as the approximate groundwater table at the time of the survey, ranging from 8 mBGL to 23 mBGL, shallowest beneath the Isaac River channel. Bore 8 (RN162827) was used to confirm the groundwater level interpretation;
- Unit 5 – inferred to be a less weathered, higher strength rock, top of unit varies from 25 mBGL to 32 mBGL;
- Palaeochannel – identified adjacent and to the north of the current location of the Isaac River channel.

The extent and thickness of the unconsolidated sediments was also assessed within the Project using a transient electromagnetic (TEM) survey conducted by Groundwater Imaging Pty Ltd in September 2018. The results of the survey are summarised below:

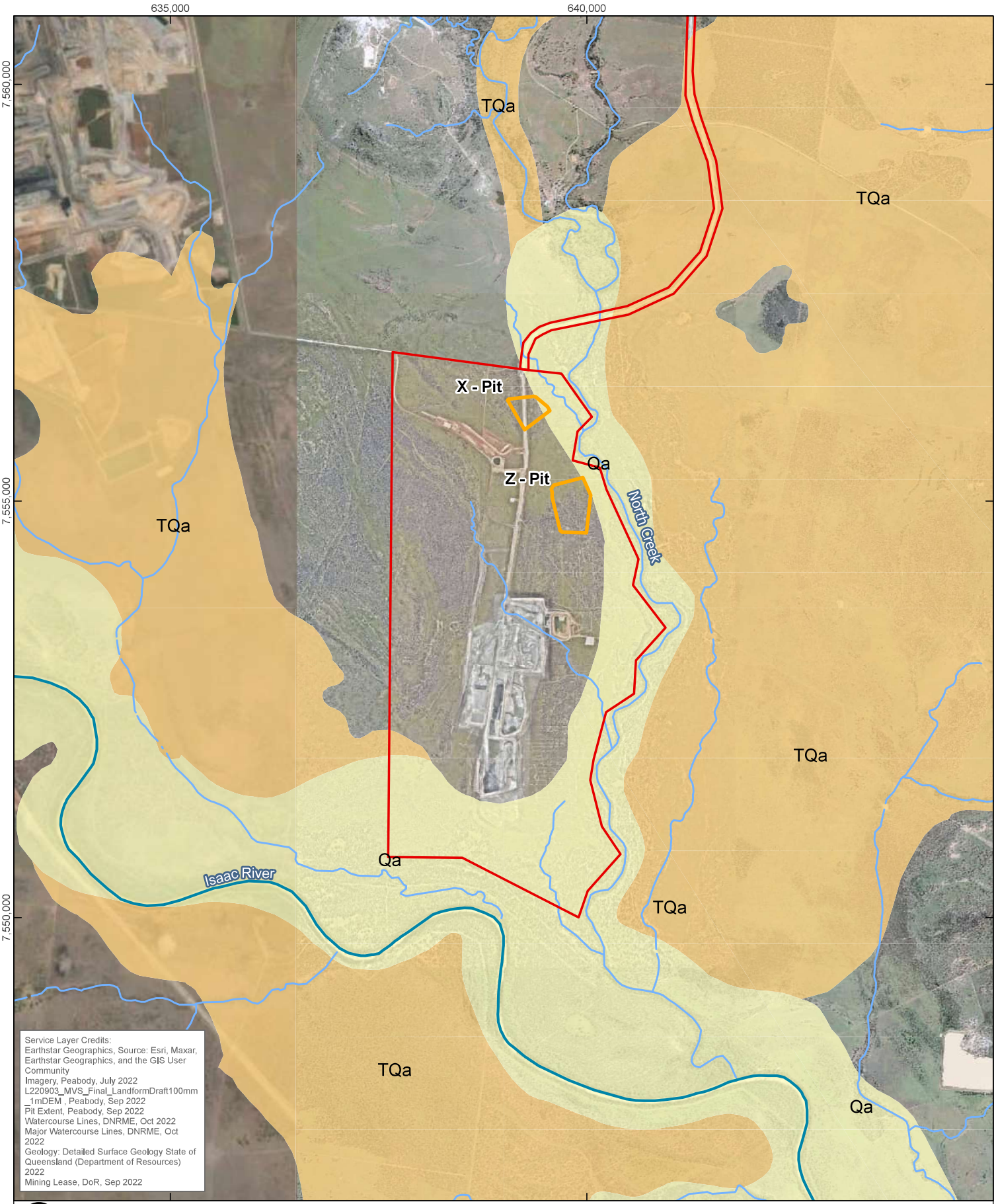
- There is a limited amount of alluvium within the Project which resulted in high electrical resistivity data. In the east of the Project there is a creek, while in the west high conductivity results suggest an upward flow of saline groundwater which appear to be at a level of approximate historical groundwater levels. Along the Isaac River the results indicate the presence of alluvial sand deposits and possibly lava flows or sills;
- Historical groundwater levels with concentrated salinity, partially controlled by strata, hydraulic conductivity, faulting and fracturing may have affected the electrical resistivity results. Electrical conductivity maximums can occur where faults or dipping strata pass through the range of historic groundwater levels, or slightly above;
- In the north of the Project there is a broad deep resistive zone which has limited, but present dipping structure evident;
- In the central west of the Project more electrically resistive data exists, but there is considerable dipping layering evident.

The extent and thickness of the unconsolidated sediments was also assessed within the Study Area using a TEM survey conducted by Groundwater Imaging Pty Ltd in July 2017 as part of the Olive Downs groundwater assessment. The survey tested the resistivity of ground cover to a depth of about 60 mBGL and was verified using geological drill data. The TEM survey identified that alluvial sediments occur further west than is mapped within the Study Area. These sediments are generally less than 12 m thick, but the alluvium can be up to 30 m thick within a narrow corridor along the Isaac River, thinning out with distance from the river. The mapped extent of alluvium is presented in **Figure 3-4**.

Lithological logs for within the Project indicate the alluvium comprises a heterogeneous distribution of fine to coarse grained sands interspersed with lenses of clays and gravels. These sediments, while spatially variable, generally comprise four main stratigraphic sequences:

- Upper soil and clay layer (0 m – 13 m thick);
- Sand and sandy clay unit (0 m – 24 m thick);
- Sand and gravel unit (0 m – 8 m thick);
- Basal clay unit (0 m – 10 m thick).

The heterogeneous distribution of alluvial sediments is shown in the geological cross sections in **Figure 3-5** (refer to **Figure 3-2** for section line locations). This heterogeneity is also visible in the TEM results, with discrete areas of more saline water detected within the alluvium, likely correlating to less permeable finer grained horizons.



0 1 2 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:60,000 at A4
Project Number:	660.30254.00000
Date Drawn:	11-Jun-2024
Drawn by:	AS

LEGEND

- Major Watercourse
- Minor Watercourse
- Final Pit Extent
- Moorvale South Mining Lease
- Quaternary Alluvium (Qa)
- Tertiary-Quaternary Alluvium (TQa)

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

SITE ALLUVIUM EXTENT

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FIGURE 3-4

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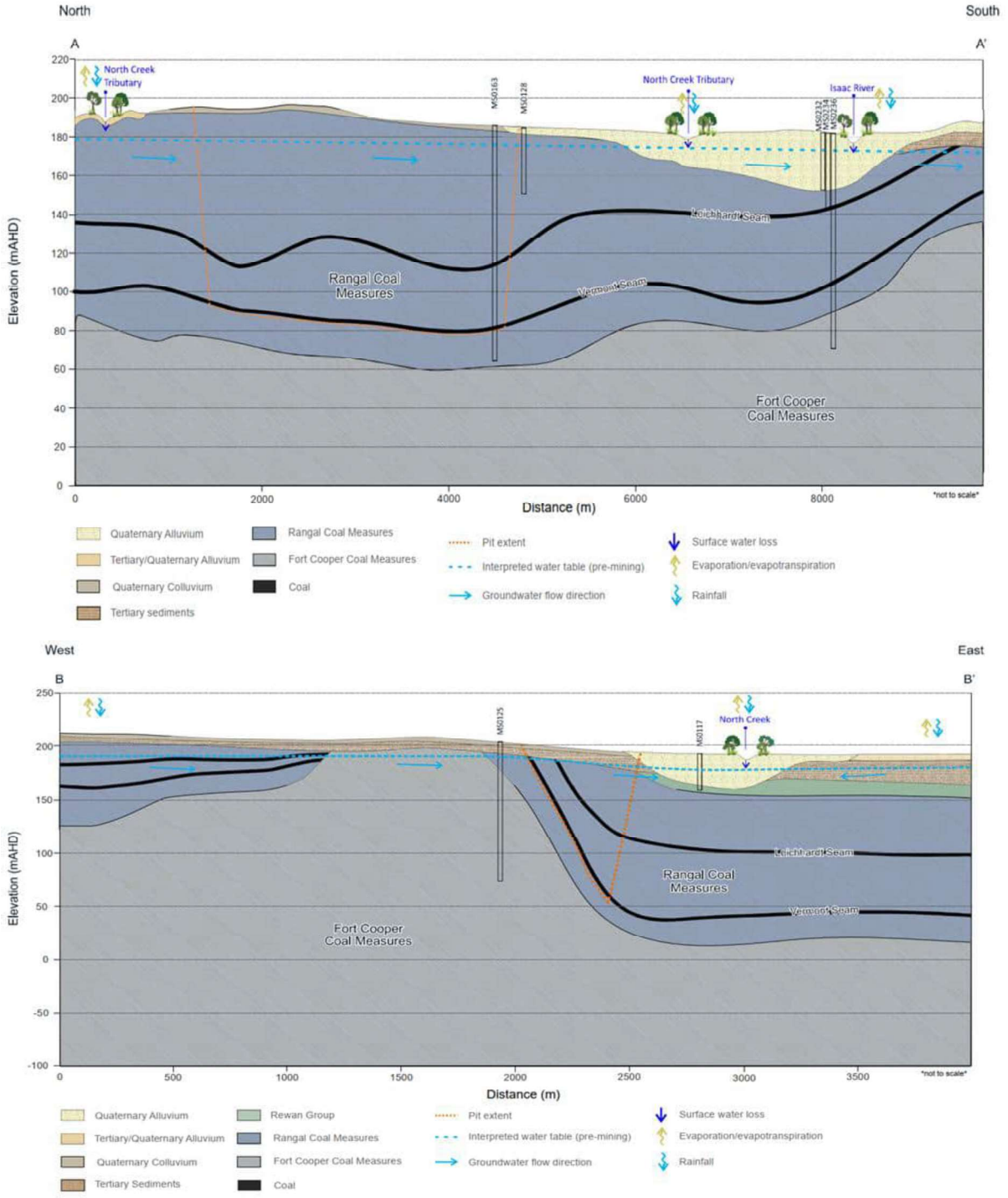


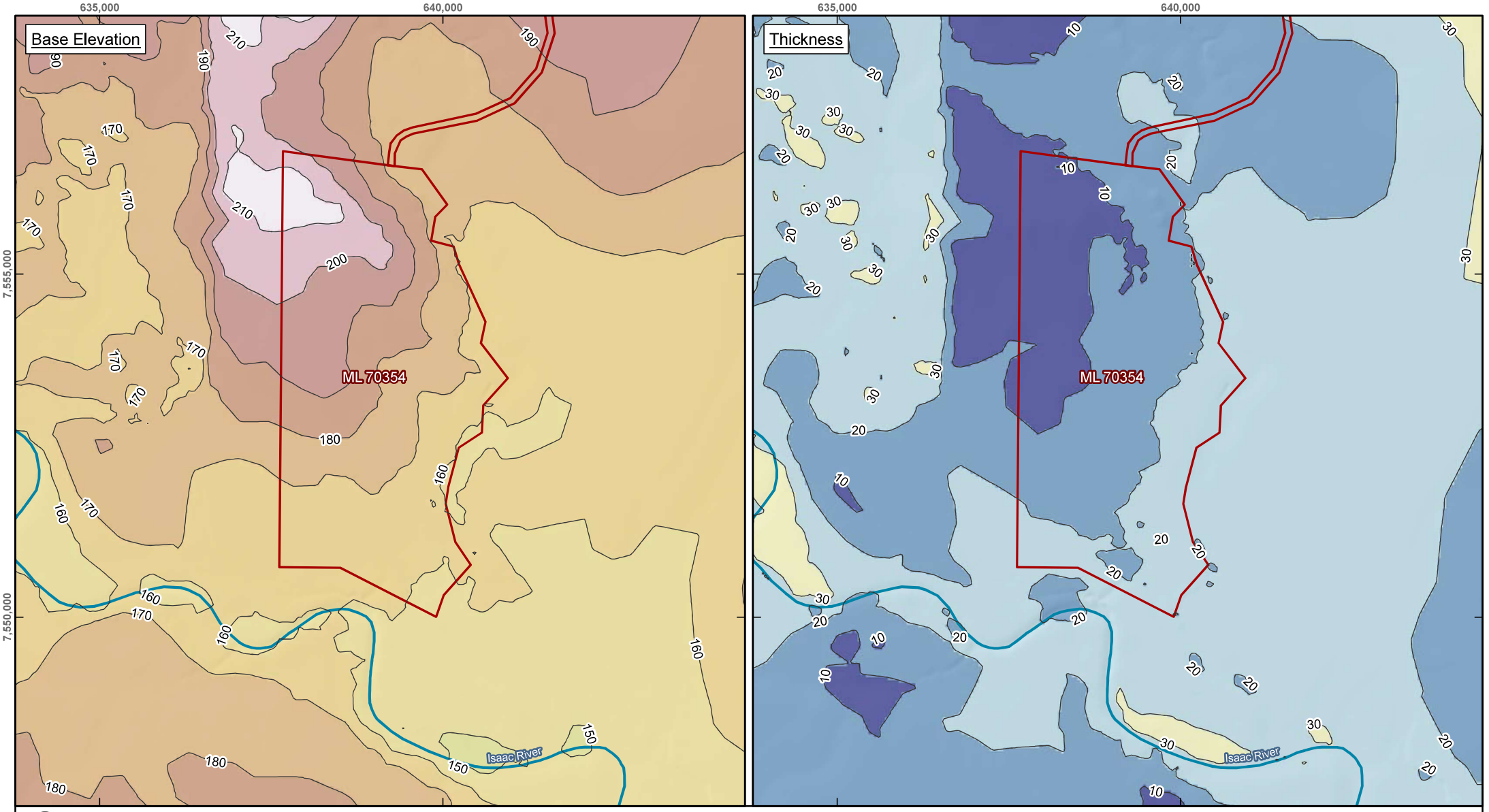
Figure 3-5 Geological cross sections and pre-mining groundwater conceptual model

Regolith

The surficial regolith material covering much of the Study Area comprises Cainozoic (Quaternary to Tertiary) aged sediments, including alluvium and colluvium, as well as unconsolidated to semi-consolidated material derived from extensive weathering of the underlying Permian bedrock. Older alluvial (TQa) sediments are distributed extensively across the region and colluvium and residual deposits (Qr and Qr\b) within isolated patches to the north. The Cainozoic (Tertiary) aged Duaringa Formation (Tu) is also mapped at surface at the southern end of the Study Area. Drilling logs indicate the sequences exhibit similar geological characteristics and have therefore been grouped as 'regolith' within this report.

Based on geological logs, the regolith comprises a heterogeneous distribution of fine to coarse grained sand, clay, sandstone and claystone. The regolith material is generally 15 m to 45 m thick. The units are highly weathered, with the depth of weathering extending to around 50 mBGL, into the underlying coal measures (IMC, 2014). The extent and thickness of the regolith material is presented in **Figure 3-6**, interpolated based on geological data and the CSIRO Soil and Landscape Grid of Australia (CSIRO, 2015) data.

Regolith deposits are present in the eastern half of the Project aligned with the southern and eastern areas of the Project near the Isaac River and North Creek. This area is comprised of Quaternary aged sediments of colluvium and residual deposits (Qr) comprising clay, silt, sand, gravel and soil. In the western half of the Project the surface is comprised of weathered Permian to approximately 20 mBGL to 30 mBGL (IMC, 2014). The depth of weathering increases from approximately 20 mBGL to 30 mBGL north of the Isaac River to 70 mBGL south of the Isaac River, within the Study Area. The depth of weathering may reflect the thicker tertiary sediments but may also be due to the more resistant nature of the Permian sediments in the Project (Lance Grimstone & Associates, 2003).



Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:75,000 at A4
Project Number:	660.30254
Date:	10-Mar-2023
Drawn by:	NT

LEGEND

- Major Watercourse
- Moorvale South Mining Lease

Elevation (mAHD)

- 120 - 130
- 130 - 140
- 140 - 150
- 150 - 160
- 160 - 170
- 170 - 180
- 180 - 190
- 190 - 200
- 200 - 210
- 210 - 220
- Elevation Contour (mAHD)

Thickness (m)

- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- Thickness Contour (m)

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

BASE ELEVATION AND THICKNESS OF SURFICIAL UNITS

FIGURE 3-6

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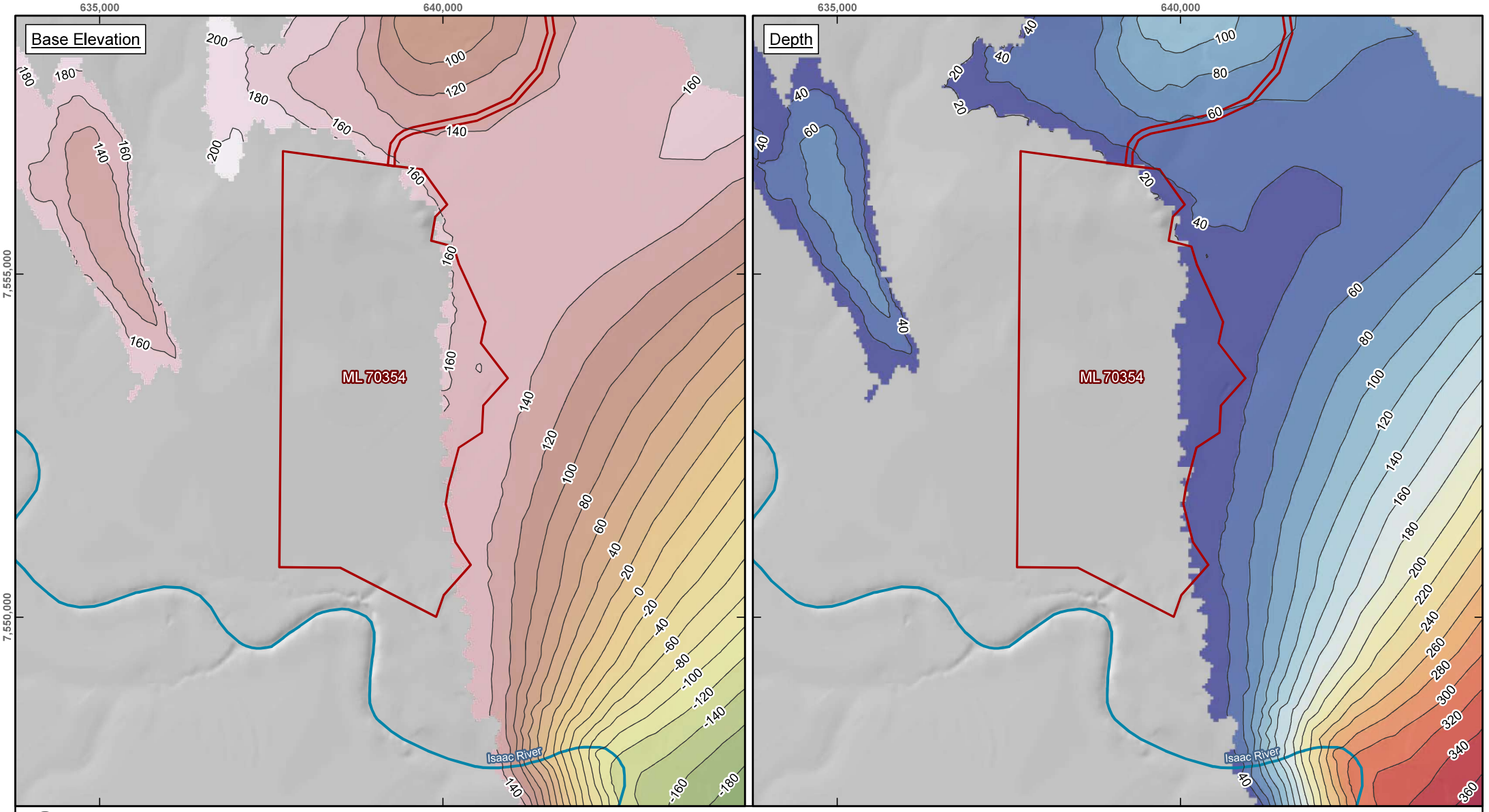
3.2.2 Triassic

The Triassic units include an isolated pocket of the Clematis Group to the east of the Isaac River approximately 8 km southeast from the Project, and the more regionally extensive Rewan Group. The outcrop of Clematis Group is approximately 100 m thick and forms a localised topographic high at an elevation of around 330 m AHD. The Clematis Group comprises cross-bedded quartzose sandstone with minor conglomerate and mudstone. Its distance from the Project site renders the Clematis Group as not relevant to this groundwater assessment.

Regionally the Rewan Group unconformably overlies the Permian coal measures as in-fill material. The unit is largely absent where the Permian coal measures occur at outcrop and thickens towards the Isaac River. At the Project, there are no outcrops of the Rewan Group however it underlies the Cainozoic sediments in places on the Project site.

The Triassic aged Rewan Group includes two formations, the Rewan Formation that comprises green lithic sandstone, pebbly lithic sandstone, green to reddish brown mudstone and minor volcanolithic pebble conglomerate, and the underlying Sagittarius Sandstone unit that comprises lithic sandstone interbedded with mudstones and siltstones with scattered carbonaceous plant material.

The Rewan Group occurs beneath the alluvium and regolith and has an average thickness of 3 m with a maximum thickness of around 24 m where it occurs within the Project. The transition from the Rewan Group to the underlying Permian coal measures is generally difficult to define. Transition is often based on the change in colour (green-grey to blue-grey) and depth (15 m to 60 m) above the first major coal seam (Leichhardt Seam) of the Rangal Coal Measures (JB Mining Services, 2016). Interpolated base elevation and depth contours of the Rewan Group in proximity to the Project are presented in **Figure 3-7**.



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3.2.3 Permian Coal Measures (Blackwater Group)

Permian coal-bearing sediments of the Blackwater Group form the main economic resource of the numerous mines in the Study Area. In increasing depth (age) order, the major coal measures in the Project include the:

- Rangal Coal Measures;
- Fort Cooper Coal Measures; and
- Moranbah Coal Measures.

Each of these units is discussed further below.

Rangal Coal Measures

The shallowest coal measures, the Rangal Coal Measures, have an average thickness of 85 m with a maximum of 160 m thickness at the Project with a depth ranging from 16 mBGL to 193 mBGL and contain the target seams for the Project. The Rangal Coal Measures comprise light grey, cross-bedded, fine to medium grained labile and well cemented sandstones, grey siltstones, mudstones, shale and coal seams. The non-coal portions of the sequence being predominantly sandstones, siltstones, mudstone and shales are referred to as interburden in the mining context. The stratified sequences can be fractured and displaced through faulting. However, drilling logs indicate this is localised along fault lines and is logged as small, discontinuous horizons vertically. Further details on the structural geology are outlined within **Section 3.2.4**.

The principal coal seams of interest in the Project are the Lower Leichhardt and Vermont Upper Seams of the Rangal Coal Measures:

- Lower Leichhardt Seam – average 4 m thick with a maximum of 6 m thickness;
- Vermont Upper Seams – with a maximum of 4 m thickness.

The Leichhardt Seam occurs at a depth ranging from 16 mBGL to 101 mBGL within the Project. The Vermont Seam is separated from the overlying Leichhardt Seam by an average of 40 m of interburden material. The Vermont Seam has been in part intruded and largely coked in the Project (Lance Grimstone & Associates, 2003). A representative stratigraphic column for the Project is shown in **Figure 3-8**, from IMC (2014). It is noted that the stratigraphic column refers to laminite, however, this is likely to be a misinterpretation and is actually colluvium and regolith. Based on the site geological model and drilling data, interpolated structure and depth contours of the Lower Leichhardt Seam and Vermont Upper Seam at the Project are presented in **Figure 3-9** and **Figure 3-10**, respectively.

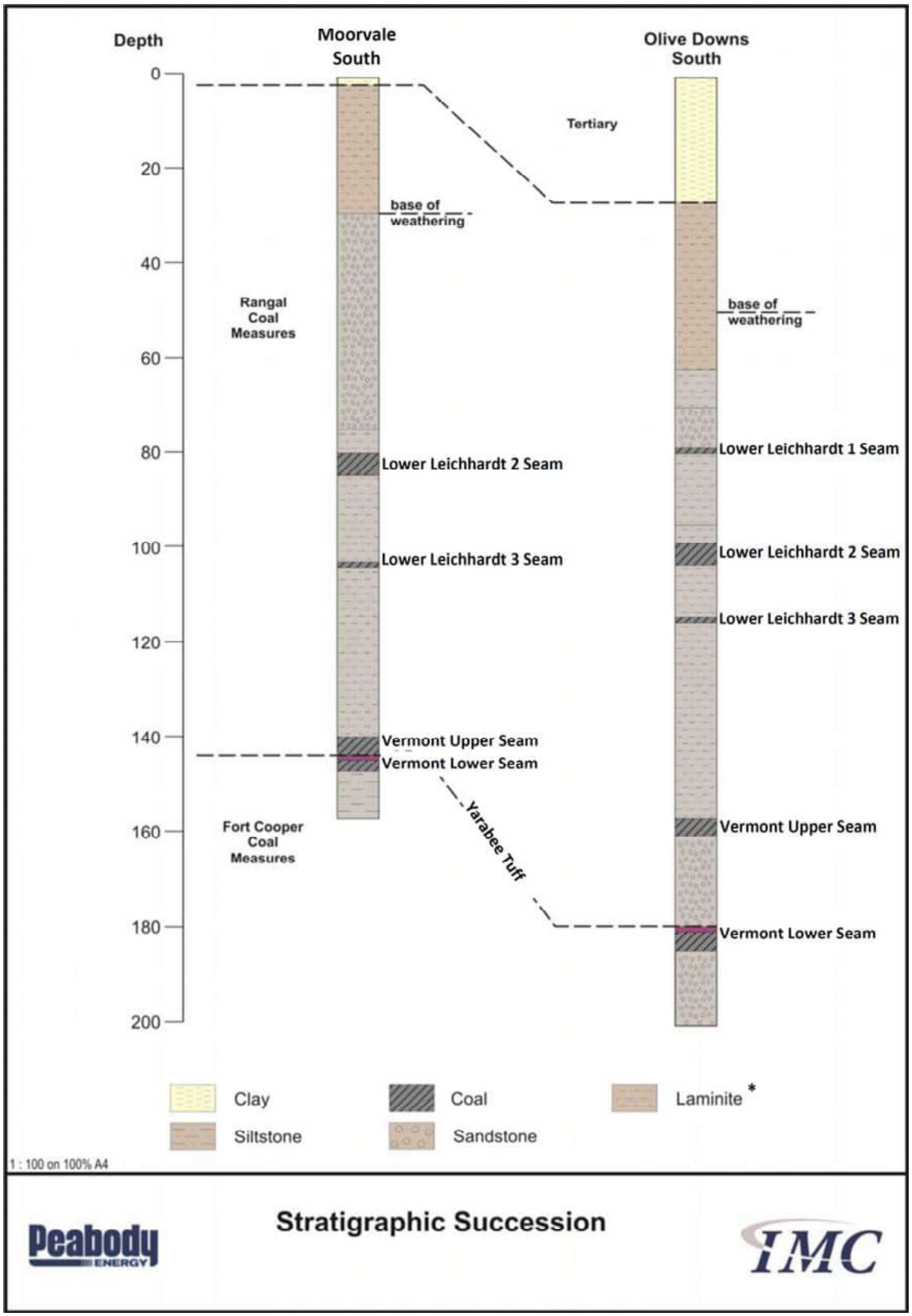
Fort Cooper Coal Measures

The Fort Cooper Coal Measures conformably underlie the Rangal Coal Measures and occur at outcrop within the Project. The transition between the Rangal Coal Measures and the Fort Cooper Coal Measures is marked by the Yarrabee Tuff which immediately overlies the Vermont Lower Seam. The Yarrabee Tuff is a basin-wide marker bed comprised of weak, brown tuffaceous claystone, ranging in thickness up to 2.5 m. On average the Fort Cooper Coal Measures are 258 m thick with a maximum thickness of 309 m within the Project and have a depth ranging from 78 mBGL to 494 mBGL. They are comprised of tuffaceous sandstones, siltstones, mudstones and coal seams. The Fort Cooper Coal Measures in the Project were hard to penetrate during exploration drilling and appear locally to have been silicified by fluid flow along fault planes generated by igneous activity known to occur in the area. The Girrah Seam, which is approximately 10 m to 20 m thick, lies near the top of the formation (Lance Grimstone & Associates, 2003).



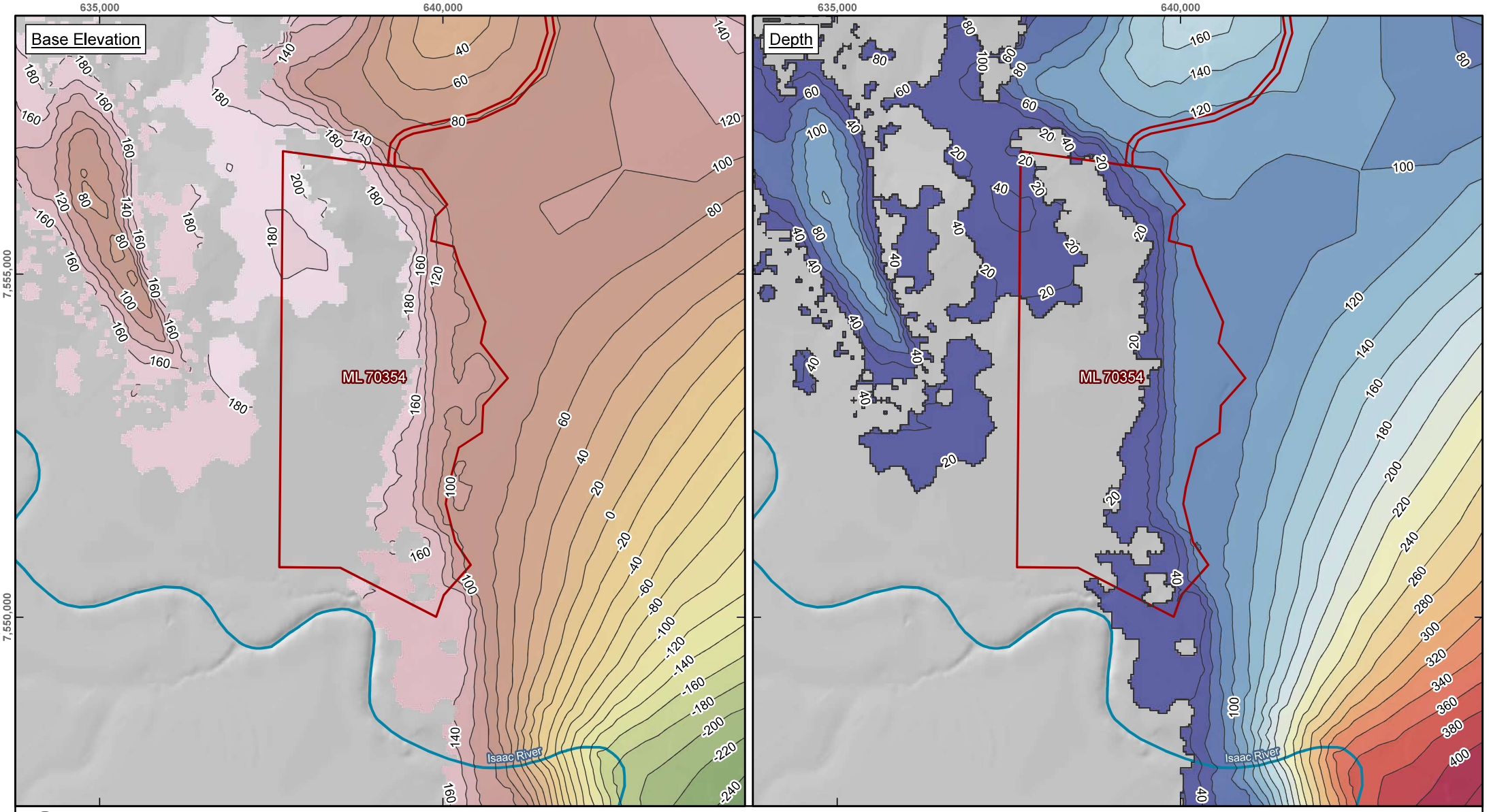
Moranbah Coal Measures

The Moranbah Coal Measures conformably underlie the Fort Cooper Coal Measures. The coal measures occur at sub-crop in the distant west of the Study Area, where they are targeted as part of the Caval Ridge, Peak Downs and Saraji mines. The Moranbah Coal Measures comprise volcanic lithic sandstones, with lesser siltstone, mudstone, conglomerate and coal. Within the Project the geological model indicates that the Moranbah Coal Measures are present with a depth ranging from 236 mBGL to 617 mBGL.



See Section 3.2.3 for explanation

Figure 3-8 Representative stratigraphic section for the Project (IMC, 2014)



0 1 2 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:75,000 at A4
Project Number:	660.30254
Date:	10-Mar-2023
Drawn by:	NT

LEGEND

- Major Watercourse
- Moorvale South Mining Lease
- Elevation Contour (mAHD)
- Depth Contour (mAHD)

Elevation (mAHD)

-260 - -240	-100 - -80	60 - 80	
-240 - -220	-80 - -60	80 - 100	
-220 - -200	-60 - -40	100 - 120	
-200 - -180	-40 - -20	120 - 140	
-180 - -160	-20 - 0	140 - 160	
-160 - -140	0 - 20	160 - 180	
-140 - -120	20 - 40	180 - 200	
-120 - -100	40 - 60	200 - 220	

Depth (m)

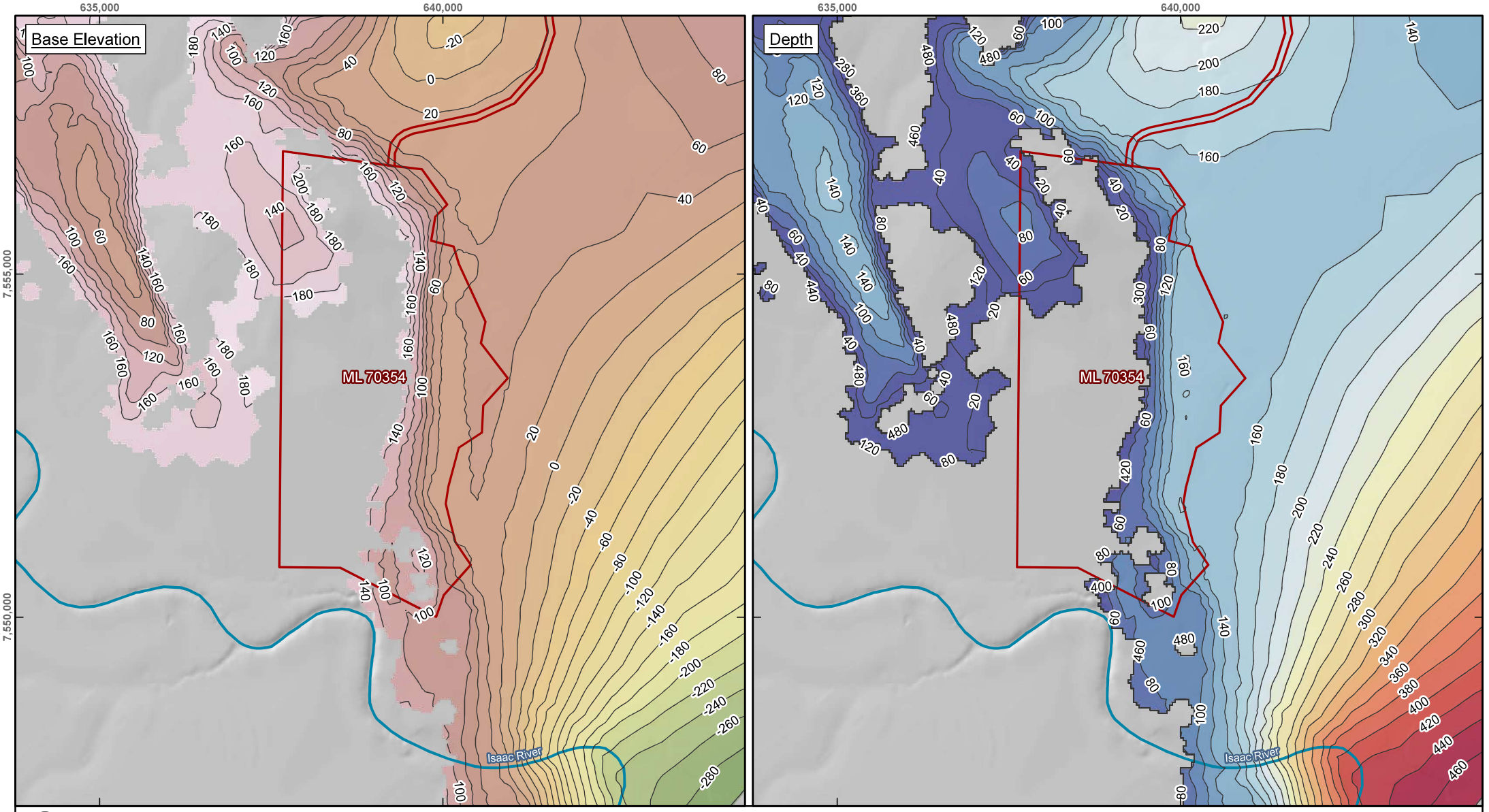
400 - 420	240 - 260	80 - 100
380 - 400	220 - 240	60 - 80
360 - 380	200 - 220	40 - 60
340 - 360	180 - 200	
320 - 340	160 - 180	
300 - 320	140 - 160	
280 - 300	120 - 140	
260 - 280	100 - 120	

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

BASE ELEVATION AND DEPTH TO LEICHHARDT SEAM

FIGURE 3-9

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3.2.4 Structural Geology

The Permian coal measures occur as stratified sequences of interbedded and consolidated sandstone, siltstone, mudstone and coal. The Permian coal measures occur as a southerly plunging syncline structure, with the coal measures present at outcrop to the east and west of the Isaac River. The Project is located on the western limb of a major syncline where the Permian coal measures dip eastward (Lance Grimstone & Associates, 2003). The Permian coal measures outcrop within most of the Project, to the west of North Creek and north of the Isaac River.

The Bundara Intrusive Complex occurs to the north-east of the Project. The Fort Cooper Coal Measures are heavily intruded beneath the Project and the intrusive activity extends up the sequence to include the Vermont Upper Seam over much of the Project. The Fort Cooper Coal Measures are silicified and heat affected. The most impact upon the coal resources appears to be to the Vermont Upper Seam, which is intruded for much of its 7 km strike length within the Project and extends for a short distance south of the Isaac River. The major igneous intrusion, other than through the Vermont Upper Seam, is the Feeder Dyke running west southwest across the Project (Lance Grimstone & Associates, 2003).

Compressive deformation of the Bowen Basin units occurred from the Middle to Late Triassic period, resulting in regional uplift and erosion, folding of sediments and strike-slip movement along faults to accommodate contraction. This led to a series of north-south trending faults with (generally) westward directed thrusts, which bound the eastern margin of the basin (Green, 1997). All faulting is truncated by the Tertiary unconformity, with little to no fault activity during the Cainozoic (Esterle et al., 2002, Clark et al., 2011). Regional faults are shown on **Figure 3-2** including potential faults identified as part of the Olive Downs TEM survey in 2017.

The Study Area is moderately to highly faulted with several regional fault structures with a dominant north-north-west trend. The faults have throws of up to 100 m (JB Mining Services, 2016), resulting in vertical displacement in some places. On the western side of the Study Area is the Isaac Thrust Fault, which has up to 500 m vertical displacement. There is a south-west trending fault zone crossing the Project through the nose in the Vermont Upper Seam sub-crop. Other parallel major faults with displacements from 5 m to 15 m are interpreted to cross the Project at intervals to the north (IMC, 2014).

4.0 Hydrogeology

Based on the geological setting presented above, the hydrogeological regime relevant to the Project comprises the following hydrogeological units:

- Cainozoic sediments and weathered strata:
  - Quaternary alluvium – unconfined aquifer (water-bearing strata of permeable sand or gravel) localised along Isaac River and downstream reaches of North Creek;
  - Quaternary colluvium / regolith – unconfined and largely unsaturated unit bordering alluvium;
- Permian coal measures:
  - Low permeability interburden units; and
  - Coal sequences that exhibit secondary porosity through cracks and fissures.

During the drilling and installation of the Project groundwater monitoring bores by Golder in 2019, three main hydrogeological units were identified (**Table 4-1**). Faults and associated fracture zones have the potential to provide preferential flow pathways between aquifers. Aquifer interconnectivity may occur near structural features and may connect the alluvium with the Rangal Coal Measures and/or the Fort Cooper Coal Measures (Golder, 2019b).

This section discusses each of the hydrogeological units relevant to the Project, covering hydraulic properties, groundwater occurrence, hydraulic gradients, recharge, discharge, groundwater quality and water use.

Table 4-1 Hydrogeological units identified within the Project during drilling (Golder, 2019b)

Hydrogeological unit	Lithology	Main seams	Aquifer type
Quaternary alluvium (Isaac River and downstream North Creek)	Clay, silt, sand and gravel	N/A	Unconfined
Rangal Coal Measures	Siltstone, sandstone, carbonaceous shale and coal	Leichhardt Lower Seams (LL1, LL2, and LL3) and Vermont Upper seam (VU)	Mainly confined/fractured
Fort Cooper Coal Measures	Siltstone, sandstone, carbonaceous shale and coal	Vermont Lower Seam (VL) and Girrah Seam	Semi-confined to unconfined/fractured in the western part of the Project and confined/fractured in the eastern part of the Project

4.1 Groundwater Monitoring

Peabody has installed a Project groundwater monitoring network that comprises a total of 14 bores and one vibrating wire piezometer (VWP) containing four sensors. The monitoring network was completed in 2019. The network's monitoring bores intersects a range of hydrostratigraphic units, including:

- Alluvium;
- Coal seams of the Rangal Coal Measures;
- Overburden material of the Rangal Coal Measures;
- Coal seams of the Fort Cooper Coal Measures.

Peabody has also installed recently 10 bores in early 2024 for the Moorvale South Extension Project (MVSX) located immediately north of the Project (SLR, 2024). The newly installed bores include six bores installed into the Permian coal measures and four bores installed into the shallow groundwater system in the vicinity of North Creek, noting that no alluvial aquifer was identified associated with North Creek upstream of the MVS Project in the drilling program. However, comprehensive monitoring data from these new bores was not yet available at the time of the production of this assessment but is intended to be assessed as a component of the future groundwater assessment supporting the approvals process for the MVSX.

The locations of the Project monitoring bores, as well as newly installed MVSX groundwater monitoring bores are shown in **Figure 4-1** and details provided in **Table 4-2** and **Table 4-3** respectively.

Peabody also has a data sharing agreement with the Olive Downs Project (Pembroke Resources Pty Ltd), which has a groundwater monitoring network within the Study Area. Some of the groundwater level and quality information from the Olive Downs monitoring network has been included in this report. The details of the network are shown in **Table 4-4** and the locations of the monitoring bores and VWPs are shown in **Figure 4-2**.

Table 4-2 Project groundwater monitoring network

Mine Bore ID	Site ID	Type	Easting (GDA94)	Northing (GDA94)	Ground elevation (m AHD)	Bore screen or VWP depth (mBGL)	Bore depth (mBGL)	Monitored unit
MS0234	ODN18MB1	MB	640275	7547938	182.39	39 – 42	43	Leichhardt Seam
MS0235	ODN18MB2	MB	640267	7547944	182.45	14.8 - 18.8	19.8	Alluvium
MS0128	ODN18MB3	MB	639750	7551426	183.90	28.8 - 34.8	34.8	Leichhardt Seam
-	ODN18MB4	MB	640684	7549869	180.60	15.38 - 21.38	21.4	Alluvium
MS0135	ODN18MB5	MB	640000	7551811	184.90	7.9 - 10.9	10.9	Alluvium
MS0163	ODN18MB6	MB	639944	7551802	184.70	111.6 - 117.6	118.6	Vermont Upper Seam
MS0117	ODN18MB7	MB	640310	7554734	191.60	27.72 - 33.72	33.7	Alluvium
MS0129	ODN18MB8	MB	638921	7550183	184.20	18.48 - 24.48	24.5	Alluvium
MS0113	ODN18MB9	MB	640089	7557236	193.80	19.39 - 25.39	25.4	Regolith / Rangal Overburden
MS0125	ODN18MB10	MB	639451	7554580	198.20	112 – 124	124	Fort Cooper Coal Measures - Coal
MS0162	ODN18MB11	MB	638599	7553465	199.90	90 – 99	100	Fort Cooper Coal Measures - Coal
MS0236	ODN18MB12	MB	640276	7547944	182.40	109 – 113	113.5	Vermont Upper Seam
MS0231	ODN18VWP1	VWP	640293	7547983	181.79	13.5 38.3 44.8 118.3	128 (total drilled depth)	Alluvium Rangal Overburden Leichhardt Seam Vermont Lower Seam
MS0233	ODN18TB1	TB	640316	7547931	182.29	44 – 50	52	Leichhardt Seam
MS0232	ODN18TB2	TB	640301	7547933	182.28	13.4 - 19.4	20.4	Alluvium

mBGL – metres below ground level

mAHD – metres Australian Height Datum

MB – open standpipe monitoring bore constructed with Class 18 50 mm PVC

TB – test bore constructed with Class 18 200 mm PVC

VWP – vibrating wire piezometer

Table 4-3 Moorvale South Extension Groundwater Monitoring Network installed in 2024

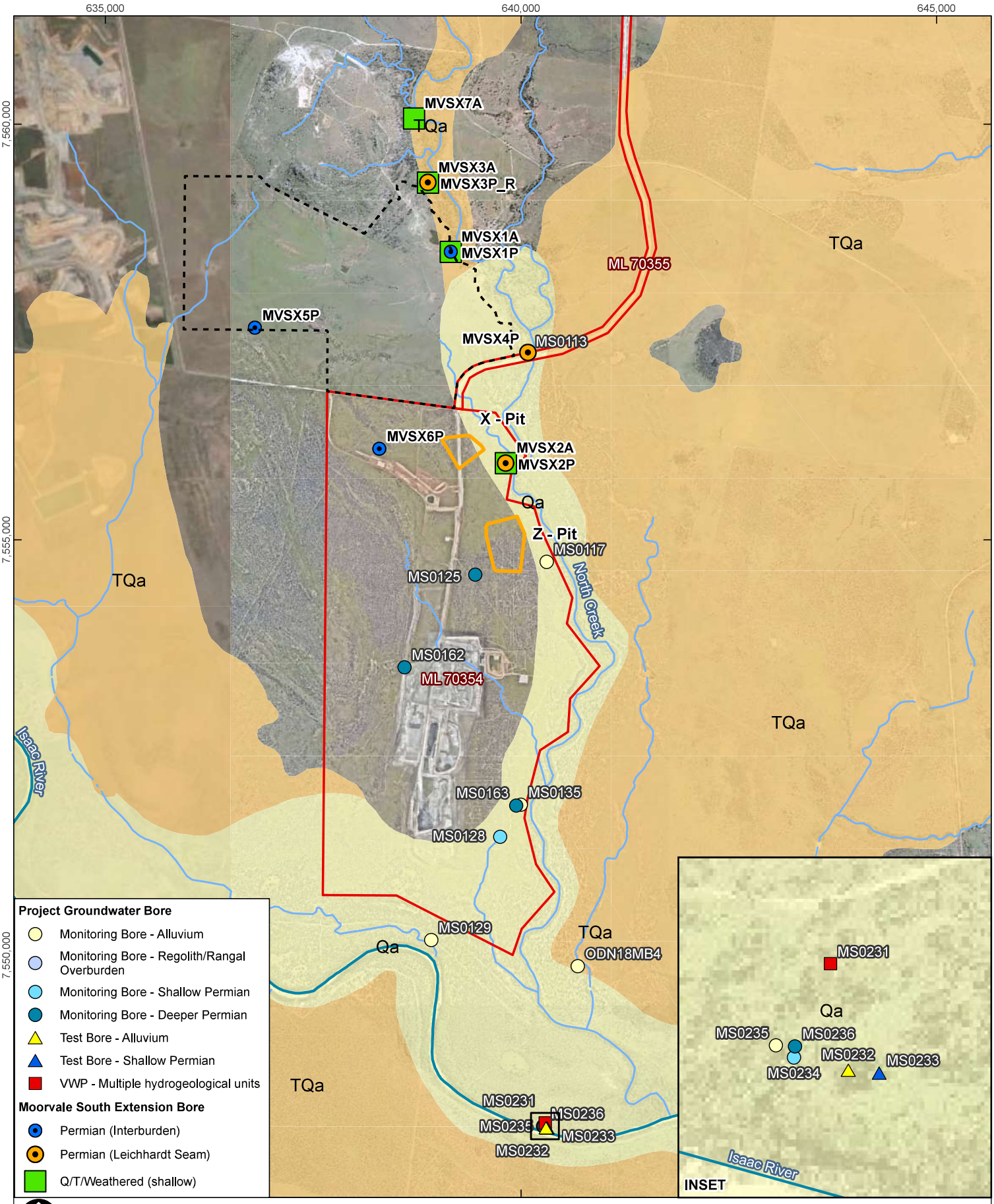
Bore ID	Easting (GDA94)	Northing (GDA94)	Ground elevation (mAHD)	Top of Casing Elevation (mAHD)	Bore screen depth (mBGL)	Bore depth (mBGL)	Monitored unit
MVSX1A	639157	7558463	195.42	196.15	16.5 – 19.5	20	Weathered Tertiary sediments
MVSX1P	639156	7558466	195.29	195.87	44.5 – 47.5	47.5	Rangal Coal Measures Interburden
MVSX2A	639820	7555922	193.04	193.82	13.5 – 16.5	17	Weathered Tertiary sediments
MVSX2P	639816	7555922	193.07	193.89	32 – 35	35.5	Rangal Coal Measures (Leichhardt Coal Seam)
MVSX3A	638881	7559297	199.29	200.02	8.5 – 11.5	12	Weathered Rangal Coal Measures
MVSX3PR	638880	7559300	199.31	200.06	44.5 – 47.5	48	Rangal Coal Measures (Leichhardt Coal Seam)
MVSX4P	640084	7557254	193.65	194.43	141 - 144	145	Rangal Coal Measures (Leichhardt Coal Seam)
MVSX5P	636799	7557552	217.21	217.96	56 – 59	60	Fort Cooper Coal Measures
MVSX6P	638296	7556095	214.87	215.67	20.5 – 23.5	24	Fort Cooper Coal Measures
MVSX7A	638715	7560069	200.03	200.8	10.5 – 13.5	14	Weathered Rangal Coal Measures



Table 4-4 Olive Downs groundwater monitoring network

Mine Bore ID	Site ID		Type	Easting (GDA94)	Northing (GDA94)	Bore screen or VWP depth (mBGL)	Monitored unit	Total drilled depth (mBGL)
IF3839P	GW01s		MB	642481	7547491	13 - 19	Alluvium	20
IF3837P	GW02s		MB	641152	7546517	7 - 19	Alluvium	19
IF3838P	GW02d		MB	641141	7546507	118.65 - 127.65	Vermont Upper	137
IF3841P	GW04		MB	643388	7544973	6 - 15	Alluvium	41
IF3835P	GW06s		MB	639329	7542005	4 - 10	Regolith	10
VP3833P	GW08s		MB	645312	7539839	6 - 12	Alluvium	13
VP3831P	GW12s		MB	641504	7532788	30 - 42	Regolith	42
VE3827P	GW16s		MB	660836	7525291	12 - 27	Regolith	27
VE3829P	GW18s		MB	656889	7522809	9 - 15	Alluvium	15
VE3830P	GW18d		MB	656868	7522804	174 - 183	Vermont Upper	183
VE3825P	GW21s		MB	661590	7521656	3 - 9	Regolith	9
VE3826P	GW21d		MB	661585	7521655	148 - 157	Rangal Interburden	157
IF3856P	S7		MB	641443	7545828	14.5 – 20.5	Alluvium	21
IF3857P	S9		MB	641767	7545426	14.5 – 20.5	Alluvium	22
IF3858P	S11		MB	642455	7545332	8 - 14	Alluvium	14
IF3859P	S10		MB	642552	7546035	18 - 24	Alluvium	24
IF3860P	S8		MB	642340	7546343	9 - 15	Alluvium	15
IF3861P	S6		MB	642054	7546721	11.5 – 17.5	Alluvium	21
IF3862P	S4		MB	641567	7546845	11.5 – 17.5	Alluvium	18
IF3863P	S5		MB	642239	7547332	11.5 – 17.5	Alluvium	24
IF3864P	S2		MB	641386	7547617	11.5 – 17.5	Alluvium	18
IF3840P	GW01d	VWP1	VWP	642479	7547491	402	VU	413
		VWP2				352	Leichhardt Seam	

Mine Bore ID	Site ID		Type	Easting (GDA94)	Northing (GDA94)	Bore screen or VWP depth (mBGL)	Monitored unit	Total drilled depth (mBGL)
		VWP3				221.5	Rewan	
		VWP4				63	Rewan	
IF3836P	GW06d	VWP1	VWP	639334	7542008	190.7	Fort Cooper - siltstone	203
		VWP2				136.5	Fort Cooper - coal	
		VWP3				117.5	Fort Cooper - sandstone	
		VWP4				38	Fort Cooper - sandstone	
VP3834P	GW08d	VWP1	VWP	645312	7539846	177	Leichhardt Seam	585
		VWP2				137	Rangal Overburden	
		VWP3				94	Rewan	
		VWP4				70	Rewan	
VP3832P	GW12d	VWP1	VWP	641495	7532795	505	Leichhardt Seam	519
		VWP2				484.5	Leichhardt Seam	
		VWP3				391	Rangal Overburden	
		VWP4				108	Rewan	
VE3828P	GW16d	VWP1	VWP	660835	7525287	327	Vermont Upper	339
		VWP2				269	Leichhardt Seam	
		VWP3				147	Rewan	
		VWP4				91	Rewan	



Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:60,000 at A4
Project Number:	660.30254.00000
Date Drawn:	28-Jun-2024
Drawn by:	AS

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

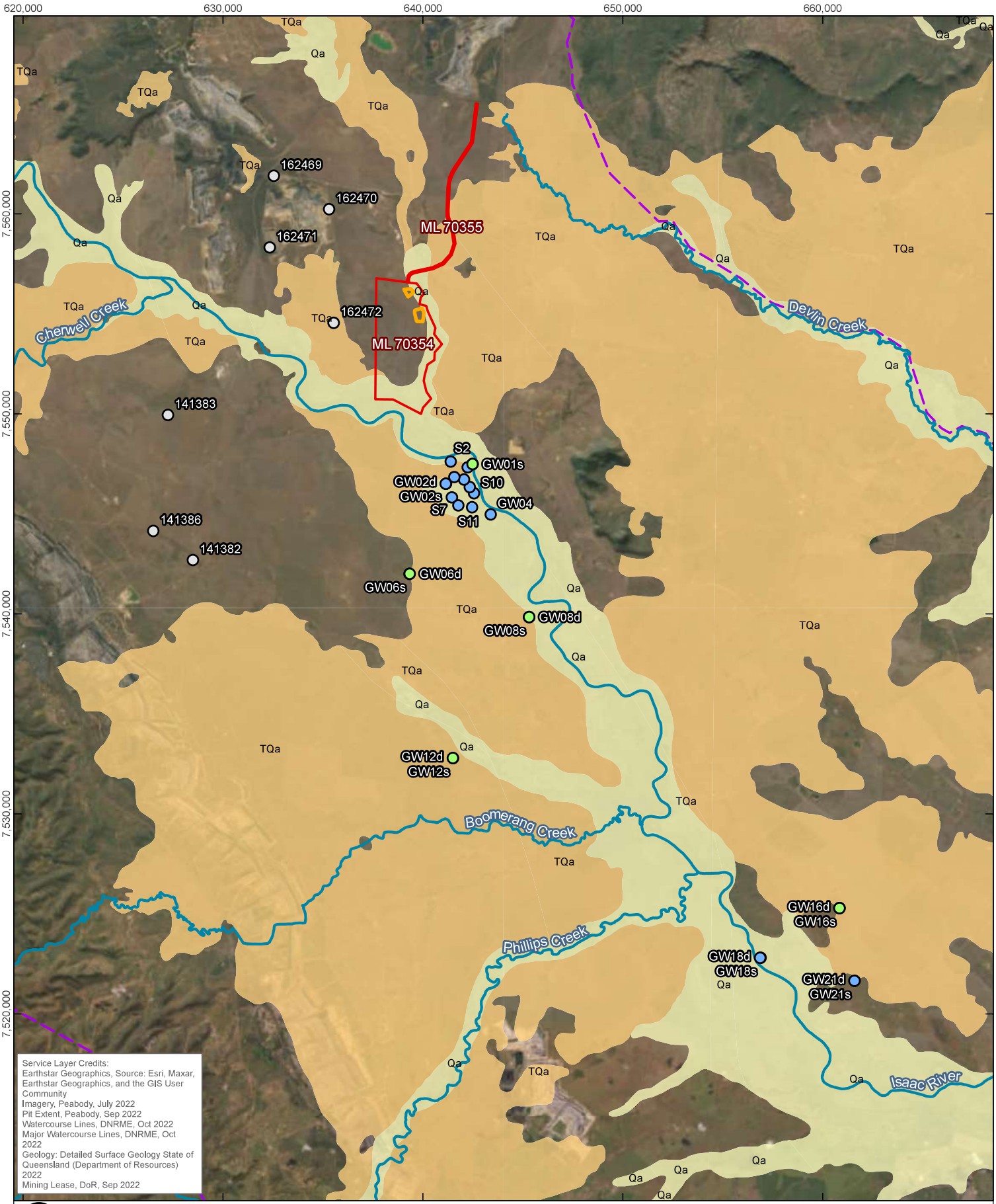
MOORVALE SOUTH GROUNDWATER MONITORING

SLR

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FIGURE 4-1

Path: \\au.slr.local\Corporate\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx



Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	660.30254.00000
Date Drawn:	11-Jun-2024
Drawn by:	AS

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

OLIVE DOWNS SOUTH GROUNDWATER MONITORING NETWORK INCLUDING LANDHOLDER BORES

SLR

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FIGURE 4-2

Path: \\au.slr.local\Corporate\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx

4.2 Hydraulic Properties

Hydraulic testing was conducted on major geological units for the Project in 2019 (SLR, 2019a, Golder, 2019b) and in 2017 for the Olive Downs groundwater assessment (HydroSimulations, 2018), which is directly south of the Project Area. Hydraulic testing included laboratory geotechnical testing of core samples for horizontal hydraulic conductivity (Kh) and vertical hydraulic conductivity (Kv), and field testing using methods such as monitoring bore slug testing, packer testing, pumping tests, as well as documenting airlift yields. In July 2019 step tests and constant rate pumping tests were conducted at two Project bores (MS0232 and MS0233) approximately 1 km south of the Project ML boundary. The purpose of these tests was to establish hydraulic characteristics of the Isaac River alluvium and coal seams of the Rangal Coal Measures.

Hydraulic testing is also planned for the newly installed MVSX bores north of the Project later in 2024 and will be reported as a component of the future groundwater assessment supporting the approvals process for the MVSX.

The Winchester South Project is located approximately 3 km southwest of the Project Area and hydraulic testing included slug tests on the monitoring network, core sample testing from the overburden and underburden of the coal seams, as well as downhole packer tests targeting major faults (SLR, 2022a).

The following sections present a summary of the available hydraulic conductivity data and comparison to reported data from external sources.

4.2.1 Hydraulic Conductivity Data

The database for field hydraulic testing results from the MVS Project bores is presented as **Table 4-5**. The entire database of available results for horizontal and vertical hydraulic conductivity from MVS and surrounding relevant sites is also presented graphically as **Figure 4-3**. The data are presented separately for each test method as results can vary based on the type of testing and analysis undertaken.

Figure 4-3 shows that the hydraulic conductivity of the alluvium is variable, ranging from 0.01 m/day to almost 10 m/day, which reflects the heterogeneous nature of the alluvial sediments. Project pumping tests conducted in 2019 reported hydraulic conductivity values in the range of 2.1 to 2.7 m/day which is within the range of values from slug testing previously conducted across the Study Area.

The Rewan Group sediments exhibit a low hydraulic conductivity, typically less than 10^{-4} m/day, similar to the interburden/overburden material of the Rangal Coal Measures. Two interburden slug tests conducted within the Winchester South Project Area in 2012 identified two bores (R2034 and R2054) with an unusually elevated hydraulic conductivity of just under 1 m/day, which is thought to be associated with faulting and fracturing in the vicinity of these bores. Other results from this testing show an interburden hydraulic conductivity of at least an order of magnitude less than that of coal seams at similar depths. Hydraulic testing of core samples from overburden and underburden of the coal seams within the Winchester South Project Area conducted in 2019 show results in the same range as those observed at the Moorvale South Project, Olive Downs Project, and previous testing within the Winchester South Project Area.

The coal seams of the Permian coal measures generally record higher hydraulic conductivity than most of the interburden/overburden tests. This is due to the dual porosity of the coal seams, with a primary matrix porosity and a secondary (dominant) porosity provided by fractures (joints and cleats) and supports the concept of the coal seams forming the dominant groundwater zones of the Permian units. The Project pumping tests conducted in 2019, performed on the Leichhardt and Vermont Seams, reported hydraulic conductivity



ranges between 0.5 to 1.5 m/day, and 0.5 to 1.2 m/day, respectively. These values generally align with previous testing of the Permian coal measures across the Study Area.

Figure 4-3 shows that the hydraulic conductivity of the Rewan Group as well as the Permian coal measures generally declines with depth, due to increasing overburden pressure reducing the aperture of secondary porosity features.

Comparison of vertical and horizontal hydraulic conductivities indicates that within the Rewan Group the vertical hydraulic conductivity is around 10% to 40% of horizontal hydraulic conductivity. Anisotropy for the Rangal Coal Measures interburden material was more variable, with vertical hydraulic conductivity ranging between 11% and 76% of horizontal hydraulic conductivity. During the Olive Downs Project groundwater assessment, core samples were collected within the coal seam roof/ floor material and proximal to fault zones, where practicable (i.e. for competent samples). Results for these samples indicated a vertical hydraulic conductivity of between 50% to 160% of horizontal hydraulic conductivity.

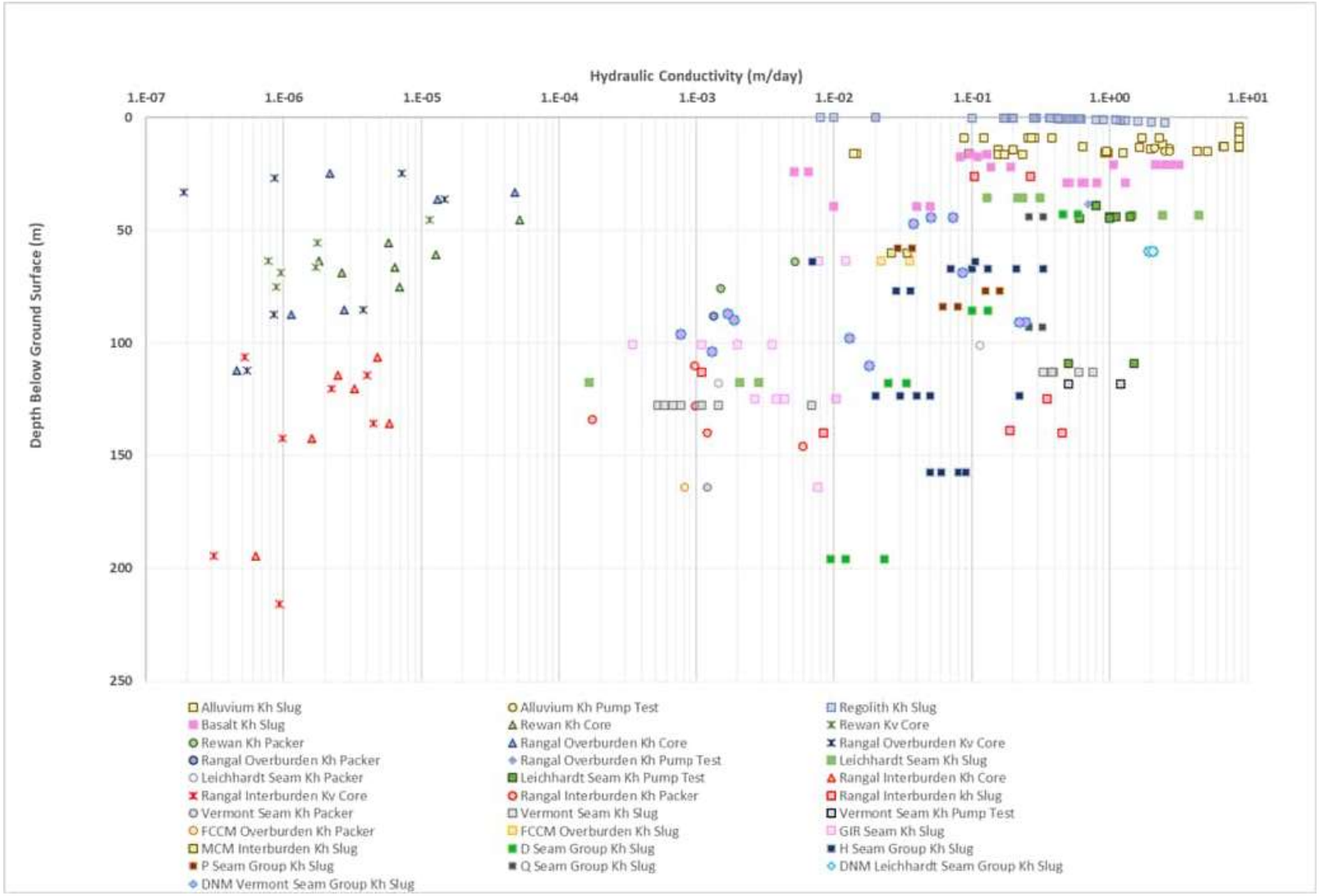


Figure 4-3 Graphical summary of all available hydraulic testing results near to the Project

Table 4-5 Summary of hydraulic conductivity estimates at MVS Project bores

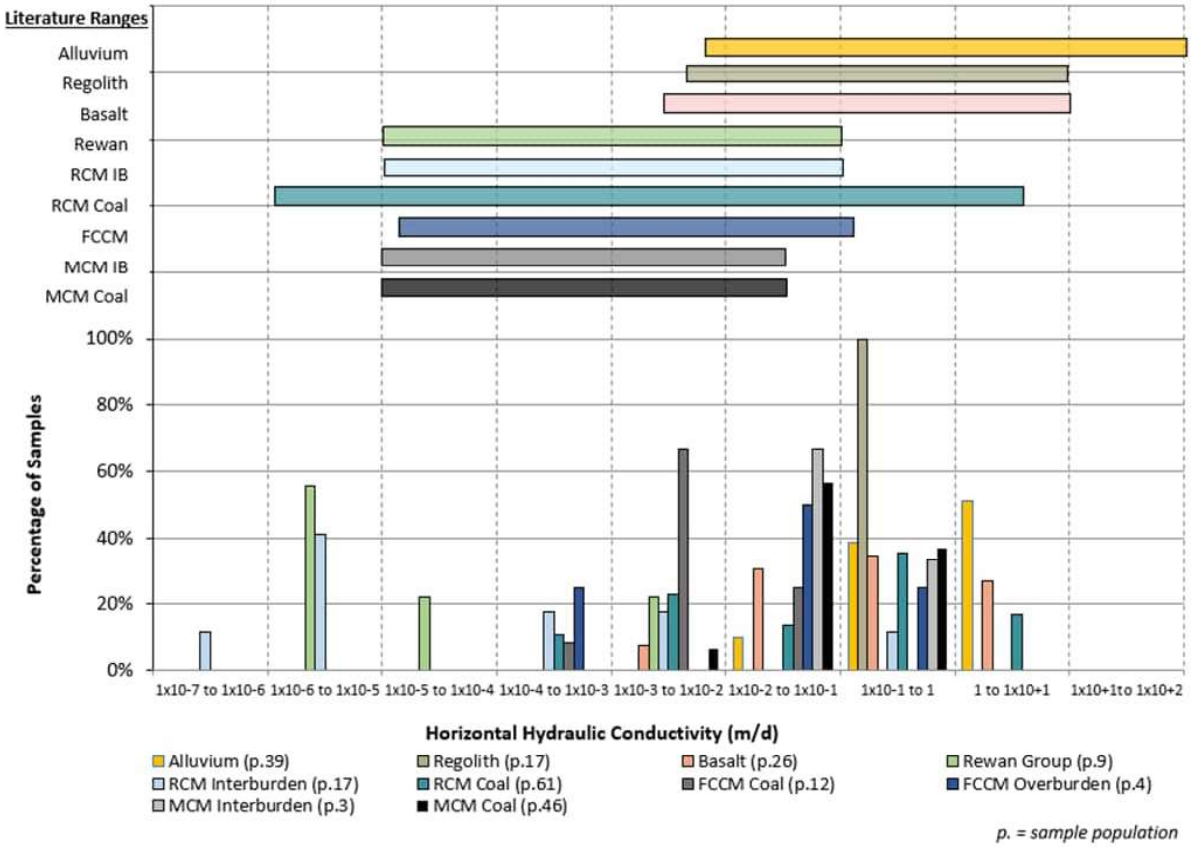
Bore	Formation	Test Type	Horizontal Hydraulic Conductivity (m/day)				
			Test Result	Bore Min	Bore Max	Bore Mean	Bore Mean (geo)
MS0117	Alluvium	Injection	0.095	0.014	0.095	0.041	0.027
		Injection	0.015				
		Injection	0.014				
MS0129	Alluvium	Slug	0.156	0.13	0.23	0.17	0.17
		Slug	0.233				
		Slug	0.13				
		Slug	0.173				
MS0135	Alluvium	Injection	0.0003	0.0003	0.003	0.001	0.0009
		Injection	0.003				
MS0232	Alluvium	Pumping	2.1	2.1	2.7	2.4	2.38
		Pumping	2.7				
MS0235	Alluvium	Slug	0.95	0.95	5.098	3.114	2.692
		Slug	4.32				
		Slug	5.1				
		Pumping	2.5				
		Pumping	2.7				
ODN18MB4	Alluvium	Slug /injection	0.0004	0.0003	0.0006	0.0004	0.0004
		Slug /injection	0.0006				
		Slug /injection	0.0003				
MS0113	Regolith / Rangal Overburden	Slug /injection	0.27	0.1	0.27	0.19	0.17
		Slug /injection	0.1				
MS0231_V2	Rangal Overburden	Pumping	0.7	0.7	0.8	0.75	0.75
		Pumping	0.8				
MS0231_V3	Leichhardt Seam	Pumping	1	0.6	1	0.8	0.77
		Pumping	0.6				
MS0233	Leichhardt Seam	Pumping	1	1	1.4	1.17	1.15
		Pumping	1.1				
		Pumping	1.4				
MS0234	Leichhardt Seam	Pumping	0.8	0.8	0.8	0.8	0.8
		Pumping	0.8				
MS0231_V4		Pumping	0.5	0.5	1.2	0.85	0.77

	Vermont Seam	Pumping	1.2				
MS0236	Vermont Seam	Slug	0.6	0.33	1.5	0.64	0.56
		Slug	0.75				
		Slug	0.39				
		Slug	0.33				
		Slug	0.38				
		Pumping	0.5				
		Pumping	1.5				
MS0125	FCCM - Coal	Slug	0.008	0.008	0.012	0.009	0.009
		Slug	0.01				
		Slug	0.008				
		Slug	0.01				
MS0162	FCCM - Coal	Slug	0.01	0.002	0.01	0.004	0.004
		Slug	0.004				
		Slug	0.004				
		Slug	0.003				
		Slug	0.004				
		Slug	0.002				

4.2.2 Hydraulic Conductivity Ranges

A histogram of the spread of horizontal hydraulic conductivity from field testing at the Project, as well as at the Olive Downs Project and Winchester South Project, is presented in **Figure 4-4**. The results are compared to the range of documented values for the various units in literature.

The comparison shows that the field results for alluvium, regolith, Rangal Coal Measures and Fort Cooper Coal Measures fall within the range of field data collected through other studies across the Bowen Basin. Results from the Project site recorded some lower readings for the Rewan Group than previously identified in literature. A broader range of hydraulic conductivity for the Rangal Coal Measures coal was also observed at the Project site, Winchester South Project and Olive Downs Project sites compared to literature ranges, with values of up to 4.4 m/day (Project Area) and 1.5 m/day (Winchester South Project Area) reported.



RCM = Rangal Coal Measures, FCCM = Fort Cooper Coal Measures, RCM IB = Rangal Coal Measures Interburden, MCM = Moranbah Coal Measures

Figure 4-4 Histogram of horizontal hydraulic conductivity distribution near to the Project

4.2.3 Faults

As discussed in **Section 3.2.4**, faulting has been mapped within the Permian coal measures at the Project (see **Figure 3-2**). As identified by Jourde et al. (2002), faulting can result in higher permeabilities within strata parallel with the fault plane, and lower permeabilities within strata perpendicular to the fault plane. However, this can also be dependent on whether faults are currently active (Paul et al., 2009). Faulting has been inactive within the Bowen Basin for over 140 million years (Clark et al., 2011), indicating that the fault zones are less likely to act as conduits to flow. This relates to filling of the fractured pore spaces over time through hydrothermal alteration and mineralisation (Uysal et al., 2000). Drill core logs from the Olive Downs Project show that where fractures and faults have been geologically logged, many fractures are “healed” with calcite and siderite. This indicates that although the system is a fractured network, many of the existing fractures are cemented. This cementation is likely to have an effect of reducing effective permeability when compared to an open fracture network.

As discussed in **Section 4.2.1**, analysis of coal seam roof/floor core samples collected proximal to a fault zone was undertaken for the Olive Downs Project. The samples recorded vertical hydraulic conductivity of around 50% to 160% of horizontal conductivity. This indicates the faulting may provide either conduits or barriers to vertical flow. It was also noted that areas of increased Kv are limited vertically, with samples collected from the same

drill hole at different horizons (interburden and Rewan Group) returning a lower Kv of between 11% and 76% of Kh.

Hydraulic testing of similar large scale faulting in the Permian coal measures was undertaken for the Winchester South Project (SLR, 2022a), 3 km southwest of the Project. Fault zones were confirmed to be intersected at two drill holes due to the presence of fracturing, calcite infills, and slickensides in core obtained from the drill holes, all of which are considered an indicative marker of faulting. Packer testing hydraulic conductivity results from bore WS3182 ranged from 9.48×10^{-4} to 1.02×10^{-3} m/day. Drill hole WS3189 reported hydraulic conductivity results ranging between 6.93×10^{-5} and 2.07×10^{-3} m/day. Full details of the testing are presented in Hydrogeologist.com.au (2019). These results represent relatively low hydraulic conductivity values indicating that the faulting zones intercepted and tested within the Winchester South Project Area are 'healed' and not pathways for preferential flow.

The behaviour of faults within the greater regional area were assessed as part of the Bowen Gas Project. Kinnon (2010) assessed the movement of water and gas across a series of faults in the Bowen Basin using stable isotope and water quality analysis to assess zones of potential recharge, water mixing and flow pathways. Higher gas production rates were observed on either side of a major fault, with differences in isotopic compositions of produced water for bores north and south of the major fault line at similar depths, implying little connection across the fault boundary, and suggesting that the fault acts as a barrier to water and gas flow. The results of the study showed that compartmentalisation was evident and that this was due to the structural geology (faulting) in the basin.

4.3 Groundwater Distribution, Levels, Flow, Recharge and Discharge

This section presents a discussion on the distribution and flow of groundwater plus the recharge and discharge processes for alluvium, regolith, Rewan Group and Permian coal measures.

The locations of the Project groundwater monitoring bores providing groundwater level data used in the following analysis are shown in **Figure 4-1**, noting again that data from the newly installed MVSX monitoring bores north of the Project was not yet available at the time of this assessment.

4.3.1 Alluvium

4.3.1.1 Distribution and Flow

There are six alluvial Project monitoring bores (MS0117, MS0135, MS0129, ODN18MB4, MS0232, MS0235). The shallowest bore MS0135 is dry to 174 mAHD. Recent data from the remaining five bores show groundwater elevations ranging from approximately 172 mAHD (MS0117) to 161 mAHD (ODN18MB4). Available groundwater level logger data and manual measurements are illustrated on the hydrographs (**Figure 4-5** to **Figure 4-9**).

Long term rainfall trends for Carfax (1962 to 2021) Iffley (1998 to 2022) and Moranbah Airport (2012 to 2024) are illustrated on **Figure 2-1**showing the cumulative rainfall departure (CRD). From 2011 to 2019 rainfall has generally been consistent with the long-term average. Since 2019 negative gradients indicate drier conditions, while over the most recent period of the record (November 2022 to May 2024) rainfall volumes have more or less been consistent with the long term average.

The rainfall trend shown on the hydrographs allows assessment of groundwater level response to rainfall. Available logger data indicates stable groundwater levels with minor groundwater level rise up to 1 m in response to rainfall in January and February 2020 at three bores (MS0129, MS0232, MS0235). Manual measurements recorded at bore ODN18MB4 from June 2020 to June 2022 indicate an increase in the groundwater level up to 2.6 m, while a decrease of 0.6 m was recorded at bores MS0117 and MS0129.

It is noted again that drilling results for the recently installed MVSX bores indicated no alluvial aquifer presence associated with the upstream reaches of North Creek north of the Project.

Interpreted hydraulic head contours within the Quaternary alluvium are illustrated in **Figure 4-10,** showing an overall south-easterly groundwater flow direction following the flow direction of the Isaac River, with a low point observed at ODN18MB4.

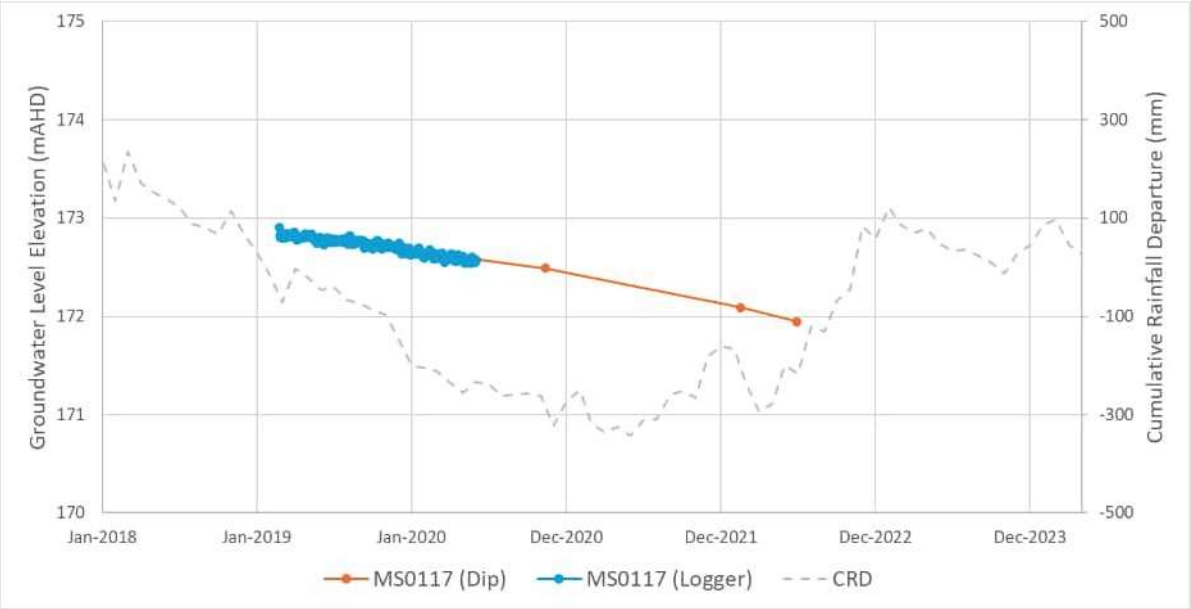


Figure 4-5 Hydrograph for alluvial bore MS0117

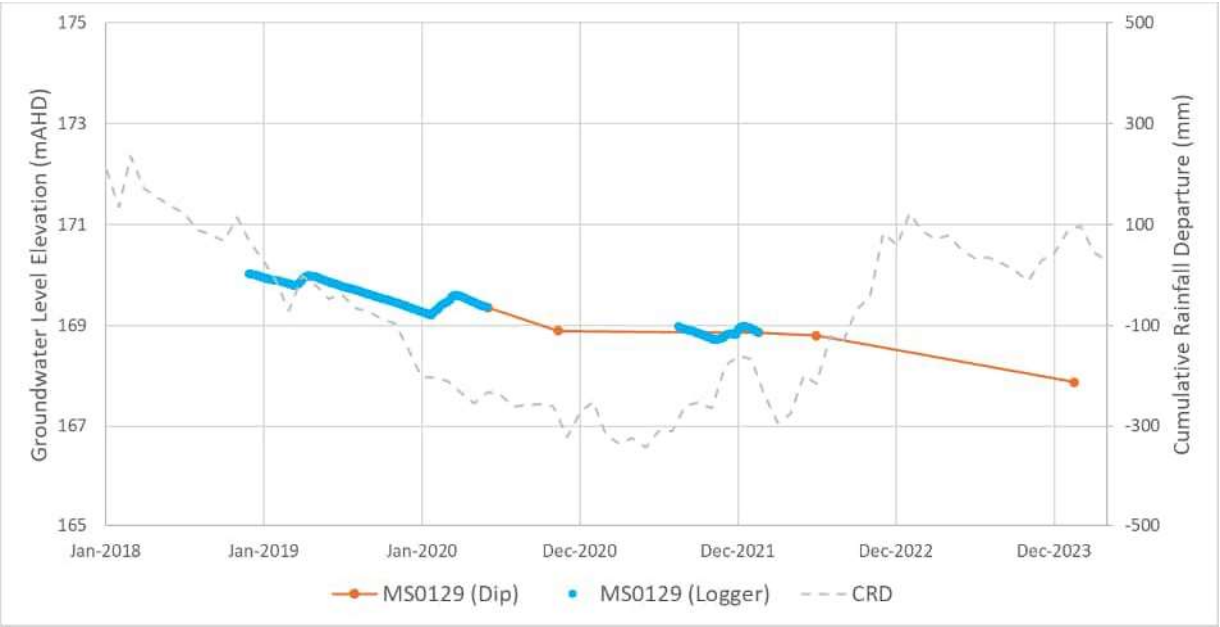


Figure 4-6 Hydrograph for alluvial bore MS0129

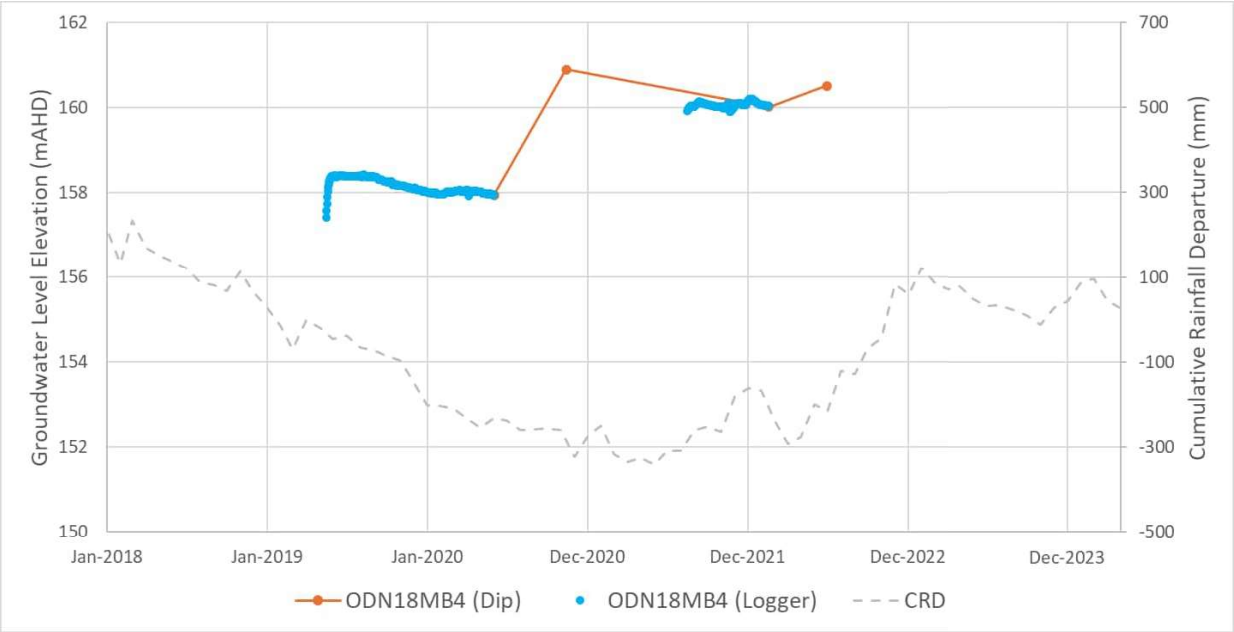


Figure 4-7 Hydrograph for alluvial bore ODN18MB4

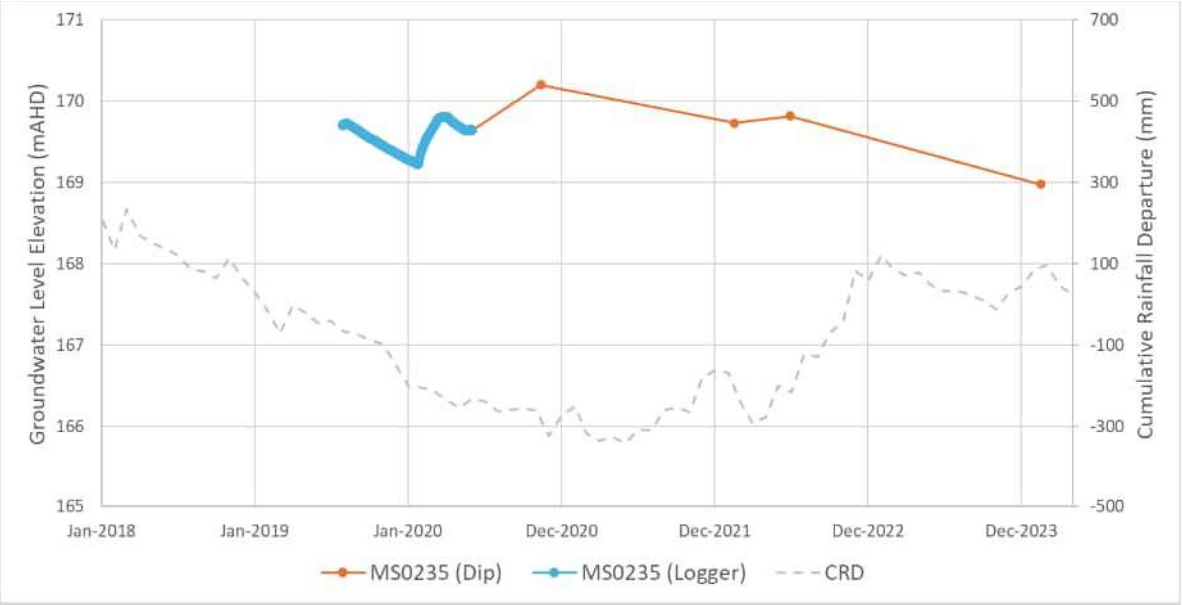


Figure 4-8 Hydrograph for alluvial bore MS0235

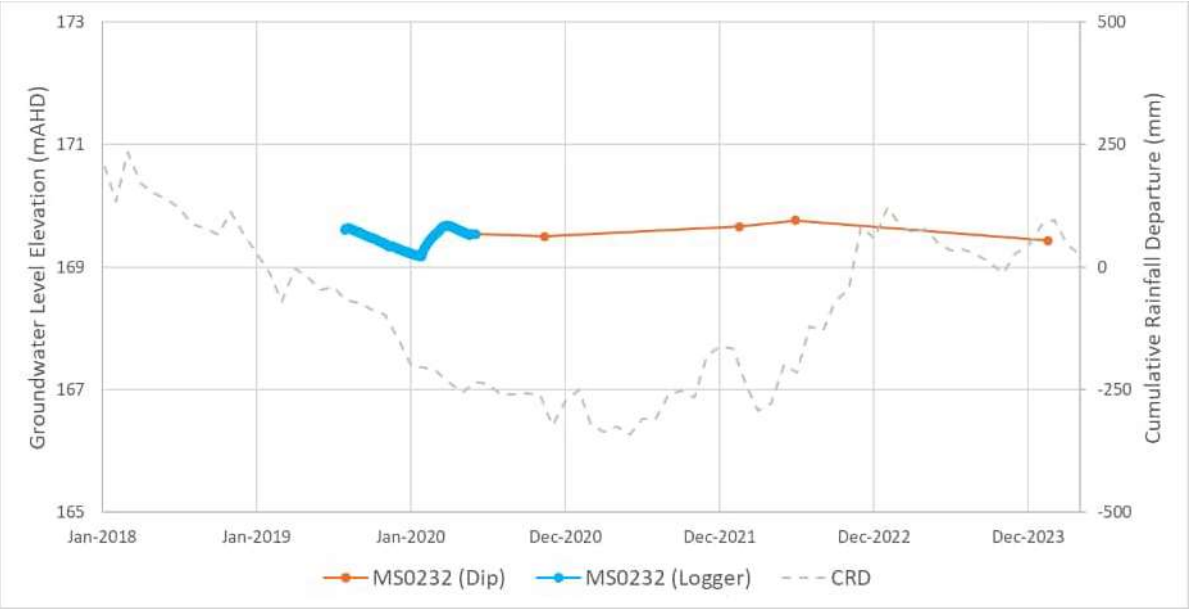
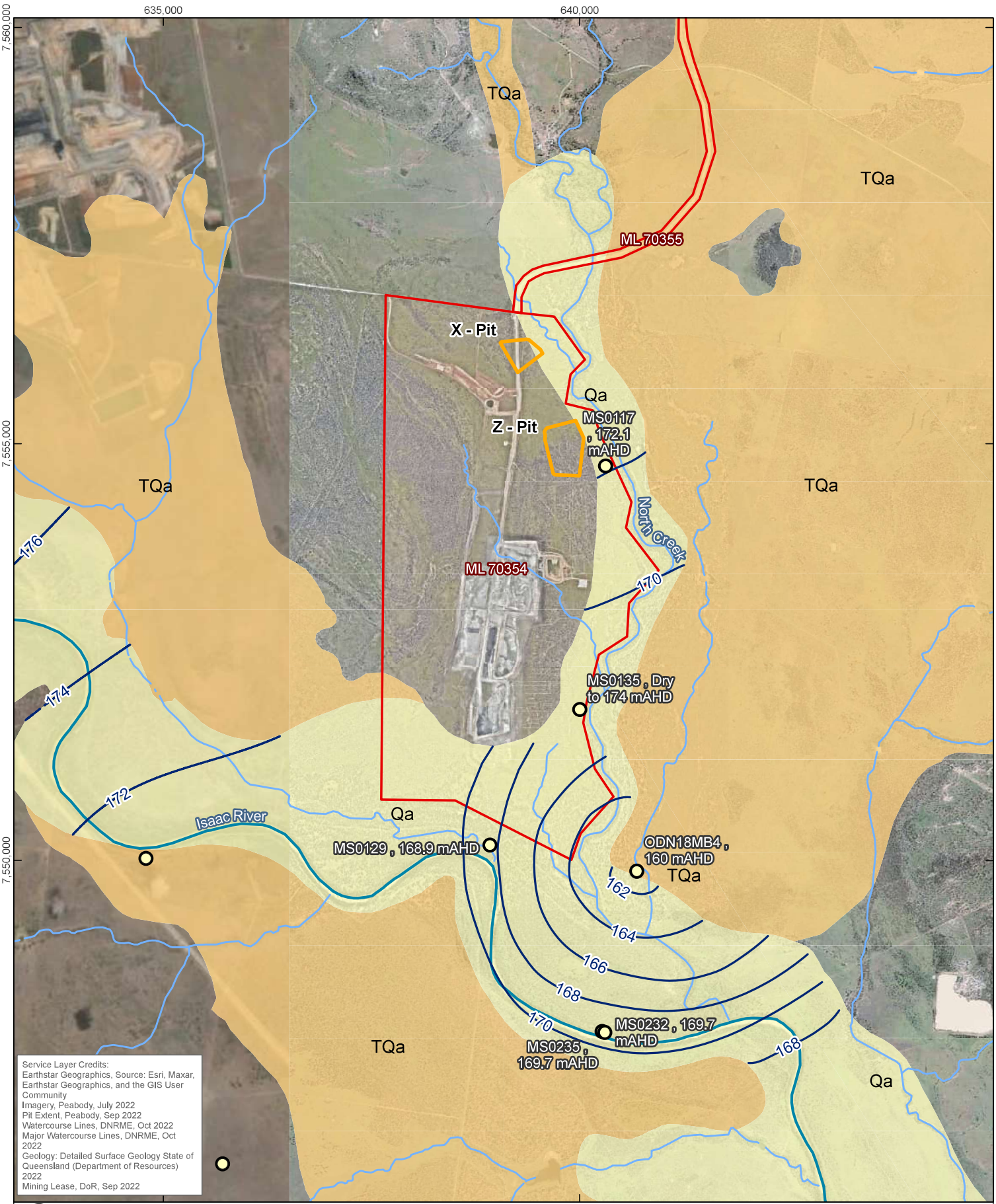


Figure 4-9 Hydrograph for alluvial bore MS0232



0 1 2 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:60,000 at A4
Project Number:	660.30254.00000
Date Drawn:	11-Jun-2024
Drawn by:	AS

LEGEND

Groundwater Monitoring Bore

- Alluvium
- Alluvial Groundwater Elevation (mAHD)
- Minor Watercourse
- Major Watercourse
- Final Pit Extent
- Moorvale South Mining Lease
- Quaternary Alluvium (Qa)
- Tertiary-Quaternary Alluvium (TQa)

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

INTERPRETED HYDRAULIC HEAD CONTOURS IN QUATERNARY ALLUVIUM

SLR

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FIGURE 4-10

Path: \\au.slr.local\Corporate\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx

4.3.1.2 Recharge and Discharge

Recharge to the alluvium in the regional area is mostly from stream flow or flooding (losing streams), with direct infiltration of rainfall also occurring where there are no substantial clay barriers in the shallow sub-surface. Groundwater within the alluvium, where present in the lower reaches of North Creek and along the Isaac River, is likely discharged as evapotranspiration from riparian vegetation, potential baseflow contributions after significant rainfall and flood events, and landholder bore pumping near the Isaac River.

Pools in the Isaac River and floodplain wetlands continue to hold water throughout the dry period where clay layers slow the vertical infiltration of surface water.

Geological logs for the Project monitoring bores indicate the alluvium is underlain by low permeability stratigraphy (i.e. claystone, siltstone and sandstone), which likely restricts the rate of downward leakage to underlying formations.

4.3.2 Regolith

4.3.2.1 Distribution and Flow

Project groundwater monitoring bore MS0113 is screened in regolith consisting of highly weathered sandstone and siltstone to a depth of 25 m. The base of the bore intersects slightly weathered siltstone of the Rangal overburden.

Available groundwater level logger data and manual measurements at MS0113 are shown in **Figure 4-11**. Groundwater levels show a slight decline from approximately 181 to 180 mAHD over the monitoring record, in line with the declining rainfall trend.

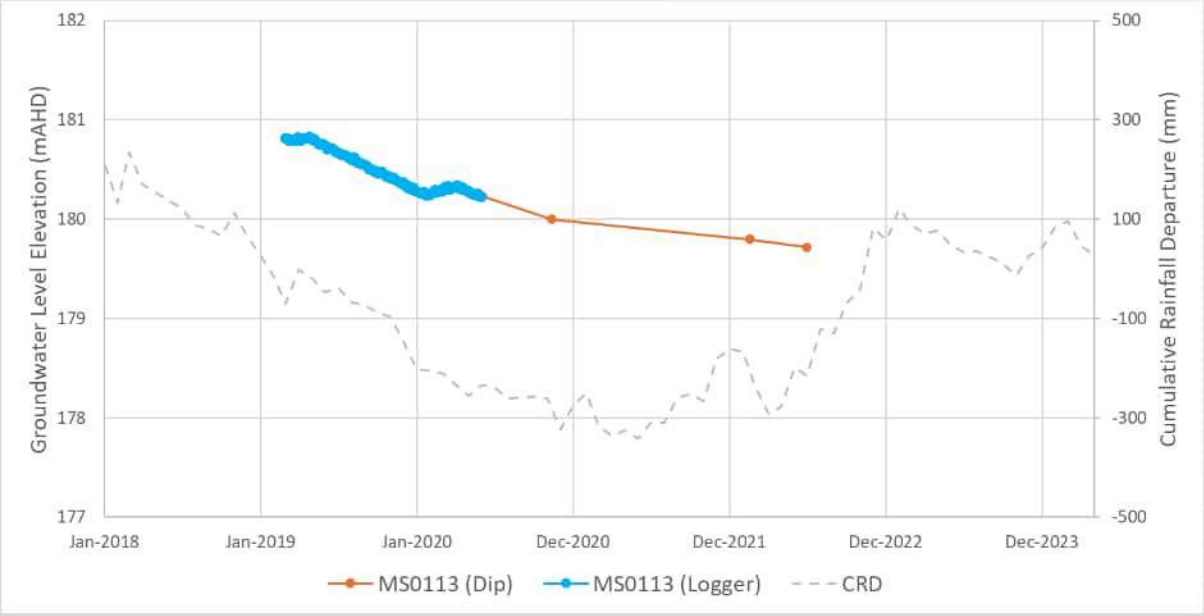


Figure 4-11 Hydrograph for regolith bore MS0113

Groundwater monitoring conducted south of the Project Area includes four monitoring bores intersecting the regolith (GW06s, GW12s, GW16s and GW21s). The location of these bores is shown in **Figure 4-2**. Of these bores, two (GW06s and GW16s) remained dry between June 2017 and February 2019 (SLR, 2019a). Similar unsaturated conditions have been recorded for exploration holes intersecting the regolith across the Study Area.

Water within the regolith, where it is saturated, occurs at depths of around 8 m to 19 m. Groundwater elevations to the south of the Project range from around 156 m AHD (GW12s) to 152 m AHD (GW21s). Groundwater levels remained relatively stable between June 2017

and February 2019. Bore GW12s, which is located along Ripstone Creek, recorded a saturated thickness of around 23 m in the regolith, while bore GW21s at Willunga recorded a saturated thickness of less than 1 m (SLR, 2019a).

Overall, the regolith is considered to be largely unsaturated, with the presence of water restricted to lower elevation areas along the Isaac River and the lower reaches of its tributaries. Flow within the regolith where it is saturated is likely a reflection of topography, flowing towards nearby drainage lines.

4.3.2.2 Recharge and Discharge

As discussed in **Section 3.2**, the regolith material comprises low hydraulic conductivity strata such as clay and claystone, which likely restricts rainfall recharge. Groundwater discharge is likely to occur primarily via evapotranspiration, with some baseflow to streams from the regolith under wet climatic conditions. Vertical seepage through the regolith is likely to be limited by the underlying low hydraulic conductivity Rewan Group and other aquitards.

4.3.3 Rewan Group

4.3.3.1 Distribution and Flow

The closest groundwater monitoring to the Project within the Rewan Group is VWP GW01d approximately 4 km southeast of the Project, on the south side of the Isaac River. The location is shown in **Figure 4-2**. The unit thickens towards the Isaac River and can be up to 300 m thick within the Study Area. In general, the occurrence of the unit can vary regionally based on the structural setting. The Rewan Group comprises low hydraulic conductivity lithologies and is typically considered an aquitard.

Groundwater elevations for VWP GW01d (logger P3 and P4) are shown in **Figure 4-12**. Excluding recovery/stabilisation trends following construction and likely erroneous data, the graph shows that groundwater elevations within the Rewan Group have remained stable to slightly declining from 2017 to 2019. There is a downward hydraulic gradient within the Rewan Group. Groundwater elevations within the Rewan Group are above those recorded within the deeper Permian coal measures, also indicating a downward hydraulic gradient. **Figure 4-12** also presents trends for the adjacent alluvial bore GW01s, which show alluvial groundwater levels above the Rewan Group groundwater elevation. This indicates a downward gradient from the overlying alluvium. As outlined above, due to the low hydraulic conductivity of the Rewan Group stratigraphy (**Section 4.2**), the unit is considered an aquitard, limiting groundwater flow.

4.3.3.2 Recharge and Discharge

As discussed above, the Rewan Group comprises low hydraulic conductivity strata, which likely restricts throughflow of recharge from overlying units. Groundwater discharge to underlying units will also be limited from the aquitard.



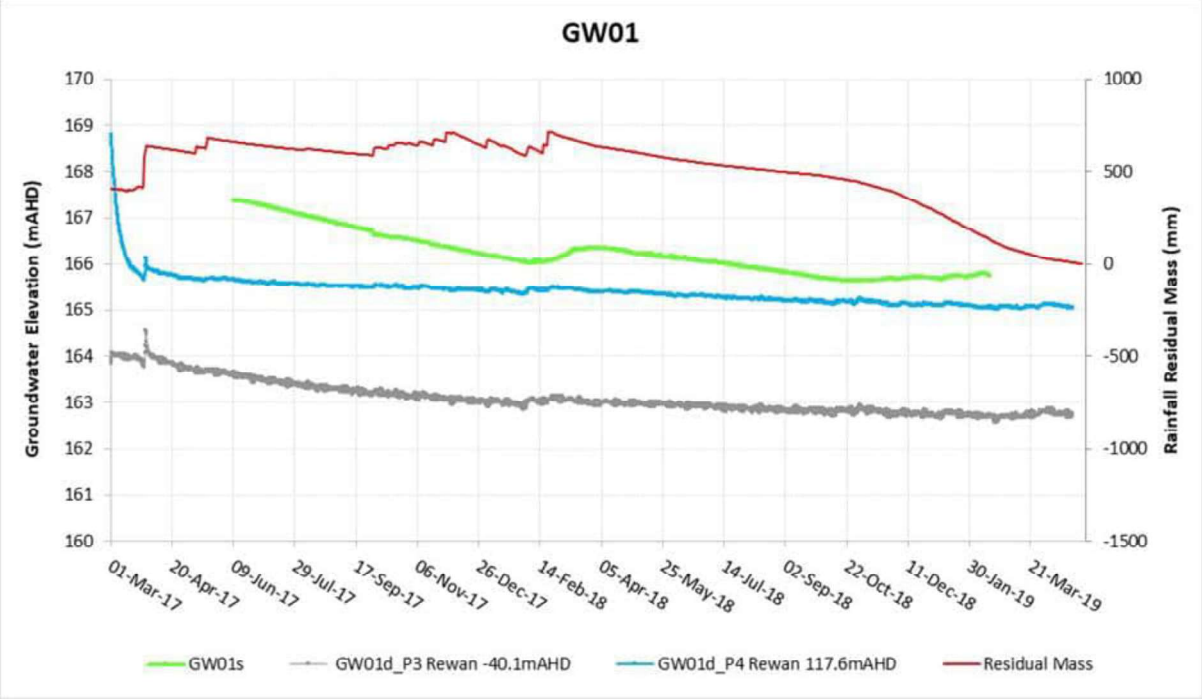


Figure 4-12 Hydrograph for Rewan Group VWP GW01d and alluvial bore GW01s (SLR, 2019a)

4.3.4 Permian Coal Measures

4.3.4.1 Distribution and Flow

Within the Project the Permian coal measures outcrop on the western part of the site and underlie the Rewan Group and surficial cover in the east. Within the Study Area they underlie the Rewan Group and surficial cover, and outcrop along the ridgelines to the east and west of the Study Area. Groundwater occurrence within the Permian coal measures is largely restricted to the more permeable coal seams that exhibit secondary porosity through fractures and cleats (**Section 4.2**).

There are seven Project bores that are part of the groundwater monitoring network, that intersect the Permian coal measures. The location of these bores is shown in **Figure 4-1**.

Five of the bores are within the Rangal Coal Measures coal, three shallower bores installed to a depth of 35 m (MS0128), 43 m (MS0234) and 52 m (MS0233), and two deeper bores installed to a depth of 118 m (MS0163) and 113 m (MS0236). Two bores are within the Fort Cooper Coal Measures coal (MS0125 and MS0162), installed to depths of 124 m and 100 m respectively.

Groundwater elevations range from approximately 174 m AHD in the northwest (MS0162) to 156 to 158 m AHD in the southeast (MS0233, MS0234 and MS0236). Available groundwater level logger data and manual measurements are illustrated on the hydrographs (**Figure 4-13** to **Figure 4-19**).

Available logger data indicates stable groundwater levels with minor groundwater level rise up to 1 m in response to rainfall at two shallow bores (MS0234 and MS0233). Manual measurements recorded from June 2020 to June 2022 indicate a 1 m decrease in groundwater levels at the three shallower bores (MS0128, MS0234 and MS0233) and one deeper bore MS0236, located approximately 3.5 km from the site. Excavation below the

water table commenced on site in May 2022. Ongoing monitoring will allow assessment of groundwater response to coal extraction.

Interpreted hydraulic head contours within the Permian sequences are illustrated in **Figure 4-20**, showing an overall south-easterly groundwater flow direction following the Isaac River.

4.3.4.2 Recharge and Discharge

Groundwater within the Permian coal measures is confined and sub-artesian. For the shallower coal measures, groundwater elevations are generally below groundwater elevations within the overlying unconfined sediments, indicating a downward hydraulic gradient. With increased depth of cover and pressure the hydraulic gradient within the Permian coal measures reverses. This coincides with a decrease in hydraulic conductivity with depth as discussed in **Section 4.2**.

Recharge to the Permian coal measures occurs where the unit occurs at subcrop. Due to the low hydraulic conductivity of the interburden material, groundwater largely flows horizontally within the coal measures, along the bedding plane of the coal seams. Groundwater discharge occurs via evaporation and abstraction from active mine areas.

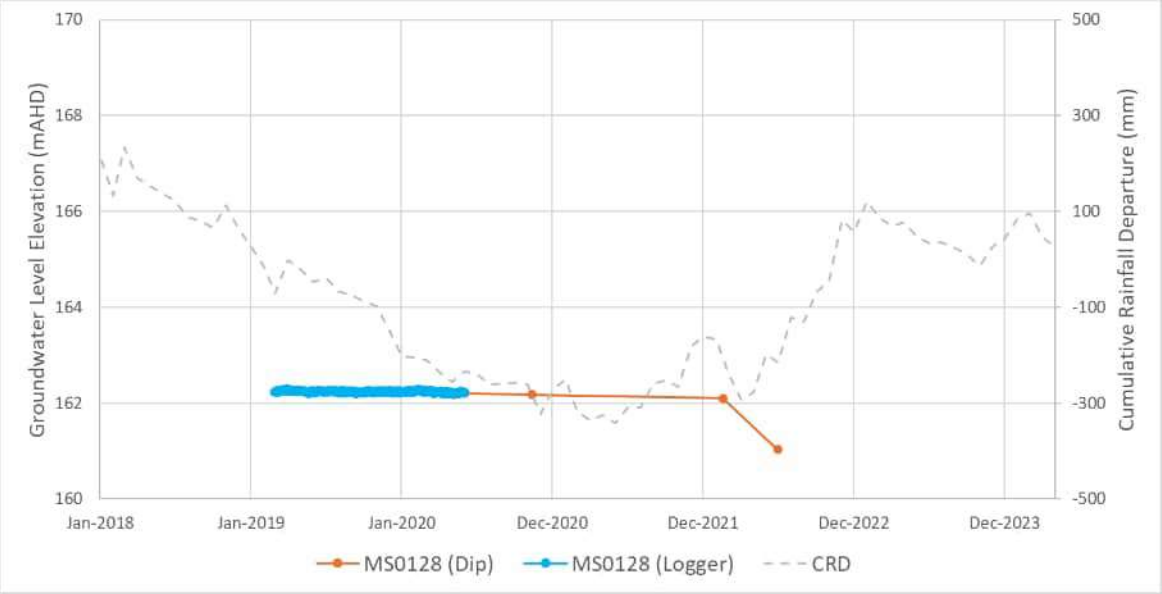


Figure 4-13 Hydrograph for shallow Rangal Coal Measures bore MS0128

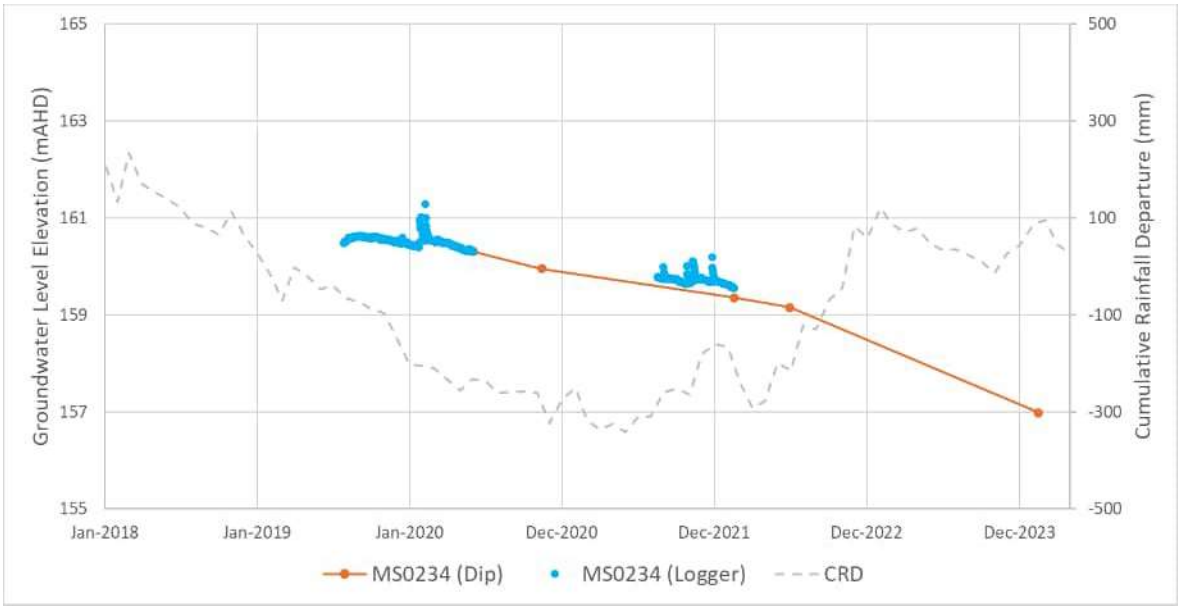


Figure 4-14 Hydrograph for shallow Rangal Coal Measures bore MS0234

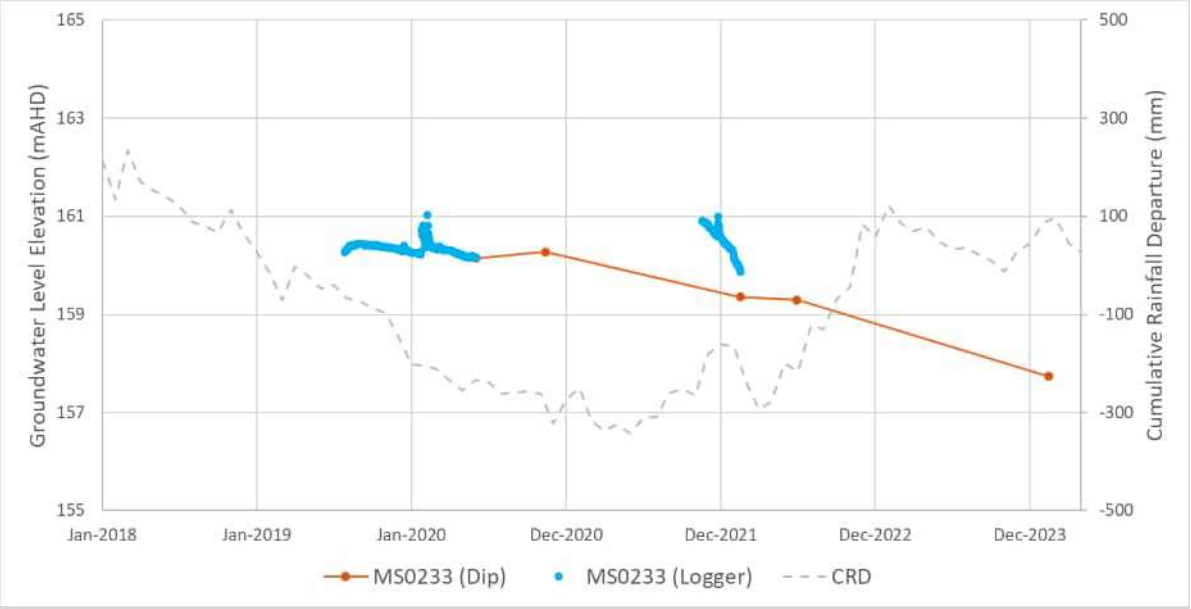


Figure 4-15 Hydrograph for shallow Rangal Coal Measures bore MS0233

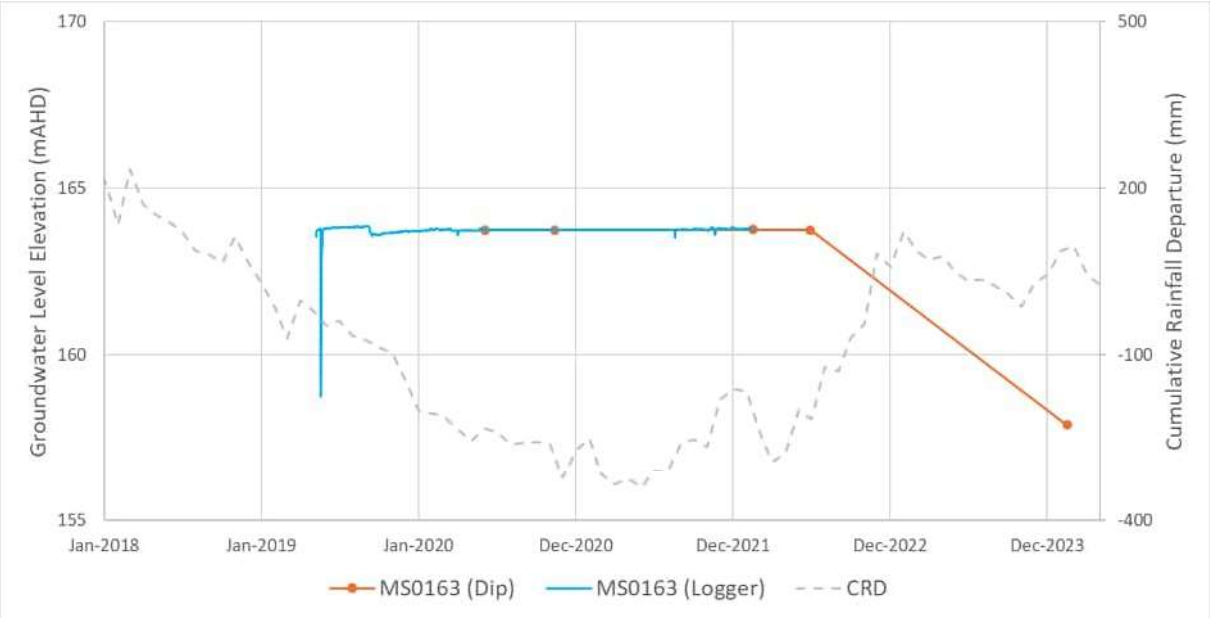


Figure 4-16 Hydrograph for deep Rangal Coal Measures bore MS0163

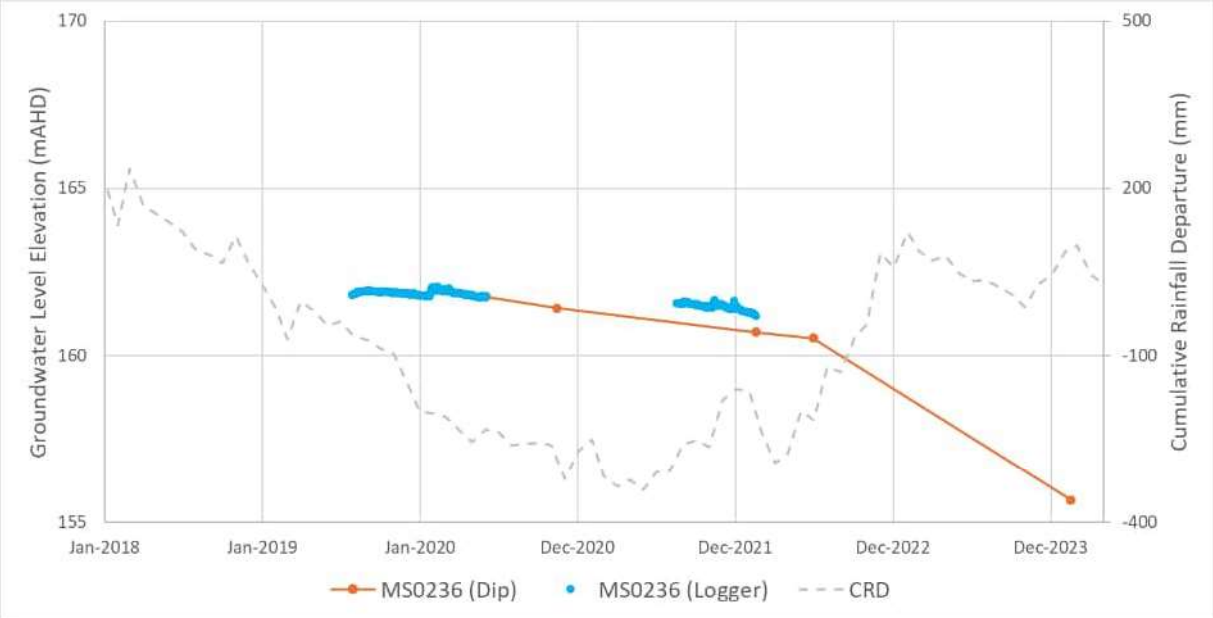


Figure 4-17 Hydrograph for deep Rangal Coal Measures bore MS0236

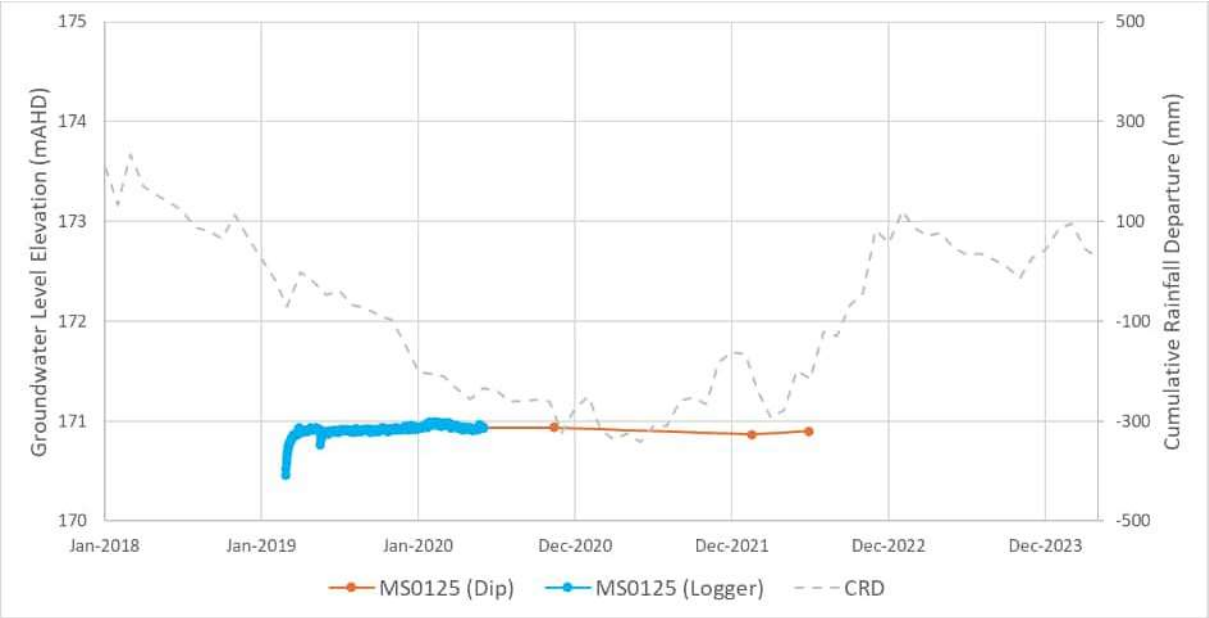


Figure 4-18 Hydrograph for Fort Cooper Coal Measures bore MS0125

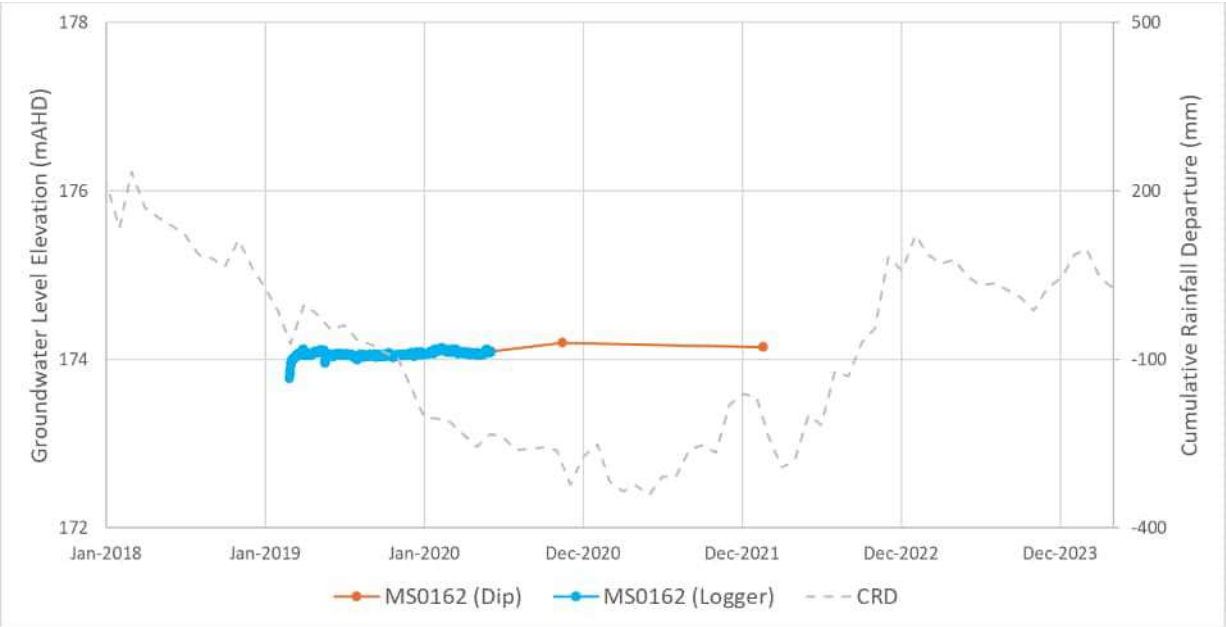
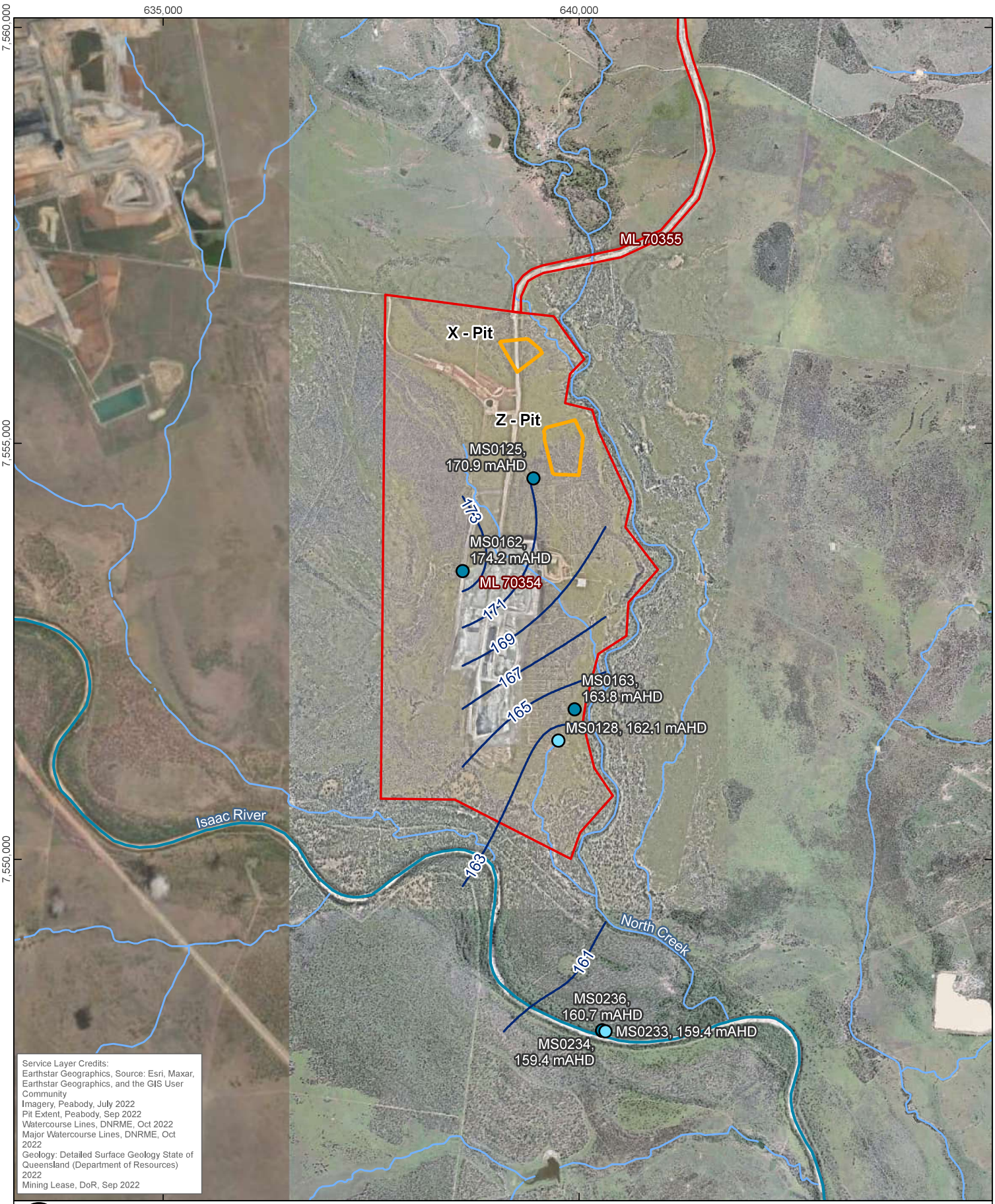


Figure 4-19 Hydrograph for Fort Cooper Coal Measures bore MS0162



0 1 2 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:60,000 at A4
Project Number:	660.30254.00000
Date Drawn:	11-Jun-2024
Drawn by:	AS

LEGEND

Groundwater Monitoring Bore

- Shallow Permian
- Deeper Permian
- Permian Groundwater Elevation (mAHD)
- Minor Watercourse
- Major Watercourse
- Final Pit Extent
- Moorvale South Mining Lease

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

INTERPRETED HYDRAULIC HEAD CONTOURS IN PERMIAN SEQUENCES

SLR

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FIGURE 4-20

Path: \\au.slr.local\Corporate\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx

4.3.5 Groundwater Interaction with Watercourses

In central Queensland, highly seasonal rainfall results in intermittent stream flow, limited groundwater recharge and deep water tables. In this environment, the most appropriate way to assess surface water and groundwater interaction is by comparing stream stage elevation data to the underlying groundwater elevation in a nearby monitoring bore. The Isaac River at Deverill (130410A) stream gauge provides a long-term record of stream stage for the Isaac River south of the Project. The data indicate that at Station 130410A surface water (flowing and ponded) elevations generally remain around 170 m AHD. The gauge has recorded a maximum stream elevation of 179 mAHD, which has been recorded four times since 1970, in March 1979, March 1988, January 1991 and February 2008. The stream gauge records average flows of 460 ML/day and 167,804 ML/year based on the average of total annual flow volume.

The closest bore with long-term groundwater level monitoring in the Isaac River alluvium is registered bore RN13040180, which is approximately 40 km downstream of the stream gauge. The bore is located approximately 80 m from the Isaac River, along Carfax Road. Groundwater levels in this bore clearly follow the rainfall residual mass curve, indicating that rainfall derived recharge (including from stream flow) is a key source of water to this aquifer (**Figure 4-21**). From 1970 to present, groundwater levels within the alluvium at RN13040180 were recorded between 12 m to 18 m below ground surface.

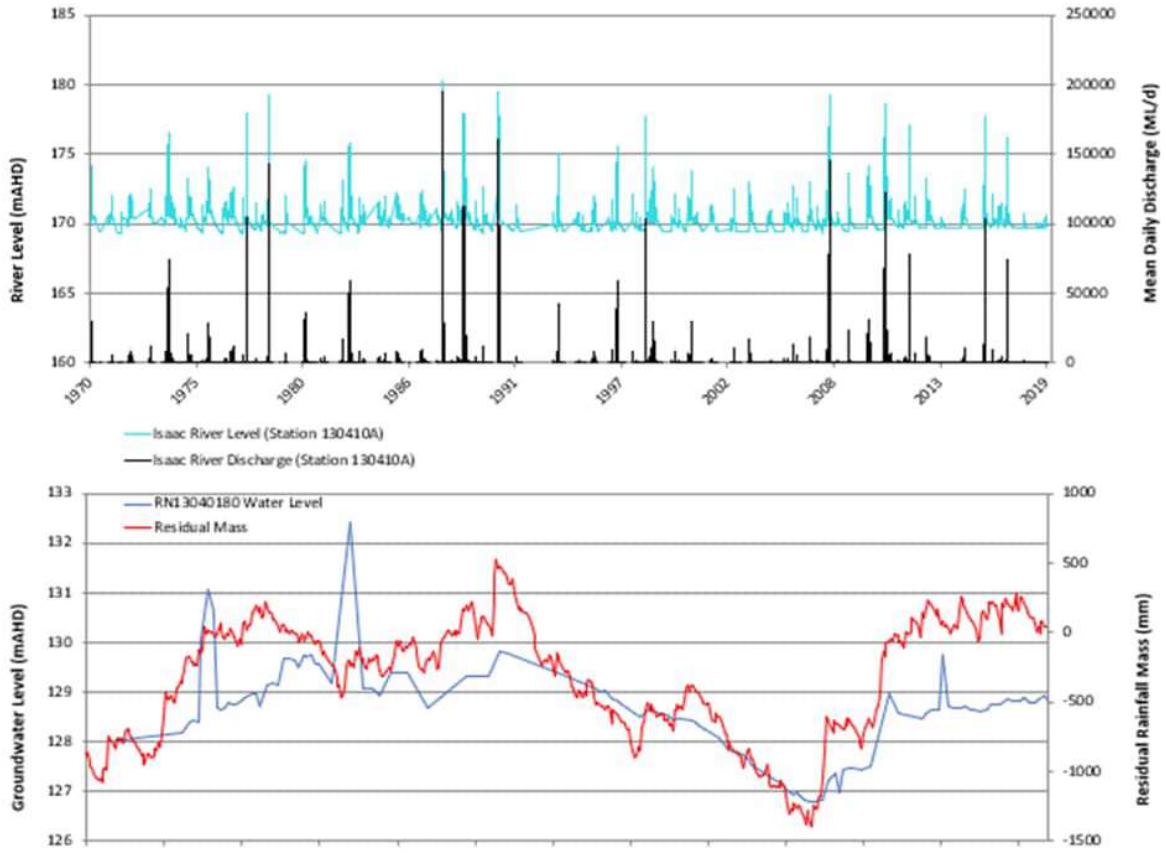


Figure 4-21 Groundwater level in bore RN13040180 with rainfall residual mass and Isaac River levels and discharge for stream gauge 130410A (SLR, 2022a)

Groundwater monitoring bores were installed within the alluvium for the Olive Downs Project, including one adjacent to the Isaac River stream gauge (GW01s) and one approximately 1.6 km south-west of the river (GW02s). Comparison between stream gauge levels and monitored groundwater levels are presented in **Figure 4-22** (SLR, 2020a). The graph shows that groundwater levels within the alluvium remained more than 2 m below river levels, with the depth to water in the alluvium increasing with distance away from the river.

The Isaac River is largely a losing system with stream-stage above that of the local groundwater levels, resulting in the water draining through the alluvial sediments to the water table. Occasional periods of baseflow to the river from the alluvium may occur after prolonged rainfall events or following flood events. Under these conditions, recharged alluvial sediments will drain to the river as the hydraulic gradient reverses and sustains streamflow for a short period after the rainfall event.

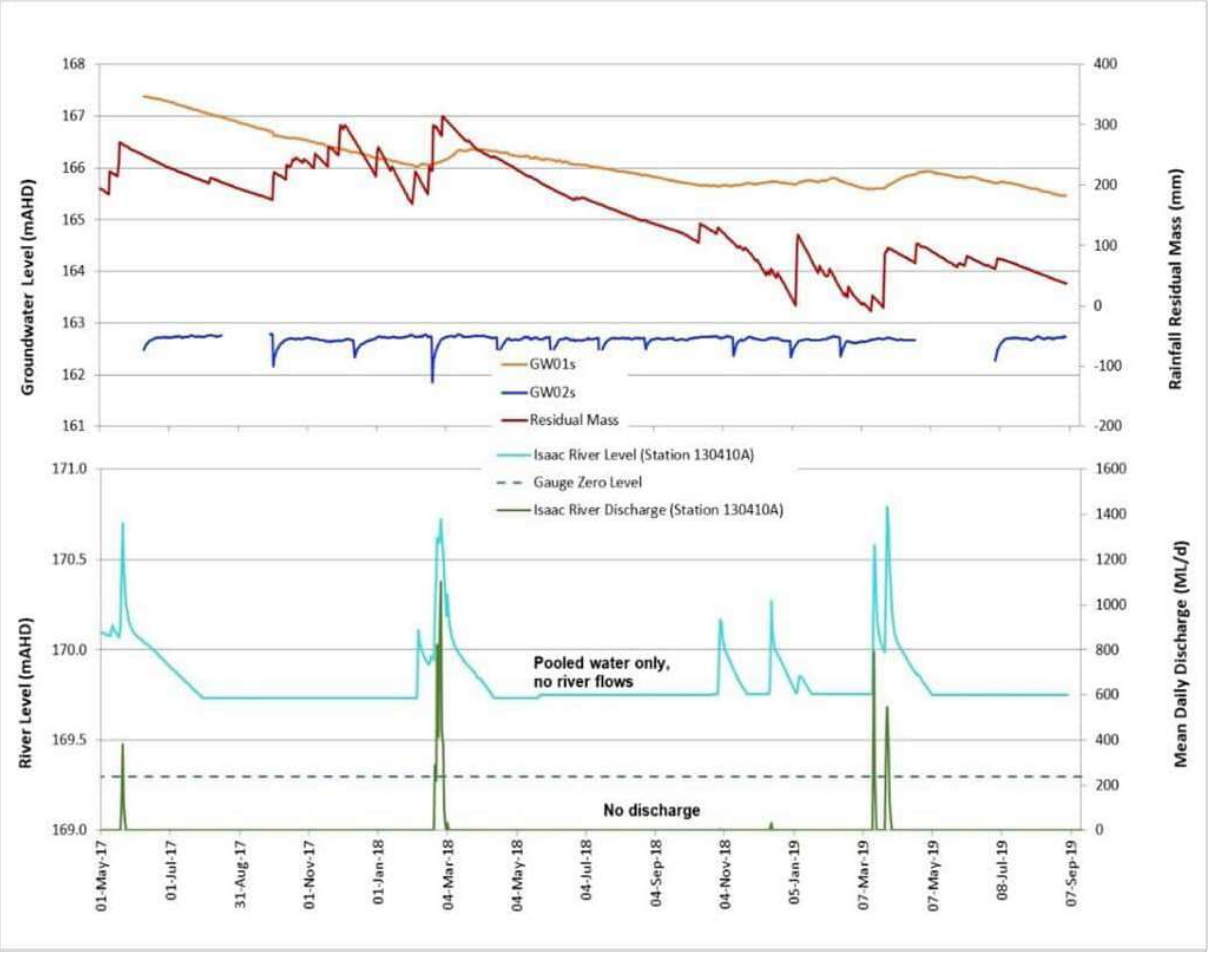


Figure 4-22 Groundwater level in GW01s and GW02s with rainfall residual mass and Isaac River levels and discharge for stream gauge 130410A (SLR, 2020a)

4.4 Baseline Water Quality

This section reports on the characteristics and beneficial use of groundwater within the various geological units across the wider Study Area. The main units include alluvium, regolith, interburden (sandstone/siltstone) and coal of the Permian aged coal measures. Water quality results for surface water (Isaac River) are also discussed below.

As well as other relevant regional data from adjacent project sites and other public sources, the groundwater quality dataset adopted for the following analysis includes initial baseline data collected in 2019 (SLR, 2019a), plus that obtained through monitoring of Project monitoring bores on an approximate biannual basis with a total of five sampling events between mid-2021 and the date of this report.

It is noted that the six completed sampling events at the Project monitoring bores between 2019 and the present is less than DES (2021) recommended minimum of eight samples, and preferably minimum 18 samples over 12 to 24 months, to assess site specific groundwater quality in a statistically robust manner.

4.4.1 Water Type

The proportions of the major anions and cations were used to determine the hydrochemical facies of groundwaters sampled. The anion-cation balance for the Project monitoring bores is shown on the Piper diagram in **Figure 4-23**.The results for these monitoring bores generally indicate that although the cation compositions are similar between groundwater units, there are clear differences in the anion composition of groundwater from each unit. Alluvial groundwater can be classified as Na-Ca-HCO3 or Na-Mg-HCO3 water type Similarly, Regolith/RCM overburden bore MS0133 is also influenced by HCO3, being Na-Cl-HCO3 water type. Of the Permian coal measures bores, those in the Vermont Seam (MS0163 and MS0236) and FCCM (MS0162, MS0125) generally contain Na-Cl type water, while bores screened in the Leichhardt Seam (MS0128, MS0233 and MS0234) are more influenced by HCO3.

Figure 4-24 presents major ion data collected from the Project bores, as well as other Study Area bores collected as part of the Olive Downs landholder bore census and publicly available sources along with data for the Isaac River at Deverill (station 130410A).

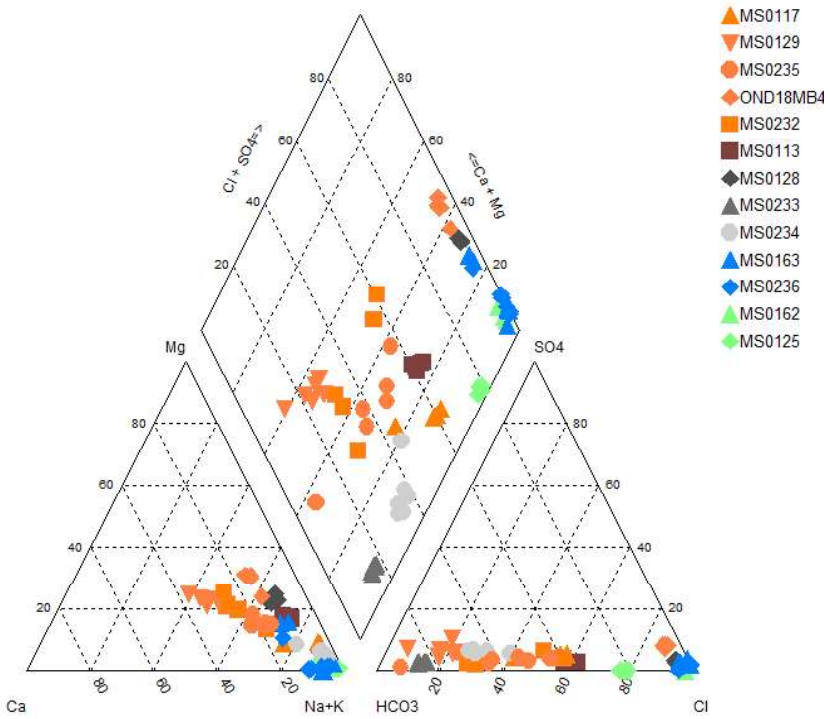


Figure 4-23 Piper diagram for Project monitoring bores

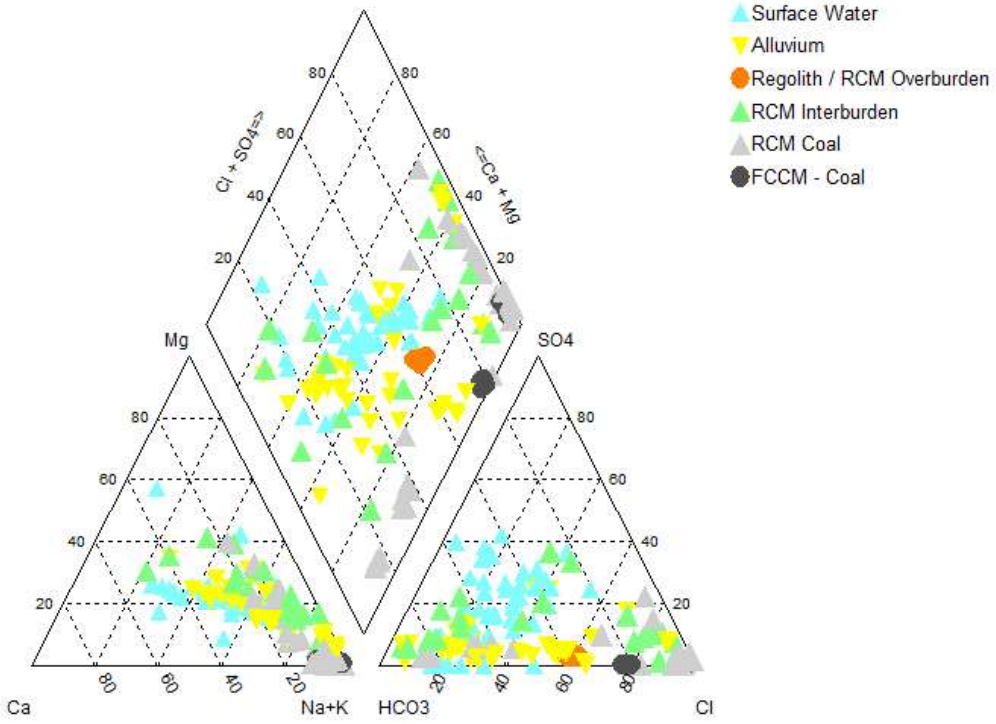


Figure 4-24 Piper diagram of regional data

4.4.2 Salinity

Water quality data from Project bores, collected as part of the landholder bore census and publicly available sources provides useful information on the beneficial use of groundwater associated with the major stratigraphic units. Salinity is a key constraint to water management and groundwater use and can be described by total dissolved solids (TDS) concentrations.

Figure 4-25 presents the TDS data collected from the Project bores, as well as other Study Area bores collected as part of the Olive Downs landholder bore census and publicly available sources along with data for the Isaac River at Deverill (station 130410A). Salinity ranges represented on **Figure 4-25** are defined by the Food and Agriculture Organization of the United Nations (FAO, 2013).

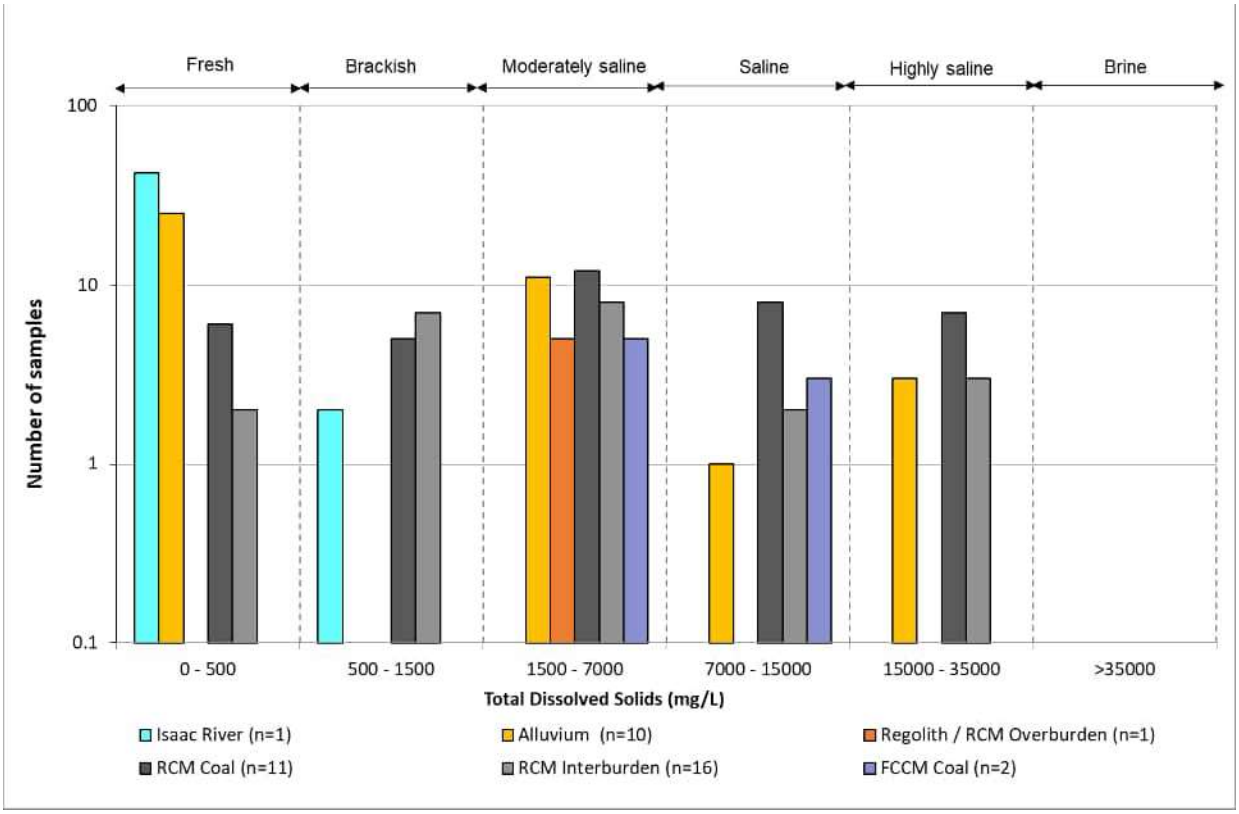


Figure 4-25 FAO (2013) Salinity ranking by unit – Project monitoring bores and regional data

As shown on **Figure 4-25**, the water within the Isaac River is largely fresh, while water within the alluvium ranges from fresh to highly saline with an average TDS of 4,108 mg/L, ranging between 184 mg/L and 3,8600 mg/L. Data from one project monitoring bore screened in the regolith records a moderately saline TDS (average 2,664 mg/L). Water within the Permian coal measures can range between fresh and highly saline, but is generally moderately saline, with Rangal Coal Measures bores recording an average TDS of 4,618 mg/L (interburden) and 6,801 (coal) and bores screened in the Fort Cooper Coal Measures (coal) recording an average TDS of 5,663 mg/L.

Available long-term trends in salinity within the alluvium and Isaac River in the regional area are presented in **Figure 4-26**. Salinity within the alluvium can be highly variable spatially. As demonstrated by **Figure 4-26**, salinity can also vary at one location temporally. Results for

government alluvial bore RN13040180 indicates EC can range between 199 µS/cm and 7,400 µS/cm (fresh to saline). **Figure 4-26** also presents EC as recorded at Isaac River station 130410A since 2011, which ranges between 49 µS/cm and 1,173 µS/cm (fresh to brackish).

The water quality data for the alluvium occasionally shows an inverse correlation in EC to the rainfall residual mass curve, with rising EC recorded during periods of declining/ below average rainfall and vice versa. However, due to the lack of temporal readings, there is no clear correlation between groundwater salinity in the alluvium at RN13040180 and stream flow and salinity of the Isaac River.

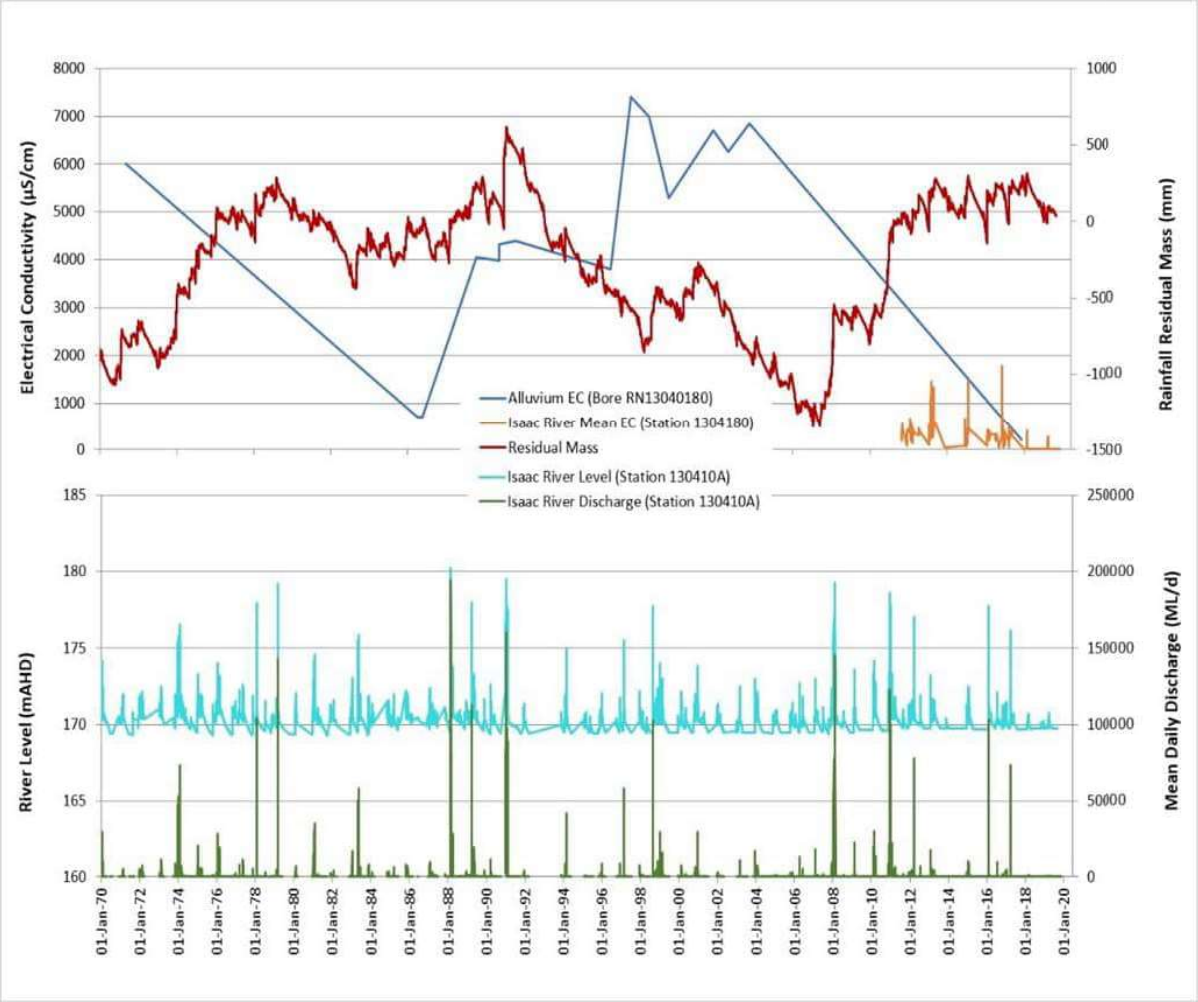


Figure 4-26 Isaac River and alluvium salinity (SLR, 2020a)

4.4.3 Beneficial Groundwater Use (Environmental Values)

The Project lies within the Isaac Connors Groundwater Management Area (GMA – Zone 34) of the Fitzroy Basin under the Water Plan (Fitzroy Basin) 2011 (**Figure 4-27**). Within the GMA, alluvial groundwater is managed as Groundwater Unit 1 and water within the hard rock aquifers as Groundwater Unit 2 (sub-artesian aquifers). Volumetric limits apply to extraction of groundwater within the GMA for non-stock and domestic purposes.

Groundwater resources in the Study Area are also scheduled under the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 as Isaac Groundwaters of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1310). The legislated environmental values (EVs) for these groundwaters are:

- Biological integrity of aquatic ecosystems;
- Human use EVs:
    - Suitability of water supply for irrigation;
    - Farm water supply/use;
    - Stock watering;
    - Primary recreation;
    - Drinking water supply;
    - Cultural and spiritual values.

The EPP Water and Wetland Biodiversity provides water quality objectives (WQOs) for the scheduled EVs in WQ1310. WQOs are long-term goals for water quality management and the purpose of the WQOs is to support and protect EVs. They are numerical concentration levels or narrative statements of indicators established for receiving waters to support and protect the designated EVs for those waters. They are based on scientific criteria or water quality guidelines but may be modified by other inputs (e.g. social, cultural, economic).

Where groundwater quality analysis results exceed a particular WQO for a particular EV, it is considered indicative that the groundwater may be unsuitable for supporting that particular EV.

The WQ1310 WQOs for groundwater at the Project are shown in **Table 4-7**.

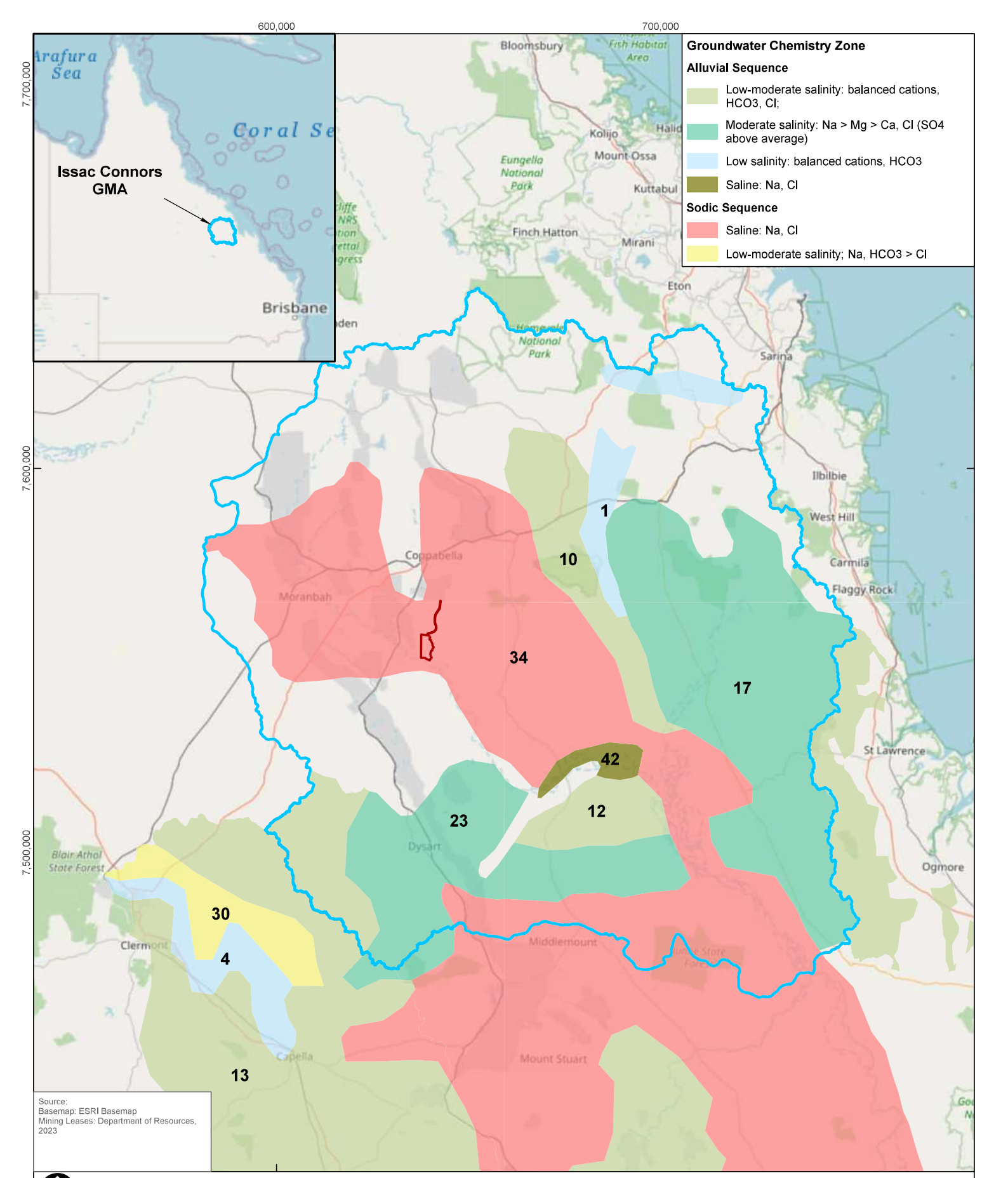

600,000
700,000
7,700,000
7,600,000
7,500,000
Groundwater Chemistry Zone
Alluvial Sequence
Low-moderate salinity: balanced cations, HCO3, Cl;
Moderate salinity: Na > Mg > Ca, Cl (SO4 above average)
Low salinity: balanced cations, HCO3
Saline: Na, Cl
Sodic Sequence
Saline: Na, Cl
Low-moderate salinity; Na, HCO3 > Cl
Issac Connors GMA
Brisbane
Arafura Sea
Coral Se
Bloomsbury
Fish Habitat Area
Kolijo
Mount Ossa
Eungella National Park
Kuttabul
Finch Hatton
Mirani
Eton
Sarina
Ilbilbie
West Hill
Carmila
Flaggy Rock
St Lawrence
Ogmore
Coppabella
Moranbah
Dysart
Middlemount
Clermont
Capella
Mount Stuart
Blair Athol State Forest
1
10
34
17
42
12
23
30
4
13
Source:
Basemap: ESRI Basemap
Mining Leases: Department of Resources, 2023
0
10
20
km
LEGEND
Moorvale South Mining Lease
Isaac Connors Groundwater Management Area (GMA)
Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:1,250,000 at A4
Project Number: 620.31445.00000
Date Drawn: 20-Jun-2024
Drawn by: RB
MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT
ISAAC CONNORS GROUNDWATER MANAGEMENT AREA, FITZROY BASIN GROUNDWATER ZONES, AND CHEMISTRY ZONES
SLR
DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.
FIGURE 4-27
Path: \\au.slr.local\Corporate\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx\66030254_F4_47_Isaac Connors GW Area, Fitzroy Basin GW Zones, and Chemistry Zones

Table 4-6 Water quality objectives for Isaac River sub-basin environmental values

Water Quality Indicator	Unit	ADWG Guidelines[1]		Isaac River Sub-basin EVs		
		Health	Aesthetic	Irrigation[2]	Stock[3]	Aquatic Freshwater 95% [4]
pH^	pH unit	-	6.5 to 8.5	-	-	6.5 to 8.5
TDS	mg/L	-	600	-	5000^	-
Ca	mg/L	-	-	-	1000	-
Cl	mg/L	-	250	-	-	-
Mg	mg/L	-	-	-	2000	-
Na	mg/L	-	180	-	-	-
SO4	mg/L	-	-	-	1000	-
F	mg/L	1.5	-	1	2	-
Ag	mg/L	0.1	-	-	-	0.05
Al	mg/L	-	0.2	5	5	0.055
As	mg/L	0.01	-	0.1	0.5	0.024
B	mg/L	4	-	0.5	5	-
Be	mg/L	0.06	-	0.1	-	-
Cd	mg/L	0.002	-	0.01	0.01	0.0002
Co	mg/L	-	-	0.05	1	-
Cu	mg/L	2	1	0.2	1^	0.0014
Cr	mg/L	0.05	-	0.1	1	0.001
Fe	mg/L	-	0.3	0.2	-	-
Hg	mg/L	0.001	-	0.002	0.002	0.0006
Mn		0.5	0.1	0.2	-	1.9
Mo		0.05	-	0.01	0.15	-
Ni		0.02	-	0.2	1	0.011
Pb		0.01	-	2	0.1	0.0034
Se		0.01	-	0.02	0.02	0.005
U		0.02	-	0.01	0.2	-
V		-	-	0.1	-	-
Zn		-	3	2	20	0.008

1. NHMRC, NRMMC (2011) Australian Drinking Water Guidelines
2. Table 9 of DEHP (2011b) Isaac River Sub-basin Environmental Values and Water Quality Objectives: Irrigation water (Long term value)
3. Table 10 and Table 11 of DEHP (2011b) Isaac River Sub-basin Environmental Values and Water Quality Objectives: Stock value)
4. ANZG (2018) Aquatic ecosystem protection for moderately disturbed system (95% protection)
^. Relevant guideline value for cattle

The EPP Water and Wetland Biodiversity also provides limited WQOs specifically for underground aquatic ecosystem protection in Fitzroy Basin groundwaters. These WQOs vary across the Fitzroy Basin and are defined on the basis of groundwater Chemistry Zones. The applicable Chemistry Zone for PTM is Isaac Groundwater (Zone 34; Sodic Sequence - Saline: Na, Cl). These WQOs are classified by groundwater depth ('shallow' being <30 m depth, and 'deep' being >30 m depth) and are summarised below. The management intent of each WQO zone is to maintain each of 20th, 50th and 80th percentile values.

Table 4-7 Isaac River Sub-basin Zone 34 WQOs for groundwater resources (aquatic ecosystem protection) (DEHP, 2011)

Water Quality Indicator	Unit	Shallow Groundwater (<30m)			Deep Groundwater (>30m)		
		20th Percentile	50th Percentile	80th Percentile	20th Percentile	50th Percentile	80th Percentile
EC	µS/cm	498	2150	8910	3419	6100	16000
Hardness	mg/L as $CaCO_3$	163	674	2228	359	919	3208
pH	-	7.1	7.75	8.1	7.4	7.8	8.03
Alkalinity	mg/L	154	435	752	156	275	536
Ca	mg/L	18	84	215	46	145	442
Mg	mg/L	27	108	389	35	115	491
Na	mg/L	135	747	1500	480	1100	2565
Cl	mg/L	171	1309	3185	753	1900	5905
SO_4	mg/L	12	140	318	25	138	398
HCO_3	mg/L	187	536	878	188	330	650
NO_3	mg/L	0	0.95	5.3	0.01	2.15	14.92
SiO_2	mg/L	21	36	52	16	25	36
F	mg/L	0.1	0.28	0.5	0.02	0.155	0.4
Fe	mg/L	0	0.03	0.14	0	0.05	0.246
Mn	mg/L	0	0.01	0.16	0	0.05	0.291
Zn	mg/L	0	0.015	0.06	0.01	0.025	0.317
Cu	mg/L	0	0.01	0.03	0.017	0.03	0.03
SAR	-	4.37	10.85	18.21	10.5	15.6	24.65
RAH	meq/L	0	0	2.3	0	0.24	6.25

In order to further understand the potential for groundwater resources within the Project and Study Area to support the scheduled EVs discussed above, the available groundwater quality data has been compared to the relevant EV protection WQOs discussed above. It is noted again that the five completed sampling events at the Project monitoring bores to date is less than DES (2021) recommended minimum data quantity to assess site specific groundwater quality in a statistically robust manner.

A comparison of the relevant EV guidelines to the 80th percentile of available groundwater quality data for each Project monitoring bore is presented as **Appendix A**.



A comparison of the relevant WQO to the 80th percentile of available groundwater quality data for each Project monitoring bore is presented as **Appendix B**.

Alluvium

Groundwater quality data from five bores in the alluvium shows that groundwater is generally unsuitable to support the drinking water (health) EV with respect to Mn, Se or U, and the drinking water (aesthetic) EV with respect to TDS, Cl, Na, Fe or Mn. Alluvium groundwater data also generally shows quality unsuitable to support the irrigation EV with respect to B, Fe, Mn, Se or U, and the aquatic ecosystems EV with respect to Al, Cu, Cr, Mn, Ni or Zn. The 80th percentile concentrations of alluvium data are also above the stock watering EV at one of the five bores (ODN18MB4) with respect to TDS, Ca, SO4 and Se, indicating that the groundwater from this aquifer may be largely suitable for supporting the stock watering EV but not in some areas (**Appendix A**).

A comparison of the 80th percentile concentrations of the alluvium data to the 80th percentile Zone 34 Fitzroy Basin WQOs for aquatic ecosystem protection shows the vast majority of bores (with the exception of MS0235) show some analyte concentrations higher than the WQO values (**Appendix B**), indicating alluvial groundwater generally does not meet aquatic ecosystem protection EV criteria.

Regolith

Groundwater quality data from one bore screened in the Regolith/RCM overburden (MS0113) shows that water quality is generally unsuitable to support the drinking water (aesthetic) EV with respect to TDS, Cl, Na and Mn, the irrigation EV with respect to Fe and U and the aquatic ecosystems EV with respect to Cu and Zn. The 80th percentile statistics at this bore were not above any of the stock watering guidelines, suggesting that the regolith groundwater may be suitable for supporting this EV (**Appendix A**).

The 80th percentile groundwater quality data from MS0113, screened in the Regolith/RCM overburden shows some analyte concentrations above the 80th percentile Zone 34 Fitzroy Basin WQOs Aquatic Ecosystem protection values (**Appendix B**).

Permian

Groundwater quality data from 7 bores in the Permian coal measures generally shows that groundwater is not suitable to support the drinking water, irrigation water, stock water, or aquatic ecosystems EVs with respect to F, Cr, Mn, Mo or Se (drinking water health), pH, TDS, Cl, Na, Fe and Mn (drinking water aesthetic), F, B, Cr, Fe, Mn or Mo (irrigation), TDS, F or Mo (stock) and pH, Al, Cd, Cu, Cr, Ni, or Zn (aquatic ecosystems) (**Appendix A**).

A comparison of the 80th percentile concentrations of the Permian Measures data to the 80th percentile for Zone 34 Fitzroy Basin WQOs Aquatic Ecosystem protection values shows that all bores show some analyte concentrations higher than the WQO values (**Appendix B**).

Summary

Generally, there is a high degree of observed variability in groundwater quality between hydrostratigraphic units, and between individual bores within individual hydrostratigraphic units. As discussed above and shown in **Appendix A**, there are bores within each aquifer that show some analyte concentrations higher than all the relevant EV guidelines/WQOs. The exception of this is the regolith (with data available from one bore MS0113), the data from which shows no 80th percentile concentrations higher than the stock water guidelines (but above the other EV criteria).

Overall, this analysis suggests that groundwater at and surrounding the Project may only be suitable to support the scheduled EVs across some areas, but not across all parts of each hydrostratigraphic units.

The comparison of 80th percentile concentrations in the available data to the relevant 80th percentile for Zone 34 Fitzroy Basin WQOs (or 20th and 80th for pH), shows that across all hydrostratigraphic units many of the analyte concentrations are higher than the guideline value (**Appendix B**). This analysis suggests that groundwater at and surrounding the Project is largely unsuitable to support the aquatic ecosystem EV.

4.4.4 Preliminary MVSX Bore Data

As discussed in **Section 4.1**, Peabody has also recently installed 10 bores in early 2024 for the Moorvale South Extension Project (MVSX) located immediately north of the Project. The newly installed bores include six bores installed into the Permian coal measures and four bores installed into the shallow groundwater system in the vicinity of North Creek, noting that no alluvial aquifer was identified associated with North Creek upstream of the MVS Project in the drilling program.

Only a single groundwater quality monitoring event has been completed by Peabody at the new MVSX bores at the date of this report, with the monitoring parameter suite being only a partial subset of the parameters described in the relevant EV protection WQO. As such, it is not yet possible to complete a comprehensive assessment of groundwater quality at the new bores with respect to EVs. None the less, the available groundwater quality data from the MVSX bores from the single monitoring event in May 2024 is provided in **Table 4-8**. Note that two of the bores installed into the shallow groundwater system (MVSX2A and MVSX3A, refer **Section 4.1**) were not able to be sampled due to a lack of groundwater presence in those bores at the time of the initial sampling in May 2024.

Table 4-8 MVSX Bores Groundwater Quality Results – May 2024

Water Quality Indicator	Unit	MVSX1A	MVSX1P	MVSX2P	MVSX3PR	MVSX4P	MVSX5P	MVSX6P	MVSX7A
pH (lab)	pH unit	8.07	7.98	8.02	8.28	7.95	8.31	8.17	8.10
EC	µS/cm	10600	9660	8750	5360	20600	3050	2520	8950
SO4	mg/L	206	280	177	367	57	29	73	129
Al	mg/L	<0.01	0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01
As	mg/L	<0.001	<0.001	0.002	0.004	0.002	0.015	0.002	0.002
Cd	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cr	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Co	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.003	<0.001	0.002
Cu	mg/L	0.007	0.003	<0.001	<0.001	0.002	<0.001	0.001	0.008
Pb	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mn	mg/L	0.026	0.209	0.188	0.183	0.011	0.175	0.012	0.041
Mo	mg/L	<0.001	0.002	0.005	0.004	0.019	0.006	0.002	0.004
Ni	mg/L	0.002	0.002	0.001	0.001	<0.001	0.002	0.002	0.005
Se	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ag	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
U	mg/L	0.013	<0.001	0.002	0.003	0.002	0.001	0.001	0.010
V	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zn	mg/L	0.035	0.030	0.008	<0.005	0.013	<0.005	0.024	0.017
Bo	mg/L	0.62	0.40	0.68	0.53	0.16	0.40	0.51	0.60
Fe	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
F	mg/L	1.0	0.4	0.8	0.4	0.1	0.1	1.2	1.9

4.5 Groundwater Receptors

4.5.1 Anthropogenic

A search of the Queensland Government's Groundwater Bore Database (GWBD) and the Bureau of Meteorology's National Groundwater Information System (NGIS) was carried out for registered bores within the Study Area (SLR, 2019a). The search indicated that there are 200 registered bores, of which 80 bores (40%) are used for groundwater monitoring and investigations, and 69 bores (34.5%) are used for water supply. The remainder of the bores have an unknown use or resulted from exploration activities (**Table 4-9**).

Table 4-9 Registered use of groundwater bores within the Study Area (SLR, 2019a)

Use	Number of bores	Percent of total
Groundwater monitoring (mine monitoring, water resource investigations)	80	40
Water supply	69	34.5
Unknown	43	21.5
Exploration (petroleum, gas, coal, stratigraphic etc)	8	4
Total	200	100

A field bore census of groundwater bores within 20 km of the Study Area was conducted by ENRS from September to November 2017 as part of the Olive Downs groundwater assessment and reported in HydroSimulations (2018). The bore census involved visiting bores on 12 properties, with a total of 120 bore locations assessed. Of the 120 bores:

- 40 bores were found to be existing and in use;
- 35 bores are existing but not in use;
- 7 bores were of unknown status (could not access); and
- 38 bores were abandoned and destroyed.

Figure 4-28 shows the locations and uses of registered bores and those visited during the 2017 bore census, with full results of the census provided in SLR (2019a) and HydroSimulations (2018).

Of the existing and unknown bores with water use information available, 49 are used for stock water supply, 17 are used of groundwater monitoring and 6 are used for domestic water supply. For the existing and unknown bores with geological information available, 22 intersect alluvium, 10 are within regolith material and 30 intersect Permian aged coal measures (Rangal Coal Measures, Blackwater Group and Back Creek Group).

22 of the inspected bores were equipped with a submersible pump with variable power sources (i.e. mains power, diesel motor and windmill). 25 bores were positioned near water storage tanks, ranging in size from 20 kilolitres (kL) to 100 kL, with two bores equipped with a float actuated pressure switch to maintain tank water levels. There were limited details on abstraction volumes and yields, but some reported maximum yields of around 1 L/s to 2 L/s.

Four of the existing bores inspected as part of the bore census are within 5 km of the proposed pit footprints within the Olive Downs lease. Three of the bores (Bore 8, RN141677 and RN136090) intersect the Isaac River alluvium, while one bore (Swamp Bore) on the Meadowbrook property intersects Permian coal measures to a depth of around 85 m. Two of the four bores (Bore 8 and RN136090) are equipped with submersible pumps and are used for stock and domestic purposes, respectively. Bore RN141677 was not in use and the measured total depth did not match with the drill details, indicating the bore may have collapsed. Swamp Bore is also not currently in use or equipped, but the landholder indicates it has previously been used for stock water supply with a yield of around 1,600 gallons per hour (GPH), which equates to approximately 1.6 L/s.

Seven of the bores inspected as part of the bore census are at the far southern end of the Study Area. The seven bores (RN97180, RN97181, RN97182, RN97183, RN97184, RN97185 and River Bore) are relatively shallow (less than 40 m deep), intersect the Isaac River alluvium and are used for stock water supply. Three of the bores (RN97181, RN97182 and River Bore) are equipped with electric submersible pumps, with a maximum yield of around 1.3 L/s. One of the bores (RN97180) is assumed to be present however could not be

accessed during the bore census, the landholder indicated the bore has had a yield of 800 GPH (0.8 L/s).

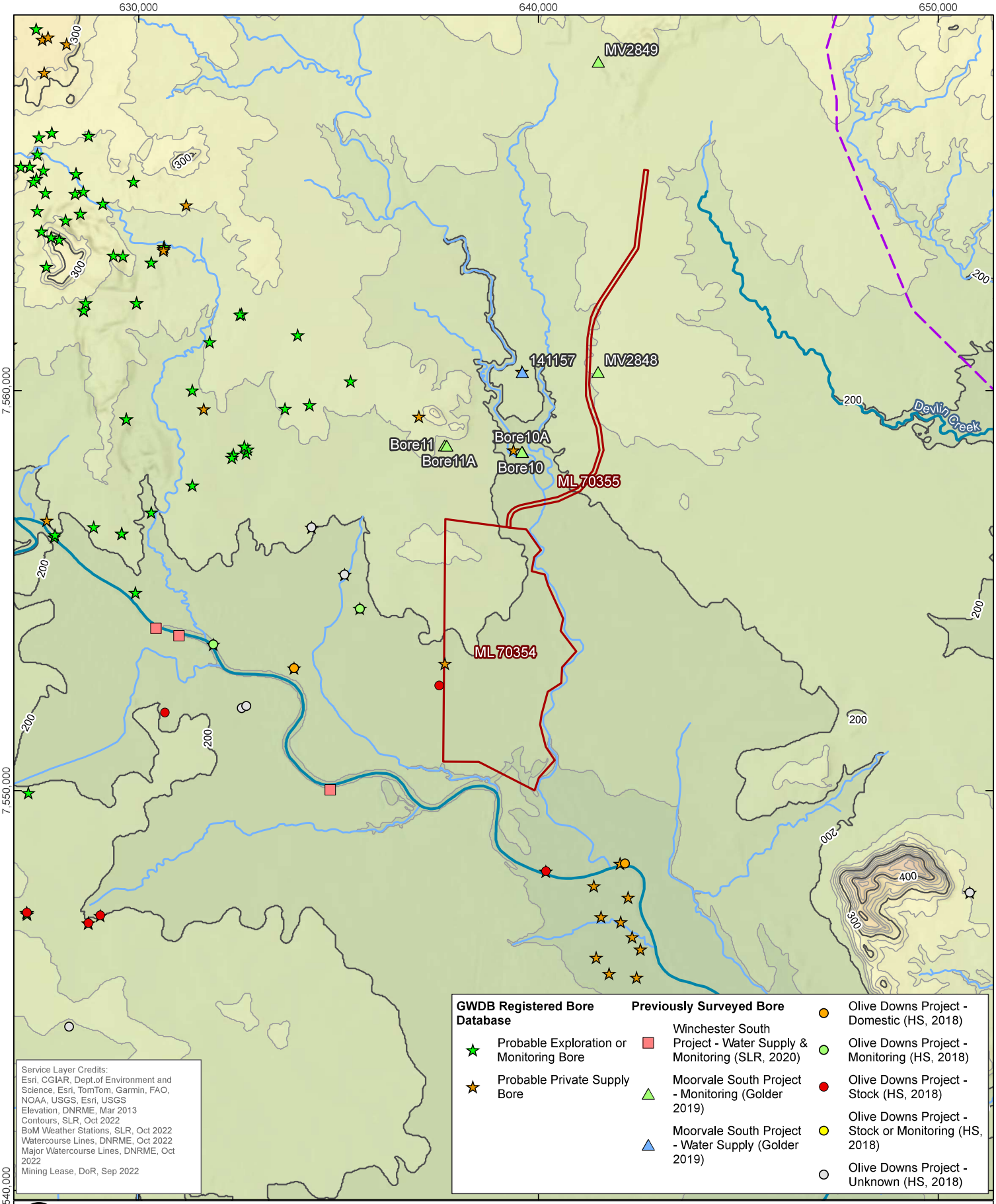
A field bore census of groundwater bores surrounding the Project was conducted by Golder in May 2019. Initially, the bore census included a total of 25 bore locations to be assessed. However, of the 25 bores:

- 16 bores belong to Olive Downs (Pembroke Resources) and there was no need to survey the bores as they are part of the data sharing agreement between Pembroke and Peabody;
- 2 bores were equipped with pumps and not to be surveyed (Bore 8 and Bore 9);
- 1 bore had been mined away (MV2850); and
- 1 bore could not be found at the specified coordinates (44164).

This left five bores to be surveyed. During the survey two additional bores, not in the GWBD, were discovered and included in the census (Bore 10A and Bore 11A). Of these seven bores:

- 2 bores belong to Moorvale Mine (Peabody) and are monitored regularly. Both were field sampled during the census (MV2848 and MV2849);
- 3 bores are used for farming, but unable to be sampled due to the presence of a pump (141157, Bore 10, and Bore 11); and
- 2 bores were abandoned and were field sampled during the census (Bore 10A and Bore 11A). Full lab testing was completed for Bore 10A.

Figure 4-28 shows the locations of bores visited during the 2019 bore census, with full results of the census provided in SLR (2019a).


630,000
640,000
650,000
7,560,000
7,550,000
7,540,000
MV2849
MV2848
141157
Bore11
Bore11A
Bore10A
Bore10
ML 70355
ML 70354
Devlin Creek
300
200
400
Service Layer Credits:
Esri, CGIAR, Dept.of Environment and Science, Esri, TomTom, Garmin, FAO, NOAA, USGS, Esri, USGS
Elevation, DNRME, Mar 2013
Contours, SLR, Oct 2022
BoM Weather Stations, SLR, Oct 2022
Watercourse Lines, DNRME, Oct 2022
Major Watercourse Lines, DNRME, Oct 2022
Mining Lease, DoR, Sep 2022
GWDB Registered Bore Database
Probable Exploration or Monitoring Bore
Probable Private Supply Bore
Previously Surveyed Bore
Winchester South Project - Water Supply & Monitoring (SLR, 2020)
Moorvale South Project - Monitoring (Golder 2019)
Moorvale South Project - Water Supply (Golder 2019)
Olive Downs Project - Domestic (HS, 2018)
Olive Downs Project - Monitoring (HS, 2018)
Olive Downs Project - Stock (HS, 2018)
Olive Downs Project - Stock or Monitoring (HS, 2018)
Olive Downs Project - Unknown (HS, 2018)
0
1
2
km
LEGEND
Major Watercourse
Minor Watercourse
Topographic Contour (100mAHD)
Topographic Contour (20mAHD)
Model Boundary
Moorvale South Mining Lease
Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:125,000 at A4
Project Number: 660.30254.00000
Date Drawn: 11-Jun-2024
Drawn by: AS
MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT
THIRD PARTY BORES
SLR
DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Australia Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.
FIGURE 4-28
Path: \\au.slr.local\Corporate\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx

4.5.2 Environmental

4.5.2.1 Groundwater Dependent Ecosystems

A groundwater dependent ecosystem (GDE) is a natural ecosystem that requires "access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis, so as to maintain their communities of plants and animals, ecosystem processes and ecosystem services" (Richardson et al., 2011). GDEs can require access to groundwater on a permanent (obligate) or intermittent (facultative) basis to meet all or some of their water requirements to maintain their communities of plants and animals, ecological processes, and ecosystem services (Doody et al., 2019).

GDEs are typically classified as either:

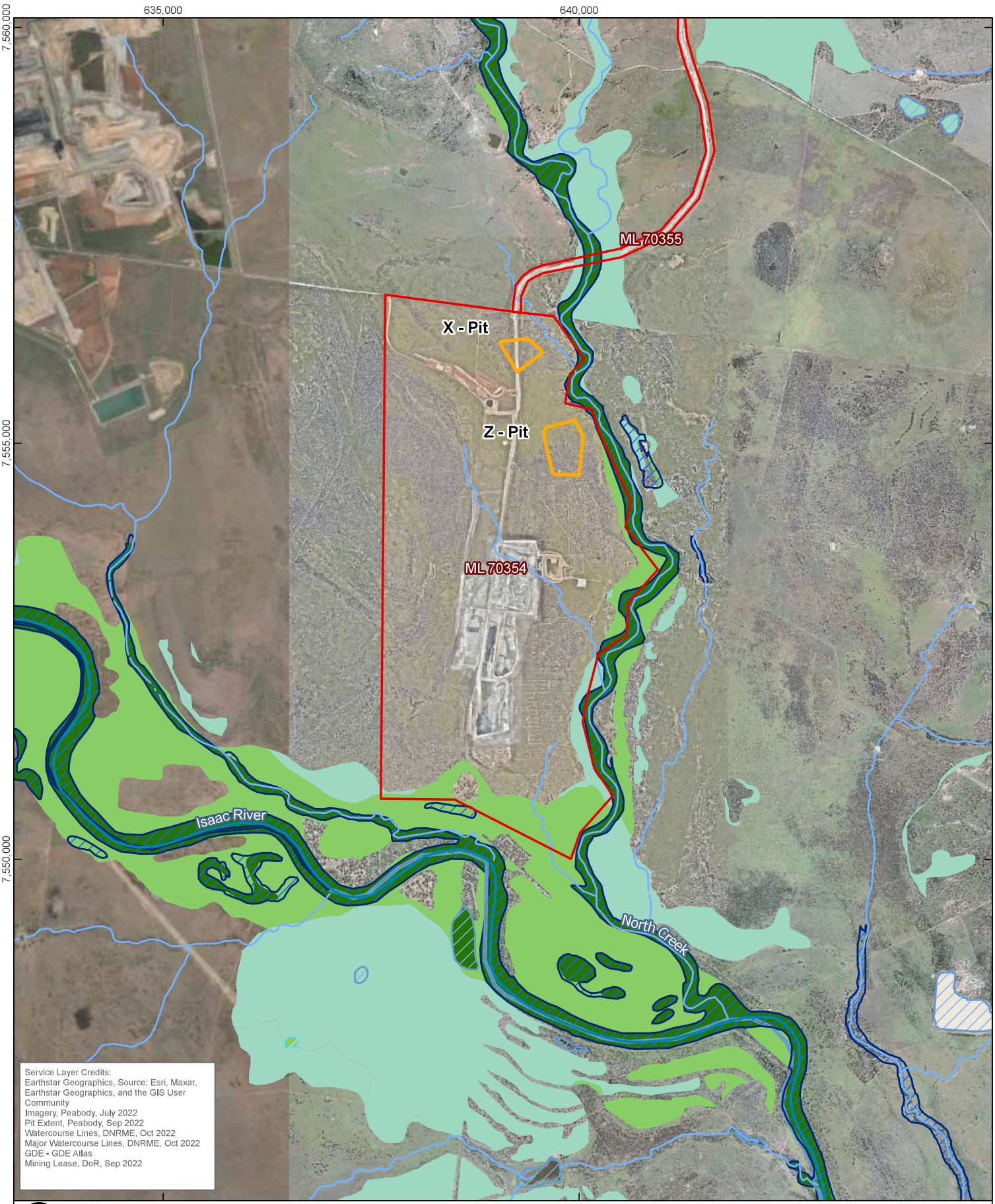
- Aquatic GDEs - ecosystems dependent on the surface expression of groundwater, such as aquatic species that inhabit groundwater-fed surface pools;
- Terrestrial GDEs - ecosystems dependent on the sub-surface presence of groundwater, including some riparian vegetation communities with rooting depths that intersect the water table; and
- Subterranean GDEs - aquifer and cave ecosystems, such as stygofauna that can live within aquifer systems.

National Atlas of Groundwater Dependent Ecosystems

National scale desktop mapping of potential GDEs is available in the Bureau of Meteorology (BoM) National Atlas of GDEs (GDE Atlas). The GDE Atlas classifies ecosystems based on the potential for dependence on groundwater through desktop collation of multiple lines of scientific evidence. Ecosystems have been mapped as either:

- High potential for groundwater dependence indicating a strong possibility the ecosystem is interacting with groundwater;
- Moderate potential for groundwater dependence; or
- Low potential for groundwater dependence indicating it is relatively unlikely the ecosystem will be interacting with groundwater and will include ecosystems that are not interacting with groundwater.

The GDE Atlas mapping of potential aquatic and terrestrial GDEs indicates that areas with possible high, moderate and low potential for groundwater interaction occur in the vicinity of the Project as illustrated in **Figure 4-29** (BoM, 2017). High potential aquatic and terrestrial GDEs are mapped along North Creek and Isaac River.



0 1 2 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:60,000 at A4
Project Number:	660.30254.00000
Date Drawn:	11-Jun-2024
Drawn by:	AS

LEGEND

- Minor Watercourse
- Major Watercourse
- Final Pit Extent
- Moorvale South Mining Lease

Aquatic GDE

- High potential GDE
- Moderate potential GDE
- Low potential GDE

Terrestrial GDE

- High potential GDE
- Moderate potential GDE
- Low potential GDE

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

POTENTIAL GROUNDWATER DEPENDENT ECOSYSTEMS

SLR

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FIGURE 4-29

Path: \\au.slr.local\Corporate\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx

A desktop assessment of potential impact on GDEs within the vicinity of the Project was undertaken by Kleinfelder Australia Pty Ltd (Kleinfelder) in June 2019. The full GDE assessment is contained in SLR (2019a). The desktop assessment was used to identify any GDEs within the Project. These were overlapped with the Queensland Herbarium Regional Ecosystem (RE) mapping to determine the vegetation types and most common tree species that may be associated with the GDEs. The following conclusions were made by Kleinfelder (2019) in relation to the presence/absence of GDEs based on the desktop assessment:

- There are 13 REs within the Project associated with GDEs. The Vegetation Management Act lists six of the REs as 'endangered', one as 'of concern' and the remaining six are listed as 'least concern'. Five of the 'endangered' REs are also listed as 'endangered' under the EPBC Act.
- The Project is situated on soils of Land Zone (LZ) 3, LZ 4, LZ 5 and LZ 9. Two LZ 3 REs had a high potential (HP) for both aquatic and terrestrial groundwater dependence while the other three LZ 3 REs mostly had a medium potential (MP) for groundwater dependence. The only other RE with an aquatic groundwater status had a MP. LZ 5 REs mostly had a low potential (LP) for groundwater dependence although those close to the major watercourses had a MP. REs on LZs 4 and 9 were more likely not to have a GDE status, but those close to the major watercourses still had a LP or MP for groundwater dependence.
- The *E. tereticornis / E. camaldulensis* dominated RE 11.3.25 within the first banks of streams on LZ 3, with roots that could reach the water table, could be dependent on groundwater, but their drought resistance may mean little impact by changes to the groundwater flow. Due to the shallow rooting and drought resistance of the dominant tree species, it is unlikely any of the other REs in the Project would be dependent on groundwater.
- Due to the shallow rooting nature of eucalypts and Brigalow in clay soils, most of the vegetation types within the Project would not be dependent on groundwater and would not be impacted by the influences on groundwater from the open cut mine in the Project. The one exception was RE 11.3.25 which, due to it being in the defined banks of the Isaac River, North Creek and other watercourses in the Project, could be considered as groundwater dependent. However, the lack of impacts on RE 11.3.25 could be a result of the drought tolerance of the associated vegetation or that the open cut mines, even when upstream of the vegetation, did not impede groundwater flow. This means that it is unlikely the proposed open cut mine at the Project would have a significant impact on any of the vegetation communities due to it not directly bisecting any upstream flow to the vegetation with the open cut mine located alongside the Isaac River and North Creek.
- A review of open cut mines in the region of the Project showed that none of the vegetation communities appeared to be impacted by the open cut mines even when the mine had diverted watercourses upstream of the vegetation communities. This outcome shows the lack of dependence of most vegetation types on groundwater and their drought resistance.

Field Verification

The most recent field verification of GDE mapping within the Study Area was undertaken by DPM Enviroscienses (2018) as part of the Olive Downs groundwater assessment. The following conclusions were made in relation to the presence/absence of GDEs based on detailed site surveys and assessments:

- Most of the terrestrial vegetation associated with the Isaac River, Phillips Creek, North Creek and Cherwell Creek is unlikely to be dependent on groundwater given the vegetation communities along these features are known to occur more widely across the landscape and are not restricted to areas where they could potentially access groundwater. There are areas of RE 11.3.25, RE 11.3.27 and RE 11.3.4 along the Isaac River which contain Queensland Blue Gum (Eucalyptus tereticornis) and River Oak (Casuarina cunninghamiana) which have the potential to be reliant on access to groundwater (IESC, 2018, Doody et al., 2019). The existing groundwater monitoring network within the Olive Downs area indicates that the groundwater levels within the Study Area ranges from approximately 10 m to 17 m below ground surface. Based on the depth to groundwater within the Study Area being greater than 10 mbgl, DPM Enviroscienses (2018) concluded that these communities have a low likelihood of being reliant on access to groundwater.
- Consistent with Doody et al. (2019), the ephemeral nature of the aquatic habitat associated with Isaac River, Phillips Creek, North Creek and Cherwell Creek indicates that these habitats have a low likelihood of being dependent on groundwater.
- Terrestrial vegetation and aquatic habitat associated with the palustrine wetlands within the Study Area could potentially be reliant on groundwater given the RE mapped by DSITI (2018). DSITI (2018) has mapped these areas as RE 11.3.27 and RE 11.5.17 which contain River Red Gum (Eucalyptus camaldulensis) and Queensland Blue Gum, both species that could be reliant on the presence of groundwater to some degree. However, given groundwater levels in this area have been identified as being in excess of 10 mBGL, DPM Enviroscienses concluded that these communities would have a low likelihood of being reliant on groundwater. In addition, the aquatic ecology surveys identified aquatic macroinvertebrate species within these wetlands that are indicative of an area subject to complete drying and wetting cycles (DPM Enviroscienses, 2018). The clay-rich substrates of these wetlands are likely to hold surface run-on for extended periods, creating a ‘perched’ system not influenced by groundwater levels (DPM Enviroscienses, 2018).

Stygofauna

Stygofauna sampling has not been undertaken at the Project. However, DPM Enviroscienses undertook stygofauna sampling in 2017 as part of the Olive Downs groundwater support assessment. Sampling of two alluvial bores was conducted, GW01s and GW18s that were identified as having favourable water quality for the presence of stygofauna. Other monitoring locations were not sampled due to being too saline or being dry at the time of sampling. The survey was conducted in October 2017, with results finding no stygofauna present within either bore. Bore GW01s is close to the Project (4 km to the south) and could be considered as representative for the Project.

5.0 Conceptual Site Model

A conceptual site model (CSM) of the groundwater regime has been developed based on the review of the hydrogeological data for the Project and surrounds presented in the above report sections. The CSM is based on the hydrogeological data review presented above, as well as the results of previous Project groundwater modelling reported in SLR (2019a).

5.1 General

The Project is located within the northern part of the Bowen Basin, which comprises Permian aged coal measures that have been folded into a syncline structure that strikes in a northwest to southeast direction. The geology of the Project comprises the stratified sequences of the Moranbah Coal Measures, Fort Cooper Coal Measures and Rangal Coal Measures that dip towards the east. The Project targets the Leichhardt Seam and Upper Vermont Seam of the Rangal Coal Measures, that occur at subcrop at the western side of the Study Area. The coal seams are deepest near the Isaac River, generally over 200 m below ground level within the Study Area. The Triassic Rewan Group unconformably overlies the coal measures and can reach a maximum of 24 m thickness within the Project and up to 300 m thick within the Study Area. Surficial cover includes the alluvium along the Isaac River and North Creek, as well as regolith material comprising Quaternary to Tertiary sediments and weathered strata. The main hydrogeological features at the Project include:

- Alluvium associated with the Isaac River and North Creek;
- Regolith;
- Rewan Group aquitard; and
- Permian strata that host the coal measures.

The alluvium comprises a heterogeneous distribution of clays, sandy clay, sands and gravels. The hydraulic properties of the alluvium vary due to the variable lithologic composition, with field tests indicating horizontal hydraulic conductivity can range between 1.4 $x10^{-2}$ m/day and 8.7 m/day. Groundwater occurs within the alluvium at depths of around 10 mBGL to 20 mBGL, and more than 4 m below the base of the Isaac River. Regionally, groundwater flow within the alluvium is a subdued reflection of topography, with groundwater flowing in a south easterly direction consistent with the alignment of the Isaac River. However, local groundwater levels within the alluvium are highest close to the river, indicating a potential local flow direction away from the river to the east and west. This also indicates potential losing conditions from the river to the underlying alluvium during flow periods. Spatially, the alluvium is variably saturated, with two alluvial bores (ODS bores GW04 and GW08s, south of the Project) recorded as dry since July 2017. Localised perched water is also evident where waterbodies continue to hold water throughout the dry period (e.g. pools in the Isaac River and wetlands) occurring where clay layers slow the percolation of surface water.

Recharge to the alluvium is mostly from stream flow or flooding (losing streams), with direct infiltration of rainfall also occurring rapidly where there are no substantial clay barriers in the shallow sub-surface. On a regional scale, discharge is via evapotranspiration from vegetation growing along creek beds and minor short duration baseflow events after significant rainfall/flooding. Infiltration to underlying formations is likely to be limited to areas in connection with relatively high hydraulic conductivity units (e.g. coal seams and possibly faults). General downwards recharge to deeper units is limited by the low hydraulic conductivity (confining) Rewan Group and coal measure interburden sequences.

Water quality data for the alluvium indicates it can be fresh to moderately saline and highly spatially and temporally variable. The alluvium is mostly suitable for stock water supply and

irrigation but is not suitable for drinking water and freshwater aquatic ecosystems. Review of the Queensland GWDB and a landholder census indicates alluvial groundwater along the Isaac River is used by local landholders, predominantly for stock water supply. Based on previous ecological studies, it was identified that riparian vegetation along the Isaac River has a low likelihood of dependence on alluvial groundwater.

Tertiary-Quaternary aged sediments and weathered strata (collectively regolith) present in the south and east of the Project, form the base of the unconfined shallow groundwater system. The groundwater flow processes are similar to those of the alluvium, however the fluxes are expected to be significantly lower due to the dominance of clay within the Tertiary sediments. Within the Study Area, near the Isaac River and creeks (North Creek and Ripstone Creek), water has been detected within the regolith material at depths of around 8 mBGL to 19 mBGL. Outside of these areas the regolith material is largely unsaturated. Water quality data for the regolith indicates it is generally highly saline but can be brackish to moderately saline. Water within the regolith is generally of poor quality and not considered suitable for stock, irrigation, aquatic ecosystems or drinking water. However, review of the Queensland GWDB and landholder census identified that six of the 120 bores surveyed potentially intersect the regolith material. These bores are located over 4 km from the Project.

In the Permian strata, groundwater is encountered in the coal seams and in the sandstone/siltstone lower hydraulic conductivity units. As with the rest of the Bowen Basin, the coal seams are the main groundwater bearing units within the Permian sequences, with low hydraulic conductivity interburden generally confining the individual seams. The coal seams are dual porosity in nature with a primary matrix porosity and a secondary (dominant) porosity provided by fractures (joints and cleats). Hydraulic conductivity of the coal decreases with depth due to increasing overburden pressure reducing the aperture of fractures. Vertical movement of groundwater (including recharge) is limited by the confining interburden layers, meaning that groundwater flow is primarily horizontal through the seams with recharge occurring mainly at subcrop.

Review of fault behaviour within the Study Area and from external studies has identified that faults can increase vertical hydraulic conductivity parallel to the fault trace and reduce it perpendicular to the fault trace. However, any increases in vertical hydraulic conductivity is limited to small vertical horizons (<20 m) and is variable between faults dependent on localised hydrothermal activity and mineralisation in-filling pore spaces. Regionally, groundwater within the Permian coal measures flows in a south-easterly direction. Review of water quality data indicates water within the Permian coal measures is generally saline but can range between fresh to highly saline. Groundwater within the coal measures is only considered suitable for some stock, with the type of stock dependent on the TDS range (i.e. beef cattle or sheep). Review of the Queensland GWDB indicates 17 private bores intersect the coal measures for water supply; only one within 5 km of the Project (Swamp Bore).

Potential GDEs are mapped along North Creek and Isaac River. The most recent field verification of GDE mapping within the Study Area was undertaken by DPM Envirosciences (2018) as part of the Olive Downs groundwater assessment. The following summary was made in relation to the presence/absence of GDEs based on detailed site surveys and assessments:

- Most of the terrestrial vegetation associated with the Isaac River and North Creek is unlikely to be dependent on groundwater, given the vegetation communities along these features are known to occur more widely across the landscape and are not restricted to areas where they could potentially access groundwater.
- There are areas of RE 11.3.25, RE 11.3.27 and RE 11.3.4 along the Isaac River which contain Queensland Blue Gum (*Eucalyptus tereticornis*) and River Oak



(*Casuarina cunninghamiana*), which have the potential to be reliant on access to groundwater (IESC, 2018, Doody et al., 2019).

The existing groundwater monitoring network within the Project and Olive Downs area indicates that the groundwater levels within the Study Area ranges from approximately 10 m to 17 m below ground surface. Based on the depth to groundwater within the Study Area being greater than 10 mBGL, DPM Enviroscience (2018) concluded that these communities have a low likelihood of being reliant on access to groundwater.

The ephemeral nature of the aquatic habitat associated with Isaac River and North Creek indicates that these habitats have a low likelihood of being dependent on groundwater, consistent with Doody et al. (2019).

Conceptual cross-sections of the hydrogeological system are presented in **Figure 3-5** illustrating the conceptual model of the area prior to mining.

5.2 End of Mining

The potential impacts to the groundwater system post-closure, as relevant to the hydrogeology assessment for the Project's PRCP and EAA, are relative to how the groundwater system recovers from active mining. Therefore, it is important to understand the nature of the groundwater system immediately prior to the closure period.

A visual representation of the end of mining CSM is provided as **Figure 5-1**, noting the features discussed above. Based on previous groundwater modelling presented in SLR (2019a), key features relevant to the discussion of potential groundwater impacts post-mining include:

- Groundwater drawdown within the Rangal Coal Measures, associated with previous dewatering of the mine pit voids, results in inwards hydraulic flow gradients in the coal measures.
- Mine pit voids capture any seepage from spoil emplacements.
- Water table depression of up to 10 m at North Creek in the north of the Project Area.
- Little to no impact on environmental receptors, particularly GDEs given the lack of evidence that the terrestrial vegetation are reliant on groundwater.
- No impact on anthropogenic receptors.

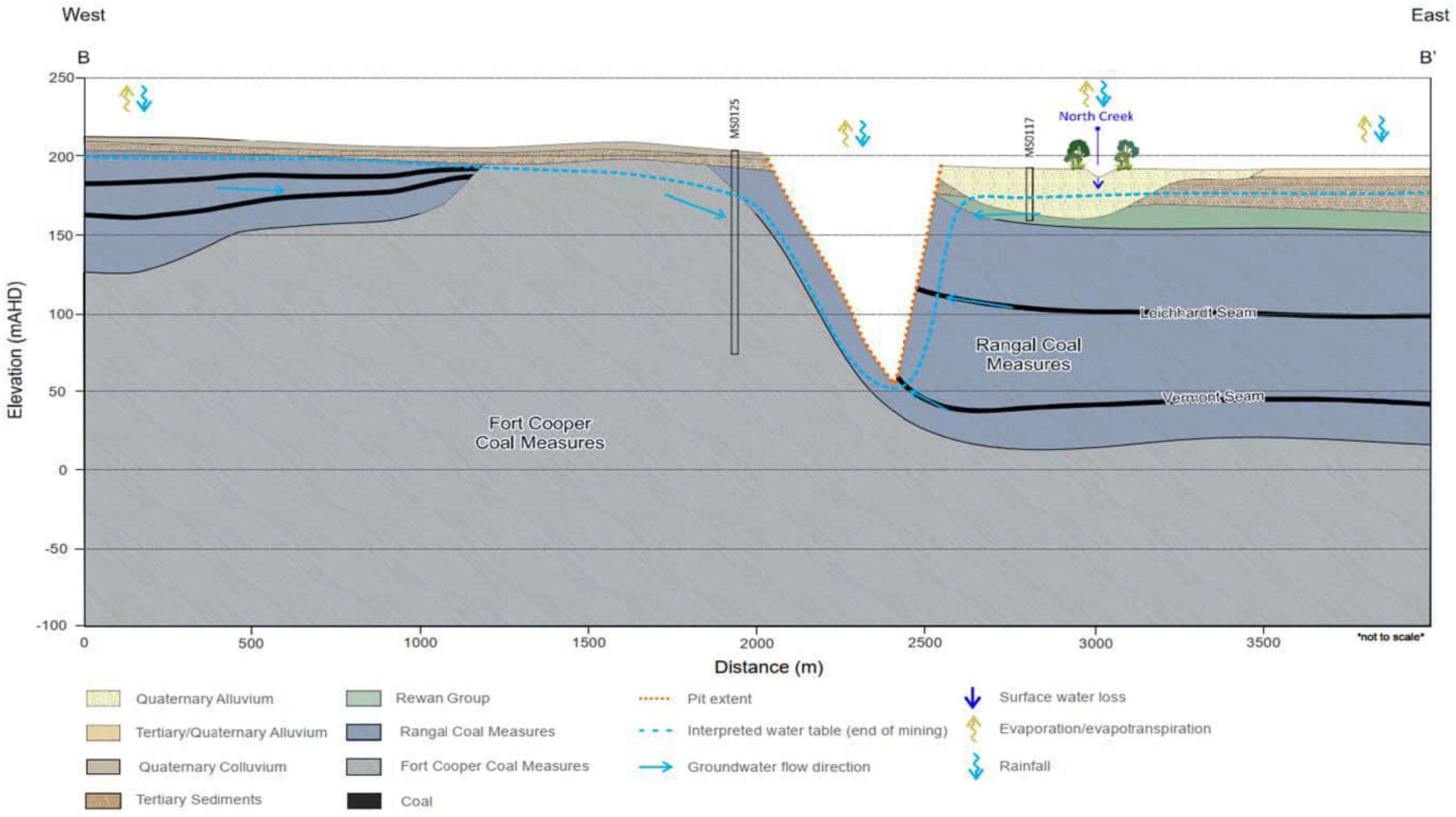


Figure 5-1 Conceptual model of the groundwater system – end of mining

6.0 Potential Impacts

This hydrogeology assessment focuses on the large-scale impacts to the Project groundwater system. The movement of potential contaminants in groundwater that might be associated with seepage from spoil dumps is considered within this hydrogeological assessment.

6.1 Groundwater System at End of Mining

The potential impacts to the groundwater system post-closure, as relevant to the hydrogeology assessment for the PRCP and EAA, are relative to how the groundwater system recovers from active mining including the groundwater flow regime that results from the final landform. Therefore, it is important to understand the nature of the groundwater system at the conclusion of mining immediately prior to the closure period. The SLR (2019a) groundwater modelled Project mine plan was reviewed to assess if the latest mine plan required an update within the model. Since the 2019 modelled mine plan did not cover the full mining area in the latest Project mine plan, the model was updated to provide an indication of the predicted nature of the Project groundwater system at the end of mining (see **Section 7.0** for modelling details), and potential groundwater system impacts that may have arisen at the end of mining. These can be summarised as:

- Groundwater level drawdown of the Permian coal measures, associated with dewatering of the active mine pit voids. The magnitude of this drawdown will be greatest in the immediate vicinity of the pit voids, but extend northwards, eastwards and southwards of the Project by several kilometres and interact with drawdown from nearby mines such as Daunia and Olive Downs.
- Limited groundwater level drawdown within the alluvium away from the Project.
- Limited groundwater-related effect on surface water flows of the Isaac River.
- Low potential for groundwater level drawdown impacts to potential GDEs along North Creek and Isaac River.
- No potential for groundwater quality impacts outside the Project associated with spoil dumps, due to the inward groundwater flow gradients towards the pit voids capturing all potential seepage.

6.2 Groundwater System Post Mining

Potential impacts to the groundwater system in the post-closure period as relevant to this groundwater assessment are summarised below. These are investigated further in this groundwater assessment by adopting the updated final landform for the final voids consistent with the PRCP and EAA.

- Residual void water level recovery (i.e. lake formation) with the potential for void water to discharge to the surrounding groundwater environment.
- Only partial groundwater system recovery outside the voids, particularly in the Permian coal measures.
- Potential for ongoing groundwater discharge to the residual voids.
- Potential for ongoing salinisation of the void lakes.



- Potential for groundwater quality impacts outside the Project site associated with seepage from spoil dumps or other mine waste areas, as outflow from residual void lakes.

In relation to the potential for groundwater quality impacts outside the Project site associated with seepage from spoil dumps, RGS (2023) provide a geochemical assessment of waste rock, coal and coal rejects at the Project. RGS (2023) concluded that waste rock and coal/coal reject materials are relatively benign but likely to generate alkaline and brackish pore water with low to moderate concentrations of major ions and low concentrations of dissolved trace metals/metalloids, and are not significantly enriched with metals/metalloids. Tailing materials generally contain higher concentrations of sulfide but have a low level of reactivity. It is noted that any poorer quality water from waste materials that enters the groundwater system would be captured by and remain within the residual void lakes, in the event that those lakes are predicted to be hydraulic sinks in the long term post-mining. This is explored in detail in **Section 7.0**.

7.0 Groundwater Modelling

7.1 Model Details

Peabody's Bowen Basin regional numerical groundwater model was adopted for the PRCP and EAA groundwater assessment. This section provides a summary of the design and development of the numerical groundwater model. Full details of the numerical groundwater model adopted in this hydrogeological assessment are included within SLR (2022b). The version of the model adopted for this groundwater assessment is an update to the earlier model version developed specifically for the Moorvale South Project (SLR, 2019b). Peabody has industry data share agreements that allow adoption of the most recently updated version of the model.

The existing regional numerical groundwater model was deemed appropriate for the purposes of the PRCP and EAA for the following reasons:

- Adoption of the MODFLOW-USG code in the existing model allows for sufficient refinement of the model grid around the Project operations such that the limitations of a regional model in terms of the grid design are mitigated.
- The model incorporates the Project geological model as well as adjacent mine/project geological models, with model layer representation consistent with the geological model.
- The model is robustly calibrated to Project specific monitoring data as well as an extensive regional dataset including that collected at neighbouring mines.
- The model incorporates regional influences that may interact with the groundwater system (and model predictions) post-closure at the Project, including operations at the neighbouring Daunia mine that are considered likely to interact with the Project residual voids given their proximity.
- The model has previously been used at the Project to support water licence compliance reporting to the State.
- The version of the model adopted for the Project PRCP and EAA is the latest update to the existing regional numerical model that has been subject to multiple independent peer reviews, as well as State and Commonwealth regulator reviews, and has found widespread acceptance as a result of those reviews.

7.1.1 Model Objectives

Numerical modelling was undertaken in support of this hydrogeology assessment for the PRCP and EAA to evaluate the potential impacts of the final landform (denoted L220903_MVS_Final_LandformDraft100mm_1mDEM, refer to **Section 1.2**) on the groundwater regime. The objectives of the predictive modelling were to:

- Assess groundwater inflow to the final landform's residual voids;
- Simulate the level and rate of recovery of the residual void lakes, and the level and rate of mining-related groundwater drawdown recovery in the groundwater system surrounding the residual voids; and
- Identify areas of potential risk, such as private supply bores (**Section 4.5.1**) or GDEs (**Section 4.5.2**), where groundwater impact mitigation/control measures may be necessary post-closure.

7.1.2 Model Design

The most recently updated version of the regional numerical groundwater model, adopted for the Project PRCP and EAA, was developed primarily to support the Saraji East Mining Lease Project approvals process as well as future approvals for the neighbouring Peak Downs Mine (SLR, 2022b). The model is regional in nature, designed primarily to predict regional scale mining impacts in a cumulative impact framework.

The latest version of the regional numerical groundwater model builds on the Olive Downs Project EIS model (the foundational regional Bowen Basin model) (HydroSimulations, 2018). The foundational model was subsequently updated for the Project in 2019 (SLR, 2019a,b), for the Winchester South Project EIS in 2020 and 2022 (SLR, 2020a, 2022), for the Lake Vermont North Project and Caval Ridge Mine Horse Pit Extension Project in 2021 (SLR, 2021a,b), Daunia Mine water licence reporting in 2021 (SLR, 2021c), and most recently for the Saraji East Mining Lease Project in 2022 (SLR, 2022b).

The numerical model was developed using a Geographic Information System (GIS) in conjunction with MODFLOW-USG, which is distributed by the United States Geological Survey (USGS). MODFLOW-USG is a relatively new version of the popular MODFLOW code (McDonald and Harbaugh, 1988) developed by the USGS. MODFLOW is the most widely used code for groundwater modelling and has long been considered an industry standard.

Model layering is based on a simplified regional scale representation of the central Bowen Basin hydrogeological framework. The model layer structure is presented in **Table 7-1**.

Table 7-1 Model layering

Model Layer	Geologic Formation	Hydrogeologic Unit	Present in the Project Area
1	Alluvium, colluvium, Tertiary basalt	Alluvium, surface cover	Yes
2	Tertiary sediments, Tertiary basalt	Tertiary sediments, weathered Permian, Tertiary basalt	Yes
3	Rewan Group	Triassic	Yes (in part)
4	Rangal Coal Measures	Leichhardt overburden	Yes
5		Leichhardt seam	Yes
6		Interburden	Yes
7		Vermont seam	Yes
8		Vermont underburden	Yes
9	Fort Cooper Coal Measures	Fort Cooper overburden	Yes
10		Fort Cooper seams (combined)	Yes
11		Fort Cooper underburden	Yes
12	Moranbah Coal Measures	Q Seam	Yes
13		Interburden	Yes
14		P Seam	Yes
15		Interburden	Yes
16		H Seam	Yes

Model Layer	Geologic Formation	Hydrogeologic Unit	Present in the Project Area
17		Interburden	Yes
18		D Seam	Yes
19		Interburden	Yes

7.1.3 Model Calibration

A detailed description of the calibration procedure is provided in SLR (2022b). The numerical model includes a steady state and a transient calibration (2008 to 2021). In all, calibration used 3,449 target heads for 281 bores, including 13 observation sites at the Project. Both the steady-state and transient calibrations capture historical mining at Daunia, Saraji, Peak Downs, Caval Ridge, Lake Vermont, Poitrel, Millennium, Isaac Plains, Olive Downs and Grosvenor mines. Mining was represented in the model using the MODFLOW drain package, with the drain cells set to the base of the target coal seam for each pit, and within the target coal seam for underground mines. Calibration of the model was carried out with the objective being to replicate the groundwater levels measured in the Moorvale South Project, Daunia, Saraji, Caval Ridge, Lake Vermont, Winchester South Project, Olive Downs, Moranbah South Project, Millennium, and Poitrel monitoring networks, as well as some registered bores, in accordance with Australian Groundwater Modelling Guidelines (Barnett et al., 2012).

Given the regional scale model design, equal weighting was applied to all bores/data from each site so as not to bias model calibration to any one area/mine and potentially decrease model reliability elsewhere but provide the most robust regional scale calibration possible given the regional cumulative hydrogeological impact framework. This approach also means that any data uncertainty associated with a single calibration point in any one model layer will not bias the calibration results, as all data for each layer from across the entire regional model domain is treated equally. Similarly, the calibration approach means that the influence on calibration performance of any perceived lack of local calibration points for a layer at any particular mine site, or a relatively short monitoring record at any one monitoring site, is somewhat mitigated by the regional scale approach to calibration where calibration is aiming to achieve the best fit to all available data across any one model layer. The number of model calibration points and associated target head measurements for each layer is provided in **Table 7-2**.

Table 7-2 Model Calibration Targets (SLR, 2022a)

Model Layer	Geologic Formation	Hydrogeologic Unit	Calibration Target Locations	Number of Target Head Measurements
1	Alluvium, colluvium, Tertiary basalt	Alluvium, surface cover	18	212
2	Tertiary sediments, Tertiary basalt	Tertiary sediments, weathered Permian, Tertiary basalt	93	910
3	Rewan Group	Triassic	15	153
4	Rangal Coal Measures	Leichhardt overburden	10	251
5		Leichhardt seam	28	358
6		Interburden	6	123
7		Vermont seam	23	259
8		Vermont underburden	5	175
9	Fort Cooper Coal Measures	Fort Cooper overburden	23	338
10		Fort Cooper seams (combined)	10	90
11		Fort Cooper underburden	4	29
12	Moranbah Coal Measures	Q Seam	3	117
13		Interburden	2	39
14		P Seam	6	99
15		Interburden	5	66
16		H Seam	14	85
17		Interburden	3	7
18		D Seam	14	138
19		Interburden	0	0
		Totals	**282**	**3449**

Calibration for the model achieved an 8.9 m root mean square (RMS) error, equating to a 5.9% scaled root mean square (SRMS) error, which is within the recommended range (up to 10%) in the Australian Groundwater Modelling Guidelines (Barnett et al., 2012). Observations from the Project monitoring bores achieved an RMS error of 7.6 m, which is lower than the RMS error for the entire model, reflecting slightly better calibration performance at the Project site when compared to the entire model calibration dataset. Calibrated hydraulic parameters were shown to be all within the range of available field data (SLR, 2022b).

7.1.4 Model Performance and Limitations

The groundwater modelling was conducted in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al. 2012), the Murray Darling Basin Commission (MDBC) Groundwater Flow Modelling Guideline (MDBC, 2001) and the IESC Explanatory Note for Uncertainty Analysis (IESC, 2018). These are mostly generic guides and do not include specific guidelines on special applications, such as underground coal mine modelling.



The 2012 Australian Groundwater Modelling Guidelines has replaced the model complexity classification of the previous MDBC guideline by a "model confidence level" (Class 1, Class 2 or Class 3 in order of increasing confidence) typically depending on:

- Available data (and the accuracy of that data) for the conceptualisation, design and model construction.
- Calibration procedures that are undertaken during model development.
- Consistency between the calibration and predictive analysis.
- Level of stresses applied in predictive models.

It is generally expected that a model confidence level of Class 2 is required for mining environmental impact assessment; the 2012 Australian Groundwater Modelling Guidelines state that a Class 2 model may be used for assessing impacts associated with mine dewatering (Barnett et al. 2012).

Table 7-3 summarises the subjective qualitative criteria allowing model classification, per Table 2.1 of the 2012 Australian Groundwater Modelling Guidelines. The classification of the latest iteration of the Peabody model as presented in **Table 7-3** has been assessed subjectively by a Principal groundwater modeller and reviewed by a Technical Director hydrogeologist/modeller, whereby:

1. The classification table was subjectively reviewed, and the specialists mutually decided, in their professional opinion, which box most appropriately describes the various characteristics of the model.
2. Thereafter, the assessors assigned an overall classification class for the model based on the characteristics selected, i.e. which class has the most selected characteristics.

The assessment shown in **Table 7-3** indicates that, overall, the latest iteration of the groundwater model can be classified as primarily Class 3 using the 2012 Australian Groundwater Modelling Guidelines classification system (effectively “high confidence”), with some aspects meeting the lower Class 2 criteria. This is considered an appropriate level for this PRCP and EAA context. The classification of the previous iteration of the model as at least Class 2 has been validated by an independent expert hydrogeologist/modeller (HydroAlgorithmics, 2021), with that independent reviewer noting that “all models are in fact mixtures of Class 1, Class 2 and Class 3”.

Table 7-3 Groundwater model classification[1,2]

Class	Model Characteristics					
	Data		Calibration		Prediction	
1		Few or poorly distributed data points		Not possible		Predictive timeframe >> calibration timeframe
		Unavailable or sparse data in areas of greatest interest		Unacceptable levels of error		Temporal discretisation is different to calibration
	✓	No metered groundwater extraction data		Inadequate distribution of data		Transient prediction but steady state calibration
		Remote climate data		Targets incompatible with model purpose		Unacceptable validation
		Little or no useful data on land-use, soils, or river flows and stage elevations				

Class	Model Characteristics					
	Data		Calibration		Prediction	
2		Some data but may not be adequate throughout domain	✓	Reasonable calibration statistics with errors in parts of the model	✓	Predictive timeframe > calibration timeframe
		Some metered groundwater extraction data		Long-term trends not replicated in all parts of domain		Long stress periods compared to calibration
	✓	Streamflow and stage measurements are available at some points		Transient calibration not extending to present day		New stresses not in calibration
		Reliable irrigation application data available in part	✓	Weak seasonal replication		Poor validation
				No use of calibration targets compatible with model purpose		
			✓	Validation not undertaken		
3	✓	Spatial and temporal distribution of data adequate	✓	Scaled RMS error or other calibration statistics are acceptable		Predictive timeframe ~ calibration timeframe
		Clearly defined aquifer geometry	✓	Long-term trends adequately replicated where important	✓	Temporal discretisation in predictive model consistent with transient calibration
		Reliable metered groundwater extraction data		Seasonal fluctuations adequately replicated	✓	Similar stresses to those in calibration
	✓	Rainfall and evaporation data is available	✓	Transient calibration is current		Steady state prediction consistent with steady state calibration
	✓	Aquifer testing data to define key parameters	✓	Model is calibrated to heads and fluxes		Model validation suggests calibration is appropriate
	✓	Good quality and adequate spatial coverage of DEM	✓	Key modelling outcomes dataset used in calibration		Steady-state predictions when the model is calibrated in steady-state
		Streamflow and stage measurements are available at many points				
		Reliable land-use and soil-mapping data available				
		Reliable irrigation application data available				

1. Refer Table 2.1 of the 2012 Australian Groundwater Modelling Guidelines (Barnett et al. 2012)
2. Green highlighted cells = model has been subjectively assessed to meet the classification criteria for that Class

7.2 Final Landform Model

Post-mining groundwater impacts at the Project were investigated for the purposes of the PRCP and EAA hydrogeology assessment with a numerical groundwater recovery model for the Project's final landform including two residual voids; refer to **Section 1.2**.

7.2.1 During Mining Model

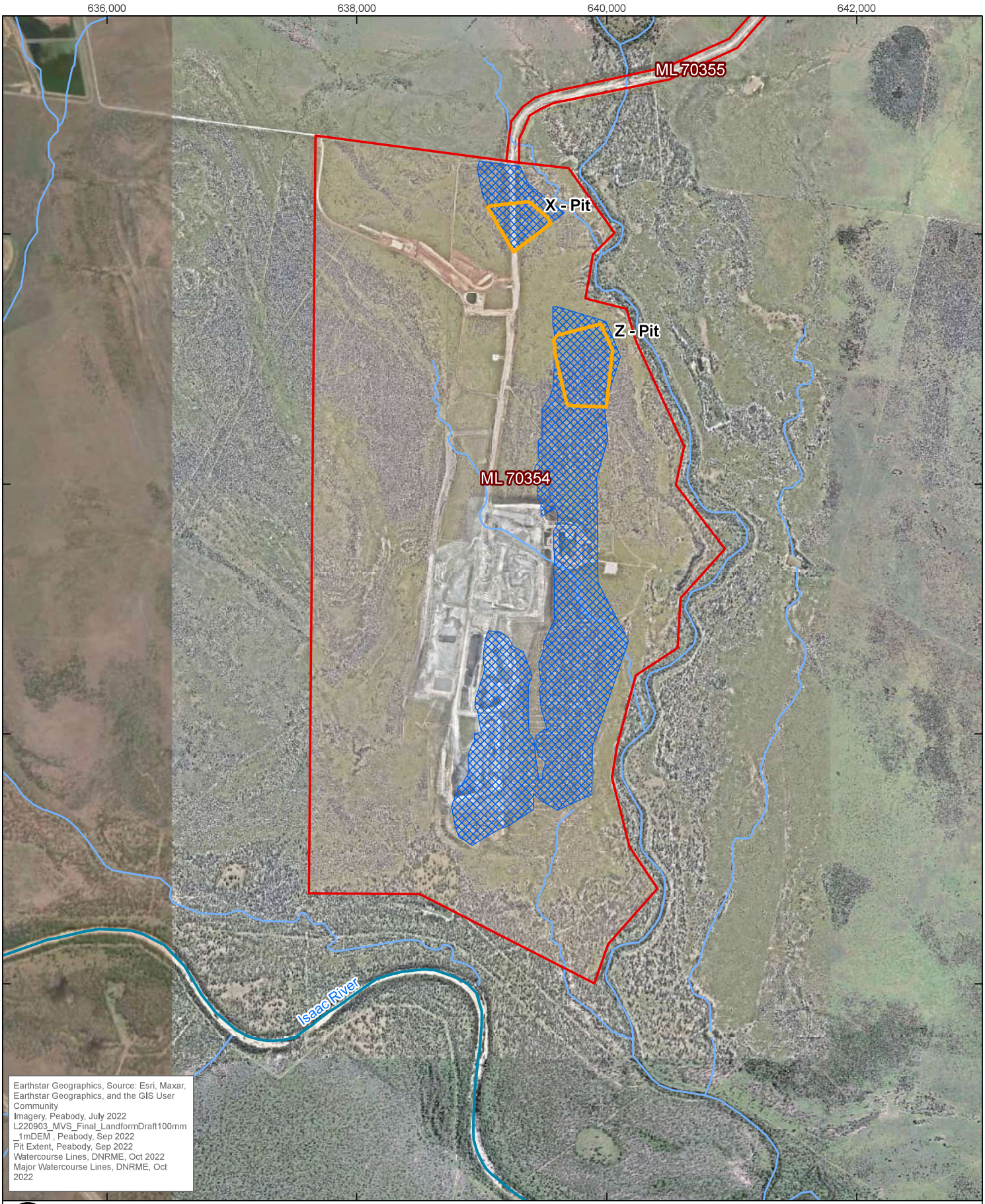
As previously discussed, the 2019 dated Project mine plan represented in the existing regional numerical groundwater model (as reported in SLR, 2022b) was reviewed as part of this assessment, to assess if the mine plan represented in the existing model required an update so that it appropriately represents the current Project mine plan provided by Peabody. That review indicated that the Project mine plan represented in the existing model required an update to match the current Project mine plan, so that the hydrogeological conditions that exist at the end of mining (the start of the PRCP period and the recovery model) are appropriately simulated. The distribution of modelled spoil emplacement is shown on **Figure 7-1**.

The methodology for representing the updated mine plan was identical to that adopted in earlier versions of the model (i.e. as reported in SLR 2022b). No other changes were made to the during-mining model reported in SLR (2022b). The predicted start of mining groundwater levels, and end of mining predicted groundwater heads from the updated Project mine plan, are provided in **Appendix C and Appendix D**, respectively.

7.2.2 Recovery Model Setup

The PRCP and EAA proposed final landform was replicated in the recovery model, including areas of spoil emplacement within mined out pits and the two proposed residual voids.

The recovery model commenced from the end of mining at the Project (end of the year 2035) and was run for 2,060 years over 82 model stress periods. The model stress period setup is shown in **Table 7-4**. Note the stress period setup also accounts for simulated recovery at other mine voids within the model domain, i.e. is not designed only for the recovery simulation at the Project.



Earthstar Geographics, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Imagery, Peabody, July 2022
L220903_MVS_Final_LandformDraft100mm_1mDEM , Peabody, Sep 2022
Pit Extent, Peabody, Sep 2022
Watercourse Lines, DNRME, Oct 2022
Major Watercourse Lines, DNRME, Oct 2022

0 0.5 1 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	660.30254.00000
Date Drawn:	23-Jun-2024
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- Road
- Final Pit Extent
- Moorvale South Mining Lease
- Modelled Spoil Extent

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

MODELLED SPOIL EMPLACEMENT

SLR

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FIGURE 7-1

Path: \\au.slr.local\Corporate\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx

Table 7-4 Recovery model stress periods

Stress Period	Stress Period Duration (Years)	Starting Year (Post-Mining)	Ending Year (Post-Mining)
1 – 20	1	1	20
21 – 28	5	21	60
29 – 48	1	61	80
49 – 58	2	81	100
59 – 63	5	101	125
64 – 77	10	126	266
78 – 81	50	267	466
82	1844	467	2060

The final recovery model adopted for reporting in this hydrogeology assessment used end of Project mining predicted groundwater levels from the updated version of the during-mining predictive model (**Section 7.2.1**) as the starting heads and removed all drain cells simulating the proposed mining areas at the Project to allow groundwater levels to equilibrate. The starting heads for the post-mining simulation for each relevant hydrostratigraphic unit (i.e. end of mining predicted heads) are provided in **Appendix C**.

Climate related boundary conditions (i.e. recharge and ET) in the recovery model were set constant for the duration of the recovery model, at their values consistent with the latest version of the predictive model (SLR, 2022b). Recharge and ET were not applied to the final voids themselves in the groundwater model since the WRM Water & Environment Pty Ltd (WRM) (2022) water balance model used iteratively with the groundwater model (see **Section 7.2.3**) accounts for these boundary conditions.

The properties of the residual void cells were converted to values representative of void values consistent with the methodology adopted in the latest version of the model (SLR, 2022b). That is, the void cells were assigned high horizontal and vertical hydraulic conductivities (1,000 m/day) and storage parameters based on the compressibility of water (specific yield of 1.0, storage coefficient of 5.0×10^{-6} m^{-1}), to simulate free water movement within the residual void. This approach is often referred to as a 'high-K' lake.

The simulation of mines adjacent to the Project (refer to **Figure 1-2**) in the groundwater model, such as Daunia to the northwest of the Project Area, has the potential to influence the model results. The simulation of Daunia Mine within the groundwater model is consistent with the PRPC being developed for that site concurrently with the Project PRCP, i.e. using the same numerical model and incorporating the preliminary Daunia final landform (including its residual voids) available at the time of the Project PRCP and EAA hydrogeology assessment development.

7.2.3 Residual Void Lake Recovery

The residual voids will accumulate water over time due to rainfall, surface water runoff and groundwater inflows from recovering groundwater levels. Void water levels were not predicted by the groundwater model but were estimated by the balance between groundwater inflow and the direct rainfall and rainfall runoff from the surrounding catchment against the evaporation loss from the lake surface through iterative surface water balance modelling (WRM, 2023). The WRM (2023) surface water balance modelling included climate sensitivity (dry, median and wet scenarios), the median climate scenario reported therein was adopted for the groundwater model.

The iterative modelling approach was undertaken in a stepwise manner as follows:

1 Initial predicted groundwater inflows with time to the Project residual voids were estimated by SLR using the numerical groundwater model.

2 The pit lake levels with time were then predicted by the WRM (2023) water balance model for the range of climate scenarios, incorporating groundwater (Step 1) and surface water fluxes and processes.

3 To refine the Step 1 estimation of residual void groundwater inflows, the daily residual void water elevations derived from the WRM (2023) water balance modelling (Step 2) were then replicated by SLR within the numerical groundwater model for the final landform using the time variant constant head boundary (CHD) condition, adopting a simplified average of the median WRM (2023) daily results over the relevant groundwater model stress period length.

4 Refined predicted groundwater inflows with time to the residual voids from the numerical groundwater model (Step 3) were then incorporated into an update of the Step 2 water balance model prepared by WRM (2023).

5 Since the updated water balance model from Step 4 resulted in somewhat different predicted void lake levels, the updated void water elevations derived from the WRM (2023) water balance modelling (Step 4) were then again replicated by SLR within the numerical groundwater model using the time variant constant head boundary (CHD) condition to produce updated predicted groundwater inflows with time to the residual voids from the numerical groundwater model, which were then incorporated into a further revision of the water balance model.

6 As the groundwater model predicted groundwater inflows to the voids were now in agreement with what was used as input to the water balance modelling (Step 5), it was considered by WRM (2023) and SLR that further iterations between the two models were not required and therefore the Step 5 groundwater model results were adopted for reporting in this groundwater assessment.

Figure 7-2 and **Figure 7-3** provide a graphical representation of the final simulated recovery of water levels in the residual voids, based on the iterative groundwater and surface water balance modelling.

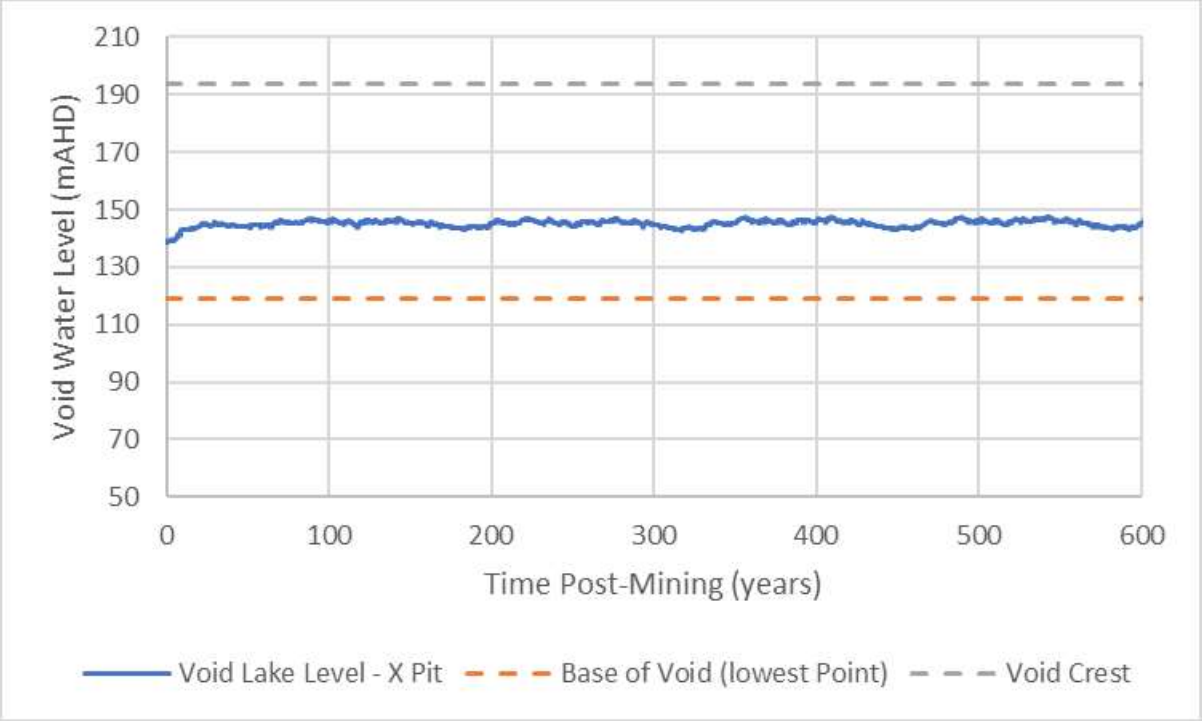


Figure 7-2 Simulated void water level over time – X Pit Void (based on WRM, 2023)

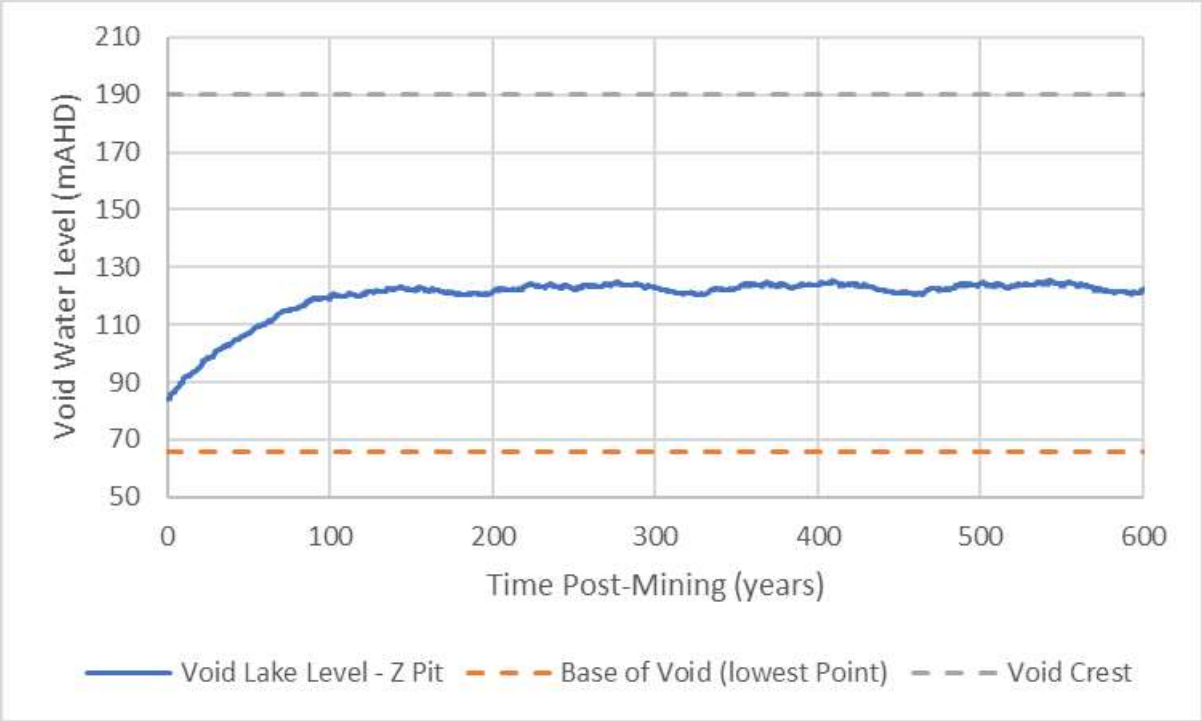


Figure 7-3 Simulated void water level over time – Z Pit Void (based on WRM, 2023)

Figure 7-2 and **Figure 7-3** show water level oscillation due to interdecadal climate patterns (wet and dry spells) adopted in the water balance model. Equilibrium water level conditions are reached after approximately 20 years for X Pit Void and 100 years for Z Pit Void (WRM, 2023). Predicted equilibrated water levels in the residual voids are shown in **Table 7-5**.

Table 7-5 Equilibrated water levels in the residual voids (based on WRM, 2023)

Climate scenario	Residual void	Initial water level (m AHD)	Equilibrium water level range (m AHD)	Average equilibrium water level (m AHD)
Median	X Pit Void	139	143 - 148	145
	Z Pit Void	84	120 - 125	123

WRM conducted a Monte Carlo assessment on the median climate water level results and adopted the 95% percentile, which is considered conservative for assessment of freeboard. The freeboard for each of the residual voids (i.e. the difference in elevation between the long-term water levels in the residual voids and the landform crest elevation) is as shown in **Table 7-6**. Predicted void lake levels remain significantly below the surface 'spill' level for each of the residual voids.

Table 7-6 Predicted freeboard in the residual voids at equilibrium

Climate scenario	Residual void	Void crest level (m AHD)	95% equilibrium water level (m AHD)	Freeboard (m)
Median	X Pit Void	194	147.7	46.3
	Z Pit Void	190	127.5	62.5

The difference in elevation between the long-term water levels in the residual voids and the lowest point of the base of the shallow geological formations (weathered regolith; model Layer 2) adjacent to the voids is as shown in **Table 7-7**. Predicted residual void lake levels remain significantly below the base of the shallow geological formations for each of the residual voids, even with the temporal fluctuations in void water levels predicted by the WRM (2023) water balance model. That is, there is not a potential for a flux of water to leave the residual voids and enter the shallow geological formations.

Table 7-7 Predicted difference between residual void water levels and shallow formations at equilibrium

Climate scenario	Residual void	Difference between average void lake level and base of Model Layer 2 (m)
Median	X Pit Void	37
	Z Pit Void	137

7.2.4 Residual Void Groundwater Inflow

The final predicted groundwater inflows to the residual voids from the groundwater model are shown on **Figure 7-4** and **Figure 7-5**, with inflows partitioned between that which flows into the residual voids through spoil, and that which flows into the residual voids through surrounding natural geological formations. As illustrated in the figures, most of the groundwater fluxes to the voids are through the spoil.



Groundwater fluxes to the voids are largely controlled by the residual void lake levels that rise and fall periodically (refer to **Figure 7-2** and **Figure 7-3**) according to the climatic simulation within the WRM (2023) water balance model, and also how the daily timestep water balance results are translated to the groundwater model's more simplified stress period setup. Accordingly, there are periods of variable groundwater inflow and outflow predicted by the groundwater model for the voids and some variability in the predicted inflows over approximately the first 150 years post-mining for both voids.

Model results show an initial outflow of rainfall derived surface water captured in the residual voids in the first one to three years post-mining (from the WRM water balance model) to the surrounding groundwater system (to the spoil), as the groundwater levels in the surrounding in-pit spoil backfill (and natural geological formations) recover from mining activities. However, as groundwater levels in the spoil and natural geology recover to elevations above the void lakes and lake levels stabilise, the direction of flow out of the void lakes is quickly reversed and long-term groundwater inflow to the lakes is established. Inflow only conditions post-mining prevails after approximately three years at the X Pit Void, and one year at the Z Pit Void.

Model results indicate that between 99% and 100% of the long-term groundwater inflow to the voids comes via the spoil, originating mainly as local recharge applied to the spoil. Predicted equilibrium groundwater inflows to each of the voids are presented in **Table 7-8**.

Table 7-8 Equilibrium groundwater inflow to the residual voids

Climate scenario	Residual void	Equilibrium Inflow Rate – Spoil (m3/day)	Equilibrium Inflow Rate – Natural Geological Formations (m3/day)	Equilibrium Inflow Rate – Total (m3/day)
Median	X Pit Void	29.5	0.0	29.5
	Z Pit Void	167.9	1.5	169.4

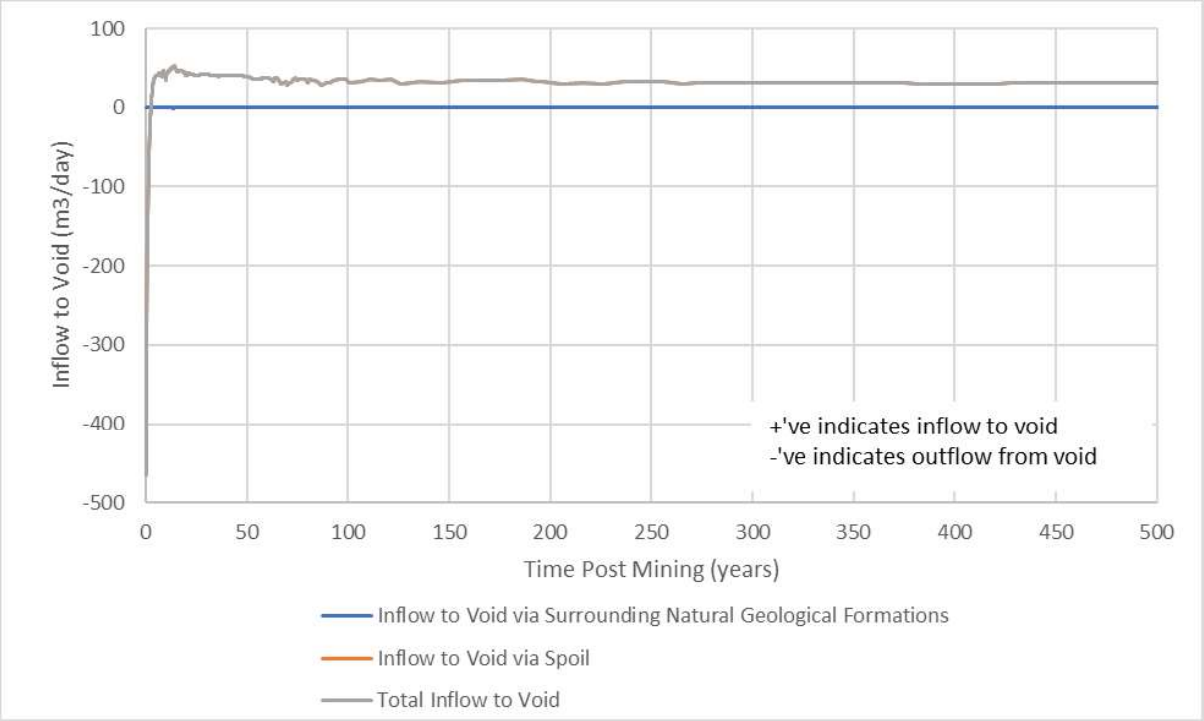


Figure 7-4 Predicted residual void groundwater inflows – X Pit Void

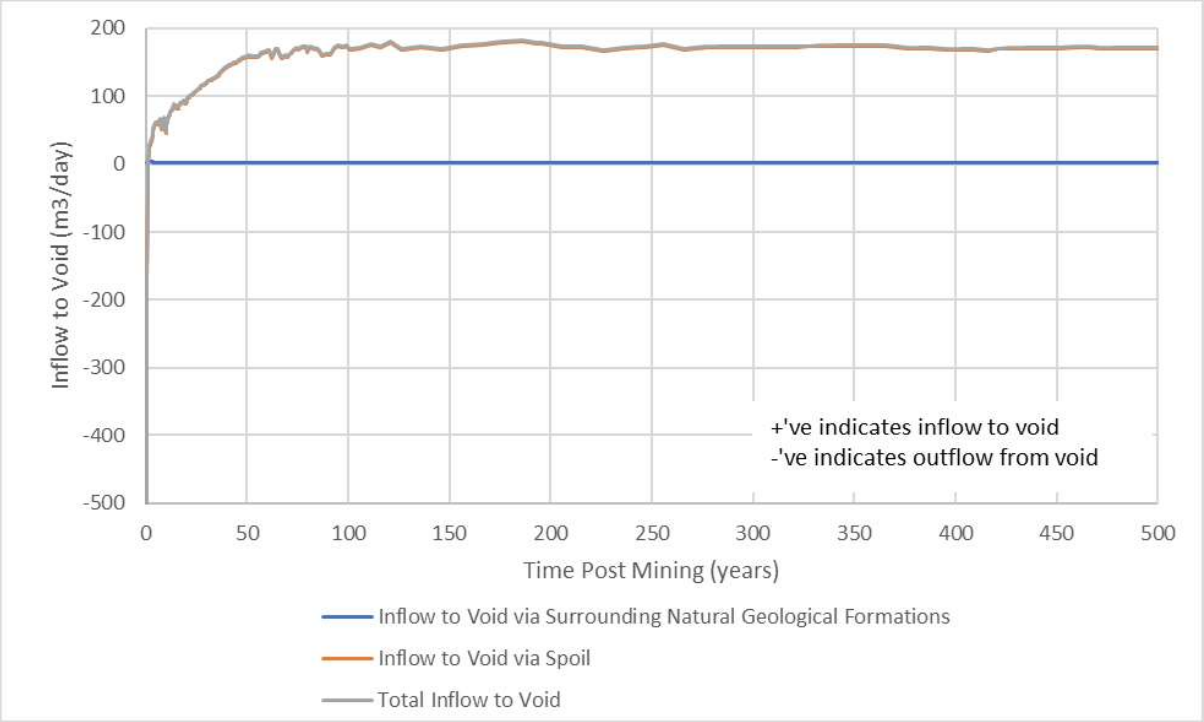


Figure 7-5 Predicted residual void groundwater inflows – Z Pit Void

7.2.5 Predicted Groundwater Levels

Groundwater level predictions and associated discussion presented herein is associated with the median climate scenario (WRM, 2023). This is considered appropriate given the relatively small difference in predicted residual void lake elevations (that drive groundwater levels) between the scenarios with respect to void lake levels (refer WRM, 2023).

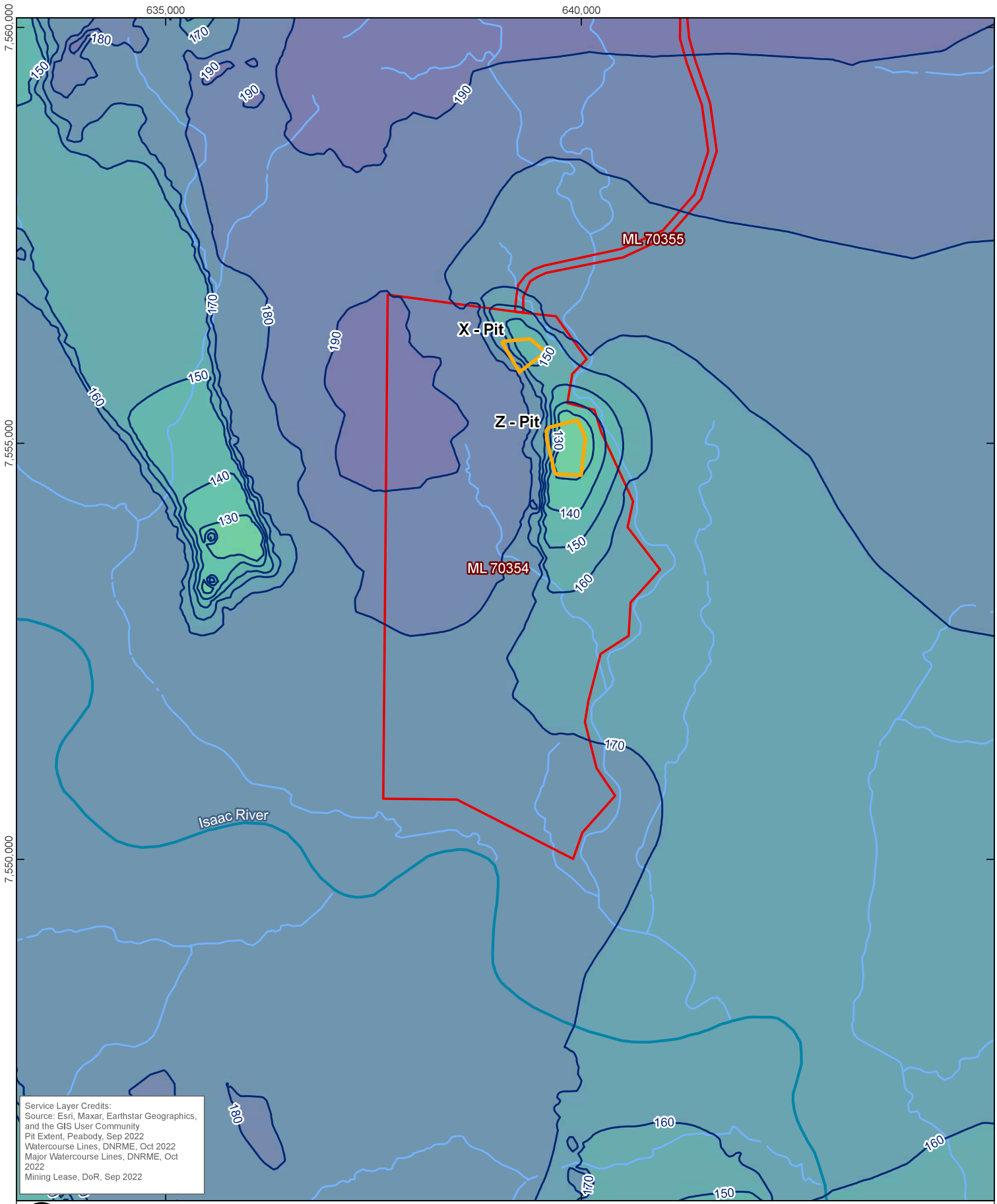
7.2.5.1 Groundwater Levels – General

The predicted equilibrium water table elevation adjacent to the residual voids is shown on **Figure 7-6**. Predicted equilibrium groundwater levels for the Leichhardt and Vermont Seams of the Rangal Coal Measures (model layers 5 and 7, respectively) outside of the residual voids are shown on **Figure 7-7** and **Figure 7-8**. Note that the simulated influence of the Daunia Mine residual voids to the west-northwest of the Project Area is evident in **Figure 7-6** through **Figure 7-8**.

The water table is predicted to remain depressed in the immediate vicinity of the Project residual voids in the long term, as well as areas of spoil backfill in the Project Area, driven by the ongoing groundwater discharge to the residual void lakes and governed by the lake elevations themselves. Long term inwards groundwater flow gradients to the residual voids are maintained post-mining. Steepest water table gradients outside the voids occur southwest of the Z Pit Void. Water table depression east of the Project Area extends up to 1 km, however water table depression west of the Project Area is limited by outcropping Fort Cooper Coal Measures. The water table is lower compared to pre-mining conditions in the area along North Creek where potential GDEs are mapped, however previous GDE assessments indicate vegetation in this area is unlikely to be groundwater dependent (refer to **Section 4.5.2**) and North Creek is unlikely to be impacted as it is an ephemeral mainly losing stream.

Predicted groundwater levels for the Leichhardt and Vermont Seams of the Permian Coal Measures indicate again that groundwater levels in the Permian sequence are predicted to remain depressed in the long term, driven by the ongoing groundwater discharge to the residual void lakes and governed by the lake elevations themselves. Generally, predicted groundwater elevations are similar between the Leichhardt and Vermont seams. The effect of the structural geology (see **Sections 3.2.4** and **4.3.4**) can be seen in **Figure 7-7** and **Figure 7-8** as broad areas to the west, north and south of the Project where the seams are geologically absent and therefore there are corresponding areas where Leichhardt and Vermont seam groundwater levels are not predicted by the model. There are also fringing areas where the seams are predicted to be ‘dry’ (unsaturated) in the long-term post-mining, particularly on and immediately adjacent to the Daunia Mine area.

Predictive hydrographs showing the change in groundwater levels over time for the Leichhardt and Vermont Seams of the Permian Coal Measures just outside the residual voids are shown as **Figure 7-9** and **Figure 7-10**, with the hydrograph locations shown on **Figure 7-7** and **Figure 7-8**. The hydrographs show that the majority of groundwater level drawdown in the Permian Coal Measures occurs during mining operations, with post-closure groundwater levels in the Permian coal seams adjacent to the residual voids recovering from their lowest point that occurred during mining. Both the Leichhardt and Vermont seams adjacent to both the X Pit Void and Z Pit Void are predicted to recover partially in the long-term post-closure, through total groundwater level recovery is more subdued at Z Pit Void. As shown on the figures, groundwater elevations in the Permian Coal Measures are predicted to be above the void lake levels at all times post-closure, indicating no potential for outflow of void water to the Permian Coal Measures groundwater system.



0 1 2 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:60,000 at A4
Project Number:	660.30254.00000
Date Drawn:	11-Jun-2024
Drawn by:	AS

LEGEND

- Water Table Contour (mAHD)
- Major Watercourse
- Final Pit Extent
- Moorvale South Mining Lease

Water Table (mAHD)

70 - 80	140 - 150	210 - 220
80 - 90	150 - 160	220 - 230
90 - 100	160 - 170	
100 - 110	170 - 180	
110 - 120	180 - 190	
120 - 130	190 - 200	
130 - 140	200 - 210	

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

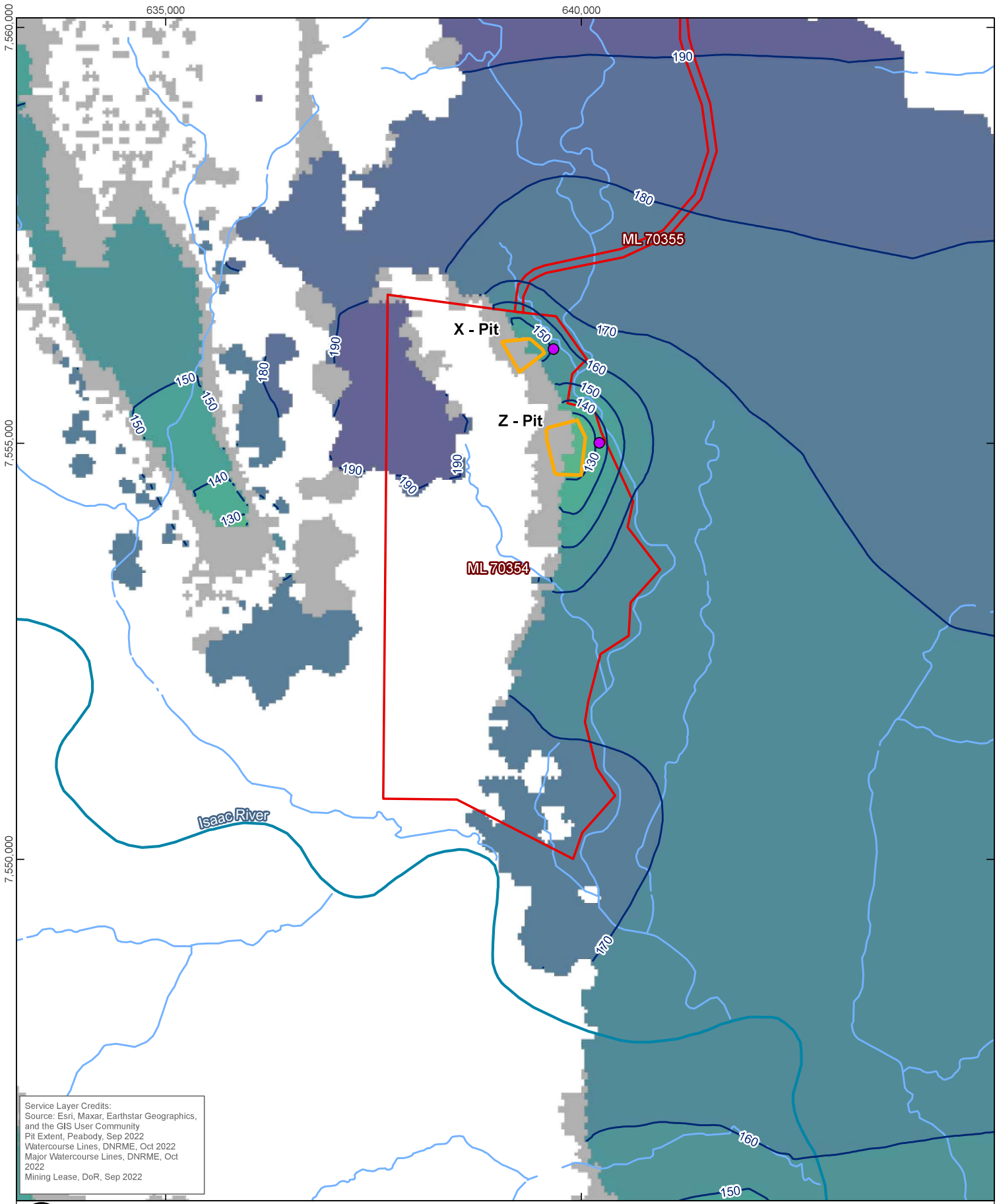
PREDICTED WATER TABLE ELEVATION CONTOURS POST-MINING EQUILIBRIUM

SLR

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FIGURE 7-6

Path: \\au.slr.local\Corporate\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx



Service Layer Credits:
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Pit Extent, Peabody, Sep 2022
Watercourse Lines, DNRME, Oct 2022
Major Watercourse Lines, DNRME, Oct 2022
Mining Lease, DoR, Sep 2022

0 1 2 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:60,000 at A4
Project Number:	660.30254.00000
Date Drawn:	11-Jun-2024
Drawn by:	AS

LEGEND

- Hydrograph Location
- Hydraulic Head Contour (m AHD)
- Major Watercourse
- Final Pit Extent
- Moorvale South Mining Lease
- Area of Modelled "Dry" Layer 5

Hydraulic Head/Groundwater Elevation (m AHD)

70 - 80	140 - 150	210 - 220
80 - 90	150 - 160	220 - 230
90 - 100	160 - 170	
100 - 110	170 - 180	
110 - 120	180 - 190	
120 - 130	190 - 200	
130 - 140	200 - 210	

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

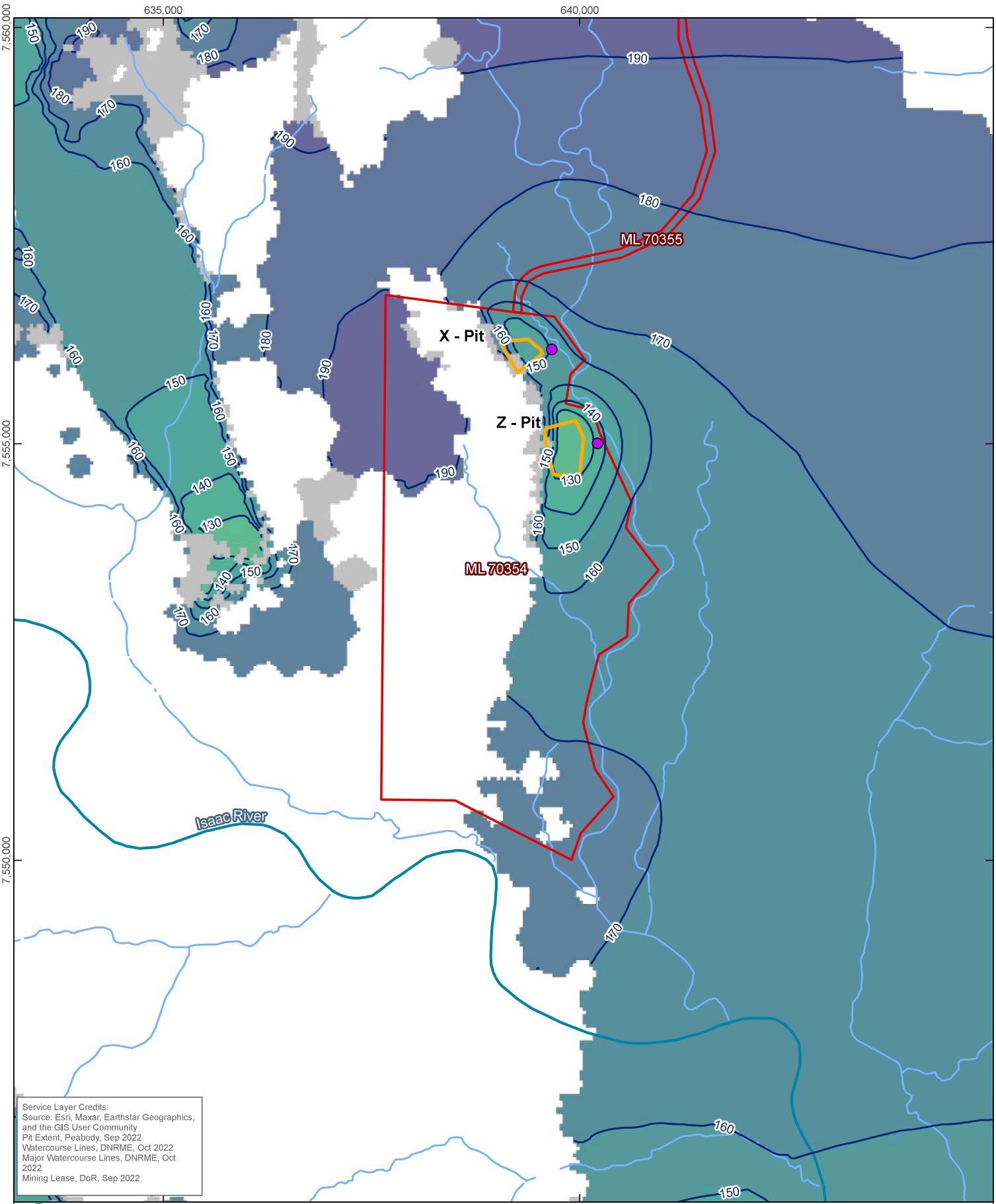
PREDICTED HYDRAULIC HEAD ELEVATION CONTOURS IN THE LEICHHARDT SEAM (LAYER 5) POST-MINING EQUILIBRIUM

SLR

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FIGURE 7-7

Path: \\au.slr.local\Corporate\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx



Service Layer Credits:
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Pit Extent, Peabody, Sep 2022
Watercourse Lines, DNRME, Oct 2022
Major Watercourse Lines, DNRME, Oct 2022
Mining Lease, DoR, Sep 2022

0 1 2 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:60,000 at A4
Project Number:	660.30254.00000
Date Drawn:	11-Jun-2024
Drawn by:	AS

LEGEND

- Hydrograph Location
- Water Table Contour (mAHD)
- Major Watercourse
- Final Pit Extent
- Moorvale South Mining Lease
- Area of Modelled "Dry" Layer 7

Hydraulic Head/Groundwater Elevation (m AHD)

70 - 80	140 - 150	210 - 220
80 - 90	150 - 160	220 - 230
90 - 100	160 - 170	
100 - 110	170 - 180	
110 - 120	180 - 190	
120 - 130	190 - 200	
130 - 140	200 - 210	

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

PREDICTED HYDRAULIC HEAD ELEVATION CONTOURS IN THE VERMONT SEAM (LAYER 7) POST-MINING EQUILIBRIUM

SLR

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FIGURE 7-8

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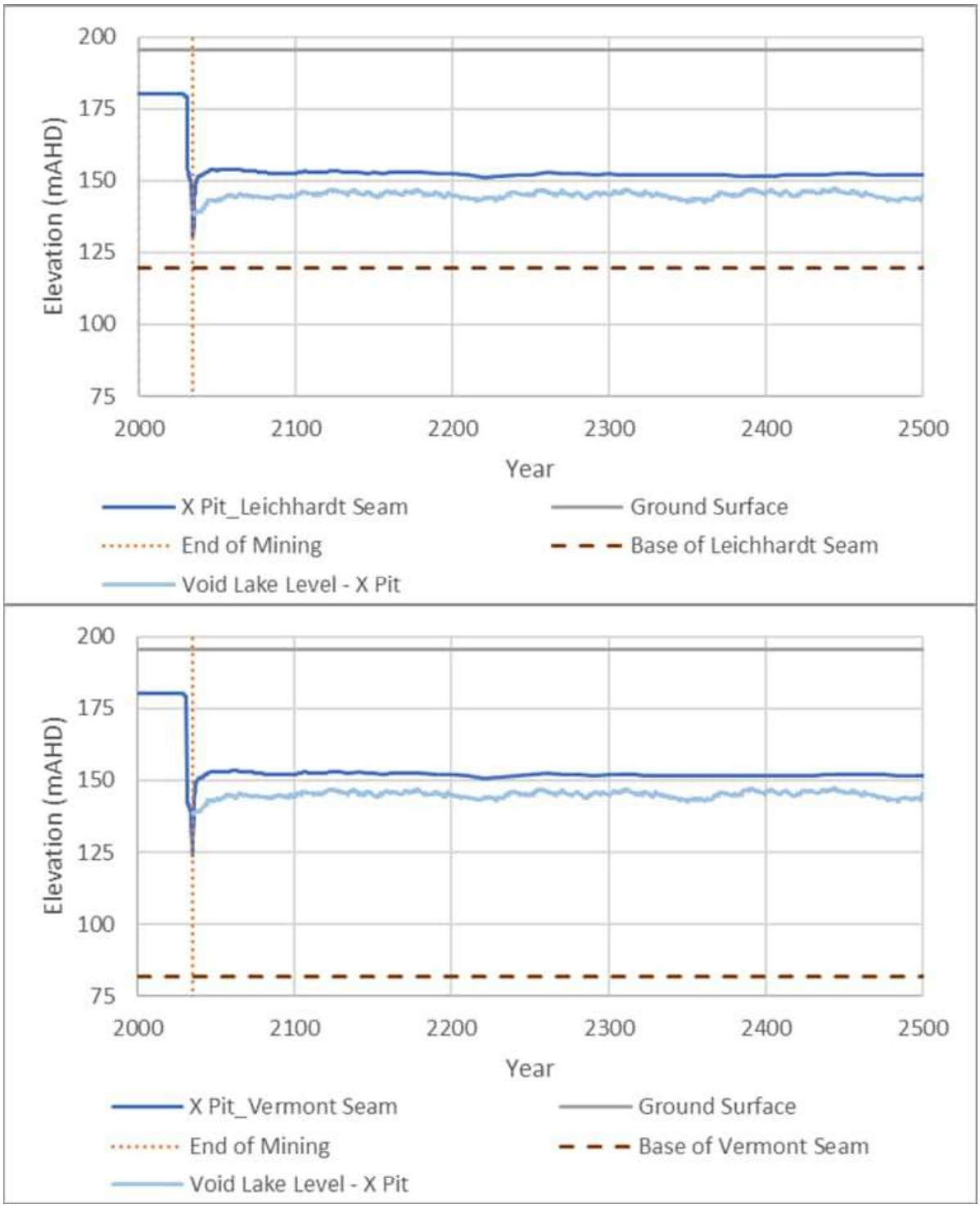


Figure 7-9 Permian coal measures predictive hydrographs adjacent to X Pit Void

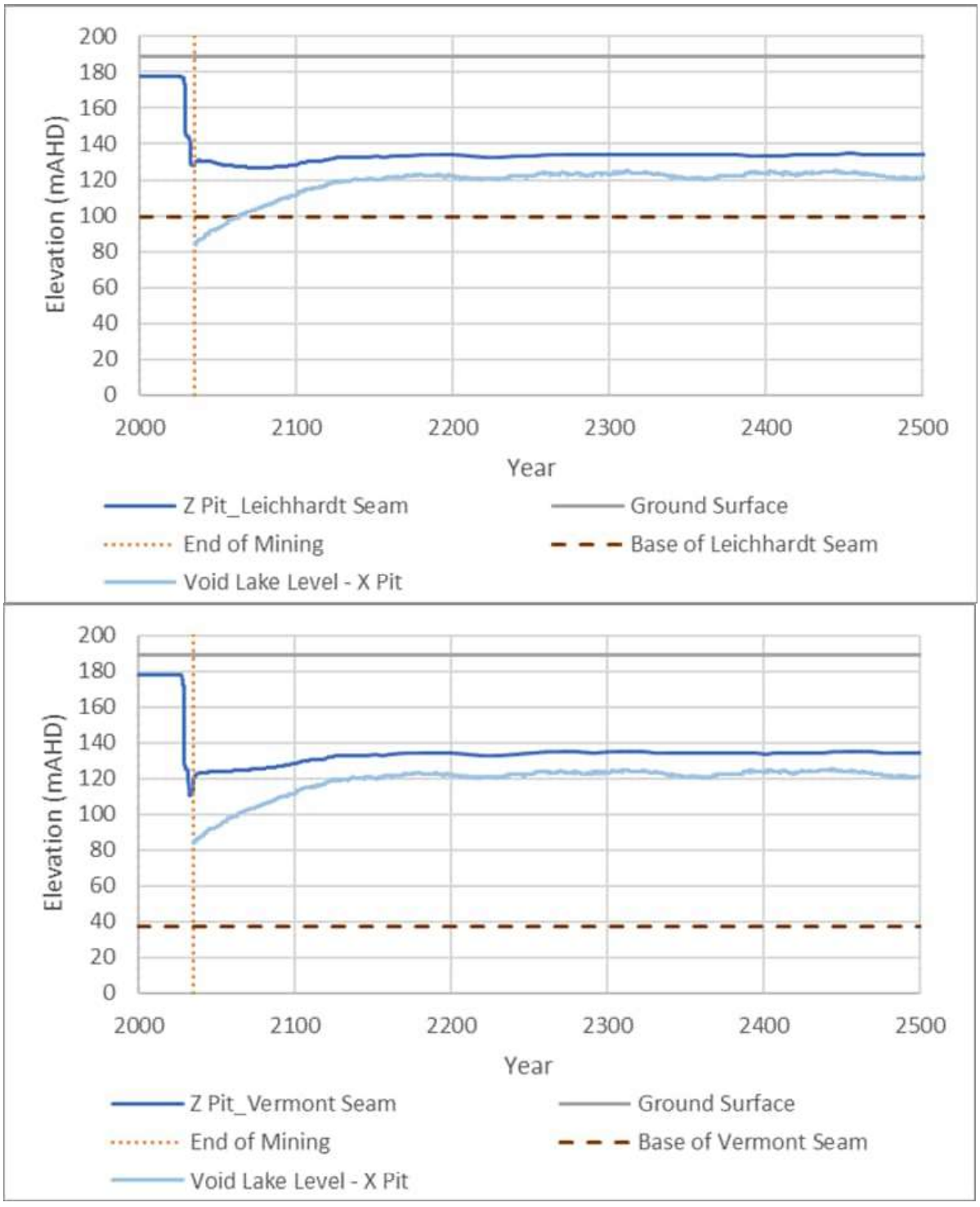


Figure 7-10 Permian coal measures predictive hydrographs adjacent to Z Pit Void

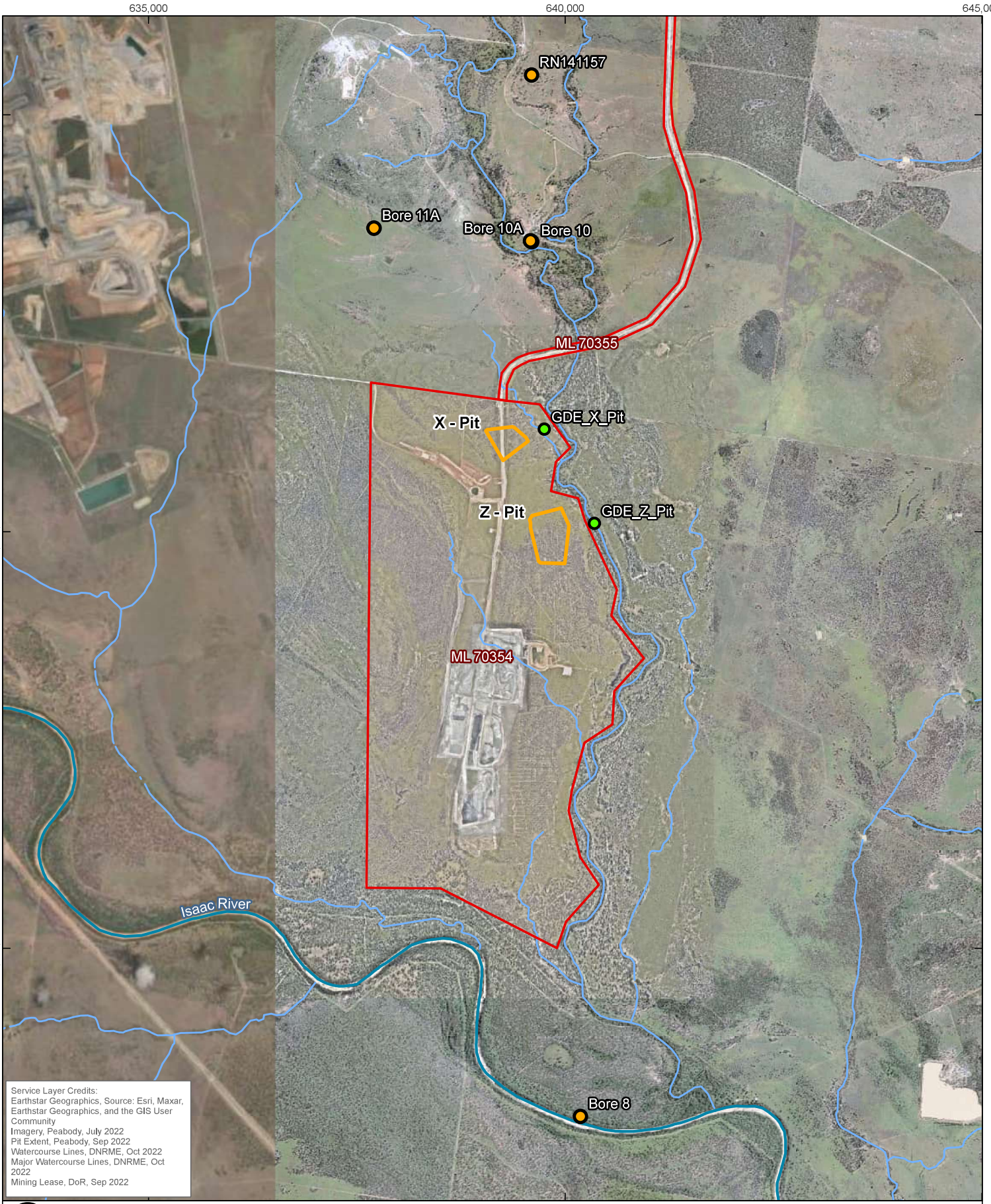
7.2.5.2 Groundwater Level Impacts to Potential Receptors

Predictive hydrographs have been derived from the groundwater model to understand the nature of likely groundwater level change in the interpreted source aquifer for identified potential natural and anthropogenic groundwater receptors in the vicinity of the Project Area (refer to **Section 4.5**). The aim of the hydrographs is to assess the potential for additional impacts to these potential receptors in the period post-mining, i.e. identify additional potential impacts beyond those that have occurred during already approved mining operations that may be attributable to the PRCP and EAA proposed final landform. **Figure 7-11** provides the hydrograph locations.

Predictive hydrographs for the water table at the potential GDE sites identified east of the Project Area along North Creek are provided as **Figure 7-12** for the median climate scenario. The end of Project mining / start of the Project post-mining period is identified on the hydrographs. The water table hydrographs indicate that for the potential GDE sites along North Creek closest to the residual voids, there is an additional drawdown of approximately 2 to 5 m in the post-mining period, compared to drawdowns of a similar magnitude that occur during (approved) mining. However, it should be noted that the model predicts that the pre-mining water table is greater than 10 m depth in this area (**Figure 7-12**), and therefore likely lies beyond the rooting depth of all but the deepest rooted terrestrial vegetation species (i.e. does not support GDEs); this is supported by previous GDE assessments indicating vegetation is unlikely to be groundwater dependent in this area (refer to **Section 4.5.2**). The additional predicted drawdown post-mining potentially attributable to the Project final landform is therefore unlikely to impact on any GDE vegetation.

The predictive hydrographs provided as **Figure 7-12** demonstrate that the model predicts that the pre-mining groundwater table is greater than 10 m depth proximal to North Creek, with groundwater hosted within the bottom portion of the Regolith. This indicates significant hydraulic separation between the creek bed and the underlying groundwater system. As such, lowering of groundwater levels as a result of the Project would not have any material effect on North Creek surface flows which are wholly derived from rainfall runoff but with no connection to the groundwater table. As discussed previously, recent MVSX Project drilling along the upstream reaches of North Creek north of the Project, which aimed to identify any shallow groundwater system presence associated with North Creek, failed to locate any such shallow groundwater system (SLR, 2024). This further supports the results of this assessment that indicate no impacts to surface features of North Creek.





0 1 2 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:60,000 at A4
Project Number:	660.30254.00000
Date Drawn:	28-Jun-2024
Drawn by:	AS

LEGEND

- Private Bore
- Potential GDE
- Minor Watercourse
- Major Watercourse
- Final Pit Extent
- Moorvale South Mining Lease

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

POTENTIAL RECEPTOR PREDICTIVE HYDROGRAPH LOCATIONS

SLR

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FIGURE 7-11

Path: \\au.slr.local\Corporate\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx

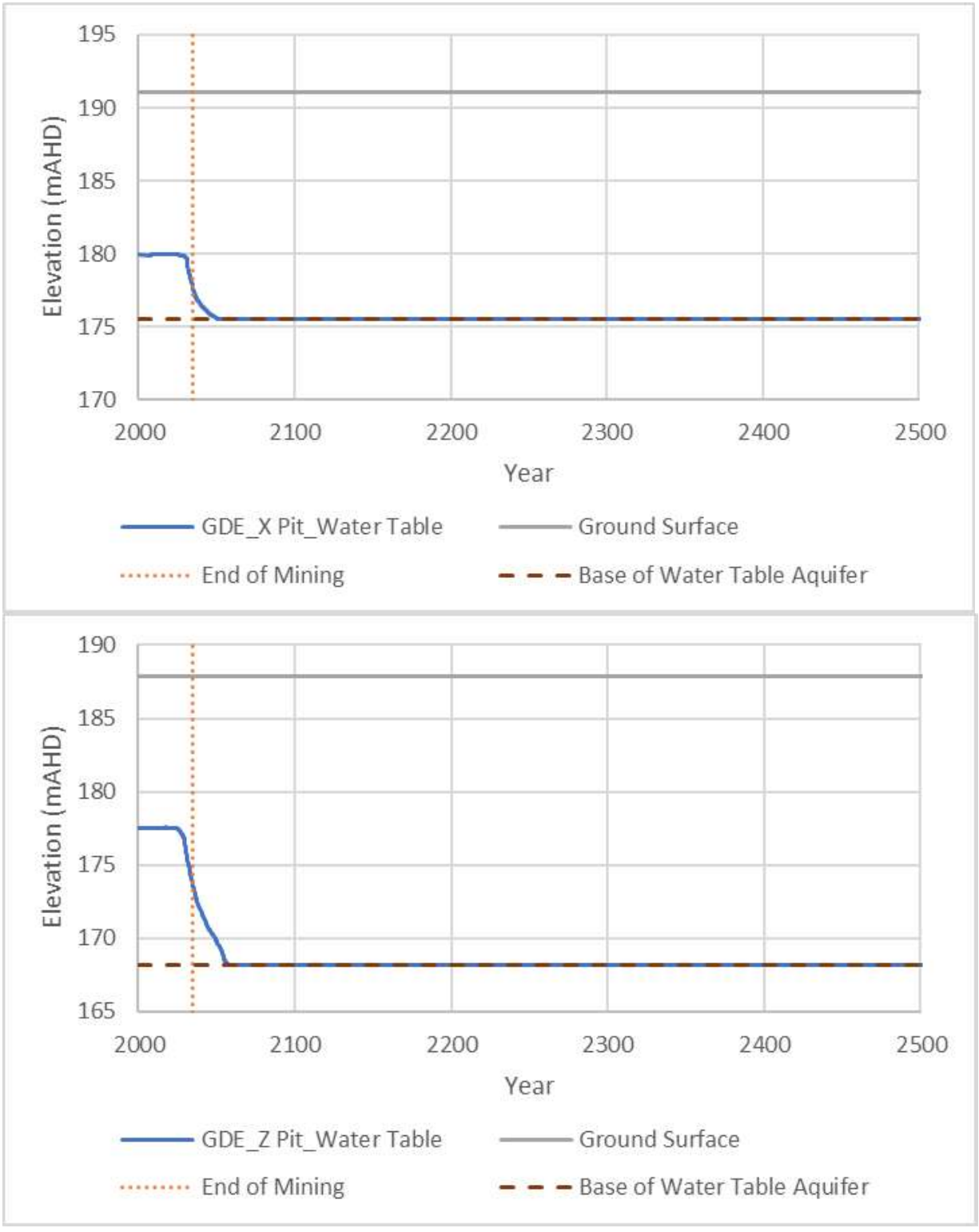


Figure 7-12 Water table hydrographs at potential GDEs

Predictive hydrographs for the five identified third party water supply bores in the 2019 bore census with sufficient information to attribute a source aquifer (refer to **Section 4.5.1**) are provided as **Figure 7-13** for the median climate scenario. The end of Project mining / start of the post-mining period is identified on the hydrographs. Minor additional cumulative groundwater drawdown over the Project's post-mining period is predicted at most bores, as listed in **Table 7-9**. The greatest additional drawdown is predicted at Bore 10 and Bore 10A located approximately 2 km north of the X Pit Void, with 2.5 m and 2.2 m predicted additional drawdown respectively in the long term post-closure, which remains less than the relevant 5 m drawdown 'bore trigger threshold' for consolidated aquifers identified in Chapter 3 of the *Water Act 2000*, i.e. the threshold at which drawdown impacts may need to be further investigated for the purposes of determining any requirement to 'make good' a bore impairment. It should also be noted that these predicted drawdowns are cumulative in nature, meaning that they are a result of the combined effect of all mining operations represented in the model and can not be cattributed to the Project alone.

Table 7-9 Predicted cumulative drawdown at surveyed third party supply bores with attributable source aquifer

Bore ID	Easting (GDA94)	Northing (GDA94)	Screened Unit	Observed SWL (mbgl)	Predicted Cumulative Drawdown (m)		
					At End of Mining (m)	At Post-Mining Equilibrium (m)	Additional Drawdown during Post-Mining Period (m)
RN141157	639596	7560480	Permian Blackwater Group	21.74*	0.0	0.7	0.7
Bore 10	639599	7558478	Permian#	19.75**	0.1	2.6	2.5
Bore 10A	639584	7558489	Rewan#	19.78**	0.1	2.3	2.2
Bore 11A	637705	7558642	Regolith#	18.61**	0.0	0.0	0.0
Bore 8	640184	7547982	Alluvium	-	7.0	1.3	-5.7

SWL – static water level

mbgl – metres below ground level

*2017 observation

**2019 observation

Inferred from recorded bore depth and groundwater model layer elevations

Bore 8 is predicted to show relatively significant groundwater level recovery in the post-mining period, with groundwater levels rising approximately 5.7 m from the lowest point that occurred during active (approved) Project mining activities.

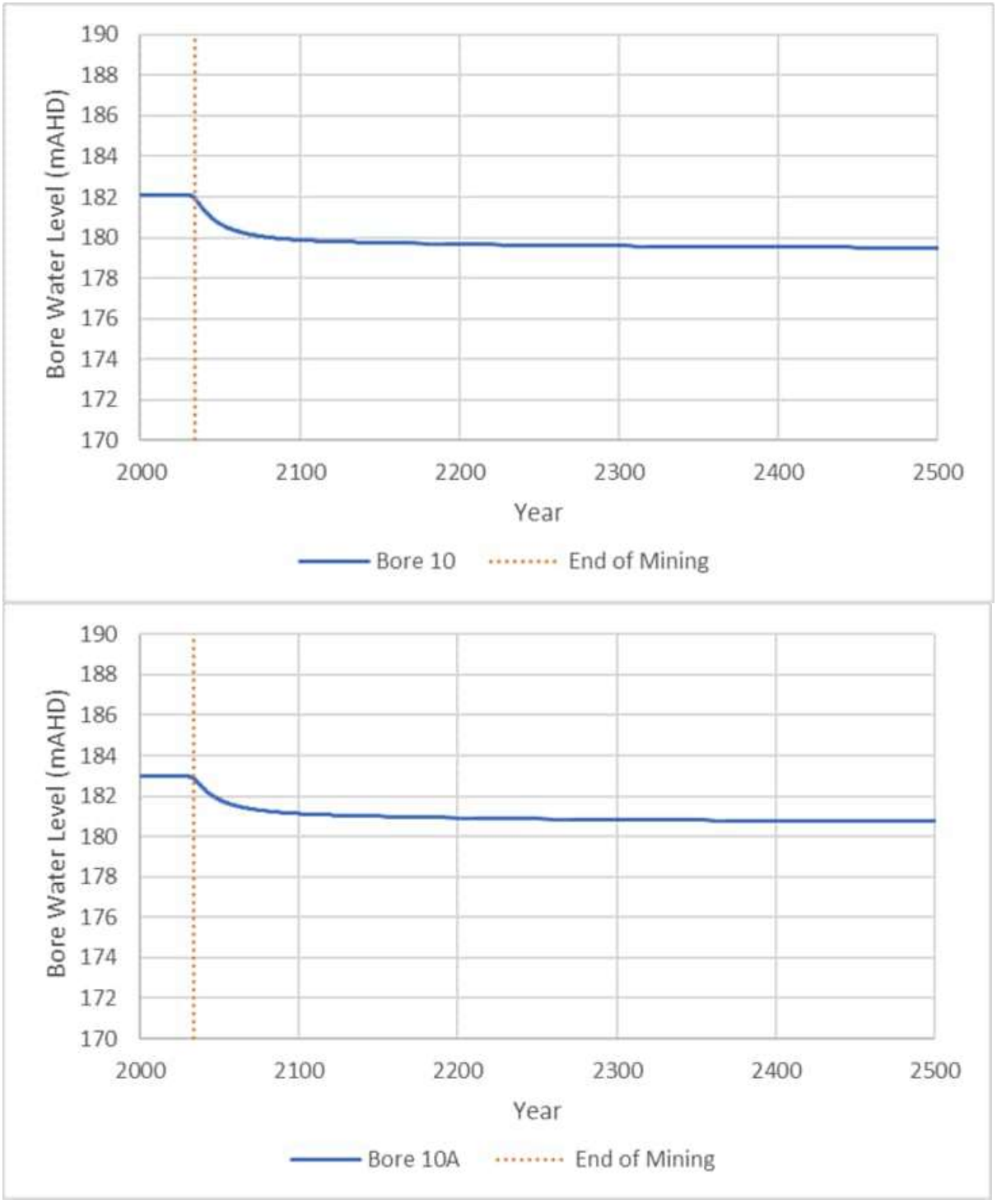


Figure 7-13 Hydrographs for surveyed third party supply bores with attributable source aquifer

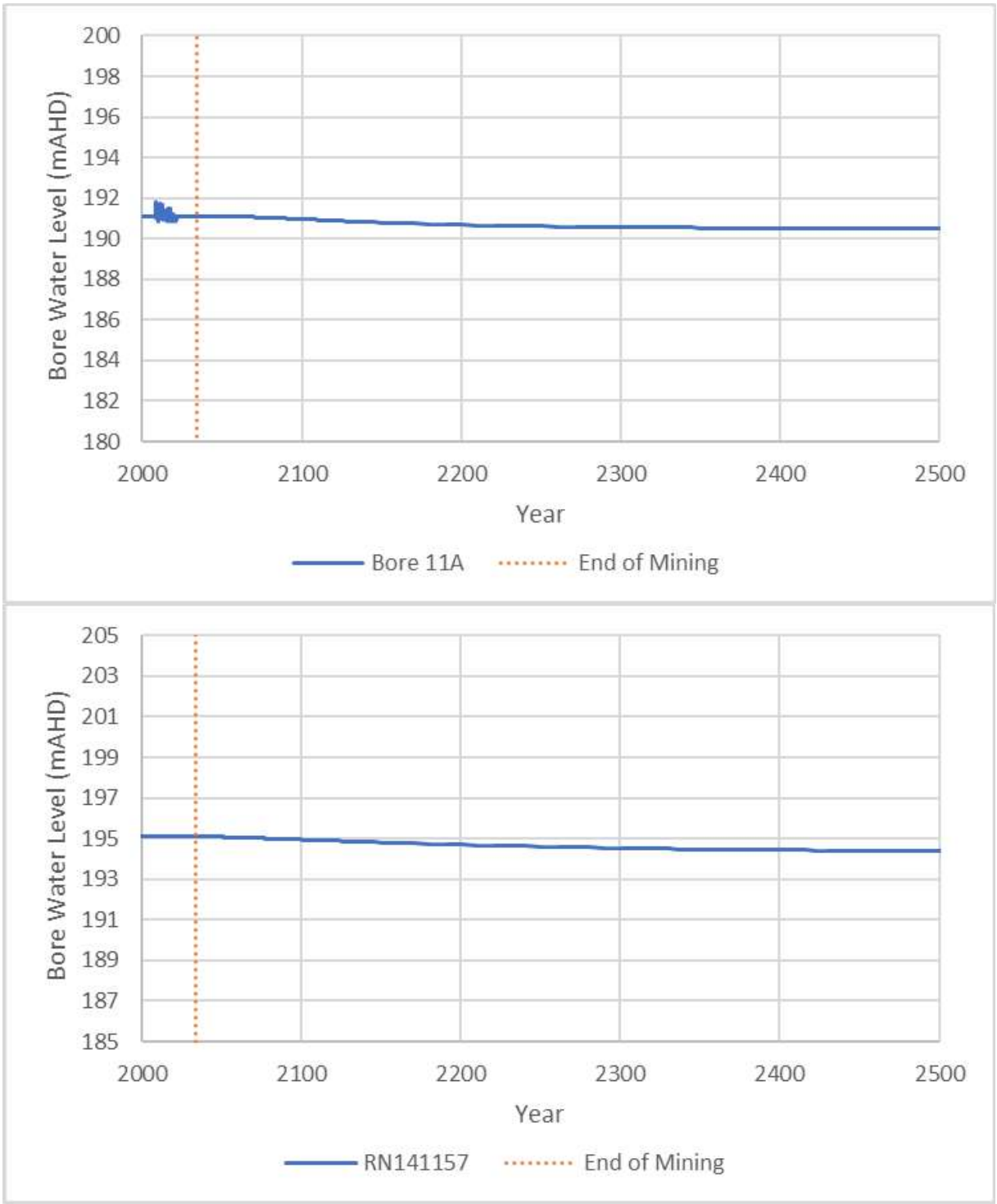


Figure 7-14 Hydrographs for surveyed third party supply bores with attributable source aquifer (continued)

7.2.6 Predicted Incremental Drawdowns

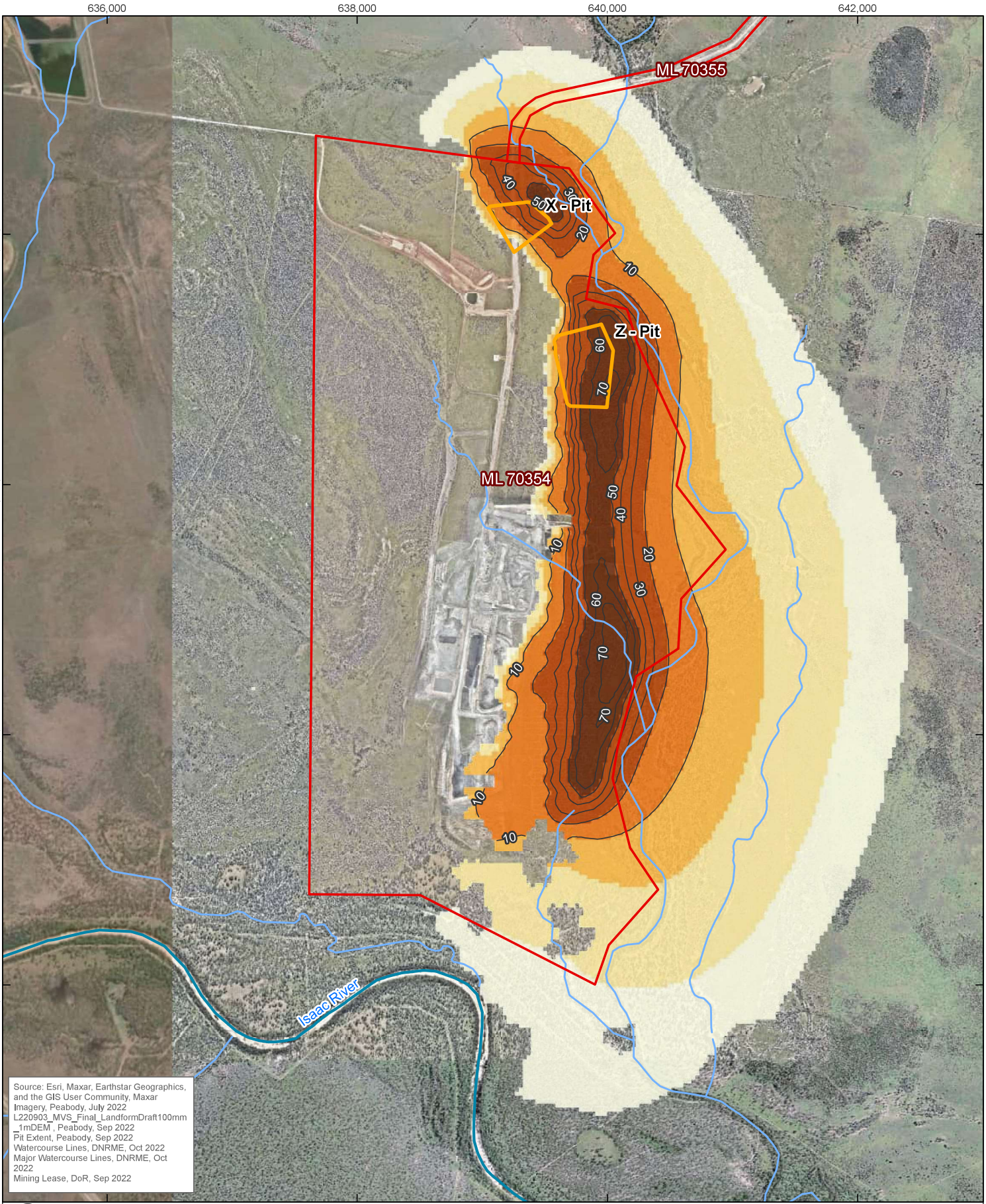
In this report, incremental drawdown refers to the drawdown impact associated with the Project only and is obtained by comparing the difference in predicted aquifer groundwater levels for the Approved scenario (without Moorvale South mine) and the Project scenario (including the Moorvale South mine) at matching times.

The coal seams of the Rangal Coal Measures are the primary groundwater bearing strata at Moorvale South and will experience drawdowns as a result of direct mining disturbance at the Project. Groundwater level drawdown within the mined coal seams is influenced by the unit structure and is confined to unit extents. Predicted drawdown figures (**Figure 7-15** to **Figure 7-19**) show incremental drawdown impacts in the Permian coal measures exceeding 1 m, at both the end of Moorvale South mining and at post-mining equilibrium.

The extents of predicted incremental drawdown impacts in the Rangal Coal Measures coal seams are generally elongated along strike in the northeast-southeast direction, extending 2 km to 6 km east of the Project boundary at the end of mining and at equilibrium, respectively, noting that westwards propogration of drawdown is limited by coal seam subcrop.

Drawdowns propagate further within the shallower coal seams (i.e., Leichhardt seam) when compared to the Vermont seam. Given the use of depth dependance for assigning the hydraulic properties in the model, the shallower coal seams generally have higher modelled hydraulic conductivities in comparison to deeper ones, which facilitates the further propogation of drawdown in the shallower seam.

For the Alluvium, model results predict a small area of incremental drawdown at the southern end of the Project site adjacent the Isaac River (**Figure 7-17**). Modelling results show that no incremental drawdown impacts greater than 1m are predicted for the Alluvium as a result of mining at the Project at post-mining equilibrium, indicating that the alluvial groundwater levels are expected to recover in the post-mining period.



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community, Maxar Imagery, Peabody, July 2022
L220903_MVS_Final_LandformDraft100mm_1mDEM , Peabody, Sep 2022
Pit Extent, Peabody, Sep 2022
Watercourse Lines, DNRME, Oct 2022
Major Watercourse Lines, DNRME, Oct 2022
Mining Lease, DoR, Sep 2022

0 0.5 1 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	660.30254.00000
Date Drawn:	25-Jun-2024
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- Road
- Final Pit Extent
- Moorvale South Mining Lease
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

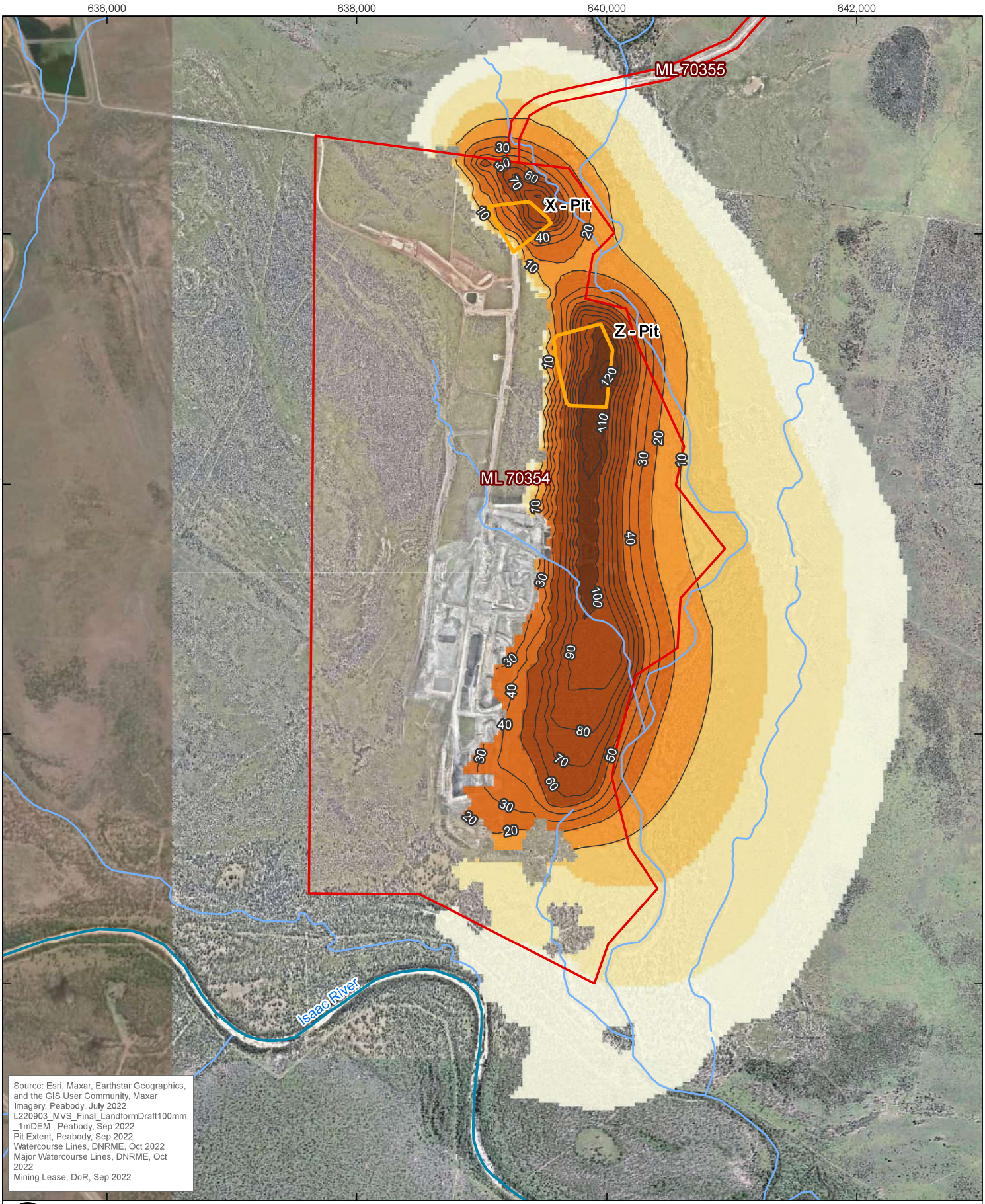
INCREMENTAL DRAWDOWN IN LEICHHARDT SEAM (LAYER 5) AT THE END OF MVS MINING

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FIGURE 7-15

Path: \\au.slr.local\Corporate\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community, Maxar Imagery, Peabody, July 2022
L220903_MVS_Final_LandformDraft100mm_1mDEM , Peabody, Sep 2022
Pit Extent, Peabody, Sep 2022
Watercourse Lines, DNRME, Oct 2022
Major Watercourse Lines, DNRME, Oct 2022
Mining Lease, DoR, Sep 2022

0 0.5 1 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	660.30254.00000
Date Drawn:	25-Jun-2024
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Road
- Final Pit Extent
- Moorvale South Mining Lease

Drawdown (m)

- 1- 2
- 2 - 5
- 5.- 10
- 10- 20
- 20 - 50
- 50 - 100
- 100 - 200

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

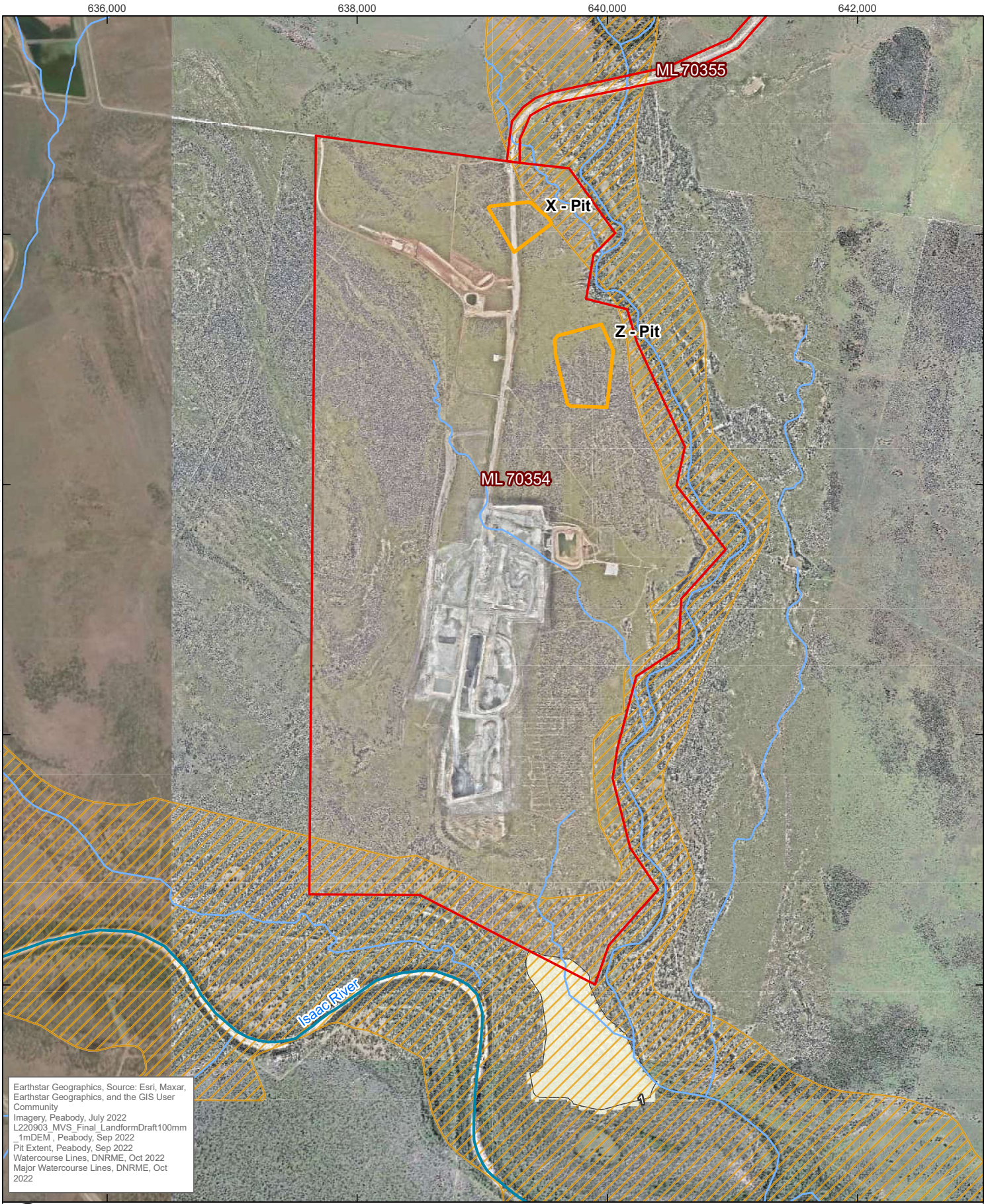
INCREMENTAL DRAWDOWN IN VERMONT SEAM (LAYER 7) AT THE END OF MVS MINING)

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FIGURE 7-16

Path: \\au.slr.local\Corporate\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx



Earthstar Geographics, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Imagery, Peabody, July 2022
L220903_MVS_Final_LandformDraft100mm_1mDEM , Peabody, Sep 2022
Pit Extent, Peabody, Sep 2022
Watercourse Lines, DNRME, Oct 2022
Major Watercourse Lines, DNRME, Oct 2022

0 0.5 1 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	660.30254.00000
Date Drawn:	27-Jun-2024
Drawn by:	AS

LEGEND

- Final Pit Extent
- Moorvale South Mining Lease
- Isaac River Alluvium Extent (SLR, 2020)
- Major Watercourse
- Minor Watercourse
- Drawdown Contour (m)

Drawdown (m)

- 1- 2

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

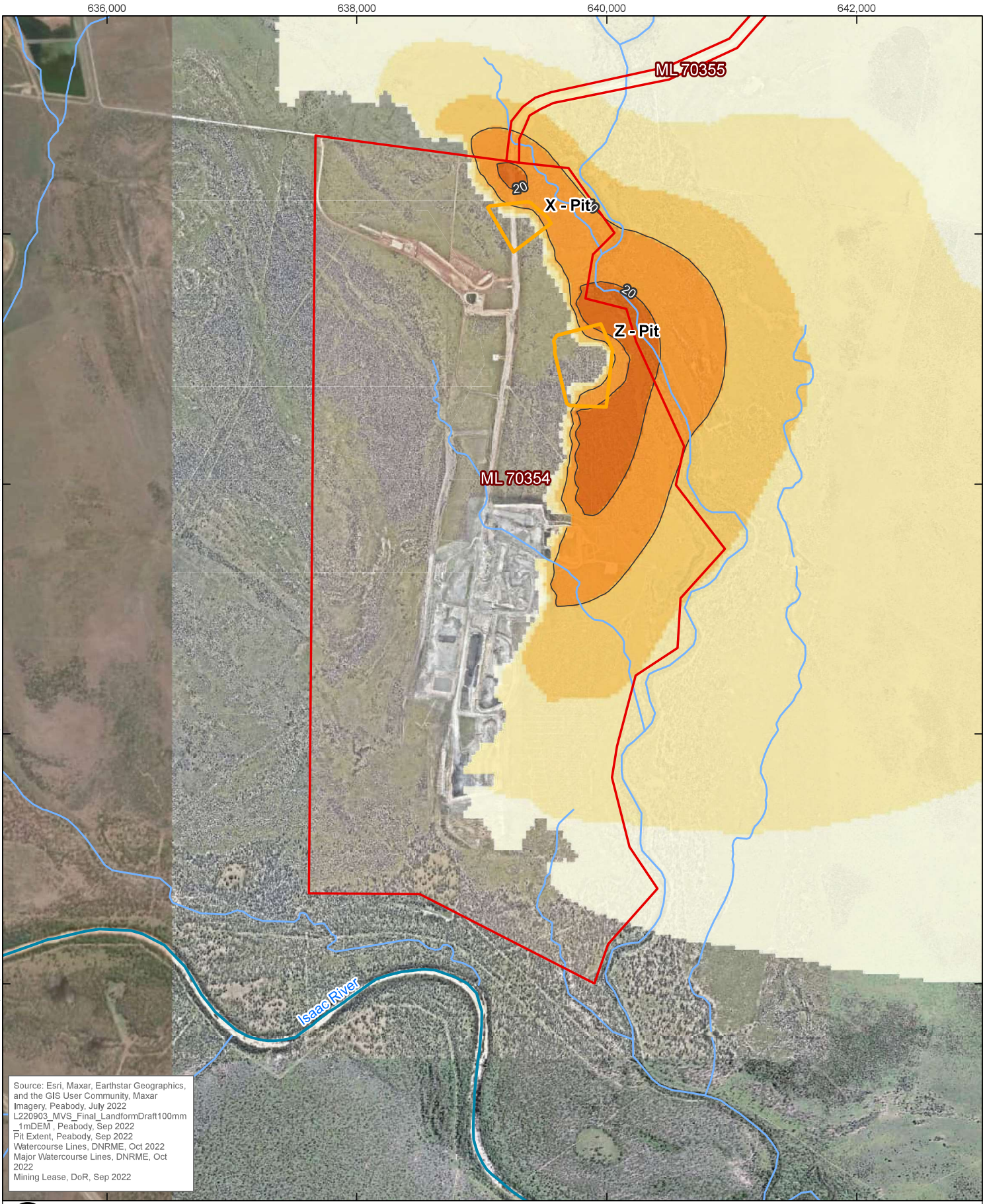
INCREMENTAL DRAWDOWN IN ALLUVIUM (LAYER 1) AT THE END OF MVS MINING

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FIGURE 7-17

Path: H:\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community, Maxar Imagery, Peabody, July 2022
L220903_MVS_Final_LandformDraft100mm_1mDEM , Peabody, Sep 2022
Pit Extent, Peabody, Sep 2022
Watercourse Lines, DNRME, Oct 2022
Major Watercourse Lines, DNRME, Oct 2022
Mining Lease, DoR, Sep 2022

0 0.5 1 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	660.30254.00000
Date Drawn:	28-Jun-2024
Drawn by:	RB

LEGEND

- Final Pit Extent
- Moorvale South Mining Lease
- Major Watercourse
- Minor Watercourse
- Road
- Drawdown Contour (m)

Drawdown (m)

- 1- 2
- 2 - 5
- 5.- 10
- 10- 20
- 20 - 50

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

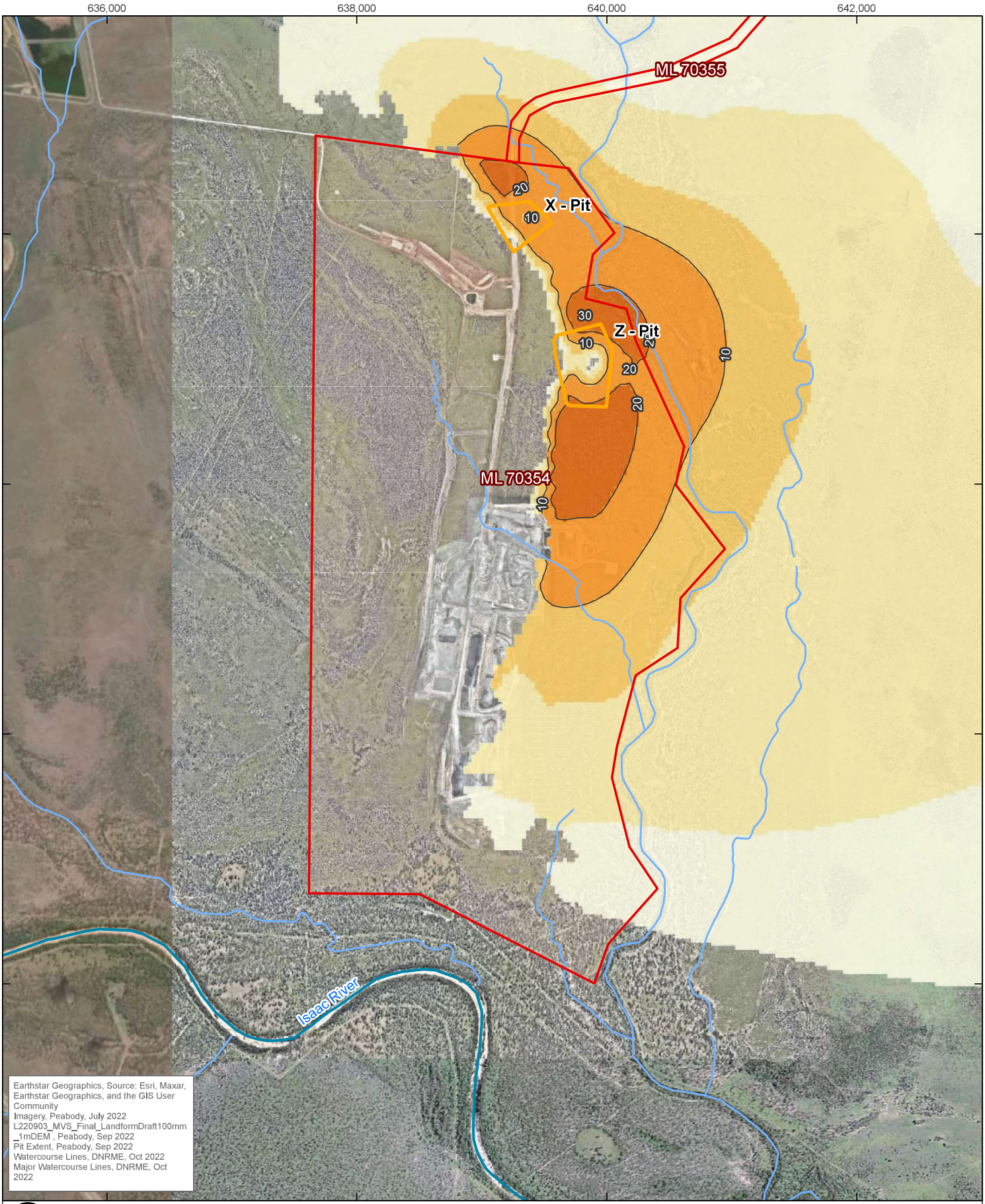
INCREMENTAL DRAWDOWN AT POST-MINING EQUILIBRIUM IN LEICHHARDT SEAM (LAYER 5)

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FIGURE 7-18

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0 0.5 1 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	660.30254.00000
Date Drawn:	28-Jun-2024
Drawn by:	RB

LEGEND

- Final Pit Extent
- Moorvale South Mining Lease
- Major Watercourse
- Minor Watercourse
- Road
- Drawdown Contour (m)

Drawdown (m)

- 1- 2
- 2 - 5
- 5.- 10
- 10- 20
- 20 - 50

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

INCREMENTAL DRAWDOWN AT POST-MINING EQUILIBRIUM IN VERMONT SEAM (LAYER 7)

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FIGURE 7-19

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7.2.7 Flow Path Simulation

An analysis of the water movement within the Project final landform was undertaken to simulate and assess the movement and fate of water particles through the groundwater system post-mining. A number of particles were placed within the residual voids in the recovery groundwater model and the mod-PATH3DU code (S.S. Papadopulos & Associates, Inc., 2018) was used to simulate particle pathways along the groundwater flow field during recovery (i.e. 2,000 years). To run the mod-PATH3DU code the transient head outputs from the groundwater flow model were used by mod-PATH3DU to simulate particle flowpath lines.

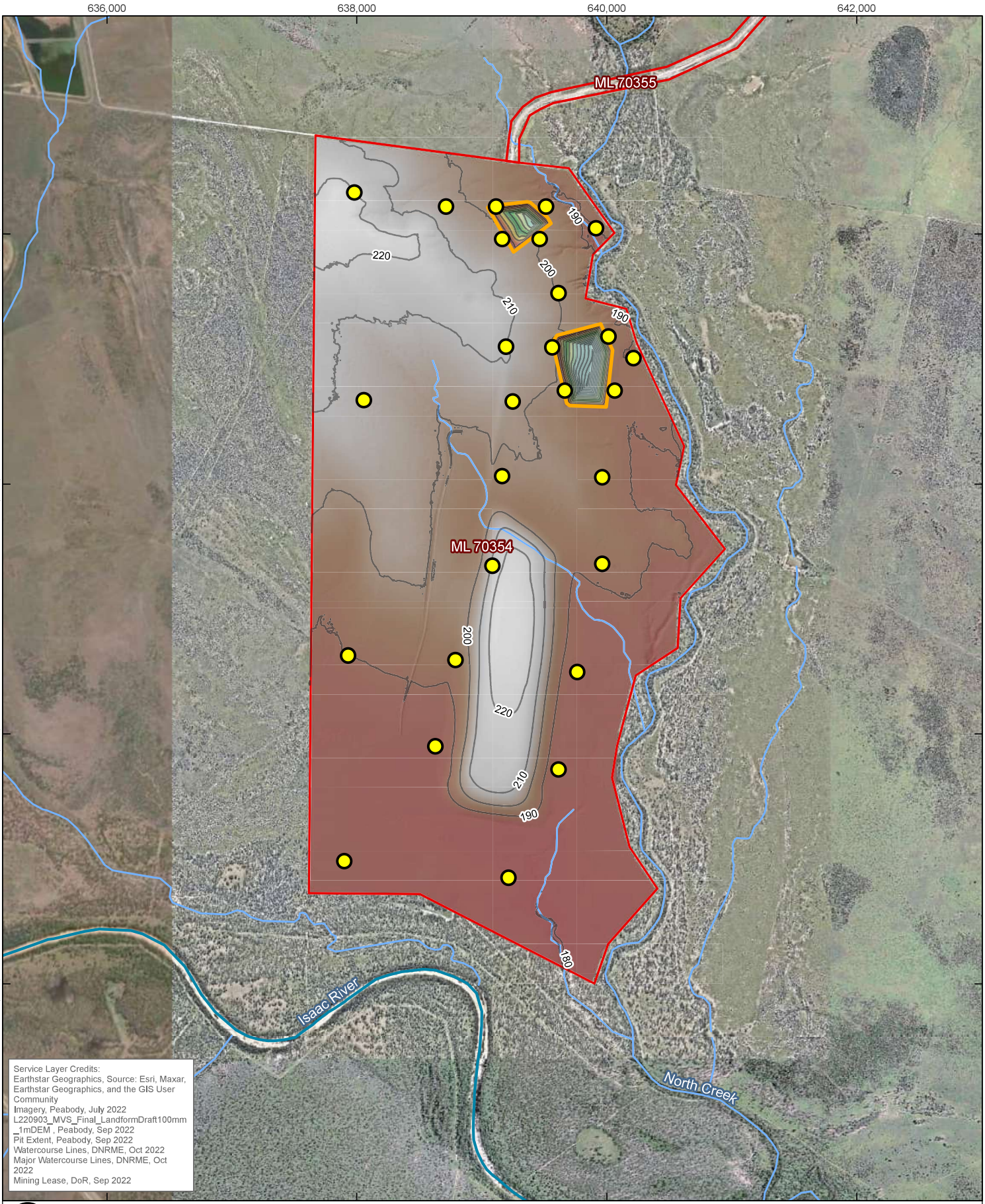
Figure 7-14 shows the initial location of particles on the final landform. The particles were placed at the surface of the model and released at the start of the post-mining simulation, with the movement of the particles then recorded during the post-mining simulation. It should be noted that the mod-PATH3DU code automatically moves the particle from the model surface to the shallowest saturated layer at the commencement of the simulation; for many of the particles this represents the Permian layers (including areas of spoil backfill in model layers that represent Permian units pre-mining) as the shallow layers (Layers 1 and 2) are unsaturated across much of the Project Area at the commencement of the post-mining simulation. Locations where the model predicts saturation in the shallow groundwater system (i.e. Layer 1 and 2) at the end of mining and therefore where particles did commence in shallow groundwater include the western and southern side of the elevated final landform area in the southern half of the Project site.

7.2.7.1 Median Climate Scenario

Figure 7-20 shows the predicted movement of water particles in the 2,000-year recovery simulation of the final landform for the median climate scenario. The colours along the predicted particle flow paths provides the model layer the particle was simulated to be moving through, with the green to red scale classification representing particles moving from shallow to deep model layers.

The colour changes along the paths on **Figure 7-20** indicate that particles situated within the shallower saturated layers at the beginning of the post-mining simulation generally move progressively toward deeper layers representing the Permian coal measures (or backfilled spoil where the coal measures have been mined out) over the post-mining period. The flow path analysis indicates the particles generally move toward the void lakes, particularly from south to north across most of the Project site, with many of the particles captured in the voids. Particles starting in the residual voids themselves remain captured by the voids. No particles are shown to move outside the Project Area to the broader receiving environment, nor do any particles travel eastwards towards North Creek or southwards towards the Isaac River.

Overall, the particle movement simulation indicates that all groundwater within the Project, including that flowing through spoil of the final landform, would remain within the final landform (e.g. backfilled spoil and residual voids) in the long term with no groundwater predicted to flow to the receiving environment. The residual voids are predicted to remain groundwater sinks and groundwater would not flow from the residual voids off-site.



Service Layer Credits:
Earthstar Geographics, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Imagery, Peabody, July 2022
L220903_MVS_Final_LandformDraft100mm_1mDEM , Peabody, Sep 2022
Pit Extent, Peabody, Sep 2022
Watercourse Lines, DNRME, Oct 2022
Major Watercourse Lines, DNRME, Oct 2022
Mining Lease, DoR, Sep 2022

0 0.5 1 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	660.30254.00000
Date Drawn:	11-Jun-2024
Drawn by:	NT

LEGEND

- Starting Location of Particle
- Minor Watercourse
- Major Watercourse
- Final Pit Extent
- Moorvale South Mining Lease

LEGEND

- Topographic Contour (10 m)

Post Mining Landform Elevation (mAHD)

227
66

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

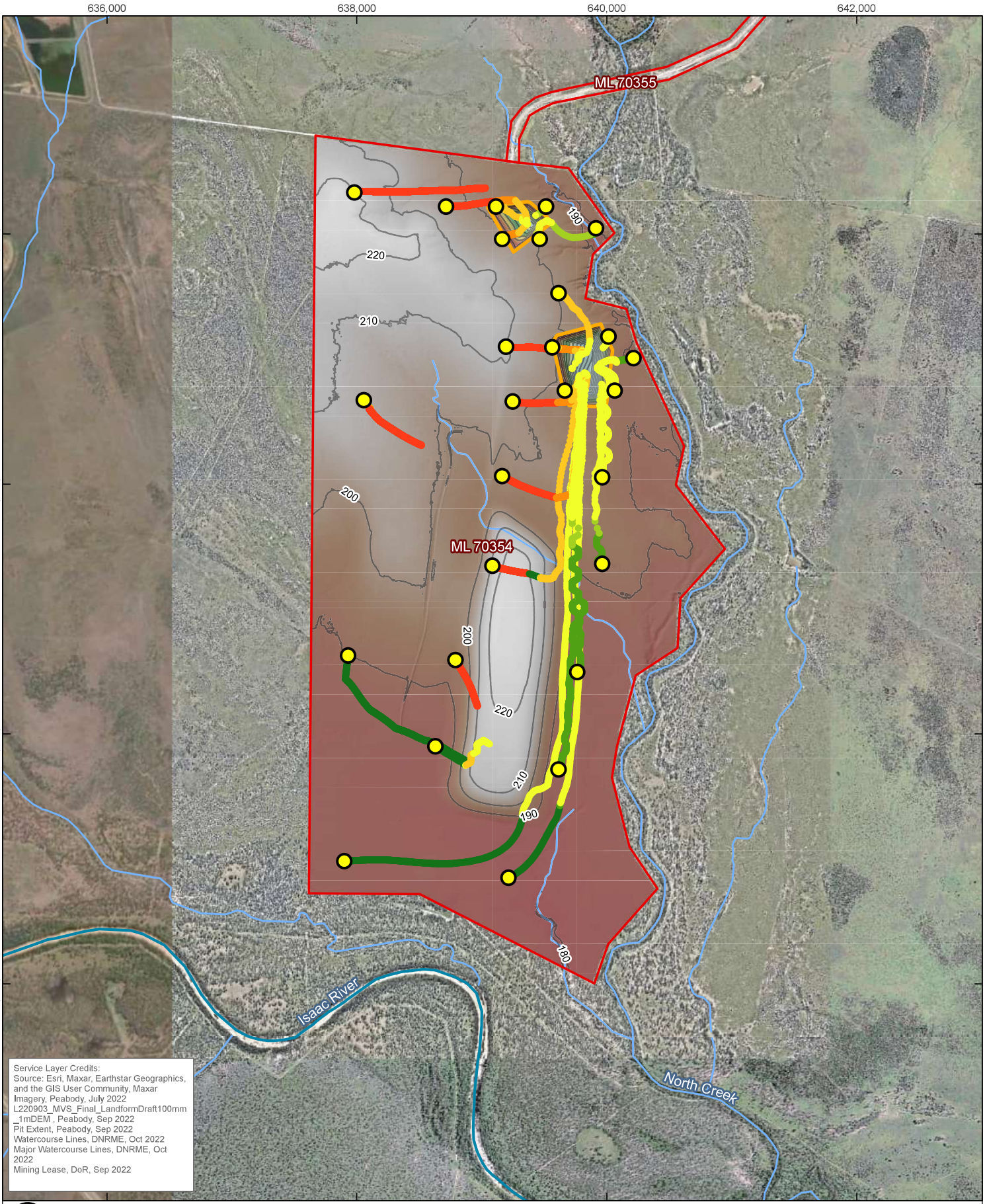
STARTING LOCATION OF PARTICLES

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FIGURE 7-20

Path: \\au.slr.local\Corporate\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx



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Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community, Maxar Imagery, Peabody, July 2022
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Pit Extent, Peabody, Sep 2022
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Major Watercourse Lines, DNRME, Oct 2022
Mining Lease, DoR, Sep 2022

0 0.5 1 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	660.30254.00000
Date Drawn:	11-Jun-2024
Drawn by:	NT

LEGEND

- Starting Location of Particle
- Minor Watercourse
- Major Watercourse
- Moorvale South Mining Lease
- Final Pit Extent

Model Layer Traversed

- 2
- 4
- 5
- 6
- 7
- 8
- 9

- Topographic Contour (10 m)

Post Mining Landform Elevation (mAHD)

227

66

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

PREDICTED MOVEMENT OF PARTICLES

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FIGURE 7-21

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8.0 Conceptual Site Model – Post-Mining

A visual representation of the post-mining CSM is provided as **Figure 8-1**, based on the end of mining CSM discussed in **Section 5.0** and the post-mining groundwater modelling presented in **Section 7.0**. There is no evidence from a groundwater perspective that the final landform is unsuitable for the proposed PMLUs, given the hydrogeological assessment objectives outlined in **Section 1.3** and the following key features:

- Residual void lake formation, with lake levels stabilising below the pre-mining groundwater elevations and any shallow post-Permian strata regardless of climate scenario modelled, including the base of surficial weathering and shallow hydrostratigraphic units (i.e. alluvium and regolith).
- Residual groundwater drawdown within the Rangal Coal Measures as caused by the approved Moorvale South Project mining operation, with ongoing evaporative discharge from the residual void lakes, resulting in continued inwards hydraulic flow gradients in the coal measures to the residual voids and no outflow in the long term regardless of climate scenario modelled.
- Residual voids continue to capture any seepage from spoil emplacements.
- Little to no impact on environmental receptors caused by the PRCP and EAA final landform.
- Little to no impact on anthropogenic receptors caused by the PRCP and EAA final landform.

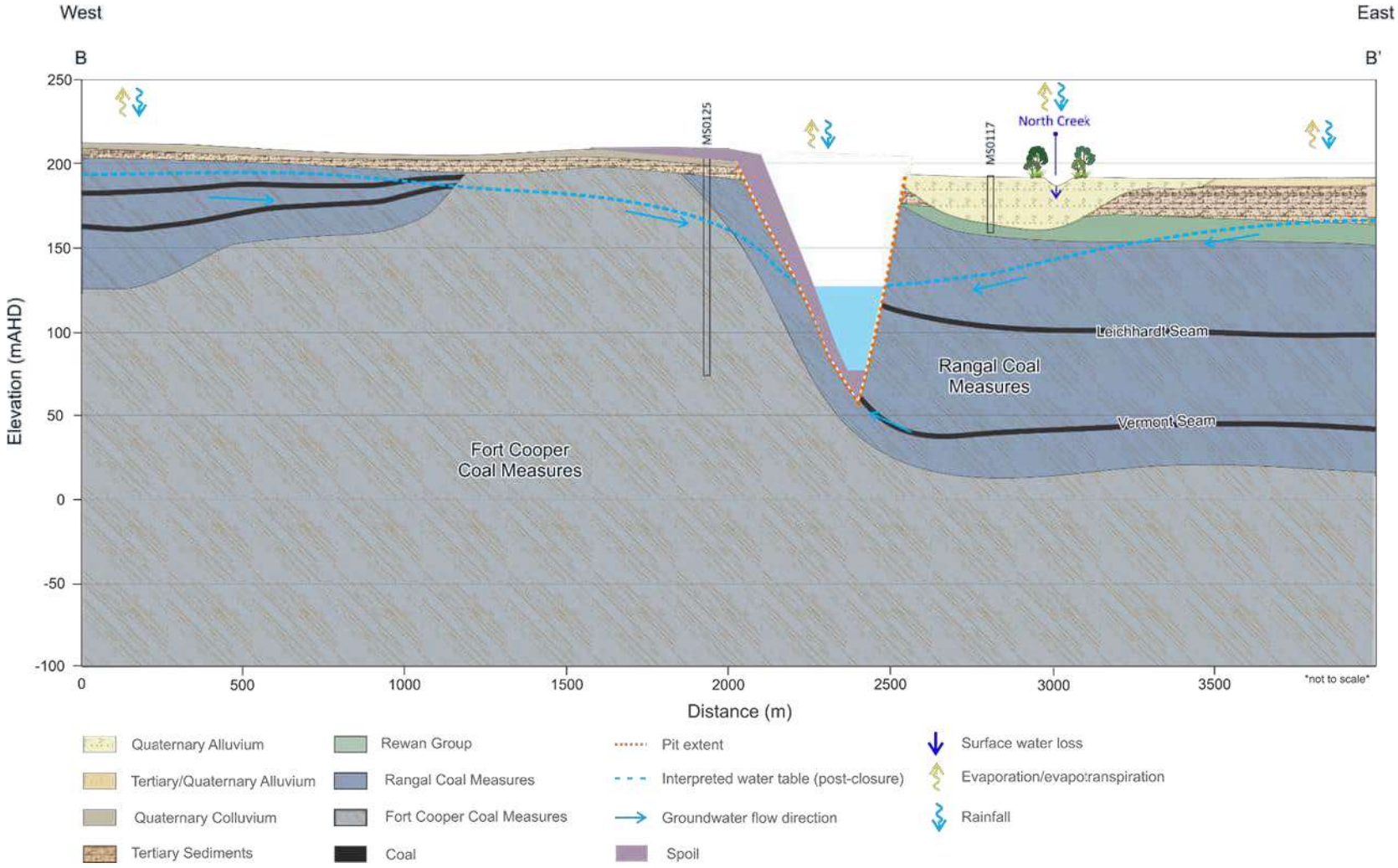


Figure 8-1 Conceptual model of the groundwater system – post-closure

9.0 Post-Mining Groundwater Monitoring

9.1 Overview

The results of the hydrogeology assessment presented in the preceding report sections indicate that groundwater levels at the Project site are expected to recover partially in the post-mining period. The recovery of groundwater levels in is governed by the recovery of the residual void lakes, with the final lake levels dictating the degree to which groundwater levels in the surrounding spoil and natural geologies recover. Ongoing partial recovery of Permian coal measures groundwater levels (and residual void lake formation) has the net effect of limiting the potential impacts of closure on the groundwater system by maintaining a permanent inwards hydraulic gradient in the groundwater system towards the residual void lakes, and thus it is assessed that there no potential for potentially poor quality groundwater in the spoil or water in the residual void lakes to discharge to the receiving environment (such as shallow aquifer systems).

None the less, a groundwater monitoring program will be developed by Peabody in order to validate the prediction of limited potential for additional impacts to the groundwater environment following rehabilitation (i.e. following establishment of the final landform). During the period of rehabilitation whilst the final landform is being established, monitoring would continue in accordance with the requirements of the Project's EA.

The process by which the Peabody will establish the post-mining groundwater monitoring program is described below.

9.2 Monitoring Network

The post-mining groundwater monitoring network has been established on the basis of the following key objectives:

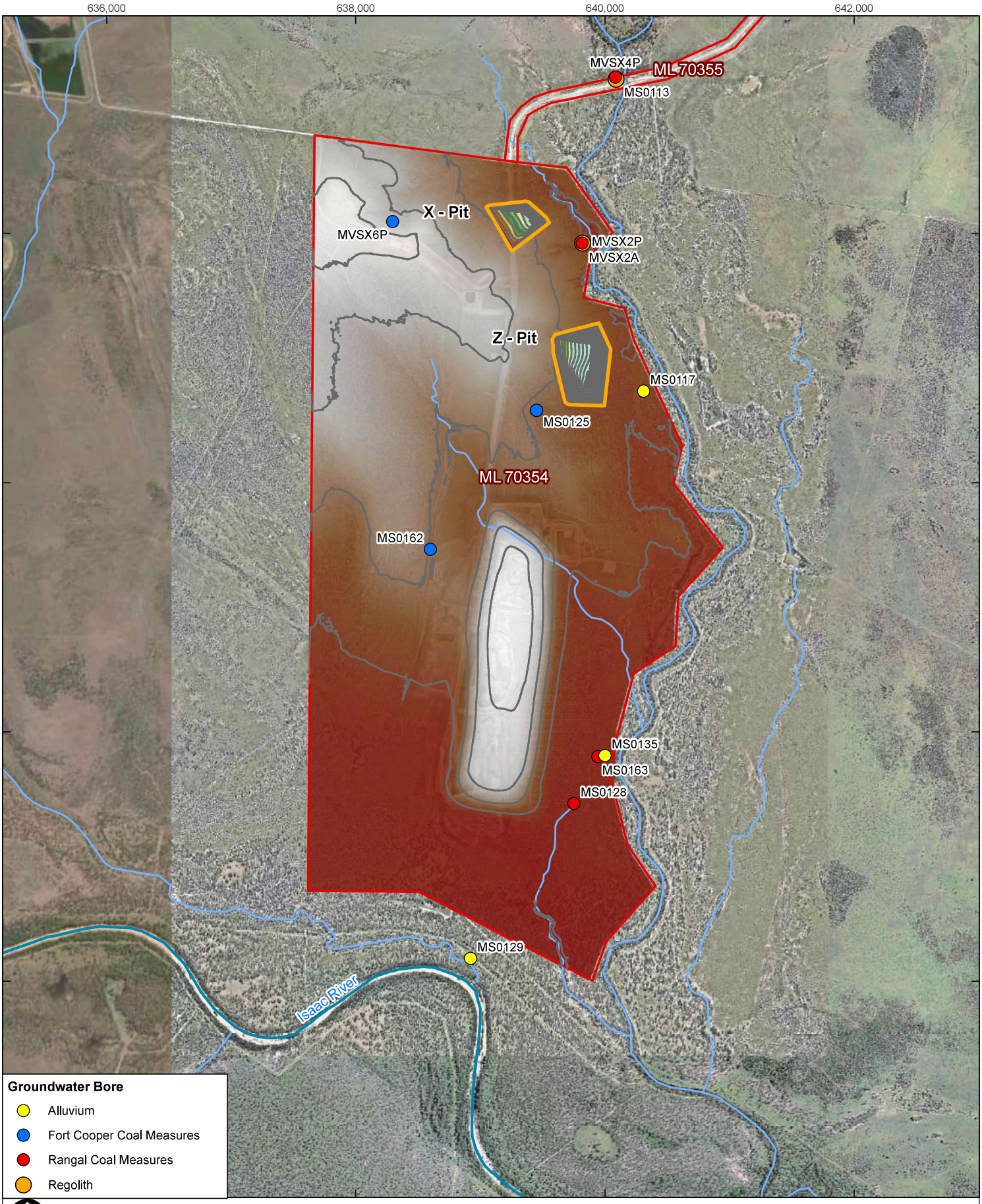
1. Spatial coverage of all relevant aquifer units in the vicinity of the residual voids, such that any post-mining impacts to the groundwater system outside the final landform would be detected.
2. Provide for validation of model predictions for groundwater level changes post-mining, both generally within the groundwater system and at key potential environmental receptors.
3. Provide for validation of the results of this assessment that indicate no potential for release of contaminants to the groundwater environment.

The location of bores established in the post-mining groundwater monitoring network is therefore be based upon identifying a subset of the bores identified in **Section 4.1** that achieve the above aims with respect of the receptor identification provided in **Section 4.5** and the model predictions presented in **Section 7.2**.

The proposed post-mining groundwater monitoring network is provided in **Table 9-1**. Locations are also shown on **Figure 9-1**. The proposed network includes existing Project bores and bores recently installed for the MVSX Project.

Table 9-1 Proposed post-mining groundwater monitoring network

Bore ID	Easting (GDA94)	Northing (GDA94)	Monitored unit
MS0128	639750	7551426	Leichhardt Seam
MS0135	640000	7551811	Alluvium
MS0163	639944	7551802	Vermont Upper Seam
MS0117	640310	7554734	Alluvium
MS0129	638921	7550183	Alluvium
MS0113	640089	7557236	Regolith / Rangal Overburden
MS0125	639451	7554580	Fort Cooper Coal Measures - Coal
MS0162	638599	7553465	Fort Cooper Coal Measures - Coal
MVSX2A	639820	7555922	Weathered Tertiary sediments
MVSX2P	639816	7555922	Leichhardt Seam
MVSX4P	640084	7557254	Leichhardt Seam
MVSX6P	638296	7556095	Fort Cooper Coal Measures



Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	660.30254.00000
Date Drawn:	28-Jun-2024
Drawn by:	RB

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

PROPOSED POST-MINING GROUNDWATER MONITORING NETWORK

SLR

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FIGURE 9-1

Path: \\au.slr.local\Corporate\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx

9.3 Monitoring Criteria and Impact Triggers

Post-mining groundwater level monitoring will be undertaken biannually, consistent with the current monitoring program. Impact triggers for groundwater levels will be established on the basis of model predictions as provided in **Section 7.2**.

Post-mining groundwater quality monitoring will be undertaken biannually, consistent with the current monitoring program. Groundwater quality criteria have been selected based on the mining-related Contaminants of Concern (CoC) identified in the RGS (2023) geochemical assessment's recommended post-mining water quality monitoring regime for the Project, and with respect to relevant Isaac River Sub-basin EV protection criteria (see **Section 4.4.3**). The parameters that will be monitored are:

- General water quality indicators:
  - Electrical Conductivity (EC)
  - pH
- Major Ions
  - Calcium (Ca)
  - Magnesium (Mg)
  - Potassium (K)
  - Sodium (Na)
  - Sulfate (SO_4)
  - Chloride (Cl)
- Dissolved Metals and Metalloids
  - Aluminium (Al)
  - Cadmium (Cd)
  - Copper (Cu)
  - Nickel (Ni)
  - Lead (Pb)
  - Zinc (Zn)
  - Selenium (Se)

Impact triggers for post-mining groundwater quality will be established using the methodologies outlined in DES (2021), and incorporating site-specific (bore-specific) trigger derivation to take into account existing groundwater quality at each bore, once a sufficient quantum of data is available in accordance with the minimum data requirements stipulated by DES (2021). In the absence of sufficient monitoring data to derive bore-specific triggers at the present time in accordance with the methodologies prescribed by DES (2021), interim triggers have been developed based on Isaac River Sub-basin EV protection criteria relevant to groundwater (see **Section 4.4.3**). A description of the interim groundwater quality triggers is provided in **Table 9-2**. The approach to derive the interim groundwater quality triggers is to select the lowest EV guideline value (WQO) that is above the existing range of groundwater quality monitoring data for each individual bore proposed for the post-mining monitoring network.

It is proposed that formal exceedance of the triggers would apply if groundwater quality monitoring results exceed the triggers for three (3) consecutive monitoring events.



Table 9-2 Interim Post-Mining Groundwater Quality Trigger Limits

Monitored unit	Bore ID	Parameter[1]	Trigger Limit Value[2]	Justification
Alluvium	MS0135 MS0117 MS0129	pH	Below 6.5 or above 8.5	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		EC (µS/cm)	7463	Isaac River Sub-basin Stockwater WQO[3]
		Ca (mg/L)	215	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
		Mg (mg/L)	389	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
		K (mg/L)	TBD	Parameter not identified in any EV WQO
		Na (mg/L)	1500	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
		SO_4 (mg/L)	318	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
		Cl (mg/L)	3185	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
		Al (mg/L)	0.055	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Cd (mg/L)	0.0002	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
	MS0135 MS0129	Cu (mg/L)	0.0014	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
	MS0117		0.03	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
	MS0135 MS0117 MS0129	Ni (mg/L)	0.011	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Se (mg/L)	0.005	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Zn (mg/L)	0.06	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
Weathered Tertiary sediments	MVSX2A	pH	Below 6.5 or above 8.5	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		EC (µS/cm)	7463	Isaac River Sub-basin Stockwater WQO[3]
		Ca (mg/L)	215	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
		Mg (mg/L)	389	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
		K (mg/L)	TBD	Parameter not identified in any EV WQO
		Na (mg/L)	1500	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
		SO_4 (mg/L)	318	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
		Cl (mg/L)	3185	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
		Al (mg/L)	0.055	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO



Monitored unit	Bore ID	Parameter[1]	Trigger Limit Value[2]	Justification
		Cd (mg/L)	0.0002	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Cu (mg/L)	0.03	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
		Ni (mg/L)	0.011	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Se (mg/L)	0.005	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Zn (mg/L)	0.06	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
Regolith / Rangal Overburden	MS0113	pH	Below 6.5 or above 8.5	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		EC (µS/cm)	7463	Isaac River Sub-basin Stockwater WQO[3]
		Ca (mg/L)	215	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
		Mg (mg/L)	389	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
		K (mg/L)	TBD	Parameter not identified in any EV WQO
		Na (mg/L)	1500	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
		SO_4 (mg/L)	318	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
		Cl (mg/L)	3185	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
		Al (mg/L)	0.055	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Cd (mg/L)	0.0002	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Cu (mg/L)	0.03	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
		Ni (mg/L)	0.011	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Se (mg/L)	0.005	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Zn (mg/L)	0.06	Isaac River Sub-basin Zone 34 Shallow 80th %ile WQO
Leichhardt Seam	MVSX2P MVSX4P MS0128	pH	Below 6.5 or above 8.5	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
	MVSX2P	EC (µS/cm)	16000	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
	MVSX4P MS0128		TBD	Existing bore data above all available EV protection criteria
	MVSX2P MVSX4P	Ca (mg/L)	442	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO

Monitored unit	Bore ID	Parameter[1]	Trigger Limit Value[2]	Justification
	MS0128		1000	Isaac River Sub-basin Stockwater WQO
	MVSX2P MVSX4P	Mg (mg/L)	491	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
	MS0128		2000	Isaac River Sub-basin Stockwater WQO
	MVSX2P MVSX4P MS0128	K (mg/L)	TBD	Parameter not identified in any EV WQO
	MVSX2P MVSX4P	Na (mg/L)	2565	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
	MS0128		TBD	Existing bore data above all available EV protection criteria
	MVSX2P MVSX4P	SO_4 (mg/L)	398	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
	MS0128		1000	Isaac River Sub-basin Stockwater WQO
	MVSX2P MVSX4P	Cl (mg/L)	5905	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
	MS0128		TBD	Existing bore data above all available EV protection criteria
	MVSX2P MVSX4P MS0128	Al (mg/L)	0.055	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Cd (mg/L)	0.0002	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Cu (mg/L)	0.03	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
		Ni (mg/L)	0.011	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
	MVSX2P MVSX4P	Se (mg/L)	0.005	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
	MS0128		0.02	Isaac River Sub-basin Stockwater WQO
	MVSX2P MVSX4P MS0128	Zn (mg/L)	0.317	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
Vermont Upper Seam	MS0163	pH	Below 6.5 or above 8.5	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		EC (µS/cm)	TBD	Existing bore data above all available EV protection criteria
		Ca (mg/L)	1000	Isaac River Sub-basin Stockwater WQO
		Mg (mg/L)	2000	Isaac River Sub-basin Stockwater WQO
		K (mg/L)	TBD	Parameter not identified in any EV WQO
		Na (mg/L)	TBD	Existing bore data above all available EV protection criteria
		SO_4 (mg/L)	398	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO

Monitored unit	Bore ID	Parameter[1]	Trigger Limit Value[2]	Justification
		Cl (mg/L)	TBD	Existing bore data above all available EV protection criteria
		Al (mg/L)	0.055	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Cd (mg/L)	0.0002	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Cu (mg/L)	0.03	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
		Ni (mg/L)	1	Isaac River Sub-basin Stockwater WQO
		Se (mg/L)	0.02	Isaac River Sub-basin Stockwater WQO
		Zn (mg/L)	0.317	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
Fort Cooper Coal Measures - Coal	MS0125 MS0162	pH	Below 6.5 or above 8.5	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
	MS0125	EC (µS/cm)	7463	Isaac River Sub-basin Stockwater WQO[3]
	MS0162			
	MS0125 MS0162	Ca (mg/L)	442	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
		Mg (mg/L)	491	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
		K (mg/L)	TBD	Parameter not identified in any EV WQO
		Na (mg/L)	2565	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
		SO_4 (mg/L)	398	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
		Cl (mg/L)	5905	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
		Al (mg/L)	0.055	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Cd (mg/L)	0.0002	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Cu (mg/L)	0.03	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
		Ni (mg/L)	0.011	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Se (mg/L)	0.02	Isaac River Sub-basin Stockwater WQO
	MS0125	Zn (mg/L)	0.008	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
	MS0162		0.317	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
Fort Cooper Coal Measures	MVSX6P	pH	Below 6.5 or above 8.5	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		EC (µS/cm)	7463	Isaac River Sub-basin Stockwater WQO[3]
		Ca (mg/L)	442	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO

Monitored unit	Bore ID	Parameter[1]	Trigger Limit Value[2]	Justification
		Mg (mg/L)	491	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
		K (mg/L)	TBD	Parameter not identified in any EV WQO
		Na (mg/L)	2565	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
		SO_4 (mg/L)	398	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
		Cl (mg/L)	5905	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
		Al (mg/L)	0.055	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Cd (mg/L)	0.0002	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Cu (mg/L)	0.03	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO
		Ni (mg/L)	0.011	Isaac River Sub-basin Aquatic Ecosystem Protection 95% WQO
		Se (mg/L)	0.02	Isaac River Sub-basin Stockwater WQO
		Zn (mg/L)	0.317	Isaac River Sub-basin Zone 34 Deep 80th %ile WQO

1. Metals/metalloids (Al, Cd, Cu, Ni, Se and Zn) are dissolved
2. TBD = To Be Determined in accordance with DES (2021) procedure for establishing site-specific triggers following collection of sufficient data for statistical analysis.
3. Converted from DS using EC (µS/cm) x 0.67 = TDS (mg/L) per ANZECC (2000).

9.4 Monitoring Schedule

Prior to the establishment of the final landform, groundwater monitoring will be undertaken in accordance with operational groundwater monitoring requirements specified within the EA.

The proposed schedule for rehabilitation groundwater monitoring after the completion of final landform establishment and surface preparation (i.e. post-mining and completion of landform construction and topsoiling) is biannually consistent with current practices, given the results of this groundwater assessment indicate a low risk of groundwater impacts to the surrounding environment.

Rehabilitation monitoring would continue for a minimum period of 5 years. After 5 years of rehabilitation monitoring, a review is to be undertaken to determine if there is a requirement for additional monitoring, or if post-mining groundwater system behaviour is sufficiently consistent with model predictions of minimal potential for groundwater environmental impact such that monitoring can be discontinued.

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Appendix A 80th Percentile Summary Statistics Compared to EV Guideline Values

Moorvale South PRCP

Groundwater Assessment

Peabody Energy Australia

SLR Project No.: 660.30254.00000

29 July 2024

Monitored Unit	Alluvium					Regolith / Rangal Overburden	Leichhardt Seam			Vermont Upper Seam		FCCM - Coal		Drinking Water (Health)	Drinking Water (Aesthetic)	Irrigation	Stock	Aquatic Ecosystems
Bore	**MS0232**	**MS0235**	**ODN18MB4**	**MS0117**	**MS0129**	**MS0113**	**MS0234**	**MS0128**	**MS0233**	**MS0163**	**MS0236**	**MS0162**	**MS0125**					
pH (Lab)	7.1 - 7.7	7 - 7.5	7.2 - 7.5	7.7 - 8.2	6.9 - 7.3	7.5 - 8.1	7.5 - 8	7 - 7.7	8.2 - 8.5	7.3 - 11.9	9.1 - 9.7	7.9 - 8.1	8 - 8.4	-	6.5 to 8.5	-	-	6.5 to 8.5
TDS (mg/L)	280.2	308	31640	3550	287	2842	544	19500	488.6	15100	5860	8160	4376	-	600	-	5000^	-
EC (Lab) (uS/cm)	497.4	491	36680	5848	373	4672	986	26240	781.4	26200	9340	12980	7432	-	-	-	-	-
Ca (mg/L)	24.4	20	1326	44.2	25	93	9	642.2	6	696	211	178	32.2	-	-	-	1000	-
Cl (mg/L)	87.2	79	12720	1226	27	1106	117	9660	41.2	9160	3280	4630	2136	-	250	-	-	-
Mg (mg/L)	12.8	9	1656	66.6	11	102.4	8	805.2	4	525	15	24.8	6	-	-	-	2000	-
Na (mg/L)	53.6	74	5526	1230	36	871.4	219	4554	179	4810	1920	2564	1600	-	180	-	-	-
SO4 (mg/L)	11.6	11	1606	150.8	12	67	30	451.2	10	328	86	0.5	1.2	-	-	-	1000	-
F (mg/L)	0.2	0.12	0.54	0.8	0.12	0.64	1.12	0.48	2.48	0.32	0.2	0.38	0.64	1.5	-	1	2	-
HCO3 (mg/L)	113.2	129	1044	1240	144	951	318	592.8	343	424	11	187.4	834.2	-	-	-	-	-
NO3 (mg/L)	0.04	0.22	0.02	0.084	0.005	0.036	0.005	0.006	0.118	0.27	0.005	0.005	0.008	-	-	-	-	-
Total Alkalinity (mg/L)	113.2	129	1044	1240	144	951	318	592.8	356	852	98	187.4	840.6	-	-	-	-	-
Hardness as CaCO3 (mg/L)	113.4	83	10004	384.8	112	645.8	55	4844	31	3850	552	546.4	105.4	-	-	-	-	-
Ag (Diss) (mg/L)	0.0005	0.0005	0.0025	0.0005	0.0005	0.0005	0.0005	0.0009	0.0005	0.002	0.0005	0.0005	0.0005	0.1	-	-	-	0.05
Al (Diss) (mg/L)	0.014	0.07	0.06	0.006	0.02	0.006	0.03	0.013	0.012	0.025	0.06	0.008	0.012	-	0.2	5	5	0.055
As (Diss) (mg/L)	0.0084	0.0005	0.0028	0.0005	0.0005	0.0005	0.002	0.0054	0.001	0.0025	0.0005	0.0056	0.0012	0.01	-	0.1	0.5	0.024
B (Diss) (mg/L)	0.08	0.09	0.644	1.162	0.1	0.426	0.32	0.814	0.252	0.78	0.17	0.378	0.482	4	-	0.5	5	-
Be (Diss) (mg/L)	0.0005	0.0005	0.0025	0.0005	0.0005	0.0005	0.0005	0.0009	0.0005	0.0005	0.0005	0.0005	0.0005	0.06	-	0.1	-	-
Cd (Diss) (mg/L)	0.00005	0.00005	0.00025	0.00005	0.00005	0.00005	0.00005	0.00009	0.00005	0.0001	0.0003	0.00005	0.00005	0.002	-	0.01	0.01	0.0002
Co (Diss) (mg/L)	0.001	0.0005	0.017	0.0005	0.002	0.0005	0.0005	0.0028	0.0005	0.0025	0.0005	0.0005	0.0005	-	-	0.05	1	-
Cu (Diss) (mg/L)	0.0005	0.0005	0.0028	0.0018	0.001	0.0046	0.0005	0.0013	0.0014	0.012	0.0005	0.0032	0.0005	2	1	0.2	1^	0.0014
Cr (Diss) (mg/L)	0.0005	0.0005	0.0025	0.0005	0.0005	0.0005	0.0005	0.0013	0.0005	0.12	0.0005	0.0005	0.0005	0.05	-	0.1	1	0.001
Fe (Diss) (mg/L)	3.89	0.025	1.284	0.338	0.97	0.232	0.95	5.986	0.056	0.13	0.025	0.52	0.176	-	0.3	0.2	-	-
Hg (Diss) (mg/L)	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.001	-	0.002	0.002	0.0006
Mn (Diss) (mg/L)	1.0368	0.081	7.492	0.1388	0.727	0.146	0.078	1.224	0.0204	0.717	0.003	0.1344	0.0156	0.5	0.1	0.2	-	1.9
Mo (Diss) (mg/L)	0.003	0.0005	0.0025	0.003	0.0005	0.0006	0.016	0.0026	0.0092	0.099	0.497	0.0005	0.0008	0.05	-	0.01	0.15	-
Ni (Diss) (mg/L)	0.0008	0.001	0.016	0.001	0.002	0.0044	0.001	0.004	0.0012	0.012	0.002	0.0008	0.0005	0.02	-	0.2	1	0.011
Pb (Diss) (mg/L)	0.0005	0.0005	0.0025	0.0005	0.0005	0.0005	0.0005	0.0009	0.0005	0.0005	0.0005	0.0005	0.0005	0.01	-	2	0.1	0.0034
Se (Diss) (mg/L)	0.005	0.005	0.025	0.005	0.005	0.005	0.005	0.009	0.005	0.005	0.005	0.005	0.005	0.01	-	0.02	0.02	0.005
U (Diss) (mg/L)	0.0005	0.0005	0.0604	0.0124	0.0005	0.013	0.0005	0.0044	0.0005	0.0025	0.0005	0.0005	0.0005	0.02	-	0.01	0.2	-
V (Diss) (mg/L)	0.005	0.005	0.025	0.005	0.005	0.005	0.005	0.009	0.005	0.005	0.005	0.005	0.005	-	-	0.1	-	-
Zn (Diss) (mg/L)	0.0025	0.009	0.0838	0.02	0.031	0.0474	0.0025	0.017	0.008	0.015	0.0025	0.0218	0.0036	-	3	2	20	0.008

LOR x 0.5 as per DES (2021) guidelines
Highlight cell indicates 80th Percentile is above criteria (or below 20th and above 80th for pH):
Australian Drinking Water Guidelines (Health) (NHMRC, NRMMC, 2011)
Australian Drinking Water Guidelines (Aesthetic) (NHMRC, NRMMC, 2011)
Irrigation (Fitzroy Basin WQO - Long Term Value)
Stock (Fitzroy basin WQO, ^cattle)
Aquatic Ecosystem (95% Protection) (ANZG, 2018)
* result above guideline due to laboratory raised LOR, with all results below LOR.
Multiple of above

Appendix B 80th Percentile Summary Statistics Compared WQO Guideline Values

Moorvale South PRCP

Groundwater Assessment

Peabody Energy Australia

SLR Project No.: 660.30254.00000

29 July 2024

Monitored Unit	Alluvium					Regolith / Rangal Overburden	Leichhardt Seam			Vermont Upper Seam		FCCM - Coal		Zone 34 Shallow <30m	Zone 34 Deep <30m
Depth	shallow						deep								
Bore	MS0232	MS0235	ODN18MB4	MS0117	MS0129	MS0113	MS0234	MS0128	MS0233	MS0163	MS0236	MS0162	MS0125		
pH (Lab)	7.1 - 7.7	7 - 7.5	7.2 - 7.5	7.7 - 8.2	6.9 - 7.3	7.5 - 8.1	7.5 - 8	7 - 7.7	8.2 - 8.5	7.3 - 11.9	9.1 - 9.7	7.9 - 8.1	8 - 8.4	7.1 to 8.1	7.40 to 8.03
EC (Lab) (µS/cm)	497.4	491	36680	5848	373	4672	986	26240	781.4	26200	9340	12960	7432	8910	16000
Ca (mg/L)	24.4	20	1326	44.2	25	93	9	642.2	6	696	211	178	32.2	215	442
Cl (mg/L)	87.2	79	12720	1226	27	1106	117	9660	41.2	9160	3280	4630	2136	3185	5905
Mg (mg/L)	12.8	9	1656	66.6	11	102.4	8	805.2	4	525	15	24.8	6	389	491
Na (mg/L)	53.6	74	5526	1230	36	871.4	219	4554	179	4810	1920	2564	1600	1500	2565
SO4 (mg/L)	11.6	11	1606	150.8	12	67	30	451.2	10	328	86	0.5	1.2	318	398
F (mg/L)	0.2	0.12	0.54	0.8	0.12	0.64	1.12	0.48	2.48	0.32	0.2	0.38	0.64	0.5	0.4
Bicarbonate Alkalinity as CaCO3 (mg/L)	113.2	129	1044	1240	144	951	318	592.8	343	424	11	187.4	834.2	720*	533*
Nitrate as N (mg/L)	0.04	0.22	0.02	0.084	0.005	0.036	0.005	0.006	0.118	0.27	0.005	0.005	0.008	1.2^	3.4^
Total Alkalinity (mg/L)	113.2	129	1044	1240	144	951	318	592.8	356	852	98	187.4	840.6	752	536
Hardness as CaCO3 (mg/L)	113.4	83	10004	384.8	112	645.8	55	4844	31	3850	552	546.4	105.4	2228	3208
Cu (Diss) (mg/L)	0.0005	0.0005	0.0028	0.0018	0.001	0.0046	0.0005	0.0013	0.0014	0.012	0.0005	0.0032	0.0005	0.03	0.03
Fe (Diss) (mg/L)	3.89	0.025	1.284	0.338	0.97	0.232	0.95	5.086	0.056	0.13	0.025	0.52	0.176	0.14	0.246
Mn (Diss) (mg/L)	1.0368	0.081	7.492	0.1388	0.727	0.146	0.078	1.224	0.0204	0.717	0.003	0.1344	0.0156	0.16	0.291
Zn (Diss) (mg/L)	0.0025	0.009	0.0838	0.02	0.031	0.0474	0.0025	0.017	0.008	0.015	0.0025	0.0218	0.0036	0.06	0.317

LOR x 0.5 as per DES (2021) guidelines
Highlight cell indicates 80th Percentile is above criteria (or below 20th and above 80th for pH):
Zone 34 Shallow Groundwater <30m (DEHP, 2011)
Zone 34 Deep Groundwater >30m (DEHP, 2011)
*Converted from HCO3 to bicarbonate as CaCO3 as divided by 1.22
^Converted from NO3 to Nitrate as N as x 0.2259

Appendix C Predictive Model Starting Heads

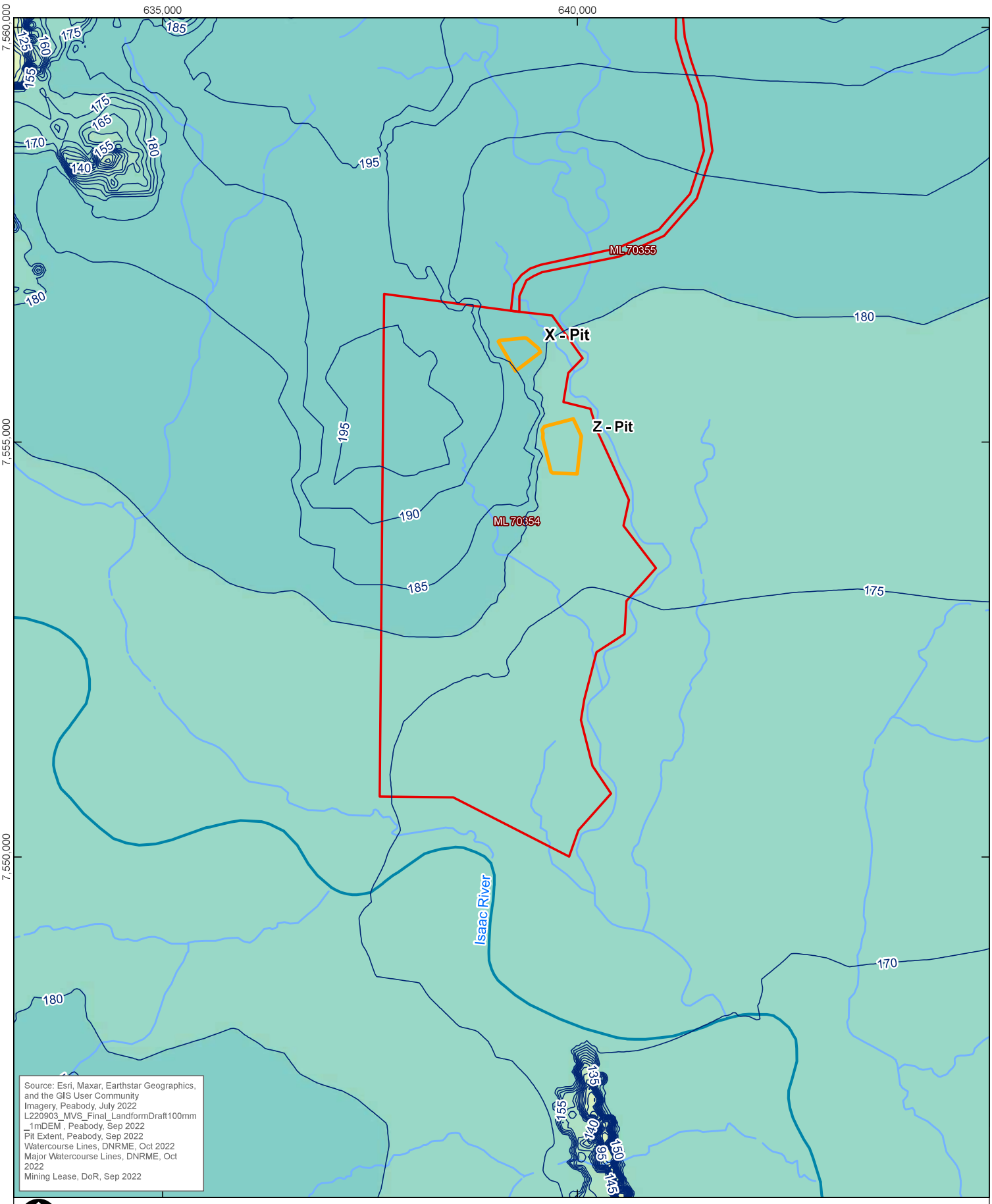
Moorvale South PRCP

Groundwater Assessment

Peabody Energy Australia

SLR Project No.: 660.30254.00000

29 July 2024



0 1 2 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:60,000 at A4
Project Number:	660.30254.00000
Date Drawn:	28-Jun-2024
Drawn by:	RB

LEGEND

- Groundwater Contour (mAHD)
- Major Watercourse
- Minor Watercourse
- Final Pit Extent
- Moorvale South Mining Lease

Groundwater Level (mAHD)

- 80 - 100
- 100 - 120
- 120 - 140
- 140 - 160
- 160 - 180
- 180 - 200
- 200 - 220

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

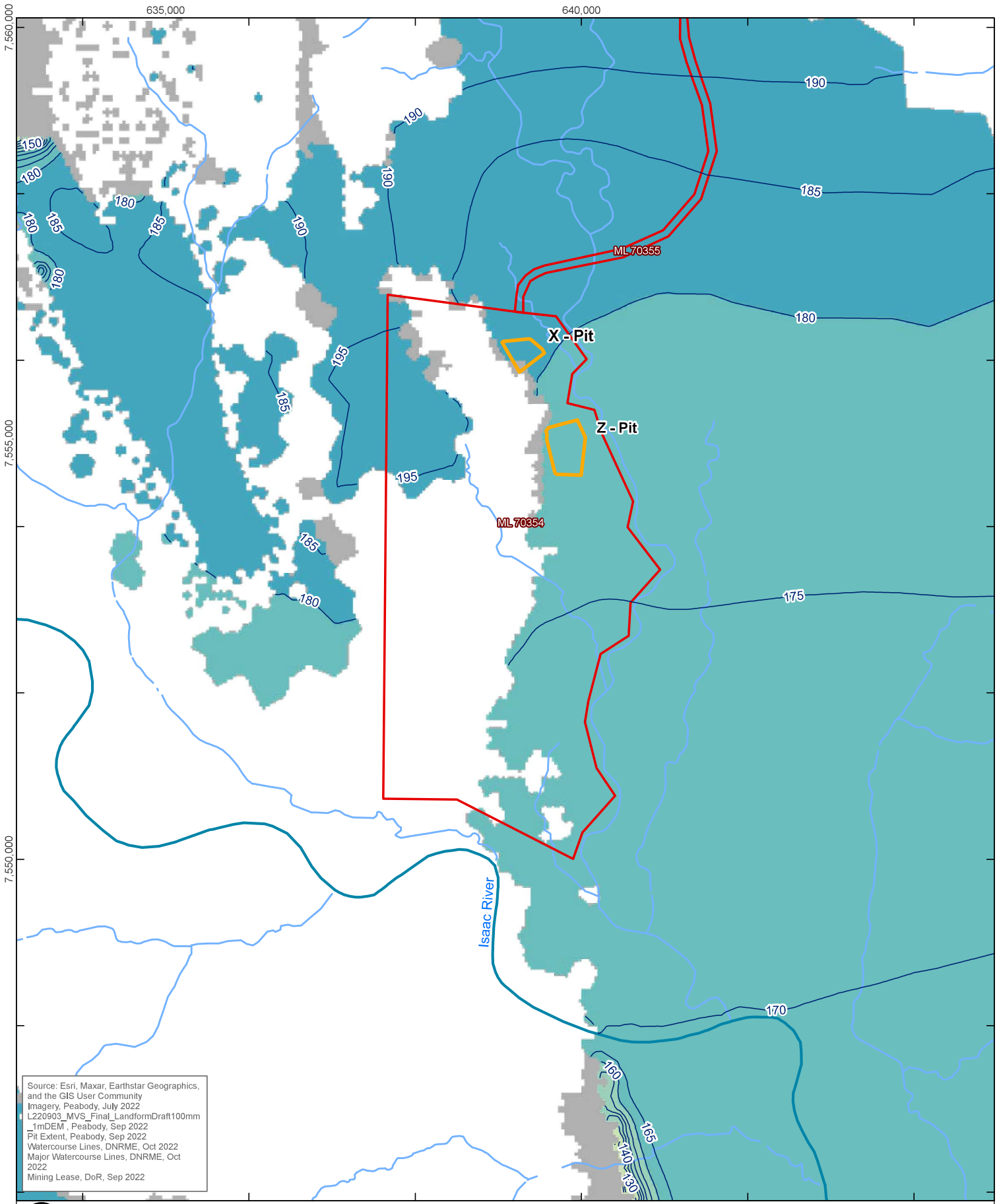
START OF MINING GROUNDWATER LEVELS - WATER TABLE

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FIGURE C-1

Path: \\au.slr.local\Corporate\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx



0 1 2 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:60,000 at A4
Project Number:	660.30254.00000
Date Drawn:	28-Jun-2024
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- Final Pit Extent
- Moorvale South Mining Lease
- Area of Modelled "Dry" Layer 5
- Groundwater Contour (mAHD)

Groundwater Level (mAHD)

- 120 - 140
- 140 - 160
- 160 - 180
- 180 - 200

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

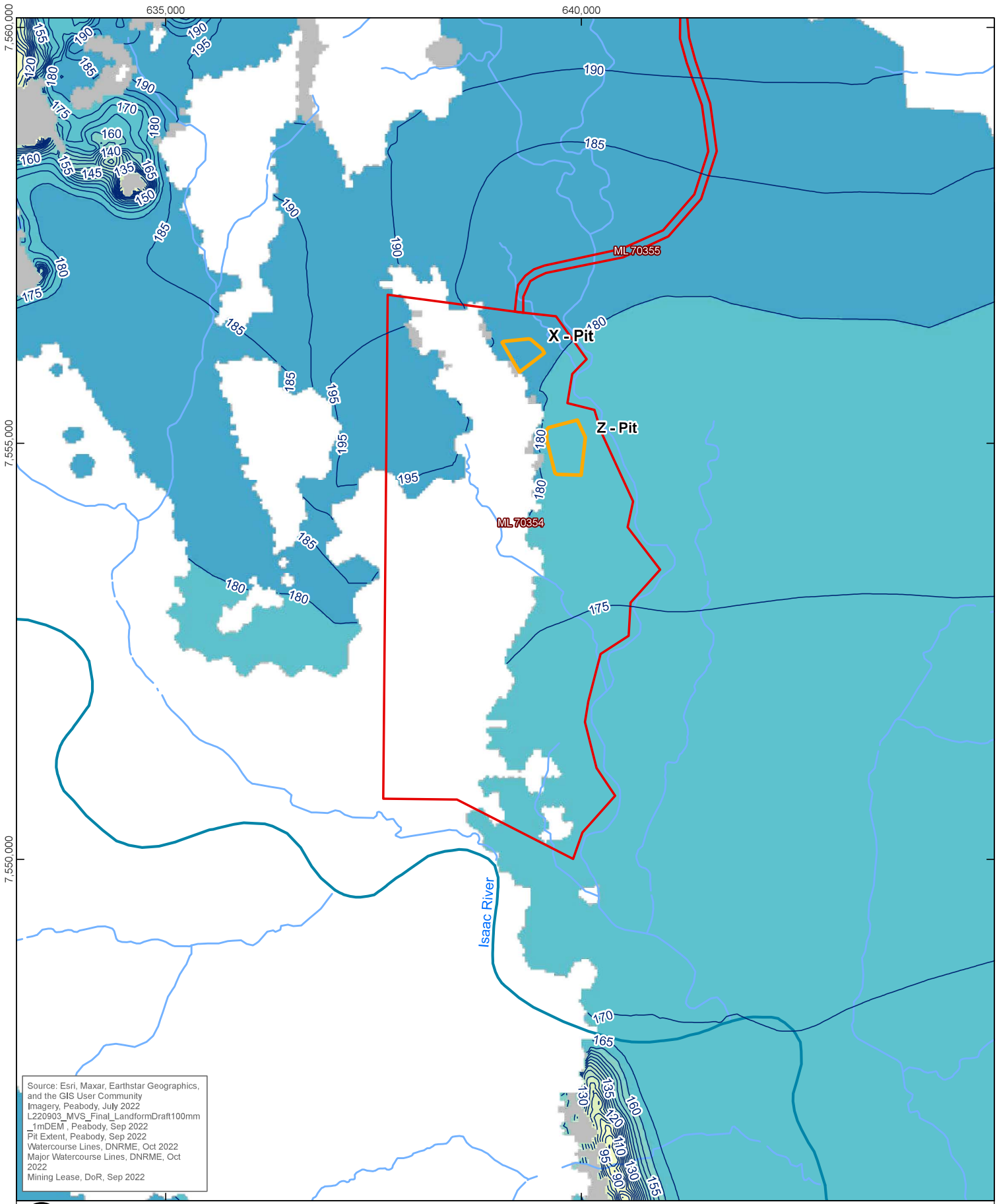
PREDICTED START OF MINING GROUNDWATER LEVELS - LEICHHARDT SEAM

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FIGURE C-2

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0 1 2 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:60,000 at A4
Project Number:	660.30254.00000
Date Drawn:	28-Jun-2024
Drawn by:	RB

LEGEND

- Groundwater Contour (mAHD)
- Major Watercourse
- Minor Watercourse
- Final Pit Extent
- Moorvale South Mining Lease
- Area of Modelled "Dry" Layer 7

Groundwater Level (mAHD)

- 80 - 100
- 100 - 120
- 120 - 140
- 140 - 160
- 160 - 180
- 180 - 200

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

PREDICTED START OF MINING GROUNDWATER LEVELS - VERMONT SEAM

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FIGURE C-3

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Appendix D Recovery Model Starting Heads

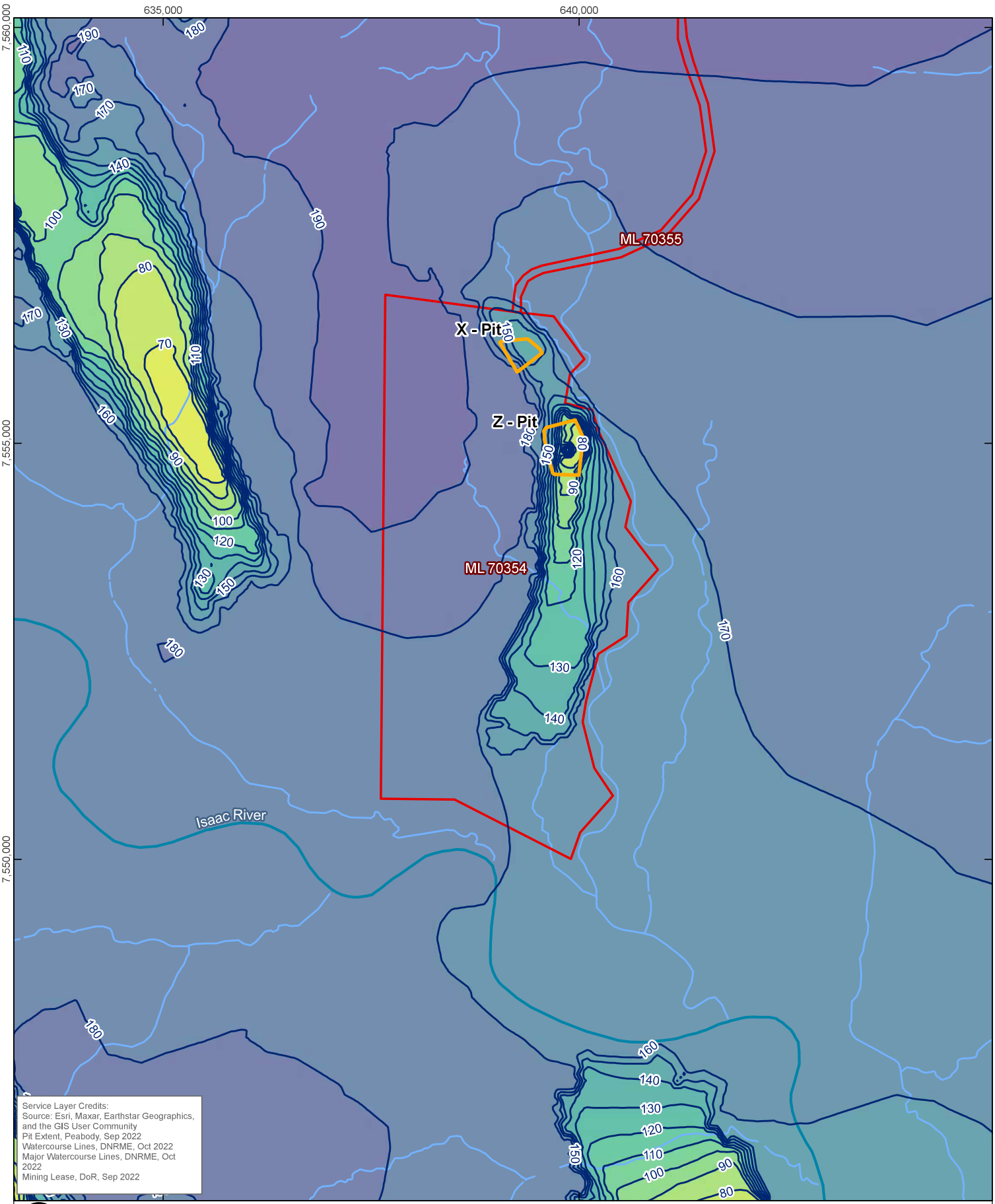
Moorvale South PRCP

Groundwater Assessment

Peabody Energy Australia

SLR Project No.: 660.30254.00000

29 July 2024



0 1 2 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:60,000 at A4
Project Number:	660.30254.00000
Date Drawn:	11-Jun-2024
Drawn by:	AS

LEGEND

- Water Table Contour (mAHD)
- Major Watercourse
- Final Pit Extent
- Moorvale South Mining Lease

Water Table (mAHD)

60 - 70	130 - 140
70 - 80	140 - 150
80 - 90	150 - 160
90 - 100	160 - 170
100 - 110	170 - 180
110 - 120	180 - 190
120 - 130	190 - 200

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

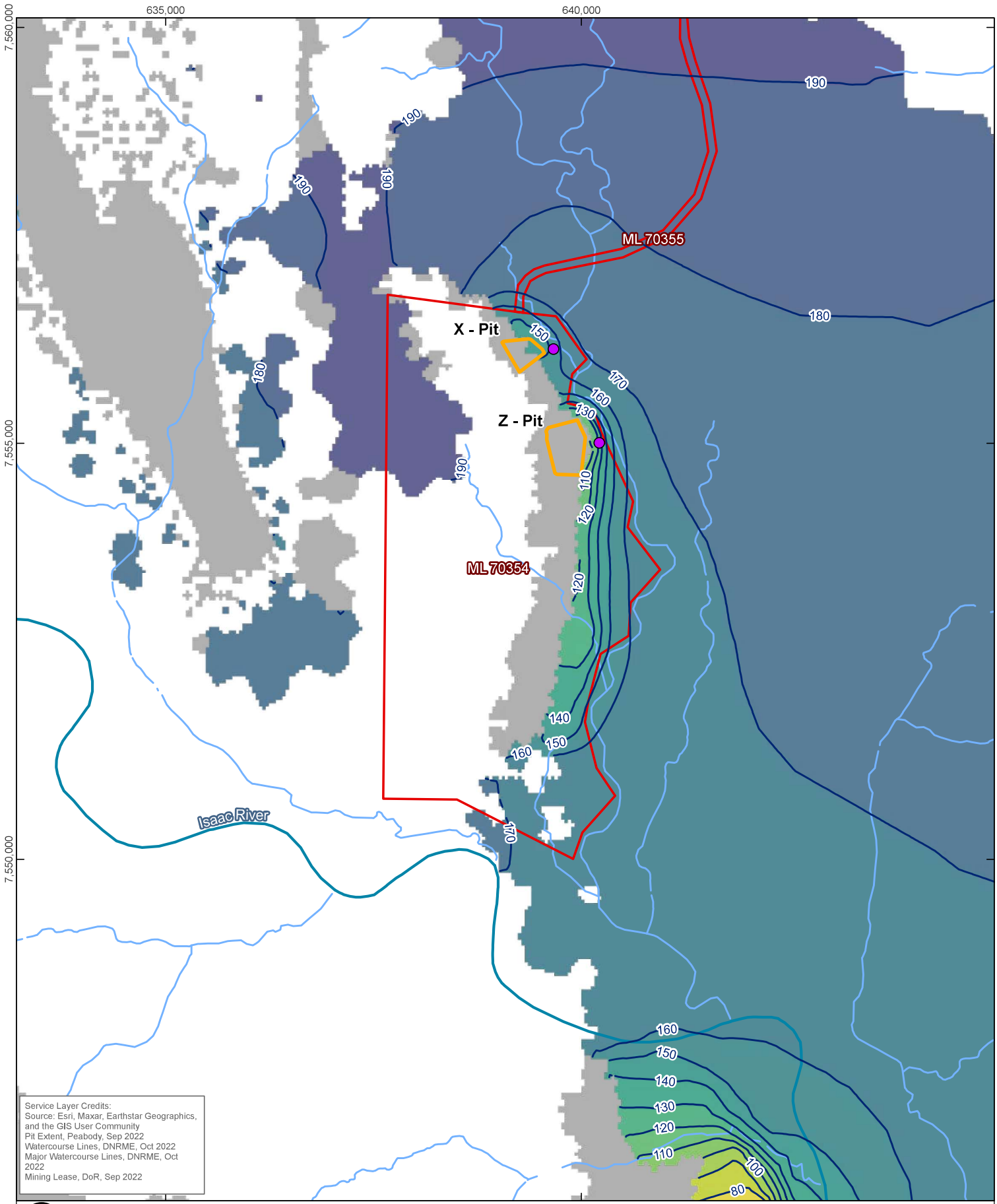
END OF MINING GROUNDWATER LEVELS – WATER TABLE

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FIGURE D-1

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Service Layer Credits:
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Pit Extent, Peabody, Sep 2022
Watercourse Lines, DNRME, Oct 2022
Major Watercourse Lines, DNRME, Oct 2022
Mining Lease, DoR, Sep 2022

0 1 2 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:60,000 at A4
Project Number:	660.30254.00000
Date Drawn:	11-Jun-2024
Drawn by:	AS

LEGEND

- Hydrograph Location
- Hydraulic Head Contour (m AHD)
- Major Watercourse
- Final Pit Extent
- Moorvale South Mining Lease
- Area of Modelled "Dry" Layer 5

Hydraulic Head/Groundwater Elevation (m AHD)

70 - 80	140 - 150	210 - 220
80 - 90	150 - 160	220 - 230
90 - 100	160 - 170	
100 - 110	170 - 180	
110 - 120	180 - 190	
120 - 130	190 - 200	
130 - 140	200 - 210	

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

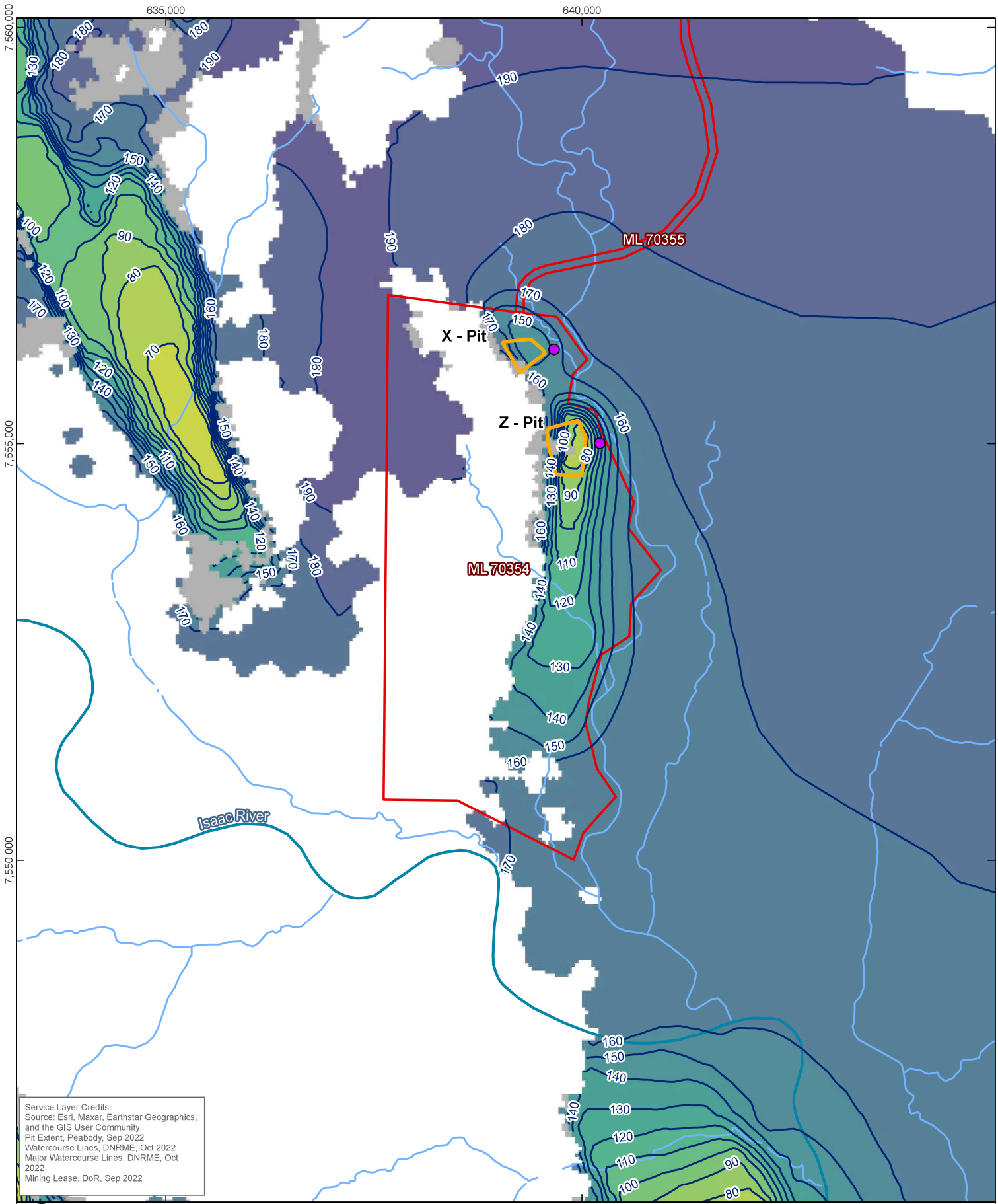
END OF MINING GROUNDWATER LEVELS – LEICHHARDT SEAM

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FIGURE D-2

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Service Layer Credits:
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Pit Extent, Peabody, Sep 2022
Watercourse Lines, DNRME, Oct 2022
Major Watercourse Lines, DNRME, Oct 2022
Mining Lease, DoR, Sep 2022

0 1 2 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:60,000 at A4
Project Number:	660.30254.00000
Date Drawn:	11-Jun-2024
Drawn by:	AS

LEGEND

- Hydrograph Location
- Water Table Contour (mAHD)
- Major Watercourse
- Final Pit Extent
- Moorvale South Mining Lease
- Area of Modelled "Dry" Layer 7

Hydraulic Head/Groundwater Elevation (m AHD)

60 - 70	130 - 140	200 - 210
70 - 80	140 - 150	210 - 220
80 - 90	150 - 160	220 - 230
90 - 100	160 - 170	
100 - 110	170 - 180	
110 - 120	180 - 190	
120 - 130	190 - 200	

MOORVALE SOUTH PRCP GROUNDWATER ASSESSMENT

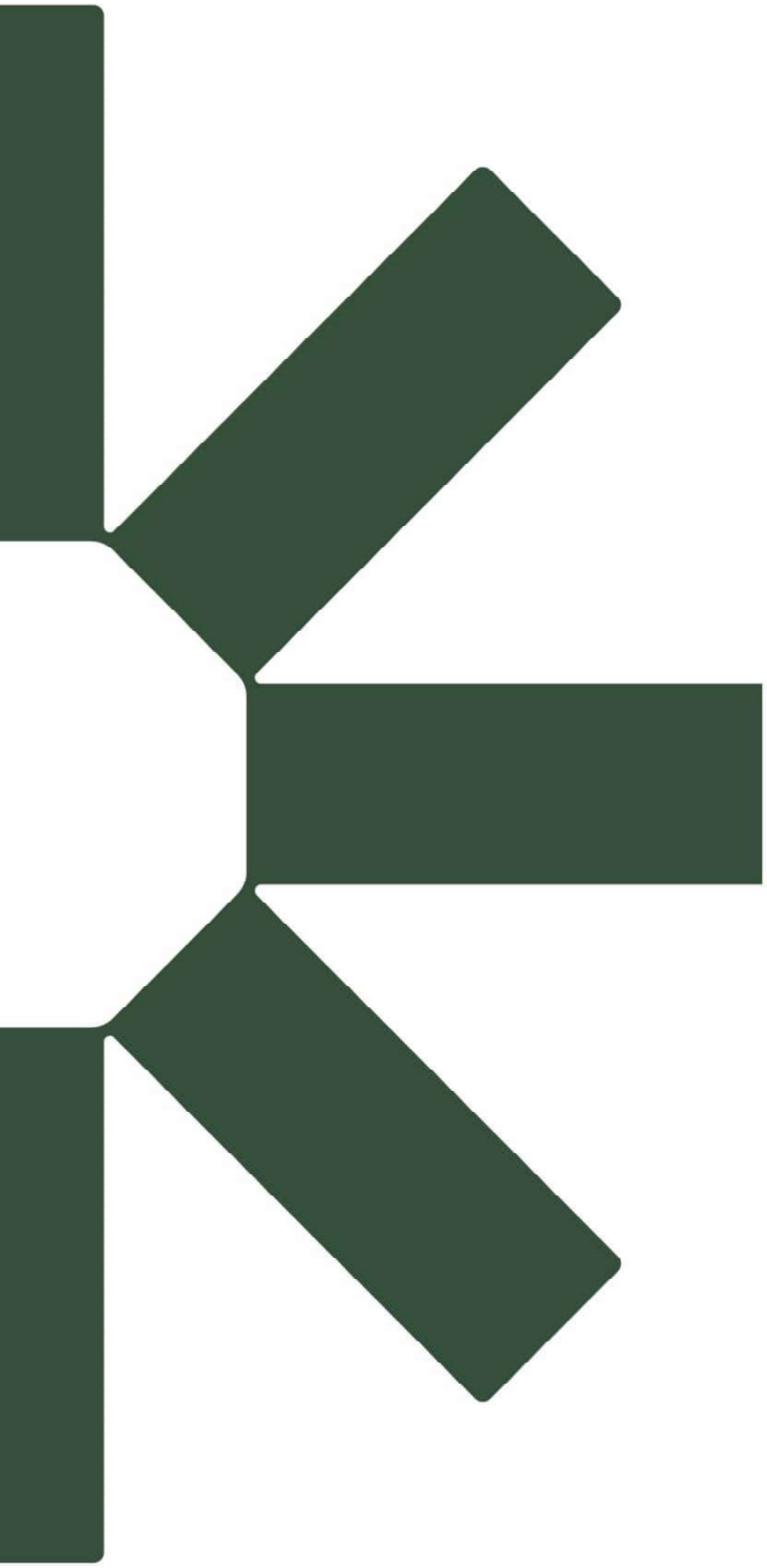
END OF MINING GROUNDWATER LEVELS – VERMONT SEAM

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FIGURE D-3

Path: \\au.slr.local\Corporate\Projects-SLR\660-SrvWOL\660-WOL\660.30254.00000 Moorvale South PRCP GW\06 SLR Data\01 CADGIS\GIS\Moorvale South PRCP GW\Moorvale South PRCP GW.aprx



Making Sustainability Happen

OLIVE DOWNS COAL PROJECT

LAND RESOURCE ASSESSMENT REPORT

Prepared for:

McCollum Environmental Management Services Pty Ltd

Prepared by:

R. Masters
Principal
GSS Environmental

Global Soil Systems Project No: MEM 4-1
Issue No. 3
Copy No. 1

DOCUMENT CONTROL SHEET

Project No: MEM 4-1

Title: Olive Downs Coal Project
Land Resource Assessment Report

Project Manager: Rod Masters

Author: Rod Masters

Client: McCollum Environmental Management Services Pty Ltd (MEMS)

Client Contact: Paul Tett

ISSUE AND AMENDMENT CONTROL HISTORY

Issue	Date	Description	By	Checked
# 1 (Draft)	11 October 2004	Issued to MEMS	GSSE	RM
# 2 (Draft)	6 December 2004	Issued to MEMS	GSSE	RM
# 3 (Final)	7 February 2005	Issued to MEMS	GSSE	RM

Description

Master: GSS Environmental
Copy 1: Paul Tett

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1.2 Location 1
1.3 Regional Setting 1
1.4 Landform & Topography 1
1.5 Vegetation 2

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Appendices

Appendix 1 Field Assessment Procedure
Appendix 2 Soil Information
Appendix 3 Soil Test Results

1.0 INTRODUCTION

1.1 Objectives

GSS Environmental (GSSE) was commissioned by McCollum Environmental Management Services Pty Ltd (MEMS) to undertake a land resource assessment of the proposed Olive Downs Coal Project study area. Field surveys were conducted by GSSE in June 2004 for the proposed mine area (MLA Olive Downs A) and August 2004 for the proposed haul road route to Moorvale Mine (MLA Olive Downs B) and the area extending south of the proposed lease boundary to the Isaac River.

The major objectives of the field surveys were to:

(1) describe and classify soils, land use & suitability within the study area; and

(2) analyse the various soil units to identify their suitability for topdressing of disturbed areas within the study area.

The following report describes the results of the field surveys undertaken by GSSE.

1.2 Location

The proposed Olive Downs Coal Project is located some 30 km south-east of Moranbah and immediately east of the Kerlong Range in central Queensland. The Peak Downs Highway traverses the region, some 28 km north of the site.

The study area encompasses approximately 800 ha of land that covers the areas to be affected by mining operations, overburden dumps and infrastructure areas.

1.3 Regional Setting

The region is underlain by rich coal resources and several coal mines operate nearby, supplying both domestic and export markets. The Moorvale Mine is situated some 15 km north of the Olive Downs Project.

1.4 Landform & Topography

The project site is undulating with low hills / ridges (2 to 4% gradient) trending north south. The proposed mine site (includes pit area and out of pit overburden emplacements) lies to the north west of the junction between the Isaac River and North Creek.

1.5 Vegetation

The most significant stands of vegetation in the study area are the woodlands and forests associated with the Isaac River and North Creek and the narrow plains between, at the junction of the two watercourses which is located outside the proposed mining lease boundaries. The woodlands are mostly eucalypt dominated with very little brigalow (*Acacia harpophylla*) remaining. *Eucalyptus populnea* dominates most of the higher forested areas and includes small patches of *E. orgadophila* and *E. cambageana*, while *E. tereticornis* and *E. camaldulensis* dominate on the Isaac River and North Creek.

2.0 SOIL SURVEY METHODOLOGY

2.1 Introduction

A soil survey was undertaken to qualify the reserves of suitable topdressing material to assist planning of future rehabilitation operations and identify any potentially adverse soil materials so that they can be managed during rehabilitation of post-disturbance areas within the project.

2.2 Mapping

An initial soil map was developed using the following resources and techniques:

(i) Aerial photographs and topographic maps

Aerial photo and topographic map interpretation was used as a remote sensing technique allowing detailed analysis of the landscape and mapping of features related to the distribution of soils in the area.

(ii) Previous soil survey

A survey of the region was undertaken by Shields (1984) at a scale of 1 : 250,000. The Olive Downs lease area was not included in the survey, however, it lies immediately to the east and south of the Shields (1984) study area.

(iii) Stratified observations

Upon drafting of mapping units, soil profile exposures were visually assessed to ascertain potential mapping units.

2.3 Profiling

During the June 2004 GSSE survey a total of eighteen (18) soil profile exposures were assessed at selected sites within the proposed mine area (MLA Olive Downs A) and in the area extending south of the proposed lease boundary to the northern bank of the Isaac River to enable soil profile descriptions to be made. An additional eleven (11) soil profile exposures were assessed within the proposed haul road corridor to Moorvale Mine (MLA Olive Downs B) in August 2004. The exposure locations were chosen to provide representative profiles of the soil types encountered over the study area. The soil profile sites are shown in ***Figures 1*** & ***2***.

The soil layers were generally distinguished on the basis of changes in texture and/or colour. Soil colours were assessed according to the Munsell Soil Colour Charts (Macbeth, 1994).

Soil observations were also conducted in eroded areas, small access track cuttings, etc by GSSE to confirm soil units and boundaries between different soils.

2.4 Field Assessment

Soil layers at each profile site were assessed according to a procedure devised by Elliot & Veness (1981) for the recognition of suitable topdressing materials. The system remains the benchmark for the Australian coal mining industry.

The system is described in ***Appendix 1***.

2.5 Laboratory Testing

Soil samples were taken from exposed soil profiles during the soil survey. The samples were subsequently analysed for the following parameters:

- Particle Size Analysis
- Emerson Aggregate Test
- pH
- Electrical Conductivity

A description of the significance of each test and typical values for each soil characteristic are included in ***Appendix 2***.

The laboratory test results were used in conjunction with the field assessment results to determine the depth of soil material that is suitable for stripping and re-use for the rehabilitation of disturbed areas. The soil test results for the soil survey are provided in ***Appendix 3***.

3.0 RESULTS

3.1 Soils

3.1.1 General

The following soil units were identified within the study area:

- Brown Duplex Loam
- Grey Gradational Clay
- Uniform Sand
- Yellow Brown Gradational Loam
- Yellow Duplex Loam

The distribution of these soils is illustrated in ***Figures 1 & 2***. Exposed profiles of each soil unit are shown in ***Plates 1*** to ***5***.

The Brown Duplex Loam occurs throughout the central area of the proposed mine site. The soil unit encompasses some 40% of the mine site component of the study area. The unit also appears in a modified form in two (2) separate areas on the southern end of the haul road corridor. The soil is characterised by sandy loam surface horizons grading to heavy textured yellowish red clay subsoils (refer ***Plate 1***).

The Grey Gradational Clay occurs in the north west corner of the mine area and within the northern section of the proposed haul road corridor. It covers approximately 31% of the mine site component of the total study area. The soil is characterised by greyish brown sandy clay loam surface horizon grading to a grey light clay and eventually to a yellowish brown light clay (refer ***Plate 2***).

The Uniform Sand adjoins the Issac River and North Creek within the immediate flood plain areas. There is no textural change throughout the profile. The unit covers approximately 29% of the mine site component of the total study area. A light brown surface sand grades to a yellowish red subsurface sand (refer ***Plate 3***).

The Yellow Brown Gradational Loam occurs on the southern boundary of Nebo Shire within the proposed haul road route. The soil unit has a brown clay loam surface horizon. A sharp texture contrast to a yellow brown clay subsoil exists (refer ***Plate 4***).

The Yellow Duplex Loam is present in the southern end of the haul road corridor. The soil is characterised by sandy loam surface horizons grading to a heavier textured reddish yellow medium clay subsoil (refer ***Plate 5***).

3.1.2 Profile Descriptions

The following profile descriptions are characteristic of their respective soil unit.

SOIL UNIT: BROWN DUPLEX LOAM		
LAYER	**DEPTH (m)**	**DESCRIPTION**
1	0 – 0.10	Yellowish brown (10 YR 5/4) sandy loam. It has strong pedality and consistence is moderately firm. Orange mottles follow some root traces. Many roots occur. The lower boundary is gradual and wavy to layer 2.
2	0.10 – 0.40	Strong brown (7.5 YR 5/6) sandy loam. It is moderately consistent and weakly coherent dry, not coherent wet: Weakly pedal with sub-angular blocky peds. Many roots are evident. The lower boundary is sharp and even to layer 3.
3	0.40 – 1.10+	Yellowish red (5 YR 5/6) light clay. The layer is massive and few roots are evident.

SOIL UNIT: GREY GRADATIONAL CLAY		
LAYER	**DEPTH (m)**	**DESCRIPTION**
1	0 – 0.20	Greyish brown (10 YR 5/2) sandy clay loam. The soil consistence is very firm and crumbly when dry. The layer exhibits strong pedality with rough-faced, polyhedral peds 50-100 mm in diameter. Many to abundant roots occur; the soil is moderately bioturbated. The lower boundary is gradual and wavy to layer 2.
2	0.20 – 0.60	Grey (10 YR 5/1) light clay. It is moderately consistent and has strong polyhedral and prismatic peds. There are many roots. The lower boundary is gradual and wavy to layer 3.
3	0.60 – 1.20+	Light yellowish brown (10 YR 6/4) light clay. It is moderately to strongly consistent and moderately coherent; moderately pedal with smooth and rough-faced peds 50-200 mm. No roots are evident

SOIL UNIT: UNIFORM SAND		
LAYER	**DEPTH (m)**	**DESCRIPTION**
1	0 – 0.20	Light brown (7.5 YR 6/4) sand. Apedal single grained. Roots are common. The lower boundary is diffuse and wavy to layer 2.
2	0.20 – 0.80	Yellowish red (5 YR 5/6) sand. Apedal single grained. Some roots occur. The lower boundary is sharp and even to layer 3.
3	0.80 – 1.50+	Reddish yellow (7.5 YR 6/6) sand. Apedal massive structure and few roots are evident.

SOIL UNIT: YELLOW BROWN GRADATIONAL LOAM		
LAYER	**DEPTH (m)**	**DESCRIPTION**
1	0 – 0.20	Brown (7.5 YR 4/3) clay loam. It is weakly to moderately consistent and coherent; moderately pedal with rough-faced porous sub-angular blocky peds 20-100 mm breaking to sub-angular blocky, round, granular and crumb peds <2-10 mm diameter. Many roots are present. The lower boundary is sharp and wavy to layer 2.
2	0.20 – 0.50	Yellowish brown (10 YR 5/4) medium clay. The structure is weakly pedal and the consistence is strong. The boundary is clear and wavy to layer 3.
3	0.50 – 1.20+	Light yellowish brown (10 YR 6/4) clay loam with abundant orange and grey mottles. No roots are present.

SOIL UNIT: YELLOW DUPLEX LOAM		
LAYER	**DEPTH (m)**	**DESCRIPTION**
1	0 – 0.10	Yellowish brown (10 YR 5/4) sandy loam exhibiting weak pedality with 20 – 50 mm subangular blocky porous peds. The soil contains many roots. The boundary is clear and wavy to layer 2.
2	0.10 – 0.30	Yellowish brown (10 YR 5/4) sandy loam that is moderately structured and sometimes bleached. This horizon contains many roots. The boundary is clear and wavy to layer 3.
3	0.30 – 1.20+	Reddish yellow (7.5 YR 6/6) medium clay. A moderately sticky apedal clay. Can become bright yellowish brown with depth. Sometimes grey or brown mottling to 20% occurs. This horizon contains no roots.



Plate 1: Brown Duplex Loam.



Plate 2: Grey Gradational Clay.



Plate 3: Uniform sand.



Plate 4: Yellow Brown Gradational Loam.



Plate 5: Yellow Duplex Loam

3.1.3 Laboratory Testing

All soil samples taken during the GSSE survey were analysed by the Department of Land's Soil and Water Testing Laboratory at Scone, NSW. All soil analytical results are provided in ***Appendix 3***. The first numeral in the sample identification (Id) refers to the profile site number (refer ***Figures 1*** & ***2***). Soil layers are signified by /1, /2 and /3 in the sample Id with the surface horizon being /1 and subsoil horizons being /2 & /3.

The Brown Duplex Loam has sandy loam surface horizons grading to a heavier textured light clay subsoil. The soil is structurally stable (Emerson rating of 3). An alkaline trend occurs down the profile with surface soil pH being slightly acidic (pH 6.4 to 6.6) and non-saline. The subsurface soil unit is alkaline and non-saline.

The Grey Gradational Clay has sandy clay loam surface horizon grading to light clay subsoil layers. The surface soil is structurally stable (Emerson ratings of 3 to 5). An alkaline trend occurs down the profile with pH recordings of 6.8 to 8.4 at the surface to 9.6 at depth. The soil profile is non-saline.

The Uniform Sand is extremely coarse textured throughout the profile. The very minor clay component is stable (Emerson rating of 3). The soil is non-saline and slightly acidic.

The Yellow Brown Gradational Loam has a brown clay loam surface horizon. A sharp texture contrast to a clay subsoil exists. The soil is structurally stable (Emerson ratings of 3 to 5). An alkaline trend occurs down the profile with pH recordings of 7.5 at the surface to 8.9 at depth. The soil profile is non-saline.

The Yellow Duplex Loam has sandy loam surface horizons grading to a heavier textured medium clay subsoil. The soil is structurally stable (Emerson ratings of 3 to 5). The profile is alkaline throughout with pH recordings of 7.6 at the surface to 8.1 at depth. The soil profile is non-saline.

3.2 Land Use & Suitability

3.2.1 Pre - Mining

The study area is currently used for low intensity cattle grazing. As a result of this past and existing land use, there has been extensive tree clearing throughout the area. The land use is consistent with that of the adjoining land.

Land suitability of the study area has been assessed largely using criteria provided in the (former) DME Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland.

The method of land suitability assessment takes into account a range of factors including climate, soils, geology, geomorphology, soil erosion, topography and the effects of past land uses. The classification does not necessarily reflect the existing land use, rather it indicates the potential of the land for such uses as crop production, pasture improvement and grazing.

The system allows for land to be allocated into five possible classes (with land suitability decreasing progressively from Class 1 to Class 5) on the basis of a specified land use that allows optimum production with minimal degradation to the land resource in the long term.

The classes are described as:

Class 1	Suitable land with negligible limitations which is highly productive requiring only simple management practices to maintain economic production.
Class 2	Suitable land with minor limitations which either reduce production or require more than the simple management practices of Class 1 land to maintain economic production.
Class 3	Suitable land with moderate limitations which either further lower production or require more than those management practices of Class 2 land to maintain economic production.
Class 4	Marginal land with severe limitations which make it doubtful whether the inputs required to achieve and maintain production outweigh the benefits in the long term (presently considered unsuitable due to the uncertainty of the land to achieve sustained economic production).
Class 5	Unsuitable land with extreme limitations that preclude its use for the proposed purpose.

Land is considered less suitable as the severity of limitations for a land use increase. Increasing limitations may reflect any combination of the following:

- Reduced potential for production;
- Increased inputs to achieve an acceptable level of production; and/or
- Increased inputs required to prevent land degradation.

All land within the vicinity of the Olive Downs Coal Project area is Class 2 land and is suitable for grazing of native and improved pastures. The land is not suitable for cultivation on a regular basis owing to a combination of limitations of slope, soil, erosion and climate. Soil conservation practices such as pasture improvement, stocking rate control, application of fertilizer and establishment or re-establishment of permanent pasture are recommended. Buffel Grass (*Cenchrus ciliaris*) is the preferred grass for introduction because of it's high nutritional value, drought resistance and tolerance of grazing pressure once established.

3.2.2 Post Mining

The recommended post mining land use objective for the Olive Downs site is grazing. The proposal is based on the assessment of the existing site conditions and rehabilitation experience at other sites throughout central Queensland. This final land use goal is considered achievable. The proposal seeks to return land of compatible use but only in accordance with the capability of rehabilitated spoil to sustain the use without degradation. The overriding principle is to create the most beneficial future use of rehabilitated land that can be sustained in view of the range of limiting factors.

Post mining lands proposed for grazing must provide and sustain a sufficient bulk of nutritious forage in addition to the following management considerations:

- The ability to access and manage livestock;
- Flood free and relatively dry ground conditions;
- Adequate stock drinking water and shelter; and
- Stock routes throughout the rehabilitated land.

Provided that environmental controls (particularly erosion & sediment controls) are in place and operating effectively during the proposed mine's construction and operation, there will be no adverse effects to the surrounding grazing enterprises.

The post mining suitability classification for the majority of reshaped and topsoiled spoil areas within the project will be Class 4 land. Rehabilitated infrastructure areas, including the haul road route, will also attain Class 4 land suitability classification. Final voids will be Class 5 land.

4.0 TOPDRESSING SUITABILITY

Details of the soil test results (refer ***Appendix 3***) were used in conjunction with the field assessment (refer ***Appendix 1***) to determine the depth or thickness of soil materials that are suitable for stripping and re-use in the rehabilitation of disturbed areas.

Structural and textural properties of soils within the study area are the most significant limiting factors for determination of topdressing suitability. The recommended stripping depth for the Brown Duplex Loam is approximately 40cm. The surface horizons have moderate texture (sandy loam), are stable, non-saline and slightly acidic. The subsoil clay content is high and has therefore been deemed unsuitable for re-use in the rehabilitation of the post-mining landform.

The recommended stripping depth for the Grey Gradational Clay is 20cm. The surface horizon has moderate texture, is stable, non-saline and slightly acidic. The subsoil clay content and alkalinity are high and has therefore been deemed unsuitable for re-use as a topdressing material.

The Uniform Sand has a very coarse texture throughout the profile and is totally unsuitable for stripping for re-use a topdressing medium. Nil stripping of this unit is recommended.

The recommended stripping depth for the Yellow Brown Gradational Loam is 20cm. The surface horizon has moderate texture, is stable, non-saline and slightly acidic. The subsoil clay content is high and has therefore been deemed unsuitable as a topdressing material.

The recommended stripping depth for the Yellow Duplex Loam is approximately 30cm. The surface horizons have moderate texture (sandy loam), are stable, non-saline and slightly alkaline. The subsoil clay content is high and has therefore been deemed unsuitable for re-use in the rehabilitation of the post-mining landform.

A summary of recommended stripping depths for all soil units within the study area follows.

SOIL UNIT	RECOMMENDED STRIPPING DEPTH (cm)
Brown Duplex Loam	**40**
Grey Gradational Clay	**20**
Uniform Sand	**Nil**
Yellow Brown Gradational Loam	**20**
Yellow Duplex Loam	**30**

5.0 STRIPPING & STOCKPILING RECOMMENDATIONS

The following stripping and stockpiling techniques are recommended to prevent excessive soil deterioration:

- Strip material in a slightly moist condition. Material should not be stripped in either a dry or wet condition.
- Place stripped material directly onto reshaped overburden and spread immediately (if mining sequences, equipment scheduling and weather conditions permit).
- Maintain a maximum stockpile depth of 3 m.
- Seed and fertilise stockpiles as soon as possible.

The quality of stockpiled materials can be expected to markedly decrease over time. Stockpiling results in diminished viability of favourable seeds and reduced soil flora and fauna levels in stockpiled material. Unfavourable effects are very pronounced when soils are stockpiled for periods greater than one year.

6.0 LANDFORM DESIGN & EROSION CONTROL RECOMMENDATIONS

Rehabilitation strategies and concepts proposed for Olive Downs Mine have been formulated according to results of industry wide research and experience.

6.1 Overburden Regrading

The main objective of regrading is to produce slopes whose angles, lengths and shapes are compatible with the proposed land use and not prone to an unacceptable rate of erosion. Integrated with this is a drainage pattern that is capable of conveying runoff from the newly created catchments whilst minimising risk of erosion and sedimentation. Regrading should be conducted to maximum slope gradients of 17%.

6.2 Topsoil Respreading

Suitable topsoil (refer Section 4.0 of this report) should be stripped and re-spread onto reshaped areas. Where suitable areas are unavailable for immediate respreading, topsoil should be stockpiled to a maximum depth of 3 m and subsequently applied when the areas become available. The period of storage should (refer Section 5.0) be minimised in order to reduce the detrimental effects of storage on any native seed in the soil. Topsoil should be spread to a minimum depth of 200mm on all regraded spoil.

6.3 Erosion & Sediment Control

The most significant means of controlling surface flow on spoil areas is to construct contour furrows or contour banks at intervals down the slope. The effect of these is to divide a long slope into a series of short slopes with the catchment area commencing at each bank or furrow. This prevents runoff from reaching a depth of flow or velocity that would cause erosion. As the slope angle increases, the banks or furrows must be spaced closer together until a point is reached where they are no longer effective. Contour ripping is by far the most common form of structural erosion control on mine sites as it simultaneously provides some measure of erosion protection and cultivates the surface in readiness for sowing.

Contour deep ripping can provide a reasonable degree of erosion protection, albeit for a limited time, on slopes of up to approximately 17%.

Graded banks are essentially a much larger version of contour furrows, with a proportionately greater capacity to store runoff and/or drain it to some chosen discharge point.

The banks are constructed away from the true contour, at a designed gradient (1% to 2%) so that they drain water from one part of a slope to another; for example, towards a watercourse or a sediment control dam.

Graded bank construction is recommended for all rehabilitation areas within the Olive Downs Project. The ideal construction plant is a small bulldozer in the 75 to 100 HP class, equipped with a multi-tyne, rear-mounted ripper and a front angle-and-tilt

blade. Most mining equipment is too large for the job and is unable to work to the exacting tolerances needed to produce satisfactory channel shapes and gradients.

Eventually, runoff that has been intercepted and diverted must be disposed of down slope. The use of engineered waterways using erosion blankets and/or rip rap is recommended to safely dispose of runoff downslope.

The construction of sediment control dams is recommended for the purpose of capturing sediment laden runoff prior to off-site release. Sediment control dams are responsible for improving water quality throughout the mine site and enhance the ecological diversity of the area.

The following points should be considered when selecting sites for sediment control dams:

- Each dam should be located so that runoff may easily be directed to it, without the need for extensive channel excavation or for excessive channel gradient. Channels must be able to discharge into the dam without risk of erosion. Similarly, spillways must be designed and located so as to safely convey the maximum anticipated discharge.

- The material from which the dam is constructed must be stable. Highly dispersible clays will require treatment with lime, gypsum and/or bentonite to prevent failure of the wall by tunnel erosion. Failure by tunnelling is most likely in dams which store a considerable depth of water above ground level, or whose water level fluctuates widely. Dams should always be well sealed, as leakage may lead to instability, as well as allowing less control over the storage and release of water.

- The number and capacity of dams should be related to the total area of catchment and the anticipated volume of runoff. The most damaging rains, in terms of erosion and sediment problems are localised, high intensity storms.

6.4 Seedbed Preparation

Thorough site preparation should be undertaken to ensure optimum establishment and growth of vegetation. To minimise erosion, ripping should be undertaken on the contour and the tines lifted for approximately 2m every 200m to reduce the potential for channelised erosion. Best results will be obtained by ripping when soil is moist and when undertaken immediately prior to sowing.

All topsoiled areas should be contour ripped (after topsoil spreading) to create a “key” between the soil and the spoil.

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Fauna and flora of the Olive Downs Mining Lease, Adjacent Southern Area and associated haul road near Moranbah, Central Queensland

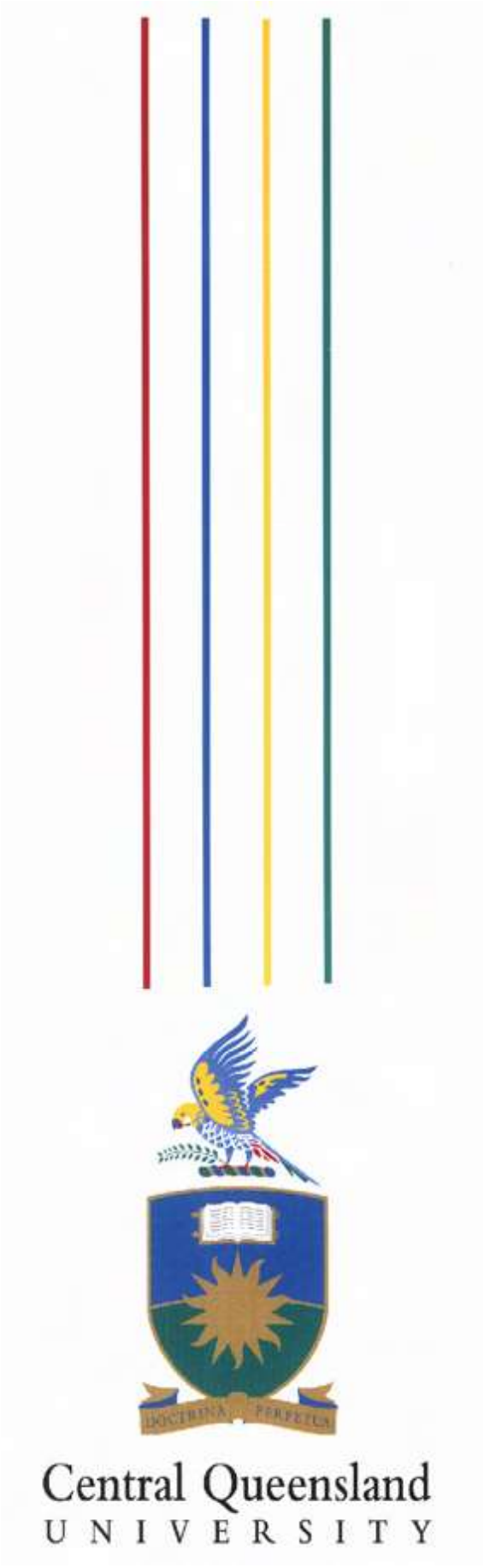
A report to McCollum Environmental Management Services

by

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Executive Summary

A flora and fauna survey of the proposed mining lease (Olive Downs A), the southern area adjacent to the proposed lease and the associated proposed haul road infrastructure mining lease (Olive Downs B) was carried out to identify the biodiversity values, identify threatening processes and make management recommendations in the maintenance of biodiversity. One hundred and three plant species in eight regional ecosystem types were recorded. Three of the regional ecosystems are listed as "endangered" and four as "of concern". Three declared weed species and another 13 weeds were recorded within the study area. GIS was used to map vegetation types, declared weeds cover and land condition. Ninety-six terrestrial vertebrate species were recorded including two rare species (Little Pied Bat *Chalinolobus picatus* and Squatter Pigeon *Geophaps scripta scripta*), two near threatened bird species (Grey-crowned Babbler *Pomatostomus temporalis* and Australian Bustard *Ardeotis australis*) and five pest species. Nine threatening processes were identified with management recommendations given.

1. Introduction

1.1. Background

Olive Downs is a grazing property 30 kilometres south-east of Moranbah in the Broardsound Shire of Central Queensland that will be subject to an application for a coal mining leases (Mining Lease (ML) - Olive Downs A) and haul road (ML Olive Downs B). The application for the project requires an Environmental Management Overview Strategy (EMOS) to comply with State Legislation – *Mineral Resources Act (1989).* The objectives of this study are to identify the flora and fauna values of the mining leases and adjacent areas, identify threatening processes to species or critical habitat, and provide management recommendations on critical factors in the maintenance of biodiversity. The information will then be used to satisfy the requirements of the EMOS.

1.2. Literature Review

The study area lies within Province 6 (Northern Bowen Basin) of the Brigalow Belt Bioregion (EPA 2004a, Young et al. 1999). Most of the land lies on soils of land zones 3, 4 and 9 described as:

- 3) Quaternary alluvial systems, including floodplains, alluvial plains, alluvial fans, terraces, levees, swamps, channels, closed depressions and fine textured palaeo-estuarine deposits';
- 4) Cainozoic clay deposits, usually forming level to gently undulating plains above current alluvial systems excluding clay plains and downs formed in-situ on bedrock;
- 9) Fine-grained sedimentary rocks, generally with little or no deformation, forming undulating landscapes with a broad range of fine textured soils of moderate to high fertility.

Regional ecosystems are referred as vegetation communities in bioregions that are constantly associated with a particular combination of geology, landform and soil (Sattler and Williams 1999) and are used by the Queensland Government to assess the conservation value of remnant vegetation. Conservation standing of regional ecosystems are assessed in two ways, (i) a status determined by the *Vegetation Management Act (1999)* in which remnant vegetation is compared with its pre-clearing and extent; (ii) its Biodiversity Status is also based on the pre and remnant clearing but includes the condition of the remaining vegetation. These classifications are characterised as outlined in Table 1.

Table 1 Remnant vegetation classification categories for two assessment systems (EPA 2004a).

Classification	Assessment System	
	Vegetation Management Act 1999 Status	**Biodiversity Status (additional to Vegetation Management Act)**
Endangered	less than 10% of pre-clearing extent across the bioregion remains; or 10-30% of pre-clearing extent remains and the remnant vegetation is less than 10,000 hectares	less than 10% of pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss; or 10-30% of 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	10-30% of pre-clearing extent across the bioregion remains; or more than 30% of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares.	10-30% of pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss
Not of concern	Over 30% of pre-clearing extent across the bioregion remains, and the remnant area is greater than 10,000 hectares.	the degradation criteria listed above for endangered or of concern regional ecosystems are not met

The remnant regional ecosystem mapping identifies 7 vegetation communities comprising a mixture of 10 regional ecosystems within the area of Olive Downs (Appendix 1). Under the *Vegetation Management Act (1999)* one regional ecosystem is 'of concern' and four are 'endangered'. Within the framework of the biodiversity status four regional ecosystems are 'of concern' and four are 'endangered'.

Based on literature (mainly unpublished reports) and database searches (HerbRec, Wildnet and Queensland Museum), 6 flora species and 11 fauna species of conservation significance have been found within a 100 km radius of the site (Table 2).

Table 2 Species of conservation significance recorded within the region associated with Olive Downs.

(Q-C, Q-R or Q-V indicates listed as common, rare or vulnerable under *Queensland Nature Conservation Act (1992)*; F-V as vulnerable under Federal legislation *EPBC Act (1999)*; F-NT indicates listed as *near threatened* by Garnett and Crowley (2000))

Common Name	Species	Location	Status
Flora			
Black ironbox	*Bertya pedicellata*	QLD Herbarium record	Q-R
Black orchid	*Cymbidium canaliculatum*	South Walker (1999)[2]	Q-C
	Desmodium macrocarpum	QLD Herbarium record	Q-R
	Dichanthium setosum	South Walker (1999)[2]	Q-R
	Eucalyptus raveretiana	South Walker (1999)[2]	Q-V
	Persoonia amaliae	QLD Herbarium record	Q-R
Fauna			
Reptiles			
Worm Skink	*Anomalopus brevicollis*	Newlands (2003)[1]	Q-R
Brigalow Scaly-foot	*Paradelma orientalis*	Newlands (2003)[1]	Q-V; F-V
Ornamental Snake	*Denisonia maculata*	South Walker (1996, 1999)[2]; Newlands (2003)[1] and Qld Museum Records	Q-V; F-V
A black snake	*Pseudechis colletti*	Poitrel (1996)[3]	Q-R
Birds			
Great Crested Grebe	*Podiceps cristatus*	Newlands (2003)[1]	Q – R
Cotton Pygmy-goose	*Nettapus coromandelianus*	South Walker (1996, 1999)[2] Newlands (2003) [1]	Q – R; F – NT
Squatter Pigeon (southern subspecies)	*Geophaps scripta scripta*	South Walker (1996, 1999)[2]; Poitrel (1996)[3]; Suttor Creek (1996, 1998)[4]	Q – V; F - NT
Lewin's Rail	*Rallus pectoralis*	South Walker (1996, 1999)[2]	Q – R; F – NT
Ground Cuckoo-shrike	*Coracina maxima*	Poitrel (1996)[3]	Q – R
Red Goshawk	*Erythrotriorchis radiatus*	South Walker – unsourced report	Q – E; F - V
Mammals			
Little Pied Bat	*Chalinolobus picatus*	Newlands (2003)[1]	Q - R

1 Houston et al. 2003a
2 Melzer et al. 1996b, Houston and Melzer 1996, Tucker et al. 1999
3 Houston et al. 1996
4 Tyler 1996, Environmental Research and Education 1998

2. Methods

2.1. Study Site

Olive Downs lies 30 km south-east of Moranbah and approximately 130 km west of Mackay (Lot 3 on GV90, Parish of Ilsington, County of Grosvenor, Broadsound Shire). The proposed mining leases comprise approximately 1632 ha for Olive Downs A and 107.2 ha for Olive Downs B (total area = 1739.2 ha). The Olive Downs A area is bounded by North Creek on the east and the Isaac River is located approximately 500m to the south at it's closest point. The study area includes the area south of the proposed Olive Downs A mining lease extending to the northern bank of the Issac River and the western bank of North Creek. The southern section of the study area which is outside the propose mining lease areas was included due to its potential habitat importance in the context of the area. The landscape of the study area is alluvial plains and terraces bordering the Isaac River and associated drainages.

The survey was undertaken during the winter dry season between 16th and 25th August 2004, with a second visit to record birds on the 6th September. In the region, over two-thirds of rainfall falls between December and March giving the region a characteristic dry season / wet season pattern of rainfall coinciding with winter / summer seasons. The region is currently drought declared but did receive rain in January 2004.

2.2. Flora

A total of 32 vegetation sites were assessed within proposed ML Olive Downs A and the area south to the Isaac River and a further 3 in the proposed ML Olive Downs B. Vegetation communities were identified on site with reference to Regional Ecosystem Mapping (EPA 2004b). Sites within all vegetation communities were established and assessed for species richness and abundance, topography, substrate, density and faunal habitat values.

Field proformas consistent with the Environmental Protection Agency (Melzer (in prep) - a system for the collection of site-based flora and habitat data) were used to assess community type, vegetation composition and abundance and basal area (along with some fauna habitat characteristics). Plant species were identified on site where possible, and specimens collected for confirmation. Species identification was confirmed by A. Melzer (Centre for Environmental Management) and the Queensland Herbarium.

Vegetation units were identified from 1:40,000 stereo, colour air photos with ground truthing. Plant community classifications were derived from Walker and Hopkins (1990). Vegetation mapping was facilitated by ArcView GIS Version 3.2 in AGD84. Weed species were named and classified according to Land Protection (2004) and Henderson (2002).

2.3. Fauna

2.3.1. Site Habitat Characteristics

Five sites were established within the major regional ecosystems and habitat types represented at Olive Downs (Figure 1). At two points approximately 35 m apart at each trap site, the following vertebrate habitat characteristics were assessed (Melzer in prep):

- basal area and species of live trees using a basal area wedge;
- basal area of stags using a basal area wedge;
- abundance of hollow-bearing trees (HBTs) and density HBTs estimated by the formulae HBTs/ha = $10,000/D^2$ (D = average distance between HBTs);
- abundance of hollow and solid fallen logs;
- abundance of decorticating bark; and
- abundance of ground cover of tussock grass, low shrubs, leaf litter, twig litter, logs and rocks within a 10 m radius of each point.
- presence of water, crevices and caves

2.3.2. Survey Methods

Vertebrate fauna associated with each site in a 3 ha area (approximately a 100 m radius around each trap site within the same habitat or a linear shape in the case of riparian habitats) was surveyed using standard techniques over a 5-day survey period:

- a 30 m drift fence incorporating 5 shaded 20 litre buckets;
- twenty-three Elliot A and two bandicoot trap (Elliot B) for small mammals were placed at 5 to 20 m intervals depending on the terrain;

- intensive diurnal searches for reptiles and animal traces such as scats, tracks, skeletal remains, scratch marks on trees and carcasses (2 person hours during the middle part of the day at each site);
- intensive nocturnal searches for nocturnal mammals, birds, geckos, snakes and frogs (1 person hour at each site) and spotlighting from vehicles along the roads and tracks of the property for nocturnal mammals and birds;
- diurnal bird observations based on a minimum of two searches (totalling 2 hours at each site);
- owl audio observations using recorded calls to elicit calls from nearby birds (3 minutes replay of relevant species calls and two minutes listening time); and
- insectivorous bats were recorded for 30 minutes at each site using ANABAT equipment (analysis, Appendix 5).

All traps were checked twice daily to avoid trap losses of fauna. In addition, opportunistic sightings were made during the day and night from the vehicle or on foot transects while traversing the study area.

Fish were surveyed at the only waterbody (a small stock dam) using baited traps and a Seine net (12 mm mesh).

2.3.3. Abundance

Estimates of the abundance of species within the study area were made, definitions of abundance class differed for birds and other vertebrates:

- birds were defined as uncommon (U) - one or two individuals; common (C) – three to 19 individuals at more than one site or locally common (LC) three to 19 individuals at one site only; abundant (A) – 20 to 49 individuals; and very abundant (VA) - ≥50 individuals;
- abundance classes of other vertebrates were based on a combination of frequency of occurrence at trap sites and abundance (1 trap site only was uncommon (U) while an abundance ≥10 individuals was abundant (A) with the remainder common (C)).

2.3.4. Identification

Preliminary identification of mammals, reptiles and amphibians was made by the survey team using Cogger (2000) for reptiles and amphibians (taxonomic keys and descriptions), Pizzey and Knight (1997), Slater et al. (1986), Simpson and Day (1996) for birds (descriptions and illustrations) and Menkhorst and Knight (2001) for mammals (keys, descriptions and illustrations). Where appropriate, one or two specimens of each species were retained for confirmation of identification and sent to the Queensland Museum. To verify field identifications of released mammals, hair samples were taken prior to their release and sent to an expert in identifying vertebrates from such material (B. Triggs). Scats were sent to B. Triggs and skeletal remains to the Queensland Museum.

Common and scientific names of birds were based on Christidis and Bowles (1994), mammals on Strahan (1995) and reptiles and amphibians on Cogger (2000). When reporting results, common names are used where possible (e.g. birds and mammals) but for taxa where many species lack common names (e.g. frogs and reptiles), scientific names are normally used.

2.4. Relevant Legislation

Determination of conservation-listed flora and fauna species was based on relevant legislation including the Queensland Government's *Nature Conservation Act (1992)* and

the Australian Government's *Environment Protection and Biodiversity Conservation Act (1999).* These acts provide a statutory framework for the declaration and management of threatened wildlife and wildlife habitat.

A number of species were listed under international treaties with Japan and China known respectively as the *Agreement between the Government of Australia and the Government of Japan for the protection of migratory birds and birds in danger of extinction and their environment* (JAMBA, Australian Treaty Series 1981 No. 6) and as the *Agreement between the Government of Australia and the Government of the People's Republic of China for the protection of migratory birds and their environment* (CAMBA, Australian Treaty Series 1988 No. 22). Under these agreements, the Federal Government has an obligation to protect habitats utilized by species that (i) undertake international migrations from each country and (ii) occur in both countries (i.e. Australia and either Japan or China).

For birds, Australian species regarded as *near threatened* (Garnett and Crowley) were also listed.

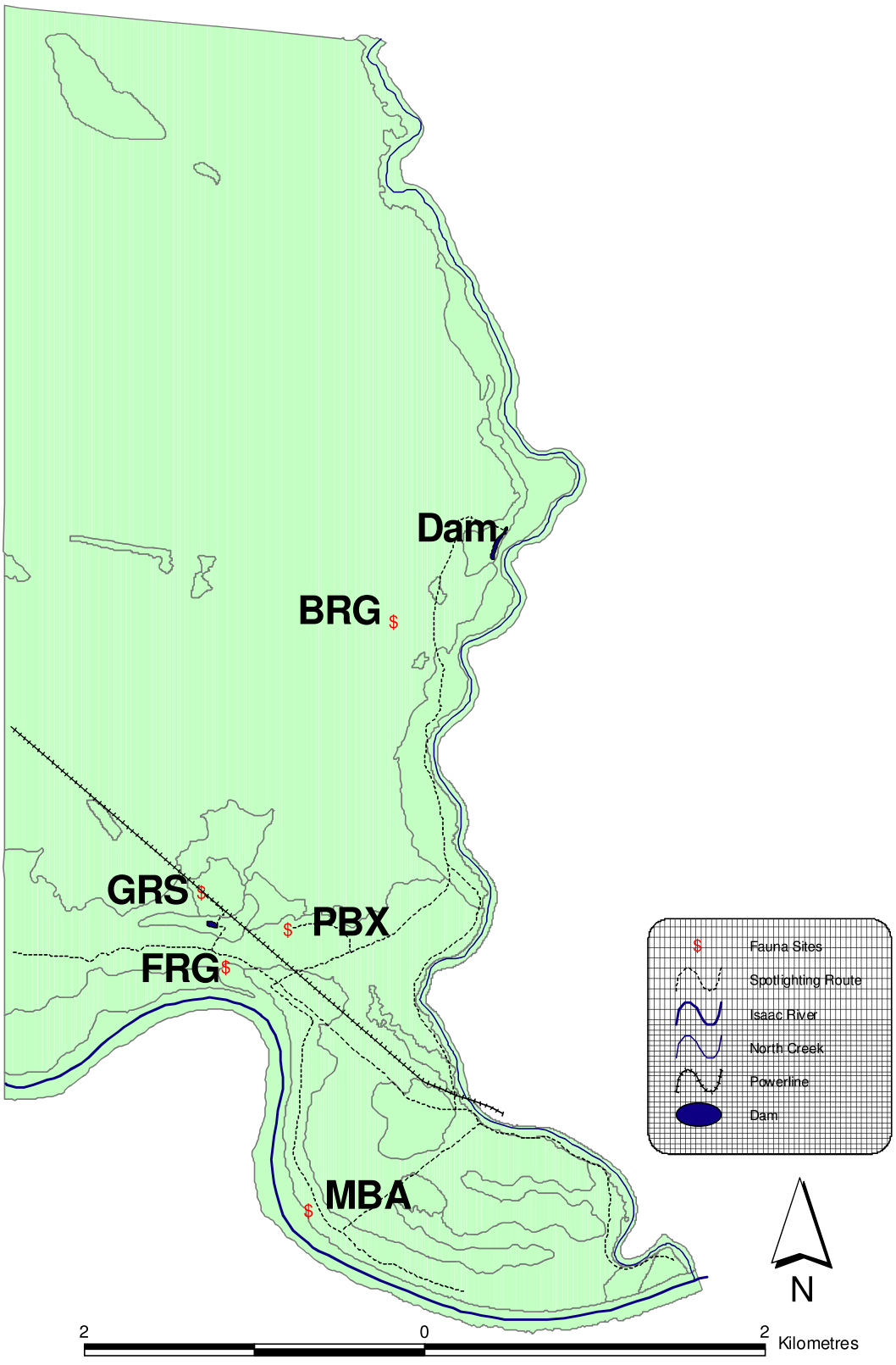


Figure 1 Fauna sites, spotlighting routes and features of the proposed ML Olive Downs A and southern section of the study area (BRG = regrowth brigalow, FRG = Forest Red Gum, GRS = grassland, MBA = Moreton Bay Ash and PBX = Poplar Box).

3. Results

3.1. Flora

One hundred and three plant species in 14 vegetation types were identified on the proposed ML Olive Downs A and southern section of the study area (Appendix 2). Vegetation at the site was associated with three main soil groupings based on geomorphology (Gunn and Nix 1977), a) coarse textured alluvium (massive earths, uniform sandy, texture-contrast and alluvial soils), b) argillaceous sediments (texture-contrast, dark brown and grey-brown and cracking clay soils) and c) tertiary weathered zone - mid catena (texture-contrast soils).

The most significant stands of vegetation are the woodlands and forests associated with the Isaac River and North Creek and the narrow plains between at the junction of the two watercourses. The woodlands are mostly eucalypt dominated with very little brigalow (*Acacia harpophylla*) remaining. *Eucalyptus populnea* dominates most of the higher forested areas and includes small patches of *E. orgadophila* and *E. cambageana*, while *E. tereticornis* and *E. camaldulensis* dominate on the Isaac River and North Creek. A full description of vegetation communities is in Table 3 along with an indication of regional ecosystems represented and their status. Vegetation mapping for the area can be seen in Figure 2 & 3. Appendix 3 shows a series of photographs for each vegetation unit identified.

Vegetation type 7 is *Eucalyptus populnea* dominated woodland which persists on both clay and shallow sandy soils (≤10 cm deep) over clay. To illustrate this, the forest on shallow sandy soils is represented by a hashed section (along North Creek).

Twelve of the fourteen vegetation communities identified can be aligned with eight different regional ecosystems, of these three are ‘endangered’ and four are ‘of concern’. The other two communities have resulted from clearing of the original vegetation.

Table 3 Vegetation mapping units with corresponding geology, Specht classifications, regional ecosystem and biodiversity status and corresponding fauna sites.

Geology	Map Unit	Vegetation Description	Specht Classification[1]	Vegetation Sites	Regional Ecosystem	Vegetation Management / Biodiversity Status	Corresponding Fauna Sites
coarse textured alluvium	1	*Eucalyptus camaldulensis* forest +/- *E. tereticornis* +/- *Corymbia tessellaris* with mid-storey of canopy species and *Acacia* sp. and dense grass cover on alluvial flats associated with the Isaac River	Forest	-	11.3.4	Of Concern / Of concern	FRG
	2	*Eucalyptus tereticornis* woodland +/- *E. populnea* +/- *Corymbia tessellaris* with no mid-storey and sparse grass cover on alluvial flats associated with the Isaac River	Forest	V25	11.3.4	Of Concern / Of concern	FRG
	3	Mixed Corymbia woodland, with *Corymbia tessellaris*, *C. dallachiana* +/- *C. clarksoniana* +/- *Eucalyptus tereticornis* +/- *E. crebra* +/- *E. populnea* with very sparse mid-storey of *Acacia* sp. and mid-dense grass cover on alluvial soil associated mainly with the Isaac River	Woodland	V01, 04, MBA	11.3.7	Not of Concern / Of concern	MBA
	4	*Eucalyptus camaldulensis* and *E. tereticornis* woodland on alluvium associated with the Isaac River	Tall open forest	V02, 05, 28, FRG	11.3.25	Not of Concern / Of concern	FRG
	5	*Eucalyptus tereticornis* woodland on alluvium associated with North Creek	Tall forest	V08, 14, 15, 24	11.3.25	Not of Concern / Of concern	FRG
	6	*Eucalyptus tereticornis* on lowlands or swales with occasional *E. populnea* no mid-storey and mid-dense ground cover	Open forest	V20	11.3.4	Of Concern / Of concern	FRG
	7	*Eucalyptus populnea* forest / woodland +/- *Terminalia* sp. *Acacia harpophylla* +/- *Lysiphyllum* sp. with occasional *Corymbia* spp. very sparse mid-storey and sparse ground cover on clay soils (solid colour) and sandy soils (hashed area)	Woodland	V03, 06, 09, 16, 27, PBX	11.3.2 / 11.4.2	Of Concern / Of concern	PBX
argillaceous sediments	8	*Eucalyptus cambageana*, *E. populnea* and *Acacia harpophylla* woodland with dense mid-storey of *Acacia* spp., *Lysiphyllum* sp. and little or no grass cover	Open forest	V29	11.4.8	Endangered / Endangered	PBX
	9	*Eucalyptus cambageana* and *E. populnea* +/- *Acacia* sp. +/- *Cassia brewsteri* +/- *Flindersia* sp. with sparse mid-storey and very sparse grass cover	Woodland	V21, 26	11.4.8	Endangered / Endangered	-

Geology	Map Unit	Vegetation Description	Specht Classification[1]	Vegetation Sites	Regional Ecosystem	Vegetation Management / Biodiversity Status	Corresponding Fauna Sites
tertiary weathered zone	10	*Acacia harpophylla* woodland with mid-storey of *Lysiphyllum* sp. +/- *Cassia brewsteri* +/- *Alectryon oleifolius* on clays with very sparse ground cover	Woodland	V10	11.9.5	Endangered / Endangered	BRG
	11	*Eucalyptus orgadophila* woodland +/- *Corymbia* dallachiana +/- *Acacia harpophylla* with very sparse mid-storey of canopy species +/- *Lysiphyllum* sp. and very sparse grass cover	Open woodland	V12	11.9.2	Not of Concern / Not of concern	-
	12	*Eucalyptus cambageana* and *Acacia harpophylla* woodland with little to no mid-storey	Woodland	V23	11.9.1	Endangered / Endangered	-
cleared or regrowth vegetation	13	Grasslands with emergent *Eucalyptus tereticornis*, *Corymbia* spp. and *Acacia harpophylla* on sandy alluvial soils	Grassland	V07, 11, GRS	not applicable		GRS
	14	Sparse shrubland of *Acacia harpophylla* +/- *Lysiphyllum* sp. +/- *Flindersia* sp. +/- *Atalaya hemiglauca* on tertiary clay soils.	Open shrubland	V13, BRG	not applicable		BGR

[1] Specht (1970)

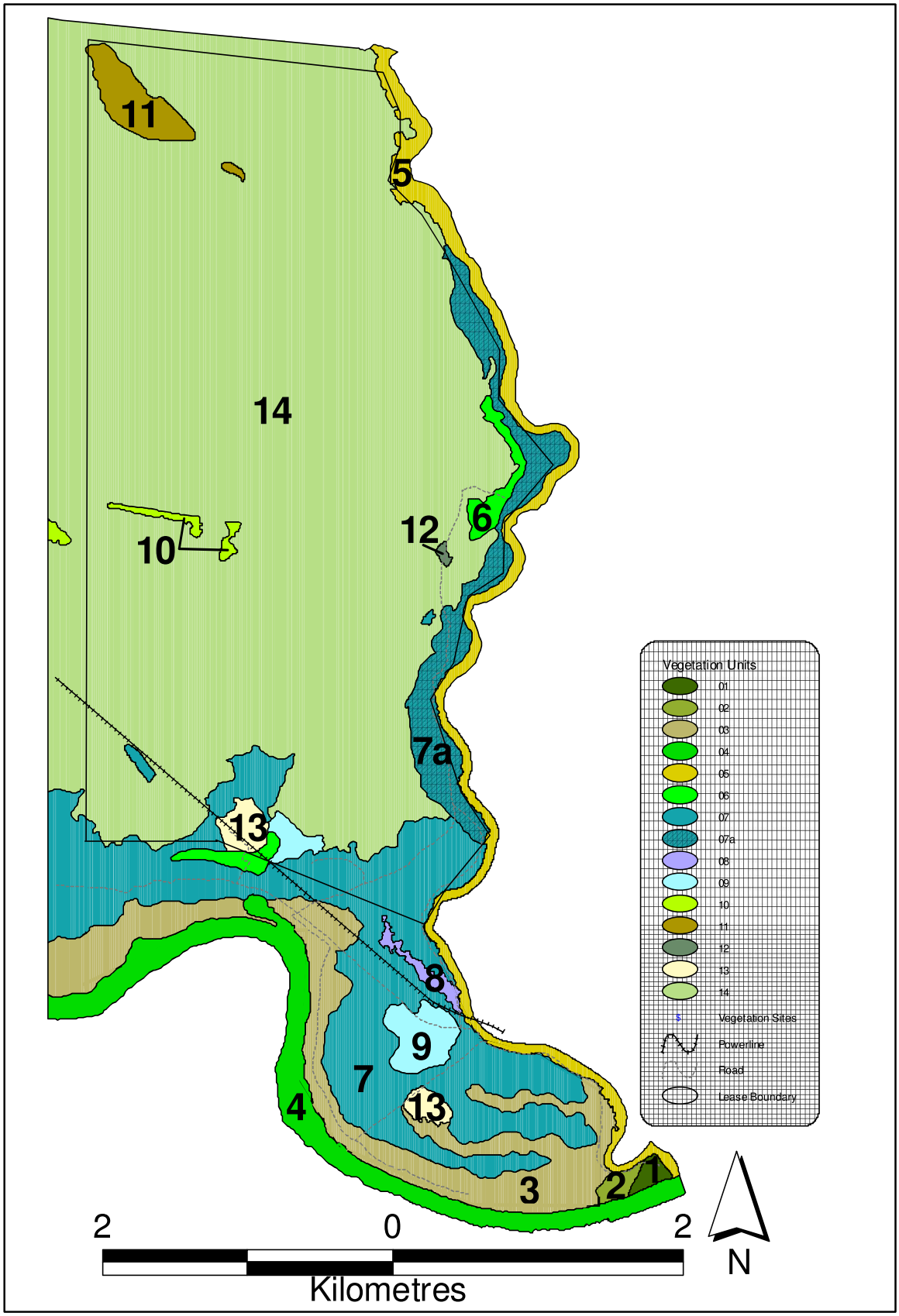


Figure 2 Vegetation of proposed ML Olive Downs Mining A and southern section of the study area - see Table 3 for vegetation unit descriptions.

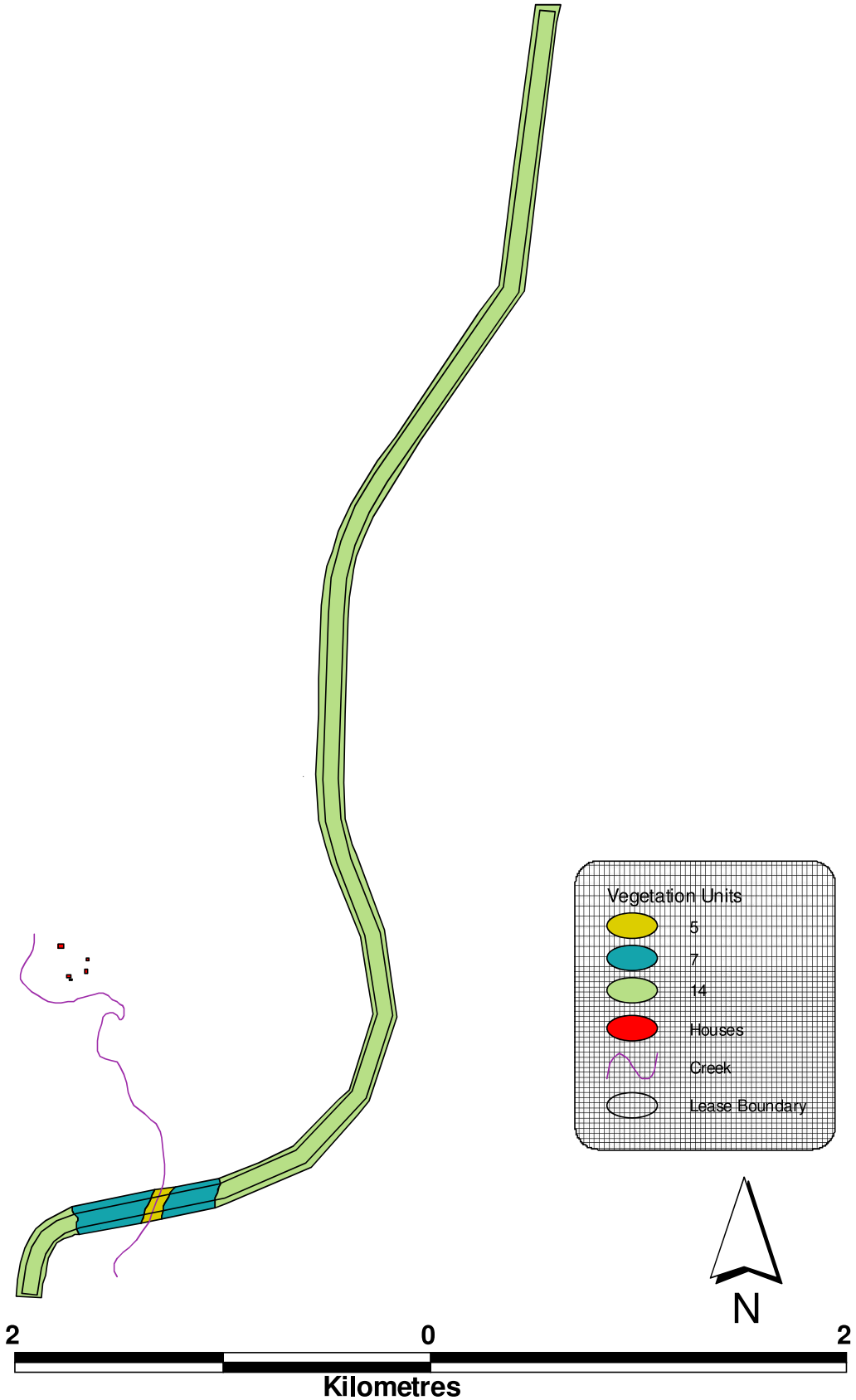


Figure 3 Vegetation of the proposed Olive Downs to Moorvale Haul Road (ML Olive Downs B) - see Table 3 for vegetation unit descriptions

There were four declared weed species within the study area and 12 weed species not declared but of environmental and/or biodiversity significance at Olive Downs (Table 4).

Table 4 Weeds of environmental and/or biodiversity significance at Olive Downs

Family	Species	Common Name	Declared
Amaranthaceae	*Alternanthera* sp.		no
Asteraceae	*Emilia sonchifolia*		no
Asteraceae	*Parthenium hysterophorus*	parthenium	yes
Cactaceae	*Eriocereus* sp.	harrisia cactus	yes
Cactaceae	*Opuntia stricta*	prickly pear	yes
Euphorbiaceae	*Ricinus communis*	castor oil plant	no
Fabaceae	*Stylosanthes* sp.		no
Malvaceae	*Hibiscus trionum*		no
Malvaceae	*Malvastrum americanum*		no
Malvaceae	*Sida* sp. *rhombifolia*?		no
Papaveraceae	*Argemone ochroluca*	prickly poppy	no
Poaceae	*Cenchrus ciliaris*	buffel grass	no
Poaceae	*Chloris* sp. *gayana*?		no
Poaceae	*Chloris virgata*	rhodes grass	no
Poaceae	*Panicum maximum*	green panic	no
Verbenaceae	*Lantana camara* var *camara*	lantana	yes

3.2. Land Condition

Specht (1970) classifications have also been assigned to each community which is representation of clearing severity, correlating with grazing intensity. A representation of this is in Figure 4, a series of land condition maps. Historic logging in all riparian zones is evident. Declared weeds noted included:

- *Parthenium hysterophorus* - Class 2 - reasonable steps must be taken to free land of pest;
- *Eriocereus* sp. - Class 2 - reasonable steps must be taken to free land of pest; and
- *Lantana camara* - Class 3 - may be subject to local legal control.

Parthenium hysterophorus and *Lantana camara* locations and severity are included in the land condition maps (Figure 4). Erosion is also present on site, however, it is generally associated with vehicle crossings on gullies, with old cattle pens at the southern end of the eastern boundary of the study area and some patches on the north-eastern end of the proposed Olive Downs A mining lease. The most severe area of erosion was at the north-eastern end of the proposed Olive Downs A lease and crossed the boundary to the bank of North Creek. There was some erosion at an old crossing on North Creek just outside the boundary of the proposed mining leases.

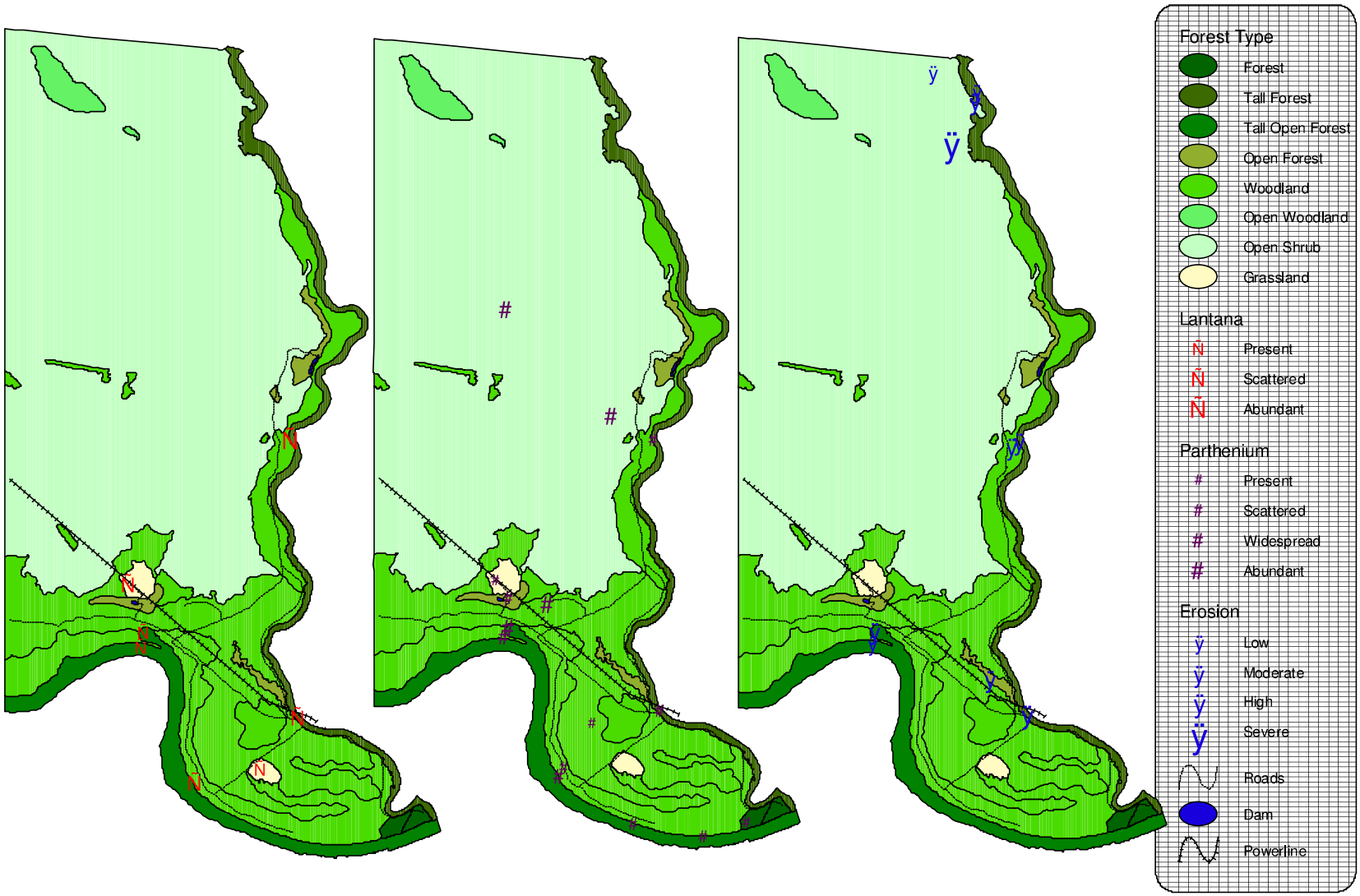


Figure 4 Land condition of the proposed ML Olive Downs A and southern study area, including forest type, *Lantana camara*, *Parthenium hysterophorus* and erosion locations and severity.

3.3. Fauna

3.3.1. Habitat Description

The three fauna trap sites in *Eucalyptus* / *Corymbia* dominated areas (MBA, FRG and PBX) provided the most diverse range of microhabitats including: large trees, tree hollows, fallen logs, decorticating bark and litter (Table 5). The grassland site did provide some hollows in trees due to standing dead trees and there was a high abundance of logs on the ground, however there was very little litter on the ground at the site. The cleared brigalow site (BRG) had the least diverse range of microhabitat due to the lack of any tree hollows and decorticating bark. There were no rock crevices, caves or free water at any of the sites. The only open water available for wildlife within the study area was the dam just east of the BRG site.

Table 5 Habitat characteristics for each fauna site.

Habitat Characteristics	Site				
	MBA	FRG	PBX	GRS	BRG
Hollow-bearing trees/ha	<1	6	4	<1	0
Abundance hollows in trees / stags	1	6	3	4	0
Abundance fallen hollow logs	0	4	1	5	1
Abundance fallen 'solid' logs	1	2	2	2	5
Abundance decorticating bark	6	5	1	1	0
Abundance course litter (2-10 cm diameter)	3	5	5	1	5
Abundance fine litter (<2 cm diameter)	5	7	5	3	2
Abundance bare ground	5	4	5	4	5
Abundance rock crevices	0	0	0	0	0
Free water present	n	n	n	n	n
Caves present	n	n	n	n	n
Total basal area (m^2/ha)	2	11.5	4.5	0.5	0.5

Similar to the fauna trap sites the range of microhabitats was most diverse in the *Eucalyptus* / *Corymbia* dominated vegetation types (2-7 & 10-12) and the grasslands (13), while the remaining small patches of brigalow dominated woodlands and the cleared brigalow woodlands had the least diverse range of microhabitats (Table 6).

Table 6 Habitat characteristics averaged for sites within each of the vegetation communities (the fauna survey site associated with a vegetation type is bracketed).

Habitat Characteristics	Vegetation Communities											
	2	**3 (MBA)**	**4 (FRG)**	**5**	**6**	**7 (PBX)**	**9**	**10**	**11**	**12**	**13 (GRS)**	**14 (BRG)**
Hollow-bearing trees/ha	11	2	2.5	5	6	2	1.5	0	11	40	<1	0
Abundance hollows in trees / stags	5	4	3	5	3	3	3	0	7	5	2	0
Abundance fallen hollow logs	3	2	2	2	3	1	2	0	5	3	2	0
Abundance fallen 'solid' logs	2	2	2	2	2	3	4	5	4	3	1	4
Abundance decorticating bark	5	5	4	3	4	1	2	5	4	2	1	0
Abundance course litter (2-10 cm diameter)	4	3	4	3	4	4	4	5	3	5	2	4
Abundance fine litter (<2 cm diameter)	5	5	6	9	5	4	4	5	2	4	3	3
Abundance bare ground	3	5	3	3	3	5	5	5	5	4	4	4
Abundance rock Crevices	0	0	0	0	0	0	0	0	0	0	0	0
Free water present	n	n	n	n	n	n	n	n	n	n	n	n
Caves present	n	n	n	n	n	n	n	n	n	n	n	n
Total basal Area (m^2/ha)	8	4	8	10	14	6	5	5	3	6	0	4

3.3.2. Terrestrial Fauna and Birds

Ninety-seven terrestrial vertebrate species were found over the winter dry season survey including one toad, 11 lizards, two snakes, 65 birds, 13 non-microchiropteran mammals and five microchiropteran bats (Tables 7 & 8). Domestic species such as cattle were also present but have not been included in species' lists.

Only one amphibian was found – the Cane Toad (*Bufo marinus*) - and this reflected the winter timing of the survey with most frog species active during the wetter warmer months when breeding.

Typical gecko fauna associated with peeling bark of gum trees (*Gehyra dubia*) and ground-active species (*Diplodactylus steindachneri*) were widespread. Litter and grass tussock associated lizards such as *Carlia foliorum*, *Menetia greyii* and *Ctenotus strauchii* were also common. An absence of fence skinks of the genus *Cryptoblepharus*, normally encountered on logs and under bark of trees was notable. Typically, large agamids such as Frilled Lizard (*Chlamydosaurus kingii*) and Bearded Dragon (*Pogona barbata*) were present but in low abundance. Other taxa, dependent on seasonally favourable conditions to stimulate activity (either breeding or feeding), were also absent (e.g. snake-lizards in the family Pygopidae) or with few species (e.g. snakes).

Eastern Grey Kangaroos (*Macropus giganteus*) were the most abundant mammal fauna but other species were present in low numbers reflecting the dry conditions within the study area. These included Short-beaked Echidna (*Tachyglossus aculeatus*), Stripe-faced Dunnart (*Sminthopsis macrora*), Common Planigale (*Planigale maculata*), and hollow-dependent species such as Greater Gliders (*Petauroides volans*) and Common Brushtail Possums (*Trichosurus vulpecula* - Trace) were present but in low numbers although there was a medium density of hollow-bearing trees and the *Eucalyptus camaldulensis* / *E. tereticornis* woodlands are a high quality habitat. Species identified from trace evidence only included Koala (*Phascolarctos cinereus*), and Feral Pigs (*Sus scrofa*). Koala traces were found within the *Eucalyptus camaldulensis* / *E. tereticornis* vegetation (RE

11.3.4/25). The Northern Brown Bandicoot (*Isoodon macrourus*), a normally common mammal, were not found indicating rarity or absence and this is considered unusual.

The lack of native rodents is not unusual in this area (e.g. a study of Newlands reported a similar finding, Houston et al. 2003a) but rodents were found at Poitrel (Houston et al. 1996) immediately downstream of the study area. Typically, rodent numbers fluctuate widely in response to climatic events such as droughts and sampling during a more 'normal' rainfall period may have detected this group. Absence at Olive Downs may reflect drought conditions and lack of food sources for predominantly graminivorous species such as rodents.

Other guilds not found in the study area were goannas and fruit bats. Goannas can be difficult to detect during cooler months and may have been present. Few flowering trees were present within the study area and this may account for absence of fruit-bats.

The dam had the greatest diversity and abundance of insectivorous bats but with a few call sequences from the two riparian sites. All species have been recorded previously in the region at Newlands Mine (Houston et al. 2003a). Four of the five species roost in tree hollows and are frequently encountered in riparian woodlands (Churchill 1999).

The majority of bird species were typical of open woodland vegetation. The presence of Large-tailed Nightjar is of interest as, although within its range (Higgins 1999), it is not often observed in this region.

Missing from the species list were most of the summer migrants (e.g. cuckoos) and nomadic species (e.g. some kites, honeyeaters, waterbirds and aerial predators such as swallows and martins) targeting locally abundant prey resources. Some winter migrants were present (e.g. Grey Fantail) but some may have left (e.g. Scarlet Honeyeater).

3.3.3. Aquatic Fauna

One species of fish was found – Spangled Perch (*Leiotherapon unicolor*) and one turtle – the Eastern Snake-necked Tortoise (*Chelodina longicollis*). A wet or post-wet season survey would be required to identify species using ephemeral pools within the Isaac River and North Creek. A study of North Creek upstream of the study area in the post-wet season period identified five fish species.

Table 7 Abundance (combined sightings and trap catches) and presence of ground-active and arboreal vertebrate fauna at Olive Downs.

Conservation Status: * - introduced species; Q-R or Q-V - rare or vulnerable under Qld Government legislation; F-V - vulnerable under Federal legislation
Identification status: t - trace only and abundance uncertain, V - voucher specimen held by Qld Museum; C - specimen captured, positively identified and released; F - specimen positively identified in field; T - specimen positively identified from animal traces (scats, hairs contained in predator scats or other sources, tracks, diggings, burrows, scratch marks on trees); AN - Anabat identification
Abundance rating: A - abundant, C - common, U – uncommon. Trap Sites: P = possibly present.

Species	Common Name	Conservation Status	Identification Status	Abundance	Trap sites					Other	
					GRA	BRG	PBX	MBA	FRG	DAM	Incidental sightings
FISH											
Leiopotherapon unicolor	Spangled Perch		V	LC						3	
TURTLES											
Chelodina longicollis	Eastern Snake-necked Tortoise		V	U						T	
FROGS											
Bufo marinus	Cane Toad	*	T	U						1	
LIZARDS											
Geckoes											
Diplodactylus steindachneri	a terrestrial gecko		C	C	1			2			
Gehyra dubia	an arboreal gecko		C	C				1	4		
Dragon-lizards											
Chlamydosaurus kingii	Frilled Lizard		C	U							Veg 04
Pogona barbata	Bearded Dragon		C	U							Veg 07
Skinks											
Carlia foliorum	a terrestrial skink		V	C				1	2		
Carlia munda	a terrestrial skink		V	U	1						
Ctenotus strauchii	a terrestrial skink		V	C	1		1				
Ctenotus taeniolatus	Copper-tailed Skink		V	U							
Menetia greyii	a terrestrial skink		V	C	1		1				
Menetia timlowi	a terrestrial skink		V	U					1		
Morethia taeniopleura	Fire-tailed Skink		V	U	1						
SNAKES											
Colubrids											
Dendrelaphis punctulata	Common Tree Snake		T	U					1		
Elapids											
Hoplocephalus bitorquatus	Pale-headed Snake		V	U			1				

Species	Common Name	Conservation Status	Identification Status	Abundance	Trap sites					Other	
					GRA	BRG	PBX	MBA	FRG	DAM	Incidental sightings
MAMMALS											
Monotremes											
Tachyglossus aculeatus	Short-beaked Echidna		T	C							
Marsupials											
Macropus giganteus	Eastern Grey Kangaroo		F	C	1	1		1	1		
Petauroides volans	Greater Glider		F	U							Veg 04
Phascolarctos cinereus	Koala		T	C					1		Veg 02
Planigale maculata	Common Planigale		C	U		1					
Sminthopsis macrora	Stripe-faced Dunnart		C	U		1					
Trichosurus vulpecula	Common Brushtail Possum		T	U					1		
Placental Mammals											
Canis familiaris	Wild Dog	*	F	U							Veg 06
Canis lupus dingo	Dingo		F	U					1		
Felis catus	Feral Cat	*	F	C							Veg 13 & 07
Mus musculus	House Mouse	*	V	C	3						
Oryctolagus cuniculus	Rabbit	*	F & T	C	1	2					
Sus scrofa	Feral Pig	*	T	U							Veg 07
MICROCHIROPTERAN BATS											
Chalinolobus gouldii	Gould's Wattled Bat		AN	LC							
Chalinolobus picatus	Little Pied Bat	Q - R	AN	C				P?	P?	P?	
Mormopterus beccarii	Beccari's Freetail Bat		AN	U						P?	
Mormopterus sp.	Eastern Freetail Bat		AN	LC						A	
Taphozous georgianus	Common Sheathtail Bat		AN	U						P?	
Total	32				8	5	4	4	8	1	7
Frog	1				0	0	0	0	0	1	0
Lizards	11				4	1	3	1	3	0	0
Snakes	2				0	0	1	0	1	0	0
Mammal (excluding bats)	13				2	1	0	0	1	0	3
Microchiropteran bats	5				0	0	0	1	1	5	0

Table 8 Bird fauna at Olive Downs and abundance at sampling sites

Conservation Status: * - introduced species; Q-R, Q-V or F-V - rare or vulnerable under Qld Government legislation or as vulnerable under Federal legislation; F-NT - listed as *near threatened* by Garnett and Crowley (2000); J or C - listed under JAMBA or CAMBA (bilateral agreements between Australia and Japan or China respectively for the protection of migratory birds)
Abundance rating: VA - very abundant, A - abundant, C - common, LC - locally common, U - uncommon
Habitat Group: (Modified from Bentley and Catterall (1996)): Open - cleared or open; FRes - forest resident, FSMig - forest summer migrant, FWMig - forest winter migrant, FUnc - forest uncertain, Gen - generalist, Unc - uncertain, Wat - water associated

Common Name	Species	Status	Abundance	Habitat Group	Trap Sites					Other	
					GRA	BRG	PBX	MBA	FRG	DAM	Incidental sites
EMU											
Emu	*Dromaius novaehollandiae*		U	Open					1		Veg 03
DUCKS & ALLIES											
Grey Teal	*Anas gracilis*		LC	Wat						4	
Pacific Black Duck	*Anas superciliosa*		U	Wat						1	
DARTERS											
Darter	*Anhinga melanogaster*		U							p	
CORMORANTS											
Little Black Cormorant	*Phalocrocorax sulcirostris*		LC							p	
HERONS, BITTERNS & EGRETS											
Great Egret	*Ardea alba*	J; C	U							p	
CRANES											
Brolga	*Grus rubicundus*		U			2					
RAPTORS											
Black Kite	*Milvus migrans*		U	Gen							Veg 14
Wedge-tailed Eagle	*Aquila audax*		U	Gen			2				
FALCONS											
Brown Falcon	*Falco berigora*		U	Gen							Veg 14
Nankeen Kestrel	*Falco cenchroides*		U	Gen		p					Veg 14
BUSTARDS											
Australian Bustard	*Ardeotis australis*	F-NT	U	Open							Veg 14
LAPWINGS, PLOVERS & DOTTERELS											
Masked Lapwing	*Vanellus miles*		U							2	Veg 14
PIGEONS AND DOVES											
Bar-shouldered Dove	*Geopelia humeralis*		C	FUnc		3				3	Veg 07

Common Name	Species	Status	Abundance	Habitat Group	Trap Sites					Other	
					GRA	BRG	PBX	MBA	FRG	DAM	Incidental sites
Crested Pigeon	*Ocyphaps lophotes*		C	Gen		p				4	
Squatter Pigeon	*Geophaps scripta scripta*	Q-R	U								Veg 03
COCKATOOS, CORELLAS & COCKATIEL											
Sulphur-crested Cockatoo	*Cacatua galerita*		C	Gen	p	p	2		4	2	Veg 14
PARROTS											
Budgerigar	*Melopsittacus undulatus*		C							16	
Galah	*Cacatua roseicapilla*		C	Open	10			1	2	6	Veg 14
Pale-headed Rosella	*Platycercus eximtus*		A	Gen	4		6	2	4	6	
Rainbow Lorikeet	*Trichoglossus haematodus*		VA	Gen	16	2	10	2	10	10	
Red-winged Parrot	*Aprosmictus erythropterus*		C	FUnc	2		1	2	3	2	
Scaly-breasted Lorikeet	*Trichoglossus cholorolepidotus*		U	Open							Veg 04
HAWK OWLS											
Southern Boobook	*Ninox novaeseelandiae*		C	FUnc				3	2	1	
NIGHTJARS & ALLIES											
Large-tailed Nightjar	*Caprimulgus macurus*		U							1	
Tawny Frogmouth	*Podargus strigoides*		U	Gen						1	
KINGFISHERS AND KOOKABURRAS											
Blue-winged Kookaburra	*Dacelo leachii*		U	FUnc							Veg 03
Forest kingfisher	*Todiramphus macleayii*		U	FRes						1	
Laughing Kookaburra	*Dacelo novaeguineae*		C	Gen					6	p	Veg 07
BEE-EATERS											
Rainbow Bee-eater	*Merops ornatus*		C	Gen	5	1	5	2	2	1	
FAIRY-WRENS & ALLIES											
Red-backed Fairy-wren	*Malurus melanocephalus*		LC	Gen	5						
Variegated Fairy-wren	*Malurus lamberti*		U			p					
PARDALOTES, SCRUB-WRENS, THORNBILLS & WARBLERS											
Striated Pardalote	*Pardalotus striatus*		C	FRes	3	p		3	3	4	
Weebill	*Smicrornis brevirostris*		C		p	p	p	p	p		
White-throated Gerygone	*Gerygone olivacea*		C		p	p		p	p	p	
HONEYEATERS											

Common Name	Species	Status	Abundance	Habitat Group	Trap Sites					Other	
					GRA	BRG	PBX	MBA	FRG	DAM	Incidental sites
Blue-faced Honeyeater	*Entomyzon cyanotis*		C	Gen	1		p		p	3	Veg 07
Brown Honeyeater	*Lichmera indistincta*		C		p		10		p		
Little Friarbird	*Philemon citreogularis*		A	Gen	10		p		2	10	Veg 07
Noisy Friarbird	*Philemon corniculatus*		A	Gen	4		10	2	6	4	
Noisy Miner	*Manorina melanocephala*		U	Open						2	
Singing Honeyeater	*Lichenostomus virescens*		C	Gen	10					2	
White-throated Honeyeater	*Melithreptus albogularis*		C	FUnc	4			p	p	2	
ROBINS & SMALL FLYCATCHERS											
Jacky Winter	*Microeca fascinans*		U				p				
BABBLERS											
Grey-crowned Babbler	*Pomatostomus temporalis*	F-NT	LC	FUnc			5				
SITELLAS											
Varied Sittella	*Daphoenositta chrysoptera*		C					p	p		
WHISTLERS & SHRIKE-THRUSHES											
Grey Shrike-thrush	*Colluricincla harmonica*		U	FRes		2					
Rufous Whistler	*Pachycephala rufiventris*		U						p		
FLYCATCHERS, MONARCHS, FANTAILS, MAGPIE-LARK & DRONGO											
Grey Fantail	*Rhipidura fuliginosa*		C	FWMig	2	p	2		1	2	
Leaden Flycatcher	*Myiagra rubecula*		C				p			p	
Magpie-lark	*Grallina cyanoleuca*		C	Open		p				3	
Spangled Drongo	*Dicrurus bracteatus*		U	Func					p		
Willie Wagtail	*Rhipidura leucophrys*		C	Open	2		2			1	
CUCKOO-SHRIKES, CICADABIRD & TRILLERS											
Black-faced Cuckoo-Shrike	*Coracina novaehollandiae*		C	Gen	2	p	1	1	1	4	
ORIOLES & FIGBIRD											
Olive-backed Oriole	*Oriolus sagittatus*		U	Gen						1	
WOODSWALLOWS, BUTCHER BIRDS, MAGPIES & CURRAWONGS											
Australian Magpie	*Gymnorhina tibicen*		C	Open	2	2	2	2	1	4	
Black-faced Woodswallow	*Artamus cinereus*		LC			4					
Pied Butcherbird	*Cracticus nigrogularis*		C	Gen	1	p	p		p		

Common Name	Species	Status	Abundance	Habitat Group	Trap Sites					Other	
					GRA	BRG	PBX	MBA	FRG	DAM	Incidental sites
Pied Currawong	*Strepera graculina*		U				p				
CORVIDS											
Torresian Crow	*Corvus orru*		C	Gen	5	1	4	2	4	2	
MUD-NESTERS (CHOUGHS & APOSTLE BIRDS)											
Apostle Bird	*Struthidea cinerea*		C	Gen	10					6	Veg 07
BOWERBIRDS											
Spotted Bowerbird	*Chlamydera maculata*		C	FRes	p					1	Veg 07
PIPITS											
Richard's Pipit	*Anthus novaeseelandiae*		U			p					
FINCHES & ALLIES											
Double-barred Finch	*Taeniopygia bichenovii*		C	Gen						2	Veg 04
Zebra Finch	*Taeniopygia guttata*		A	Gen	10					30	
FLOWERPECKERS											
Mistletoebird	*Dicaeum hirundinaceum*		U	FUnc					1		
Species richness	65				25	20	21	15	26	40	18

4. Discussion

4.1. Flora

The number of vegetation types and species richness at Olive Downs was similar to a neighbouring mining lease (Poitrel) where 108 species were found in 11 vegetation types of similar overstorey species (Houston *et al.* 1996). However, the species richness was less than that of South Walker Creek where 180 species were found from 11 vegetation types (Tucker et al. 1999). The relatively high proportion of vegetation types of conservation significance found within the study area reflects the extent to which the brigalow belt has been cleared. The preservation of any remnants would be a positive conservation benefit.

A search of the Queensland Herbarium database reported the possible presence of three species of conservation significance. It is very unlikely that two of these species would be found in the study area because the normal habitat for those species. *Persoonia amaliae* Domin (rare), is found exclusively on steep sandstone slope associated with *Eucalyptus aureola*, none of which is present in the study area and *Bertya pedicellata* F. Muell. (rare) is generally found on skeletal soils or shallow clays associated with vine thickets or dense vegetation on rocky outcrops, and associated with Eucalypt and Acacia woodlands and forests. The third species, *Desmodium macrocarpum* Domin (rare) is generally found in open woodlands of *Eucalyptus populnea* with sparse shrub layer, associated with *Carissa ovata*, *Grewia retusifolia*. This habitat was common in the study area but *D. macrocarpum* was not located during the study.

The impact from declared weeds in the Olive Downs study area was low in severity, although *Parthenium hysterophorus* was widespread and *Lantana camara* was thick in patches. Erosion was limited to small areas and low in severity in most places but was high at the old cattle yards on the southern end of North Creek and the patch at the north-eastern end of the proposed Olive Downs A mining lease and adjacent to North Creek outside the proposed lease area. Erosion will be further discussed in threatening processes.

4.2. Fauna

4.2.1. Conservation-listed Fauna

One conservation-listed species was confirmed – the southern subspecies of the Squatter Pigeon (*Geophaps scripta scripta*) with another likely based on ANABAT analysis – the Little Pied Bat (*Chalinolobus picatus*), both listed as *rare* under the Queensland Government's *Nature Conservation Act* 1992. Two *near threatened* species – Australian Bustard (*Ardeotis australis*) and Grey-crowned Babbler (*Pomatostomus temporalis*) were present (Garnett and Crowley 2000). Other species listed under international treaties and requiring consideration under the Federal EPBC Act are listed in Table 9 and include the Great Egret (*Ardea alba*).

Squatter Pigeons were observed incidentally in the southern section of the study area within *Corymbia tessellaris* (Vegetation Unit 03) near the Isaac River (dry) but within reach of a cattle watering point off the proposed mining leases. This matches their preferred habitat of grassy woodlands with regular access to water. Also, Squatter Pigeon are known to prefer short sparser grasses to dense longer grasses allowing ease of movement when feeding and provision of nesting habitat (Higgins and Davies 1996; Garnett and Crowley 2000), indicating that grazing may enhance their habitat provided if it is maintained at low to moderate levels.

Little Pied Bats could not positively be identified as present at Olive Downs but were regarded as likely using ANABAT analysis (Appendix 5) and was found at both river-associated sites and the dam. It is a tree hollow nesting species and its habitat at Olive Downs falls within the range of feeding habitats reportedly used by this species - 'dry, open forest, open woodlands, Mulga woodlands, chenopod shrublands, *Callitris* forest and mallee' (Churchill 1999). Also, critical habitat for roosting is present; i.e. hollow trees along Isaac River and North Creek.

4.2.2. Declared Pest Species

Several exotic species declared as pests under the Land Protection (Pest and Stock Route Management) Act 2003 were found at Olive Downs including the Cane Toad (*Bufo marinus*), Feral Cat (*Felis catus*), Feral Pig (*Sus scrofa*), Rabbit (*Oryctolagus cuniculus*) and Wild Dog (*Canis familiaris*). Included in this is the Dingo (*Canis lupus dingo*) and these were also seen but were uncommon. Under this act, landholders are required to take action to reduce numbers on their property. Both Feral Cats and Rabbits were common on the property. The low numbers of Cane Toads most probably reflected unfavourable conditions (winter and drought).

The House Mouse (*Mus musculus*) was common within the study area but this is not a declared pest species.

4.2.3. Regional Context of the Study Area

Species richness was less than that found at Poitrel, the property immediately downstream from Olive Downs and lower than all other surveys from the Brigalow Belt surveyed using similar methods (Table 9). However, the surveys are not directly comparable due to differences in:

- Seasonal timing - Olive Downs was surveyed in winter and Poitrel in mid to late spring, and all others incorporated a summer sampling period;
- Survey effort – most other surveys were 10 days compared with 5 at Olive Downs;
- Landscape and soil complexity – Poitrel and most other surveys encompassed vegetation ranging from flats to at least low hills, whereas Olive Downs was primarily river terraces with only a few gentle rises.

At Newlands mine over half the bird species were found in one season only, indicating that if a similar pattern occurred at Olive Downs, then species richness would be enhanced by a summer sampling period. *It is recommended that a post rain summer/autumn sampling be undertaken to ensure all gaps in the faunal record can be covered.*

Table 9 Comparison of vertebrate species richness of the Olive Downs study with fauna surveys from elsewhere in the region and the Brigalow Belt.

Taxon	Olive Downs	Within the Region				Outside region but same methods	
		Poitrel (spr)[1]	Newlands (win & sum)[2]	South Walker (sum & aut)[3]	Curragh (sum, win & spr)[4]	Mt Morgan (win & sum)[5]	Stanwell (sum, win & spr)[6]
Frogs	1	11	10	12	12	9	14
Lizards	11	23	27	24	24	21	31
Snakes	2	4	9	7	12	9	11
Mammals (excluding Microchiroptera)	13	20	18	17	21	22	28
Total (non-bird fauna)	27	58	64	60	69	61	84
Birds – all	64	104	120	118	149	60	134
Survey data							
No. seasons trapped	1	1	2	2	3	2	3
no. search sites in native vegetation	5	5	5	7	5	6	7
Trap duration (days)	5	10	10	10	10	10	10
trap effort (trap sites x days trapped)	25	50	100	140	150	70	210

1 - Houston et al. 1996;
2 - Houston et al. 2003a;
3 - Melzer et al. 1996b, Houston and Melzer 1996, Tucker et al. 1999;
4 - Melzer et al. 1996a;
5 - Houston et al. 2003b;
6 - Houston et al. 1999

4.3. Threatening Processes and Management Recommendations

4.3.1. Erosion and Sedimentation

Sedimentation of North Creek and the Isaac River resulting from erosion within the proposed mining leases would be low due to the small areas and overall low severity of erosion. Erosion on and surrounding the proposed mining leases is mostly limited to road crossings on river, creek and gully crossings. Renovation of the roadway at these points may be required to channel water away from the crossing to minimise the erosion. The more severe rates of erosion at old cattle yards and at the north-eastern end of the proposed Olive Downs A mining lease (on North Creek) would require land and vegetation rehabilitation to minimise further degradation and sediments entering the watercourses.

Normal levels of erosion can be important in the formation of soils and soil catena leading to floral and faunal community complexity. However, increased erosion and the resulting sediment is an inevitable process within a mine site and could place stress on the adjacent natural landscape. Stress to flora and fauna could result from siltation of riparian vegetation or the infilling of pools in the watercourse. Should the mining operation proceed, management regimes for the landforming of displaced overburden to minimise erosion, and sediment trapping will need to be adopted.

4.3.2. Weed species

Environmental weeds are exotic plants that have the capacity to displace native plant assemblages (Adair and Groves 1998) or to prevent the regrowth of native assemblages following disturbance. Declared weeds (Parthenium and Lantana) are mostly scattered to widespread within the study area indicating that the present management of grazing at Olive Downs has not facilitated severe weed infestations. Buffel grass (*Cenchrus ciliaris*) is abundant on the property, but this was expected for a grass that is cultivated to improve pastures on grazing properties.

Operations on the proposed leases will require physical disturbance and site rehabilitation. Invasion of rehabilitation sites by weeds can occur at three critical phases: (i) primary land reformation, (ii) initial community establishment and (iii) effects of disturbance (fire, drought, soil disturbance) causing a perturbation to established vegetation. Some management options available to avoid weed invasion of rehabilitation include fire, selective physical or chemical weed treatment, variation in substrate of the reformed land so that it does not favour weeds (e.g. use rubble instead of top-soil), and use native vegetation wherever possible.

4.3.3. Feral Animals

Feral animals declared as pests under the *Land Protection (Pest and Stock Route Management) Act (2003)* represent a threat to primary industries and natural resources and responsibility for their control rests with the landholder. Cane Toads, Feral Cat, Feral Pig, Rabbits and Wild Dogs were identified within the study area and will require control measures.

Feral animals, particularly domestic species such as cats are impossible to eliminate, although control programmes will greatly reduce their numbers. Options for management include:

- Cultural techniques such as management of dumps (these have food resources that attract fauna such as Feral Cats and Feral Pigs and Wild Dogs) and removal of abandoned on-site structures that provide shelter for Feral Cats; or targeted control programmes using either baits or traps.
- Cane Toads were present at one site but only a trace was found. Both quolls and monitor lizards (goannas) are thought to be vulnerable to poisons within Cane Toad skins. Control of Cane Toads is difficult, although suitability of water bodies as potential breeding sites can be reduced where dense vegetation forms around the edge.
- The rabbit population was low and there was little evidence of widespread damage to vegetation or the presence of warrens. However, if the population did increase control programmes could be required.

4.3.4. Loss of Habitat for Significant Fauna

Three bird species and one bat of conservation significance were found in the study area and the loss of habitat for these species could occur. Three species are dependent on the forested areas in the south of the study area which is outside the proposed southern boundary of the Olive Downs A mining lease and the riparian vegetation on the Isaac River and along North Creek. Damage to the forested areas should be kept to a minimum in conjunction with the following management options:

- Little Pied Bats - protect potential roost sites such as caves and tree hollows and keep disturbance of potential roost sites to a minimum. Maintain water on-site if possible;
- Squatter Pigeon - control Feral Cats, maintain water on-site and maintain current grazing regime at low to moderate levels.

4.3.5. Loss of Connectivity between Remnant Vegetation

Any reduction in connectivity between remnants would diminish the value of the study area for fauna and the potential success of rehabilitation programmes by reducing the capacity for plants and animals to immigrate to the area. Patch size is also important as, according to biogeographical theory, smaller patches of the same habitat support less species and this was demonstrated at a coal mine in Central Queensland where reduced vertebrate species richness was found in a small remnant compared with larger intact vegetation of the same type (Knight 2002). To avoid such problems, unnecessary clearing within the study area should be avoided and large remnants retained.

Current corridors and linkage of the site to existing remnant native vegetation appears to be strong except for some small patches within the large area of cleared brigalow. Most remnant vegetation abuts the riparian zones along the Isaac River and North Creek which are outside the proposed mining lease areas. If possible, clearing of native vegetation should allow for linkages to remain to the vegetation along the watercourses and prevent isolation of any more vegetation patches. Clearing should only be undertaken following an assessment of likely consequences to fauna and recolonisation of rehabilitated lands. Rehabilitation of a corridor to the large patch of *Eucalyptus orgadophila* woodland at the northern end of the proposed Olive Downs A mining lease should be considered if that patch remains during the mining operation.

4.3.6. Loss of Free Water for Wildlife

Most bird species and many mammals are dependent on a permanent water supply. The only permanent watering point within the proposed mining lease boundaries is the dam close to North Creek. The importance of the dam was evident due to the richness of vertebrates recorded at the location, including birds, bats, macropods and fish. The dam is very close to the proposed Olive Downs A mining lease boundary and should be considered as an area not to be disturbed during the mining operations.

4.3.7. Inappropriate Fire Regimes

Too frequent burning could compromise habitat availability for a range of fauna dependent on logs and deep litter, while too infrequent could result in catastrophic fires and destroy habitat. Mosaic burning patterns are recommended by Queensland Parks and Wildlife fire management guidelines to provide a range of microhabitat types within vegetation types and to promote faunal conservation values (Clarke 1999). It is recommended that site-specific fire management plans be developed similar to those developed for other industrial sites in the bioregion (e.g. Stanwell Power Station - Clarke and Melzer 2001, Yabulu Nickel Refinery - Clarke and Melzer 2000). Understanding of habitat resilience following fires will be an important aspect of such management plans.

Fire and grazing are the tools normally used to regulate fuel biomass within the understorey. Infrequent mosaic burning would enhance faunal habitat and help prevent catastrophic bushfires. Grazing at high stocking densities diminishes faunal values and

should be avoided. A fire management plan should be prepared and integrated with weed management strategies.

4.3.8. Inappropriate Stocking Densities of Domestic Animals

High stocking densities may impact on fauna by reducing ground cover availability and complexity (Arnold and Weeldenburg 1998), particularly if associated with too frequent burning. Grazing needs to be integrated with fire management as a tool to manage fuel loads and reduce frequency of 'hot' fires associated with heavy fuel loads but again an understanding of habitat resilience is required.

The present grazing management seems good and has maintained adequate ground cover, at least in the areas viewed in this study, so maintaining grazing at the present levels would be desirable.

4.3.9. Hollow-bearing Trees

Hollow-bearing trees are an important denning and nesting resource for possums and gliders, and a wide range of birds (particularly owls and cockatoos and parrots). The distribution of hollow-bearing trees is patchy and aligned with the remaining areas of old growth *Eucalyptus* / *Corymbia* woodlands. Possums and gliders were recorded in the study and the riparian vegetation is good habitat for these species. In addition, several hollow nesting birds were recorded. A management plan to best preserve patches of hollow-bearing trees is recommended.

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6. Appendices

Appendix 1 Regional Ecosystems with habitat values mapped by the Environmental Protection Agency within the Olive Downs Study area.

Code	Description	Conservation Status		Habitat Values
		Vegetation Management Act status (Sep 2003)	Biodiversity Status	
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis*, *Casuarina cunninghamiana* fringing woodland on alluvial plains	Not of concern	Of concern	Habitat for rare and threatened flora species including *Eucalyptus raveretiana*. Shown to be associated with high fauna species richness in the Taroom area. Within parts of the Fitzroy Catchment, this RE is known habitat for the rare and threatened freshwater turtle *Rheodytes leukops*.
11.3.2 / 3.7 / 3.1	*Eucalyptus populnea* woodland on alluvial plains. Texture contrast and deep clay soils / *Corymbia* spp. woodland on alluvial plains. Sandy soils / *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	11.3.2 - Of concern 11.3.7 - Not of concern 11.3.1 - Endangered	11.3.2 - Of concern 11.3.7 - Of concern 11.3.1 - Endangered	11.3.2 - Habitat for rare and threatened flora species including *Homopholis belsonii*. 11.3.7 - Habitat of the endangered hairy-nosed wombat *Lasiorhinus krefftii*. 11.3.1 - Habitat for rare and threatened flora species including painted honeyeater *Grantiella picta* particularly in sub region 35.
11.3.2 / 3.1	*Eucalyptus populnea* woodland on alluvial plains. Texture contrast and deep clay soils / *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	11.3.2 - Of concern 11.3.1 - Endangered	11.3.2 - Of concern 11.3.1 - Endangered	11.3.2 - Habitat for rare and threatened flora species including *Homopholis belsonii*. 11.3.1 - Habitat for rare and threatened flora species including painted honeyeater *Grantiella picta* particularly in sub region 35.
11.9.5 / 9.1 / 9.2	*Acacia harpophylla* and/or *Casuarina cristata* open forest on Cainozoic fine-grained sedimentary rocks / *Acacia harpophylla-Eucalyptus cambageana* open forest on Cainozoic fine-grained sedimentary rocks / *Eucalyptus melanophloia* +/- *E. orgadophila* woodland on Cainozoic fine-grained sedimentary rocks	11.9.5 - Endangered 11.9.1 - Endangered 11.9.2 - Not of concern	11.9.5 - Endangered 11.9.1 - Endangered 11.9.2 - Not of concern	None listed
11.4.9	Acacia harpophylla shrubby open forest with Terminalia oblongata on Cainozoic clay plains	Endangered	Endangered	Examples of this RE with seasonally ponded gilgai may contain the rare and threatened plant *Aponogeton queenslandicus*.

Code	Description	Conservation Status		Habitat Values
		Vegetation Management Act status (Sep 2003)	Biodiversity Status	
11.4.4 / 4.9	*Dichanthium* spp., *Astrebla* spp. grassland on Cainozoic clay plains / *Acacia harpophylla* shrubby open forest with *Terminalia oblongata* on Cainozoic clay plains	11.4.4 - Not of concern 11.4.9 - Endangered	11.4.4 - Of concern 11.4.9 - Endangered	11.4.4 - Habitat for rare and threatened flora species including *Dichanthium queenslandicum*. 11.4.9 - Examples of this RE with seasonally ponded gilgai may contain the rare and threatened plant *Aponogeton queenslandicus*.
11.9.3 / 9.2 / 9.5	*Dichanthium* spp., *Astrebla* spp. grassland on Cainozoic fine-grained sedimentary rocks / *Eucalyptus melanophloia* +/- *E. orgadophila* woodland on Cainozoic fine-grained sedimentary rocks / *Acacia harpophylla* and/or *Casuarina cristata* open forest on Cainozoic fine-grained sedimentary rocks	11.9.3 - Not of concern 11.9.2 - Not of concern 11.9.5 - Endangered	11.9.3 - Not of concern 11.9.2 - Not of concern 11.9.5 - Endangered	None listed

Appendix 2 Plant species list for Olive Downs with species occurrence within each vegetation community

Family		Species	Common Name	Vegetation Unit													
				1	2	3	4	5	6	7	8	9	10	11	12	13	14
Amaranthaceae	*	*Alternanthera* sp.		✓	✓	✓											
Apocynaceae		*Carissa ovata*	Currant Bush					✓		✓		✓	✓		✓	✓	✓
Apocynaceae		*Parsonsia lanceolata*								✓			✓				
Asclepiadaceae		*Marsdenia lanceolatum*				✓	✓			✓							
Asclepiadaceae		*Marsdenia* sp.															✓
Asteraceae	*	*Emilia sonchifolia*						✓									
Asteraceae	*	*Parthenium hysterophorus*		✓	✓	✓	✓	✓	✓	✓			✓			✓	✓
Cactaceae	*	*Eriocereus* sp.	Harrisia Cactus							✓			✓				✓
Cactaceae	*	*Opuntia stricta*	Prickly Pear											✓			
Caesalpiniaceae		*Cassia brewsteri*	Leichhardt Bean			✓	✓	✓		✓		✓	✓		✓		
Caesalpiniaceae		*Lysiphyllum hookerii*	Bauhinia			✓	✓	✓		✓	✓	✓	✓	✓		✓	✓
Capparaceae		*Capparis lasiantha*						✓		✓		✓	✓	✓	✓	✓	✓
Capparaceae		*Capparis* sp.								✓		✓	✓			✓	✓
Casuarinaceae		*Casuarina cunninghamiana*	River Oak				✓	✓									
Celastraceae		*Denhamia* sp.						✓		✓		✓			✓		✓
Chenopodiaceae		*Enchylaena tomentosa*				✓				✓							
Chenopodiaceae		*Maireana microcarpa*								✓		✓			✓		
Chenopodiaceae		*Rhagodia* sp. *linifolia*?								✓							
Chenopodiaceae		*Salsola kali*	Roly-Poly Bush							✓	✓	✓	✓		✓		
Combretaceae		*Terminalia oblongata*											✓				✓
Combretaceae		*Terminalia* sp.								✓		✓			✓		
Convolvulaceae		*Evolvulus alsinoides*						✓									
Erythroxylaceae		*Erythroxylum australe*								✓							
Euphorbiaceae		*Euphorbia* sp.				✓											
Euphorbiaceae		*Petalostigma pubescens*								✓							
Euphorbiaceae	*	*Ricinus communis*	Castor Oil Plant	✓	✓		✓		✓								
Fabaceae	*	*Stylosanthes* sp.				✓	✓	✓									
Juncaceae		*Juncus continuus*	Chinese Water Chestnut	✓	✓												

Family		Species	Common Name	Vegetation Unit													
				1	2	3	4	5	6	7	8	9	10	11	12	13	14
Lamiaceae		*Clerodendrum floribundum*						✓									
Malvaceae		*Abutilon indicum* subsp. *guinaense*															✓
Malvaceae	*	*Hibiscus trionum*							✓								
Malvaceae	*	*Malvastrum americanum*															✓
Malvaceae		*Sida cordifolia*	Flannel Weed			✓											✓
Malvaceae		*Sida* sp.				✓	✓	✓	✓							✓	✓
Malvaceae	*	*Sida* sp. *rhombifolia*?					✓									✓	
Malvaceae		*Sida subspicata*				✓											
Meliaceae		*Owenia acidula*	Emu Apple							✓							
Mimosaceae		*Acacia* sp. (QLD Herb)	Prickley Acacia							✓		✓					✓
Mimosaceae		*Acacia* sp. (QLD Herb)	Spiky Acacia Wide Leaf							✓							
Mimosaceae		*Acacia* sp. (QLD Herb)	Spiky Acacia Thin Leaf							✓							
Mimosaceae		*Acacia* sp. (QLD Herb #3)										✓					
Mimosaceae		*Acacia* excelsa												✓			
Mimosaceae		*Acacia harpophylla*	Brigalow					✓			✓	✓	✓	✓	✓	✓	✓
Mimosaceae		*Acacia salicina*	Sally Wattle			✓	✓	✓	✓	✓						✓	
Mimosaceae	*	*Acacia* sp. *farnesiana*?					✓	✓		✓							
Moraceae		*Ficus opposita*	Sandpaper Fig				✓	✓									
Myoporaceae		*Eremophila mitchellii*										✓			✓		
Myoporaceae		*Myoporum debelic*				✓	✓			✓							
Myrtaceae		*Corymbia clarksoniana*				✓	✓	✓		✓							
Myrtaceae		*Corymbia dallachiana*				✓	✓			✓				✓			
Myrtaceae		*Corymbia intermedia*						✓								✓	
Myrtaceae		*Corymbia* sp.				✓	✓										
Myrtaceae		*Corymbia tessellaris*	Morten Bay Ash	✓	✓	✓	✓	✓		✓				✓		✓	
Myrtaceae		*Eucalyptus cambageana*									✓	✓			✓		✓
Myrtaceae		*Eucalyptus camaldulensis*					✓										
Myrtaceae		*Eucalyptus crebra*	Narrow-Leaved Ironbark			✓											
Myrtaceae		*Eucalyptus orgadophila*	Mountain Coolabah											✓			

Family		Species	Common Name	Vegetation Unit													
				1	2	3	4	5	6	7	8	9	10	11	12	13	14
Myrtaceae		*Eucalyptus populnea*	Popular Box	✓	✓	✓	✓	✓	✓	✓	✓	✓					
Myrtaceae		*Eucalyptus tereticornis*	River Red Gum	✓	✓	✓	✓	✓	✓							✓	
Myrtaceae		*Eucalyptus tereticornis* X *platyphylla*												✓			
Myrtaceae		*Melaleuca bracteata*					✓										
Myrtaceae		*Melaleuca linariifolia*					✓										
Oleaceae		*Jasmine* sp.								✓							
Orchidaceae		*Cymbidium canaliculatum*	Black Orchid			✓		✓						✓			
Papaveraceae	*	*Argemone ochroluca*	Prickly Poppy				✓	✓									
Philesiaceae		*Eustrephus latifolius*	Wombat Berry			✓	✓	✓									
Poaceae		*Aristida* sp.	White Spear Grass			✓	✓			✓							✓
Poaceae	*	*Cenchrus ciliaris*	Buffel Grass	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Poaceae		*Chloris divaricata*				✓		✓	✓	✓		✓					✓
Poaceae	*	*Chloris* sp. *gayana*?								✓							
Poaceae	*	*Chloris virgata*	Rhodes Grass					✓		✓							✓
Poaceae		*Chrysopogon fallax*						✓									
Poaceae		*Dicanthium sericeum*					✓	✓		✓							✓
Poaceae		*Enneapogon* sp. 1	Button Top Grass							✓		✓					
Poaceae		*Enneapogon* sp. 2				✓											
Poaceae		*Enteropogon acicularis*				✓			✓	✓		✓	✓				✓
Poaceae		*Eragrostis* sp.								✓							
Poaceae		*Heteropogon contortus*	Black Speargrass			✓	✓	✓									
Poaceae		*Heteropogon triticenus*	Giant Speargrass				✓	✓									
Poaceae	*	*Panicum maximum*	Green Panic			✓	✓	✓	✓	✓							
Poaceae		*Setaria* sp.															✓
Poaceae		*Sporobolus caroli*	Fairy Grass			✓	✓			✓		✓					✓
Poaceae		*Sporobolus* sp. (QLD Herb)															✓
Poaceae		*Thellungia advena*											✓				
Poaceae		*Themeda* sp.						✓									
Poaceae		*Themeda triandra*	Kangaroo Grass				✓	✓						✓			

Family		Species	Common Name	Vegetation Unit													
				1	2	3	4	5	6	7	8	9	10	11	12	13	14
Portulacaceae		*Portulaca* sp.								✓		✓			✓		
Rhamnaceae		*Ventilago viminalis*										✓					
Rubiaceae		*Canthium oleifolium*												✓			
Rutaceae		*Citrus glauca*								✓		✓				✓	✓
Rutaceae		*Flindersia* sp.								✓	✓	✓				✓	✓
Santalaceae		*Santalum lanceolatum*	False Sandalwood									✓					
Sapindaceae		*Alectryon oleifolius*								✓		✓	✓				
Sapindaceae		*Atalaya hemiglauca*	White Wood							✓							✓
Solanaceae		*Nicotiana* sp.					✓										
Tiliaceae		*Grewia latifolia*	Dog's Balls	✓	✓	✓	✓	✓	✓	✓				✓			
Tiliaceae		*Grewia retusifolia*					✓										
Verbenaceae	*	*Lantana camara*	Lantana			✓	✓	✓								✓	
Vitaceae		*Cissus* sp.										✓					✓
Xanthorrhoeaceae		*Lomandra longifolia*						✓									
Xanthorrhoeaceae		*Lomandra* sp.	Long-Leafed Matrush					✓									
		Unknown species (QLD Herb #2)						✓									

Appendix 3 Photographic representation of each vegetation unit



Vegetation type 3



Vegetation type 4



Vegetation type 5



Vegetation type 6



Vegetation type 7



Vegetation type 9



Vegetation type 10



Vegetation type 11



Vegetation type 12



Vegetation type 13



Vegetation type 14

Appendix 4 Fauna site photographs



Fauna site GRS



Fauna site BRG



Fauna site PBX



Fauna site MBA



Fauna site FRG





Dam at Olive Downs

Appendix 5 ANABAT Analysis Report

Ecological Management Services Pty Ltd
ABN 98 084 304 110
P.O. Box 580
Coolum Beach
QLD 4573
Telephone: 07 5446 5333
Enquires: Paul Barden
Email: e_m_s@optusnet.com.au

Re: Analysis of Anabat Recordings from Olive Downs, Central Queensland

Site 1: Grassland. Date: 18/8/04 Time: not recorded.

No sequences.

Site 2: Brigalow Regrowth. Date: 18/8/04 Time: not recorded. Kevin & Rob

No sequences.

Site 3: Poplar Box. Date: 18/8/04 Time: not recorded. Kevin & Rob

1 short poor quality sequence, no calibration tone.

Site 4: Forest Red Gum. Date: 19/8/04. Time: 1930hrs

2 sequences. One with no calibration tone, one with insufficient cal tone to calibrate call.

1. Characteristic frequency (CF) ~40kHz: falls within the group of calls that cannot be confidently separated using the anabat system, but may include *Scotorepens greyii*, *Scotorepens sanborni* , *Chalinolobus picatus* and *Chalinolobus nigrogriseus*.

2. Possible *Chalinolobus picatus* (Cp) but without calibration difficult to be sure. The call has pulses that alternate in frequency and are slightly above 40 kHz and are characteristic of Cp, but the sequence is relatively short and of poor quality. If it was properly calibrated it could also fall within the group that calls @ ~40 kHz and may also include *Scotorepens greyii*, *Scotorepens sanborni* and *Chalinolobus nigrogriseus*.

Site 5: Moreton Bay Ash. Date: 19/8/04. Time: 2130hrs

1 sequence. Again, possible Cp as the CF is above 40kHz and the pulses are alternating. However there is no calibration tone, and the sequence short.

Site 6: Waterhole. Date: 23/08/04. Time: 45mins

Most bat activity recorded at this site, with ~60 sequences taken from the tape. Most common call types were *Mormopterus* sp. 2. Species potentially present include:

1. Eastern Freetail Bat (*Mormopterus* sp.2 in Adams et al. 1988). A few reasonable calls with (mostly) flat pulses at 33 - 35 kHz.

2. Gould's Wattled Bat (*Chalinolobus gouldii*) Cg. Some good sequences recorded, curvilinear pulse with alternating frequency, CF around 30 kHz.

The remaining species are unconfirmed:

3. Beccari's Freetail Bat (*Mormopterus beccarii*) Mb. Two short sequences with pulse shape and frequency characteristic of Mb, however the call sequences are of limited duration and quality. These calls can probably be attributed to Mb but better calls would be required to make a positive identification. These type of calls can also be confused with those of *Taphozous georgianus* when Tg shifts out its flatter search phase.

4. *Taphozous georgianus* (Tg): 1 sequence with a flat call @ ~22 to 23 kHz, possible Tg but could not confirm from a single call.

5. Group of calls with CF between 35 and 40 kHz. There are number of calls from this site which fall into this category and cannot be attributed to a particular species. Species that fall with this range include *Chalinolobus picatus, Scotorepens greyii*, *Scotorepens sanborni* and *Chalinolobus nigrogriseus*. At least one of the calls is above 40 kHz and is possible a Cp call.

Regards,

Paul A. Barden

Principal Environmental Scientist

Ecological Management Services Pty Ltd

TECHNICAL REPORT

Geochemical Assessment of Mine Waste

Moorvale South

Prepared for: Peabody Energy Australia

MINE WASTE AND
WATER MANAGEMENT

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TECHNICAL REPORT

Geochemical Assessment of Mine Waste

Moorvale South

Prepared for: **Peabody Energy Australia**

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Glossary of terms and acronyms

Acidity	A measure of hydrogen ion (H+) concentration; generally expressed as pH. Dissolved metals in solution can also contribute to the magnitude of the acidity measurement when measured as part of a titration (in units of mg/L $CaCO_3$ equivalent).
ABA	Acid Base Account. Evaluation of the balance between acid generation and acid neutralisation processes. Determines the maximum potential acidity (MPA) and the inherent acid neutralising capacity (ANC), as defined below.
ALS	Australian Laboratory Services.
AMD	Acid and metalliferous drainage from mine waste materials characterised by low pH, elevated metal concentrations, high sulfate concentrations and high salinity.
ANC	Acid Neutralising Capacity expressed as kg H_2SO_4 per tonne of sample. A measure of a sample's maximum potential ability to neutralise acid.
ANC:MPA	The ratio of the acid neutralising capacity to the maximum potential acidity of a sample. Used to assess the risk of a sample generating acid conditions.
AS	Australian Standards
CHPP	Coal Handling and Preparation Plant
DES	Department of Environment and Science
EC	Electrical Conductivity, expressed as µS/cm.
FIMS	Flow Injection Mercury System.
GAI	Geochemical Abundance Index
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
ICP-AES	Inductively Coupled Plasma Atomic Emission Spectrometry.
INAP	International Network on Acid Prevention
Interburden	The material found in between ore layers and considered to be of low economic value (i.e., a type of waste material).
KLC	Kinetic Leach Column. Leaching setup that generates time-dependent data on the kinetics and rate of acid generation and acid neutralising reactions under laboratory controlled (or onsite conditions)
LoR	Limit of Reporting. Laboratory detection limit for the reporting of results for a particular geochemical test.
MPA	Maximum Potential Acidity. Calculated by multiplying the total sulfur or sulfide-sulfur (Scr) content of a sample by 30.6 (stoichiometric factor) and expressed as kg H_2SO_4 per tonne.
NAF	Non-Acid Forming. Geochemical classification criterion for a sample that will not generate acid conditions.
NAF - Barren	Non-Acid Forming and barren of sulfur (i.e., less than or equal to 0.1 % sulfur).
NAPP	Net Acid Producing Potential, expressed as kg H_2SO_4 per tonne. Calculated by subtracting the ANC from the MPA.
Overburden	The waste rock material found overlying the first ore horizon within the stratigraphic profile.
PAF	Potentially Acid Forming. Geochemical classification criterion for a sample that has the potential to generate acid conditions.

PC Titrator	Potentiometric Compact Titrator. PC Titrators are specially designed for routine applications and simple operation, allowing basic titration analysis from a single device.
pH	A measure of hydrogen ion (H^+) concentration.
PRCP	Progressive Rehabilitation and Closure Plan
ROM	Run-of-Mine
SO_4^{2-}	Sulfate.
Static test	Procedure for characterising the geochemical nature of a sample at a single point in time. Static tests may include measurements of mineral and chemical composition of a sample and the acid base account.
TS	Total sulfur content of a sample generally measured using a 'LECO' analyser expressed as total sulfur %.
w:v	Weight to volume ratio.

1 Introduction

RGS Environmental Consultants Pty Ltd (RGS) was requested by AARC Environmental Solutions Pty Ltd (AARC) on behalf of Peabody Energy Australia (Peabody) to complete a geochemical assessment of mine waste materials from the Moorvale South Project (the Project).

The Project is an open-cut coal mine and will use conventional open-cut mining methods. Relevant site infrastructure includes in-pit and out-of-pit waste rock dumps and a run-of-mine (ROM) coal pad. Waste rock will be progressively placed within the in-pit and out-of-pit emplacement areas.

Coal will be transported from the Project ROM pad to the Moorvale Mine coal handling and preparation plant (CHPP) Mine to the north of the Project, for beneficiation. Coal reject (coarse reject and tailing) materials generated from washing and processing coal at the Moorvale CHPP will be managed at that site and will comprise a small fraction (< 2 %) of the volume of waste generated at that site.

AARC is currently developing a Progressive Rehabilitation and Closure Plan (PRCP) for the Project. This RGS technical report has been developed to meet the outcomes specified in the PRCP Guideline for waste characterisation to support the development of the PRCP for the Project.

1.1 Project description

1.1.1 Project overview

The Project is located in the northern Bowen Basin, south of the established Moorvale Mine, approximately 20 km south of Coppabella, 30 km south-east of Moranbah, and 50 km north of Dysart (**Figure 1-1**). The Project covers two mining leases and will be operated by the Moorvale Mine.

The Project will comprise multiple open pits with mining beginning in the south-west of the Project area before advancing north. A separate smaller pit in the north of the Project area is planned later in the mine life. Waste rock will initially be placed in out-of-pit dumps when mining commences with in-pit dumps to be established as mining progresses.

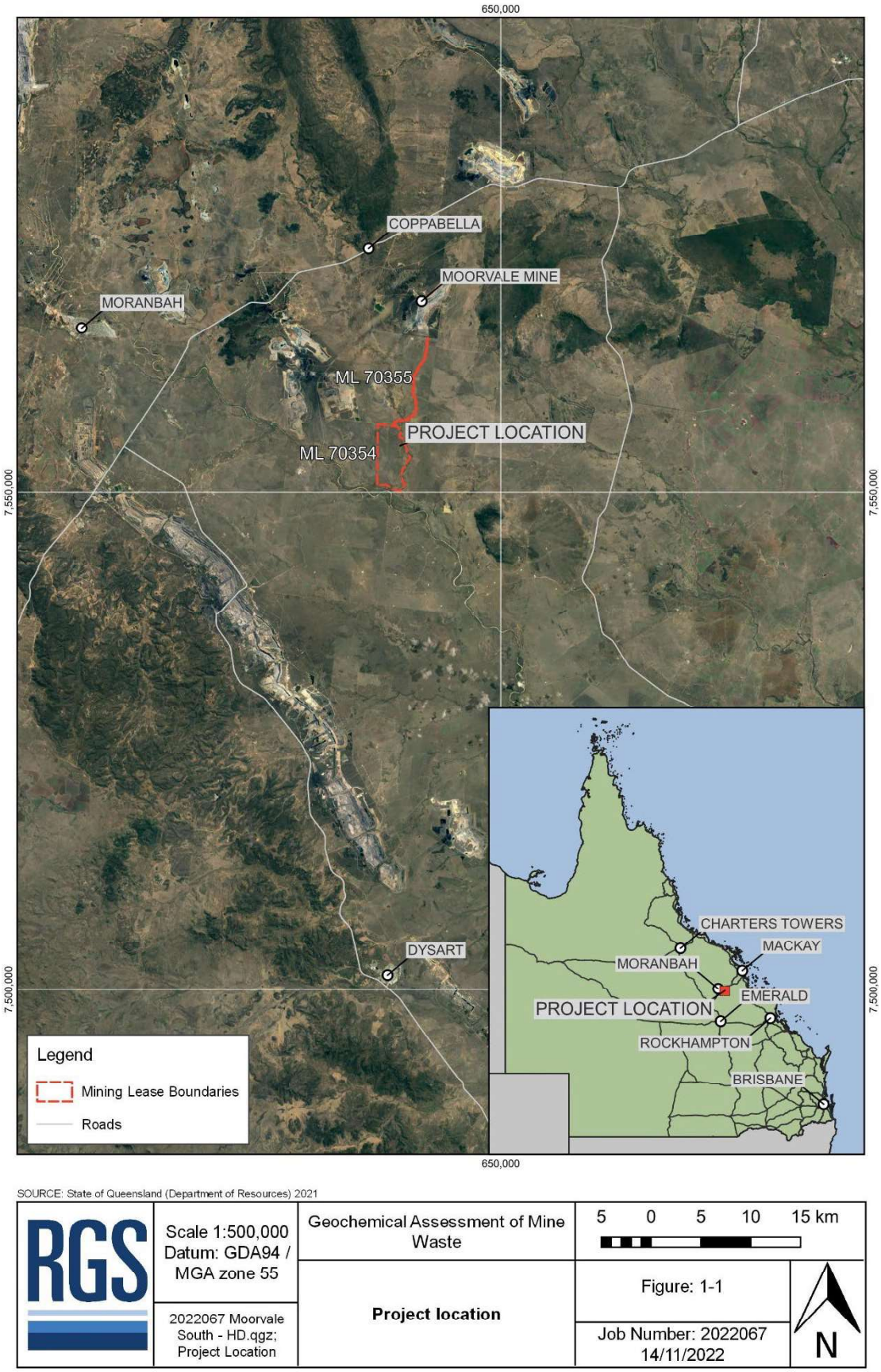


Figure 1-1: Project location

1.2 Project geology

1.2.1 Regional geology

The Bowen Basin formed as a result of plate convergence during the Permian and Triassic periods and contains up to 10,000 m of sediment in parts. Initiation in the Early Permian deposited rift related volcanics, sediments and coal seams that were buried by relatively uniform marine sediments across the Bowen Basin during the mid to late Permian. In the Latest Permian, coastal systems migrated in from the margins allowing peat to form. The environment in the Nebo Synclinorium during this time was progressively deltaic to alluvial sands and silts covered by extensive peatlands. The resulting coal seams of the Blackwater Group are renowned for their extent and continuity and support numerous mining operations in the Bowen Basin producing premium export coal (Peabody, 2022).

There are three formations in the Blackwater Group; the progressively younger Moranbah Coal Measures (MCM), Fort Cooper Coal Measures (FCCM) and Rangal Coal Measures (RCM). The MCM host numerous mines in the western Nebo Synclinorium but are generally found at depth in the east and little is known about this formation in this area. The regional geological setting showing the location of Coppabella, Moorvale and Moorvale South is provided in **Figure 1-2**.

The FCCM contain numerous tuff beds preserving volcanic ash-fall deposits both within the coal seams and interburden. While several thick seams of coal are found in the FCCM, the high inherent ash makes them currently uneconomic as mining targets. The exception is the Vermont Lower 1 (VL1) seam package which is occasionally mined in the Nebo Synclinorium when it directly underlies the target seams of the RCM.

The boundary between the FCCM and the RCM is taken at the regionally extensive Yarrabee Tuff (YT), which gives a high gamma response in downhole geophysics and is the youngest of the numerous tuffs in the FCCM. The overlying RCM are essentially free of tuff, making the YT a useful marker horizon for seam correlations.

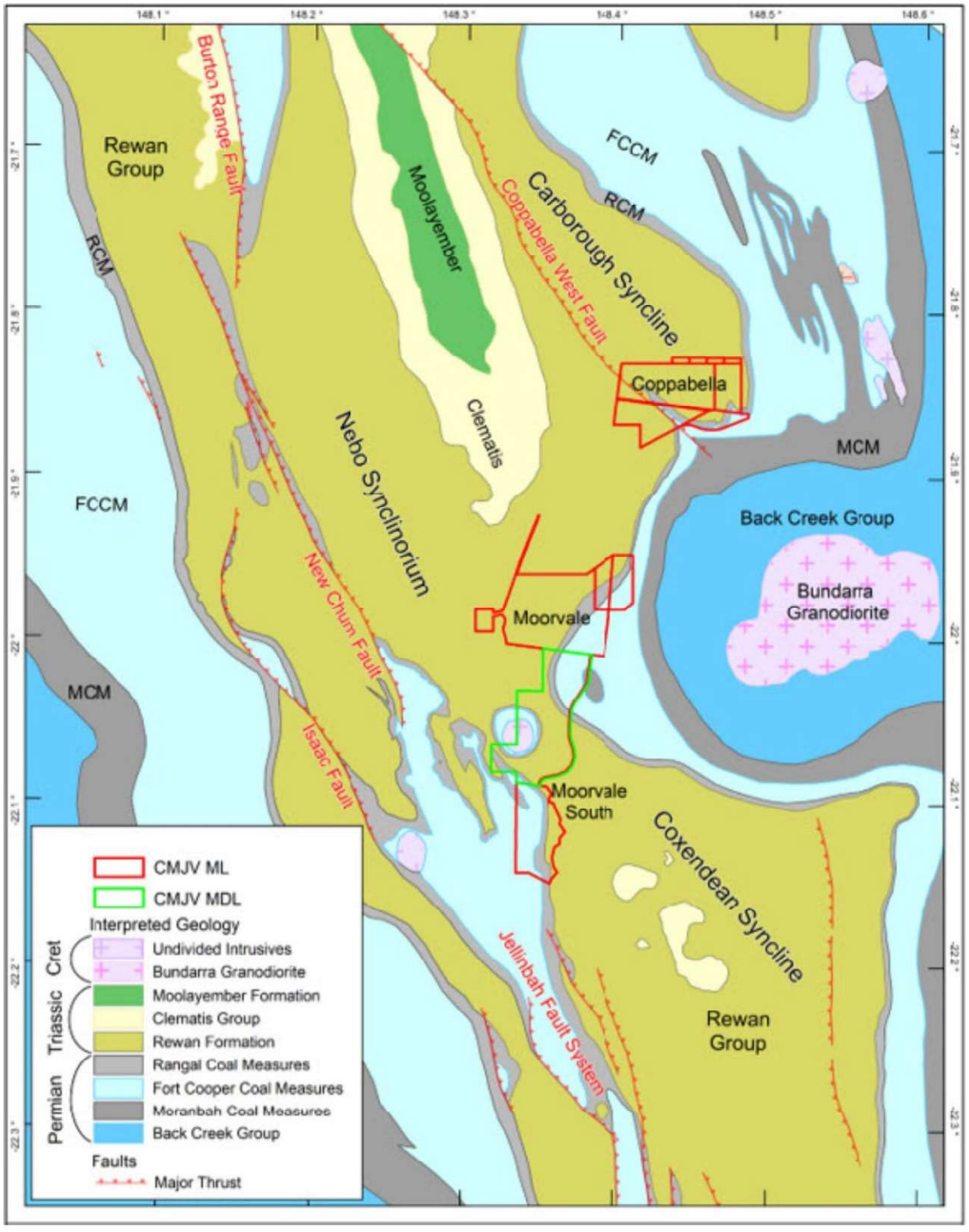
Individual coal seams are often traceable over tens of kilometres although splitting and coalescing are common on a regional scale (Sliwa et al. 2017). Thinner seams are generally less extensive being locally prone to thinning or ‘carbing’ out, particularly the uppermost Permian coal seam, the Phillips Seam, which is commonly used to define the top of the RCM.

Peat production was terminated at the Permo-Triassic boundary which is interpreted to lie immediately above the coal seams of the RCM. An increasingly arid climate during the final stages of the Permian resulted in high percentages of inertinite in the RCM seams, with the consequently lower vitrinite contents producing a coal with poorer metallurgical qualities than those of the underlying formations. Seams in the RCM show a dulling upward trend that may be associated with global climate change at this time. The overlying Triassic Rewan Group is characterized by a lack of coal seams and has a wider distribution than the Blackwater Group sediments, extending across the entire Bowen Basin and into the Galilee Basin to the west.

Deposition in the Bowen Basin ended around 230 million years ago when thrusting and folding propagated from the east caused uplift and deformation of the sediments. The resulting Jellinbah Fold and Thrust Belt (JFTB) can be traced across the Bowen Basin striking north-west through the centre of the Nebo Synclinorium. Folding and faulting is more pronounced in the east forming a series of sub-ordinate synclines and thrust faults sub-parallel to the major thrust belt.

Relaxation allowed deposition of the Jurassic-Cretaceous Surat Basin over most of the Bowen Basin however, erosion has since removed the northern and eastern sections and the original extent of the Surat Basin is unknown. Burial of the coal seams during this period raised the rank of the coal to low volatile bituminous with reflectance in the order of 1.6 – 1.8.

Intrusion of granitic plutons also occurred in the Cretaceous with a prominent example (the Bundarra Granodiorite) outcropping between the Moorvale and Moorvale South areas. Coal seams in the vicinity of these intrusions are often cindered. Fluid flow associated with emplacement of the Bundarra Granodiorite is suspected to be responsible for the high levels of phosphorous in the surrounding coal seams, but the link has yet to be definitively proved.



Source: Peabody Energy Corporation

RGS	Datum: WGS 84	Geochemical Assessment of Mine Waste		
	2022067 Moorvale South - HD.qgz; Regional Geology	**Regional geological setting**	Figure: 1-2 Job Number: 2022067 05/12/2022	N

Figure 1-2: Regional geological setting (Source: Peabody, 2022)

Uplift and erosion during the Tertiary Period exposed the Permian coals across the Bowen Basin although they are often covered by a veneer of more recent silts, sands, gravels and clays. Extensive volcanic activity along the east coast of Australia during this time introduced basaltic intrusions and eruptions, which have locally altered the coal seams and occasionally covered them with thick sequences of basalt.

1.2.2 Local geology

The Coppabella, Olive Downs, Moorvale and Moorvale South mines all target the RCM in the east of the Nebo Synclinorium. The coal seams in this formation are laterally extensive, forming numerous thin seams that occasionally coalesce into thicker seams. The geological models are constructed from sub-units known as plies which may be individual seams in some areas, or parts of thicker seams in others.

The Moorvale South tenements (formerly known as Olive Downs North) cover an area of the Nebo Synclinorium where the geological structure is dominated by a series of Cretaceous intrusions formed along an east-northeast trending lineament. The westerly dipping seams of the Moorvale deposit strike southwards through MDL 3034 following the arcuate trend around the eastern Bundarra Igneous Complex intrusions, significantly narrowing the main syncline. Several smaller intrusions are inferred to the west including the Daunia intrusion which forms a ring-like structure in the southwest of MDL 3034. The proposed initial mining area is located further south on ML 70355, along the western limb of the Coxendean Syncline where the seams dip to the east between 5° and 20°. Localised intrusions have been encountered through exploration drilling within the Leichardt and Vermont seams in this area, causing the seam to be heat-affected and partially replaced by the intrusion (Peabody, 2022).

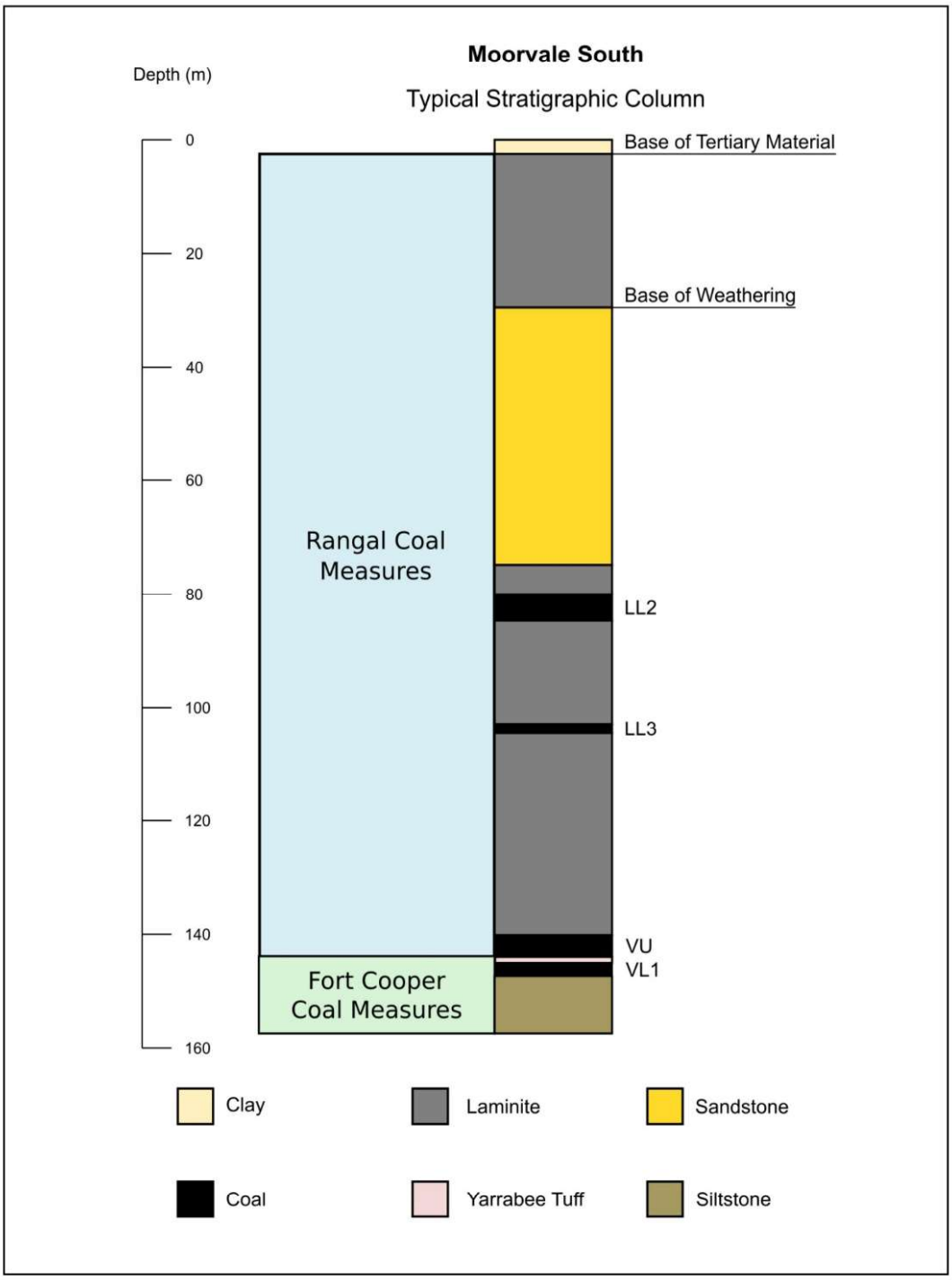
The Project area features a series of faults interpreted from drilling information, geophysical surveys and geological modelling. Interpreted project area thrust faulting is generally observed to trend northwest-southeast and possess displacements of up to ≥ 30 m.

Identified coal resources are predominantly hosted in the Leichhardt Seam package with lesser contributions from the Vermont Seam. A typical stratigraphic section at Moorvale South is provided in **Figure 1-3**. Within ML 70354, the Leichhardt Seam package occurs as 2 seams; the LL2 and LL3, and the Vermont Seam package comprises the VU of the RCM and the VL1 of the FCCM. The LL2 is composed of the LL2T and LL2B plies, which together range from 2.8 to 4.8 m thick. The coal is generally banded with the proportion of bright to dull bands increasing towards the base. The LL3 comprises interbedded carbonaceous mudstone and bright coal bands, ranging from 1.0 to 1.6 m thick averaging 1.5 m.

The Vermont Seam occurs approximately 40 m below the LL3 and comprises the Vermont Upper (VU) and Vermont Lower (VL) separated by the Yarrabee Tuff (YT). The VU is further divided into a dull, upper ply (VU1) and brighter lower plies (VU2 and VU3). The combined VU ranges from 2.5 to 3.7 m thick and is heavily intruded and cindered in the southern half of ML 70354. The VL seam is also divided into 3 plies; an upper, banded coal (VL1) and 2 lower, stony coals (VL2 and VL3). The VL1 averages 1.3 m thick and is the only FCCM ply contributing to the Moorvale South resource in the Y-pit and Y-pit North areas only.

1.3 Purpose of the report

The purpose of this geochemistry assessment is primarily to characterise geological waste rock units that will be mined from open pits and coal reject materials that will be generated from processing target seams at the Moorvale CHPP, using static and kinetic geochemical testing methods. The sampling and geochemical test program was developed taking into account knowledge of other similar mines in this area of the Bowen Basin (e.g., Olive Downs and Coppabella). Based on the characterisation results, the materials have been classified as potentially beneficial (e.g., Non-Acid Forming (NAF)) or deleterious (e.g., Potentially Acid Forming (PAF)) to assign a suitable use for each unit/material, where appropriate. For example, fresh NAF rock could be used for construction or sheeting roads. Transitional material could be used for embankments or as fill to lift infrastructure above flood plains. Highly weathered material could potentially be used as a growth medium for rehabilitation. The outcome of the program of work will assist in the development of a financially viable and environmentally robust management strategy for mine waste materials as an integral component of the PRCP developed for the Project.



Source: Peabody Energy Corporation

RGS		Geochemical Assessment of Mine Waste	
	2022067 Moorvale South - HD.qgz; Stratigraphy	**Typical stratigraphic section**	Figure: 1-3 Job Number: 2022067 06/12/2022

N

Figure 1-3: Typical stratigraphic section (Source: IMC, 2014)

1.4 Objective

The objective of the program of work described herein was to provide a stand-alone technical document that:

- Demonstrates that the sampling regime meets best practice standards, is spatially representative of all material being mined, and representative of all lithologies;
- Classifies mine waste materials based on environmental risk and management requirements;
- Is suitable for use in block modelling and to estimate the volume of mine waste materials based on waste classification type; and
- Provides recommendations for the management and mitigation of mine waste materials to manage environmental risk and achieve proposed rehabilitation methods and objectives.

1.5 PRCP requirements

The need to comply with the PRCP requirements has influenced the program of work completed for the Project. It is understood that the geochemical report will be incorporated into a PRCP for the Project.

In the PRCP guideline (DES, 2021a), geochemical and chemical analysis is referenced on pages 18, 27, 28, 29, 30 and 66.

For the PRCP, the number of samples needed to inform life of mine planning decisions varies, and is (in part) a subjective process that considers:

- Volume of mine waste being produced;
- Number of open pits being mined;
- Depth of open pits;
- Variation in soil types and regolith properties;
- Variability of the geochemical and physical properties of each rock type within and between open pits;
- Number of major rock types; and
- Mining method.

Whilst coal reject (coarse and fine) materials will not be produced on site, these materials will be generated from processing the target seams at Moorvale CHPP and therefore should also be geochemically characterised as part of this geochemical assessment program.

To address PRCP Guideline requirements, RGS has reviewed the waste rock geochemical sampling and analytical program undertaken by Peabody in February 2022 to ensure there is adequate coverage within the pits to characterise and classify and each major lithological or stratigraphic unit in the waste rock (overburden and interburden), as well as coal roof and floor units. Additional samples of coal and coal reject materials were also sourced from the Moorvale CHPP, when coal seams mined at Moorvale South were being batch processed.

The need for comprehensive **geochemical** testing is clearly defined in the PRCP Guideline i.e., the waste characterisation report should achieve the following outcomes:

- Sampling regime meets best practice standards, is spatially representative of all material being mined (i.e., the coal seams, exposed pit walls and overburden) and representative of all lithologies;
- Be capable of confidently classifying mine waste streams (waste rock and coal reject materials) based on environmental risk and managements requirements;
- Be capable of generating block models and estimating the volume of mine waste based on waste type (i.e., level of environmental risk); and,
- Provide recommendations for the management and mitigation of mine waste streams to manage environmental risk and achieve proposed rehabilitation methods and objectives.

1.6 Scope of work

The scope of work for the Project was designed to address relevant considerations in the Department of Environment and Science's technical guideline 'Progressive rehabilitation and closure plans guideline (DES 2021).

The scope of work was also completed to address relevant considerations in Australian (ACARP, 2008; COA, 2016a,b,c; DME, 1995; DEHP, 2013; DES, 2014; and International (INAP, 2022) technical guidelines for the mining industry and included:

1. Review of the existing geological and geochemical and reports and recent geochemical analysis results for waste rock from the Project;
2. Development of a sampling, and static and kinetic geochemical analysis program for representative samples of coal and coal reject materials to be generated at the Project;
3. Completion of the static, and commencement of the kinetic, geochemical analysis of representative samples of coal and coal reject materials;
4. Preparation of a stand-alone technical report (this report) detailing the findings of the geochemical analysis program to date and identifying appropriate management measures within the context of rehabilitation of waste rock and coal reject materials;
5. Completion of the kinetic geochemical analysis of the coal and coal reject samples collected; and,
6. Updating the stand-alone technical report to incorporate the findings of the kinetic geochemical testing program, when available.

2 Methodology

2.1 Sample collection

2.1.1 Drilling program

The geochemical characteristics of mine materials potentially intended for use in mine infrastructure and rehabilitation need to be sufficiently understood to ensure performance according to operational and mine closure planning expectations. Based on the PRCP guideline (pg. 30), the sampling density, should:

"Demonstrate that the sampling regime meets best practice standards, is spatially representative of all material being mined (i.e., the ore body, exposed pit walls and overburden etc.) and representative of all lithologies"

"Identify the physical and chemical properties of rock material that could be removed, disturbed or exposed to oxidisation through the mining activities."

It should also (pg. 31):

"Be capable of generating block models and estimating the volume of mine waste based on waste type (i.e., level of environmental risk)."

RGS was provided static geochemical results from a waste rock sampling program undertaken by Peabody in late 2021. The results for 81 drill chip samples (covering 3 to 5 m depth intervals) from five drill holes across the Project were received. The samples ranged in depth from near surface to 135 m below ground level. The collar locations of the sampled drill holes relative to the boundaries of the existing and planned pit areas are shown in **Figure 2-1**.

2.1.2 Coal and coal rejects

Coal and coal reject samples (comprising coarse reject and fine reject (i.e., tailing) materials) from a coal batch representing some of the target seam plys being processed from the Project (i.e., the Vermont seam) were collected by Peabody personnel from the Moorvale Mine CHPP. Six bulk (20 kg) samples of each material were collected over a 36-hour period (one sample every six hours) to provide a total of 18 samples for characterisation.

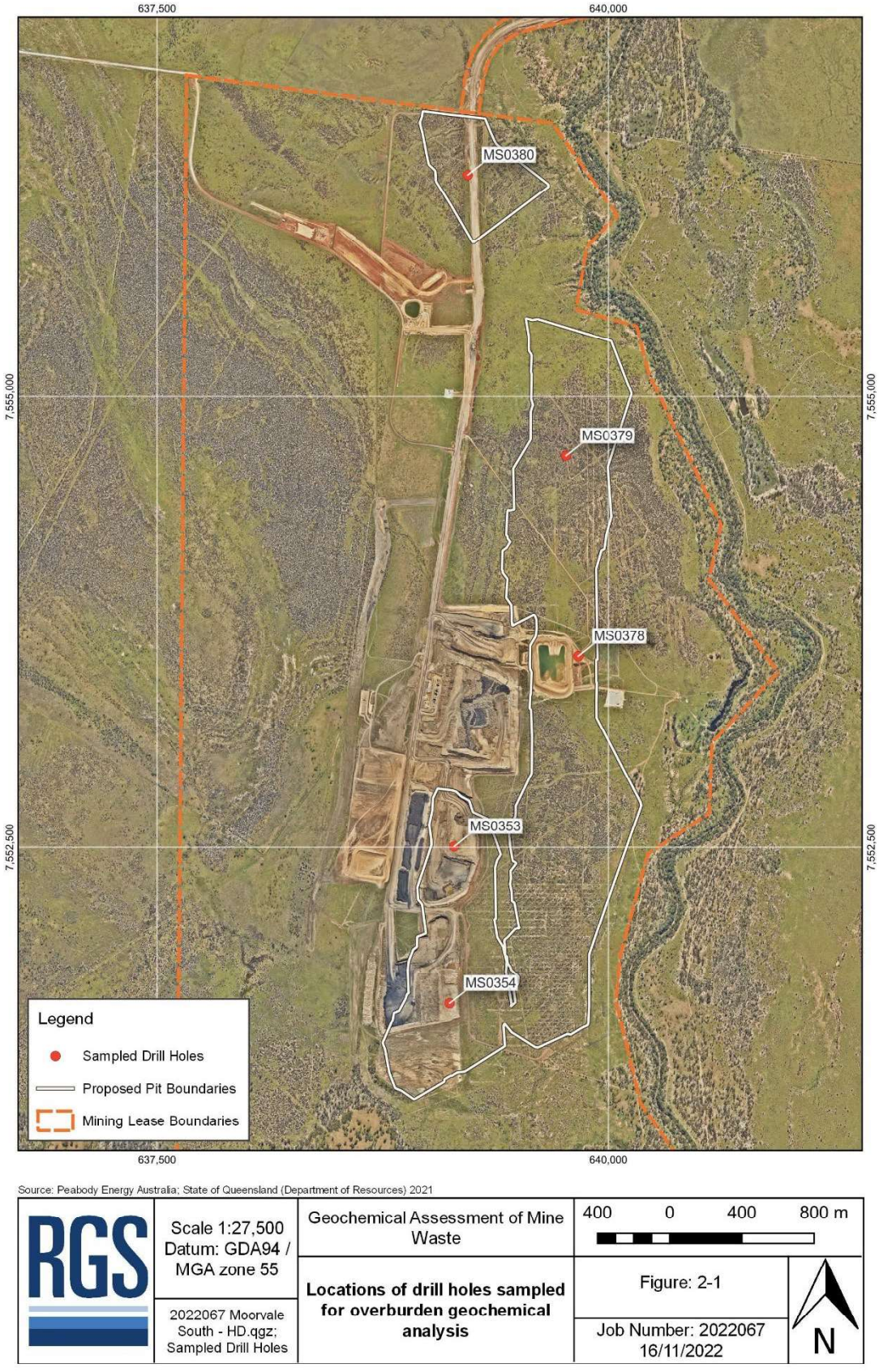


Figure 2-1: Locations of drill holes sampled for overburden geochemical analysis

2.2 Analytical program

A program of static and kinetic geochemical tests was completed to assess the geochemical characteristics of the waste rock, coal and coal reject materials that will be generated by the Project.

2.2.1 Waste rock

2.2.1.1 Acid Base Account

A series of static geochemical tests were completed by Australia Laboratory Services (ALS) in Stafford Queensland on 81 representative waste rock samples. The geochemical test program was designed to assess the degree of risk from the presence and potential oxidation of sulfides, acid generation, and the presence/leaching of soluble metals/metalloids and salts. A summary of the parameters involved in geochemical assessment of mining materials is provided in **Attachment A**.

The Acid Base Account was used to determine the acid-neutralising and acid-generating characteristics of the 81 sample materials. The ABA program included static geochemical tests for the following parameters:

- pH (1:5 sample:water (w:v)) [AMIRA, 2002];
- Electrical Conductivity (EC) (1:5 sample:water (w:v)) [electrometric];
- Total sulfur [High temperature combustion method]; and,
- Acid Neutralising Capacity (ANC) [Sobek method].

From the total sulfur and ANC results, Maximum Potential Acidity (MPA) and Net Acid Producing Potential (NAPP) values were calculated. The sample MPA was calculated using the total sulfur data. NAPP values were calculated using the MPA value balanced against the ANC.

The waste rock samples also underwent Net Acid Generation (NAG) tests to provide a direct assessment of the potential for a material to produce acid after a period of exposure and weathering. The standard NAG test involves the oxidation of sulfides within a sample material and subsequent neutralisation by inherent neutralising minerals (e.g. calcite) using an oxidising hydrogen peroxide (H_2O_2) solution buffered to pH 4.5 (AMIRA, 2002). The intent is to oxidise all inherent sulfides with the potential to contribute to the MPA of the sample and to consume all the available inherent ANC. The standard NAG test is generally used to further investigate and verify the NAPP results from selected sample materials (AMIRA, 2002).

The results of the Acid Base Account tests for the waste rock samples are discussed in **Section 3.1.1**.

2.2.1.2 Multi-element testing

The 81 waste rock samples were also submitted for multi-element testing. It should be noted that the total elemental or content in a sample does not infer that the elements will be susceptible to environmental mobility but provides an indication of any elemental enrichment. The total metal and metalloids analysis involves a 2-acid digestion method using a 1:1 ratio of hydrochloric acid (HCl) and nitric acid (HNO_3), followed by trace element analysis by ICP-MS. This incomplete digestion is applicable to environmental applications as it does not dissolve the entire silicate matrix or other extremely resilient minerals, such as zircon.

Analyses:

- Total cations (Ca, Mg, K, Na, Al, and Fe) [HCl and HNO_3 acid digest followed by ICP-AES]; and,
- Total metals/metalloids (As, B, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Pb, Sb, Se, Th, U, V, and Zn) in solids [HCl and HNO_3 acid digest followed by ICP-MS / -AES].

The results of the multi-element testing for the waste rock samples are discussed in **Section 3.3**.

2.2.2 Coal and coal reject

2.2.2.1 Acid Base Account

A total of 18 coal and coal reject (6 coal, 6 coarse reject, and 6 tailing) samples were submitted to ALS for Acid Base Account testing. The geochemical test program was designed to assess the degree of risk from the

presence and potential oxidation of sulfides, acid generation, and the presence/leaching of soluble metals/metalloids and salts.

The Acid Base Account was used to determine the acid-neutralising and acid-generating characteristics of the 18 samples. The ABA program included static geochemical tests for the following parameters:

- pH (1:5 sample:water (w:v)) [AMIRA, 2002];
- EC (1:5 sample:water (w:v)) [electrometric];
- Total sulfur [High temperature combustion method];
- Sulfide sulfur (Chromium Reducible Sulfur (Scr)) [Australian Standard AS 4969.7, 2008 method]; and
- Acid Neutralising Capacity (ANC) [Sobek method].

From the sulfur and ANC results, MPA and NAPP values were calculated. The sample MPA was calculated using the sulfide (Scr) data. The Scr test provides a more accurate representation of the MPA that could be generated from a sample material, as acid generation primarily forms from the reactive sulfide content measured by this method. NAPP values were calculated using the MPA value balanced against the ANC.

The results of the Acid Base Account tests for the coal and coal reject samples are discussed in **Section 3.2.1**.

2.2.2.2 Multi-element testing

Based on the results of the static geochemical tests received and interpreted by RGS, six composite samples of coal, coarse reject, and tailing materials (two coal, two coarse rejects, and two tailing composite samples) were prepared from the original 18 individual samples and subjected to multi-element analysis. The individual samples used to make each composite is shown in **Table B1** (**Attachment B**). The six composite samples were selected based on material type and static geochemical characteristics and tested for:

- Total metals/metalloids: (Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, Th, U, V, Zn) [HCl and HNO_3 acid digest followed by FIMS and/or ICP-AES/MS]; and,
- Total cations (Ca, Mg, Na and K) [HCl and HNO_3 acid digest followed by ICP-AES/MS].

Additionally, the solubility and mobility of metals/metalloids within the coal, rejects, and tailings samples are tested by shake flask extractions at a 1:5 w:v ratio for 16 hours, followed by analysis by ICP-MS/AES. Composite samples used in these tests are summarised in **Table B1** (**Attachment B**).

Water solubility results provide an indication of which elements may be susceptible to environmental mobility but are not directly comparable to water quality guidelines. This is because the results are derived from the leachate of single rock samples, which can be influenced by a combination of different physical parameters, such as size fraction, permeability, and temperature.

Analyses:

- Soluble metals/metalloids (Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, Th, U, V, Zn) [ICP-AES/MS and FIMS (1:5 w:v water extracts)];
- Major cations (Ca, Mg, Na and K) [ICP-AES/MS (1:5 w:v water extracts)];
- Major anions (Cl, F and SO_4) [ICP-AES/MS and PC Titrator (1:5 w:v water extracts)]; and,
- Titratable alkalinity and acidity [automatic titrator measured as $CaCO_3$].

The results of the total and water-soluble multi-element tests are discussed in **Section 3.3**.

2.2.2.3 Kinetic leach column testing

Kinetic leach column (KLC) tests simulate the weathering process that leads to acid and base generation and reaction under laboratory-controlled conditions. The kinetic tests allow an assessment of the acid-forming and acid neutralising characteristics and indicate the rate of any acid generation, the period over which it will occur,

and the management controls that may be required. A description of the method used for KLC tests is provided in **Attachment A**.

The results from the static geochemical analyses on individual and composite samples were used to assess appropriate individual and composite samples for KLC testing. Three composite samples (coal, coarse reject, and tailing) were created based on material type and geochemical nature. **Table 2-1** summarises the individual samples that were mixed and used in each column.

The three KLC tests commenced leaching in October 2022 and were subjected to monthly leach cycles over a period of six months (October 2022 to April 2023). The monthly leachate samples were subjected to the following analyses:

- pH and EC;
- Alkalinity and Acidity (as $CaCO_3$) [Automatic titrator];
- Major cations (Ca, Mg, Na and K) [ICP-MS];
- Major anions (Cl, F and SO_4) [Discrete Analyser and PC Titrator]; and
- Soluble metals/metalloids (Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, Th, U, V, and Zn) [ICP-MS/ICP-AES].

Table 2-1: Kinetic leach column test sample composites

KLC	Client ID	Material
KLC 1: Coal	MRV_FEED_20221013_0300	Product Coal
	MRV_FEED_20221013_0900	Product Coal
	MRV_FEED_20221013_1500	Product Coal
	MRV_FEED_20221013_2100	Product Coal
	MRV_FEED_20221014_0900	Product Coal
	MRV_FEED_20221014_1500	Product Coal
KLC 2: Coarse Reject	MRV_Coarse Reject_20221013_0300	Coarse Reject
	MRV_Coarse Reject_20221013_0900	Coarse Reject
	MRV_Coarse Reject_20221013_1500	Coarse Reject
	MRV_Coarse Reject_20221013_2100	Coarse Reject
	MRV_Coarse Reject_20221014_0900	Coarse Reject
	MRV_Coarse Reject_20221014_1500	Coarse Reject
KLC 3: Tailing	MRV_Fine Reject_20221013_0300	Tailing
	MRV_Fine Reject_20221013_0900	Tailing
	MRV_Fine Reject_20221013_1500	Tailing
	MRV_Fine Reject_20221013_2100	Tailing
	MRV_Fine Reject_20221014_0900	Tailing
	MRV_Fine Reject_20221014_1500	Tailing

3 Results

3.1 Waste Rock

3.1.1 Acid Base Account

Acid Base Account results for waste rock are in **Table B1** (**Attachment B)** and summarised in this section.

3.1.1.1 $pH_{(1:5)}$

The $pH_{(1:5)}$ value for the waste rock samples ranges from pH neutral to alkaline (7.5 to 9.8) and is typically slightly alkaline, (median pH 9.3) (**Figure 3-1**). The lowest pH value is associated with a waste rock materials described as carbonaceous mudstone (Sample 75) obtained from drill hole MS0379 at a depth of 55 to 60 m. The pH results indicate that materials represented by the samples tested will add some alkalinity to any contact water as the pH of deionised water used in the pH tests is typically in the range 5.0 to 6.5.

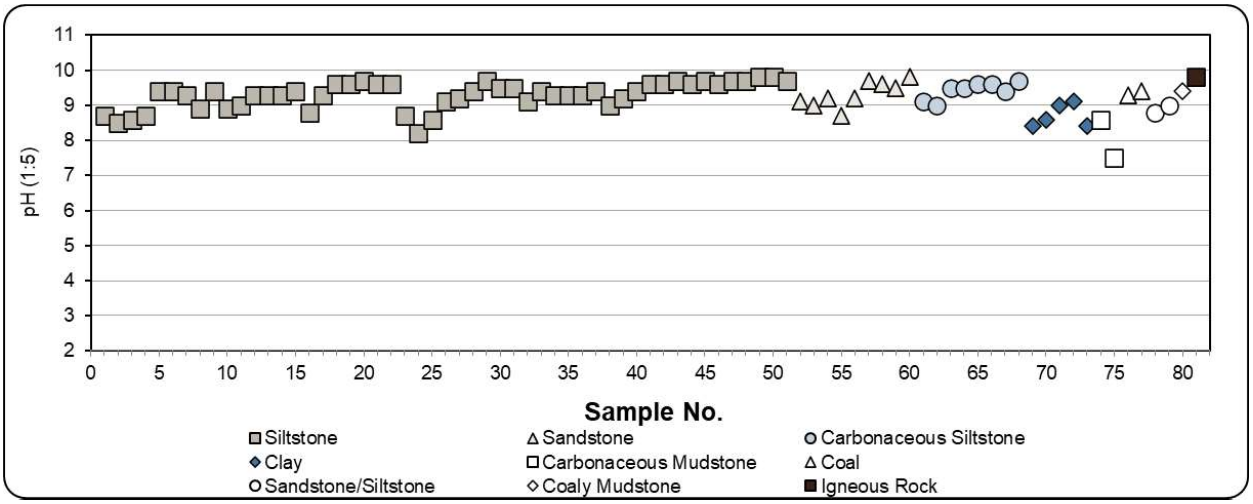


Figure 3-1: $pH_{(1:5)}$ results for waste rock samples

3.1.1.2 Electrical conductivity

The $EC_{(1:5)}$ for the waste rock samples ranges from 407 to 2,240 µS/cm and has a moderate median value of 635 µS/cm (**Figure 3-2**). The highest EC values tend to be associated with weathered overburden materials located at shallower depth in the stratigraphic profile, although a band of higher EC material was also located from 70 to 100 m depth at drill hole MS0379.

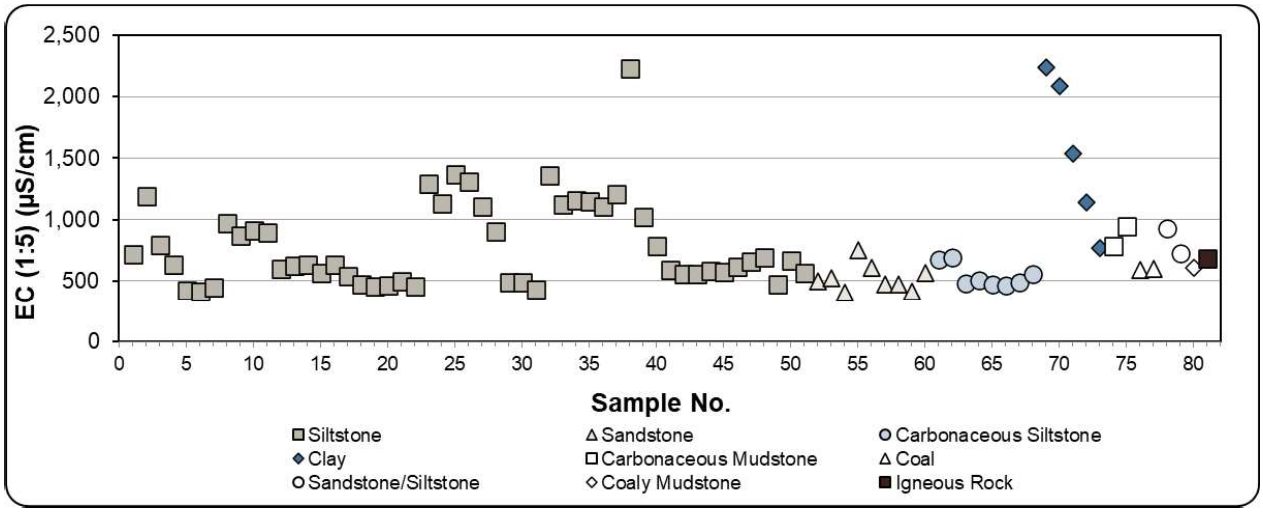


Figure 3-2: $EC_{(1:5)}$ results for waste rock samples

To provide additional context, the $pH_{(1:5)}$ and $EC_{(1:5)}$ results for the waste rock samples are classified against pH and salinity criteria for mining waste materials, as defined by as defined by technical guidelines for the environmental management of exploration and mining in Queensland (DME, 1995) (**Table 3-1**).

Based on the median pH and EC values, the waste rock samples tested are generally regarded as having a 'Very High' soil pH and 'Medium' salinity characteristics, as indicated by the distribution of samples corresponding to each pH and salinity class.

Table 3-1: pH and salinity criteria for assessment of waste rock samples

Waste Rock	Very Low	Low	Medium	High	Very High
$pH_{1:5}$	< 4.5	4.5 – 5.5	5.5 – 7.0	7.0 – 9.0	> 9.0 (Median 9.3)
$EC_{1:5}$ (µS/cm)	< 150	150 – 450	450 – 900 (Median 635)	900 – 2,000	> 2,000

Note: Adapted from DME, 1995. Highlighted cells show the category corresponding to the median pH and EC values for the samples.

The pH and EC tests were completed on pulverised samples (≤ 75 µm) with a large surface area in contact with the leaching solution, thereby providing greater potential for dissolution and reaction, and represent an assumed 'worst case' scenario. It is also expected that the salinity of leachate from low sulfur waste rock materials will diminish with time as salts are flushed from the rock matrix and a state of equilibrium develops. At that point, the salinity of seepage/runoff should stabilise at a lower asymptotic concentration relative to the weathering/erosion of the materials.

3.1.1.3 Total sulfur

Total sulfur concentration values for the waste rock samples range from below the laboratory limit of reporting (LoR) (0.01 %S) to 0.53 %S (**Figure 3-3**). Most samples have very low total sulfur concentration below the median crustal abundance of sulfur in unmineralised soils (0.07 %S) (Bowen, 1979). Generally, materials with a total sulfur content less than or equal to 0.1 %S are considered to be essentially barren of sulfur, generally represent background concentrations, and have negligible capacity to generate acidity (INAP, 2022). Slightly elevated total sulfur concentrations in waste rock samples tend to be associated with some of the carbonaceous materials (e.g., carbonaceous mudstone, coal, and coaly mudstone samples) compared to bulk waste rock samples, which have negligible total sulfur content.

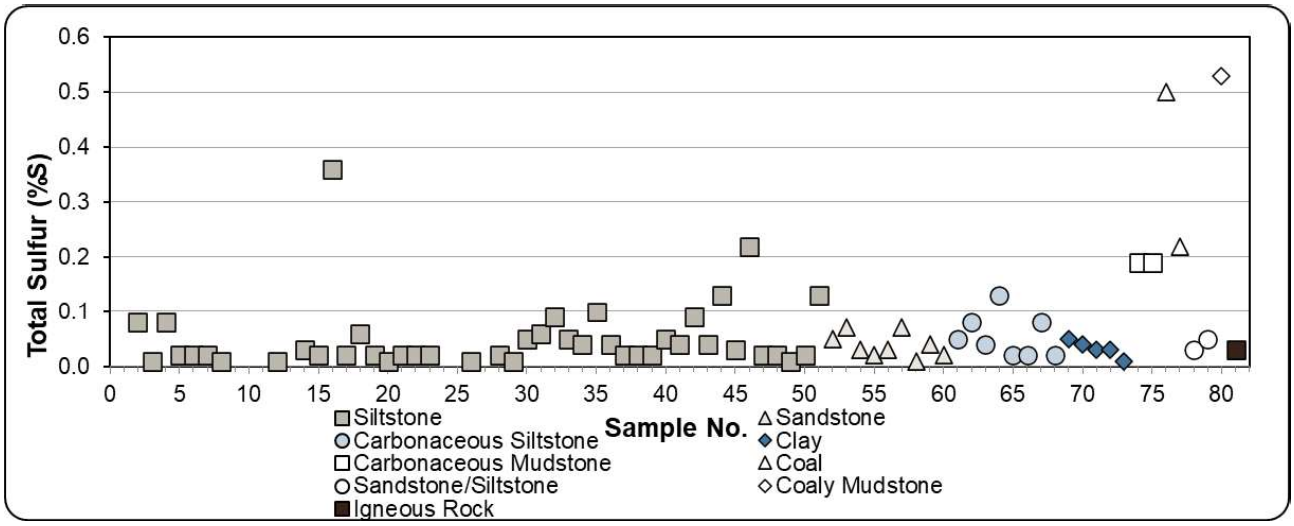


Figure 3-3: Total sulfur concentration results for waste rock samples

3.1.1.4 MPA and ANC

Based upon the total sulfur concentration values, the MPA that could be generated by the waste rock samples has been calculated and ranges from <0.3 to 16.2 kg H_2SO_4/t; and has a low median value of 0.9 kg H_2SO_4/t.

The ANC measures the amount of acid (as H_2SO_4) that could be neutralised by acid neutralising minerals present in the materials. The ANC for the waste rock samples ranges from 6.6 to 135 kg H_2SO_4/t and has a median value of 61.8 kg H_2SO_4/t.

3.1.1.5 ANC:MPA ratio

The ANC:MPA ratio measures the proportion of ANC present in the sample compared to the MPA. If the ANC:MPA is 3 or greater, there is an excess of ANC which is likely to buffer any acid produced and there is generally negligible risk of generating acidic drainage (ACARP, 2008; COA, 2016c; INAP, 2022;). If, however, ANC:MPA is 1 or less, there are equal or lesser proportions of ANC compared to MPA and there may be insufficient ANC to neutralise the MPA and therefore the samples may have some overall risk of generating acid.

The ANC:MPA ratio for the waste rock samples ranges from 2.1 to 471.5 and has a median value of 64.7. **Figure 3-4** shows a plot of ANC vs MPA for the waste rock samples by lithology. ANC:MPA ratio lines have been plotted on the figure to illustrate the factor of safety associated with the samples. The results indicate that the majority of the samples plot in the negligible risk domain shown in the graph and represent materials with a high factor of safety with respect to potential for acid generation.

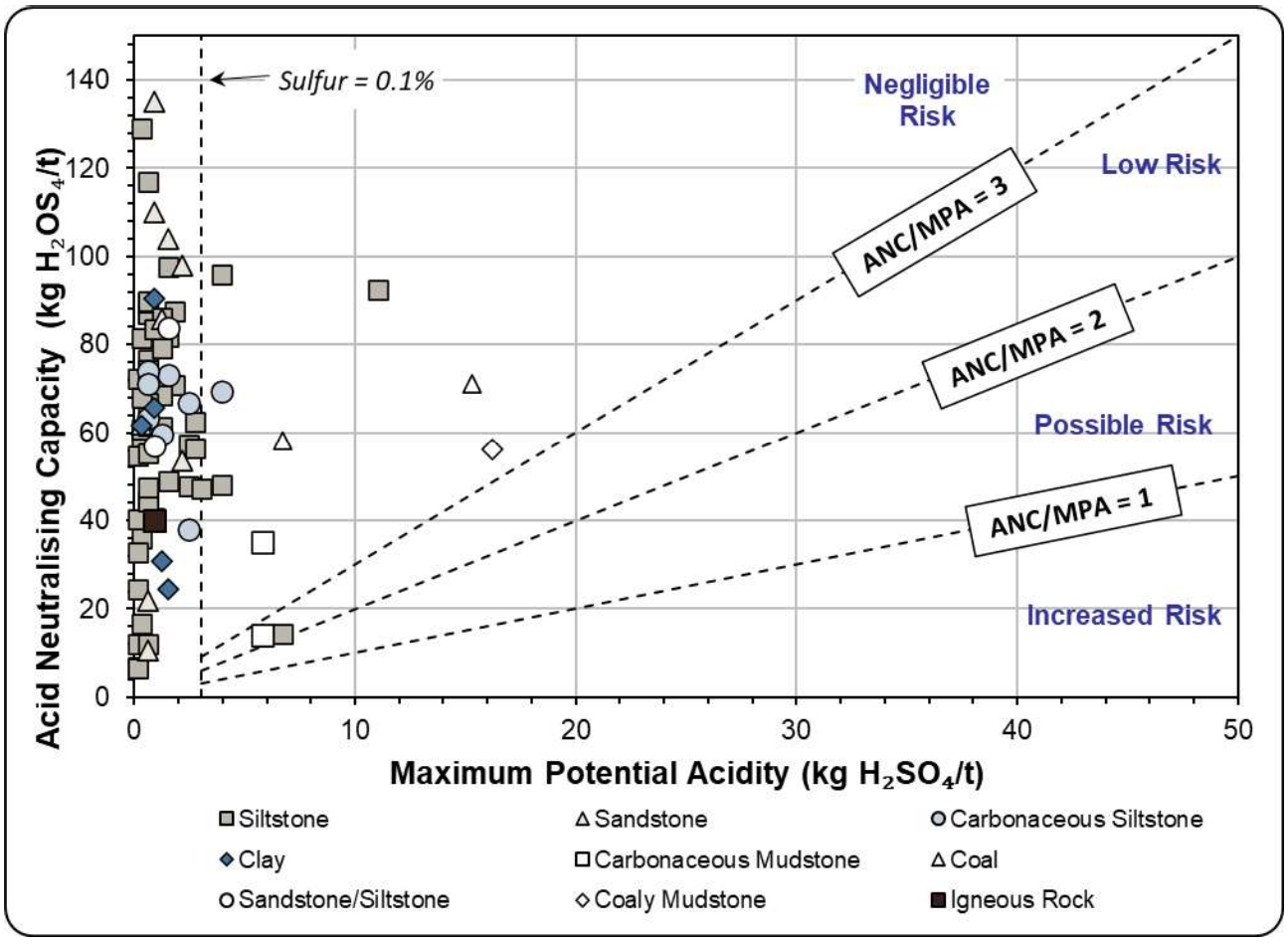


Figure 3-4: ANC vs MPA values for waste rock samples

3.1.1.6 Net Acid Production Potential

The Net Acid Producing Potential (NAPP) values for the samples are calculated by subtracting the ANC from the MPA. Positive NAPP values generally indicate that acid may be generated and negative NAPP values indicate that any acid may be neutralised; however, NAPP values close to zero (i.e., between -5 and +5 kg H_2SO_4/t) have some inherent uncertainty in terms of material classification.

The NAPP value for the waste rock samples ranges from -131.4 to -6.4 kg H_2SO_4/t and has a negative median value of -61.1 kg H_2SO_4/t. All the samples tested have a negative NAPP value, as illustrated in **Figure 3-5.**

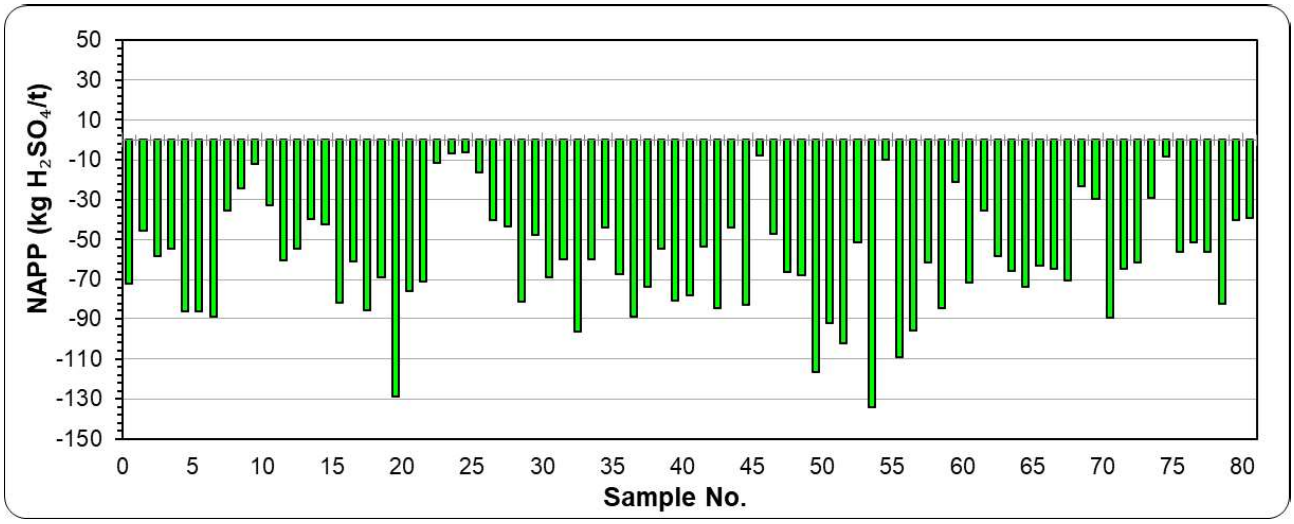


Figure 3-5: NAPP values for waste rock samples

3.1.1.7 NAG_{pH} vs NAPP

The NAG_{pH} results for the waste rock samples are all greater than pH 4.5 and range from pH 4.8 to 11.0 (median pH 9.9).

The NAG test results are typically used to confirm the results of the NAPP tests and assist with the geochemical classification of sample materials. Samples that are classified as PAF typically have a positive NAPP and a NAG_{pH} value less than 4.5 (AMIRA, 2002). The NAPP and NAG results are shown in **Figure 3-6** and align the NAPP results with all samples falling in the NAF classification category.

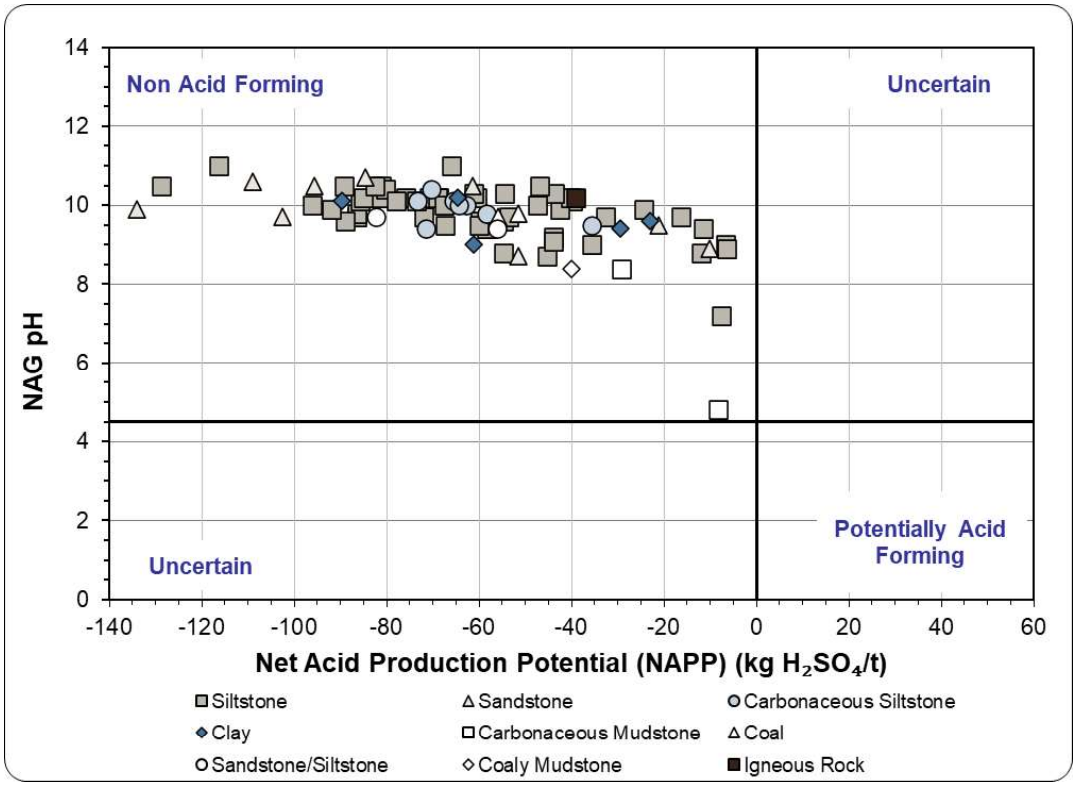


Figure 3-6: NAG_{pH} vs NAPP values for waste rock samples

3.1.2 Geochemical classification

The ABA and NAG test data presented in **Table B1 (Attachment B)** and discussed in this section have been used to classify the acid forming nature of the 81 waste rock samples. These classification criteria generally reflect Australian (COA, 2016c) and international (INAP, 2022) guideline criteria for classification of mine waste materials. **Table 3-2** provides a summary of the criteria used by RGS in this study to classify the acid forming nature of the samples and a breakdown of the number of samples in each classification category.

Of the 81 waste rock samples tested, 71 (87.7 %) are classified as NAF (Barren) as they have a low total sulfur content (≤ 0.1 %S). The remaining 10 samples have sufficiently low MPA and high ANC values to be classified as NAF. No samples were classified as Uncertain or PAF.

Table 3-2: Geochemical classification criteria for waste rock samples

Sample Classification	Total S	NAPP value	ANC:MPA Ratio	Number of Samples
Non-Acid Forming (Barren)[1]	≤ 0.1	-	-	71
Non-Acid Forming	> 0.1	< - 5	≥ 2	10
Uncertain[2]	> 0.1	> - 5 to ≤ + 5	< 2	-
Potentially Acid Forming - Low Capacity	> 0.1	> + 5 to ≤ + 10	< 2	-
Potentially Acid Forming	> 0.1	> 10	< 2	-

Notes:

1. If total sulfur is ≤ 0.1 %, the NAPP, NAG_{pH}, and ANC:MPA ratio are not required for material classification as the sample is essentially barren of oxidisable sulfur and therefore the sample essentially has negligible acid generating capacity.
2. Samples that fall outside the stated NAF/PAF classification categories based on the criteria provided are generally classified as Uncertain.

3.2 Coal and Coal Reject

3.2.1 Acid Base Account

Acid Base Account results for coal and coal reject (six coal, six coarse reject, and six tailing samples) from the Project are in **Table B1** (**Attachment B)** and summarised in this section.

3.2.1.1 $pH_{(1:5)}$

The $pH_{(1:5)}$ values for the coal and coal reject samples are alkaline and range from pH 8.9 to 9.6 with a median value pH of 9.3 (**Figure 3-7**).

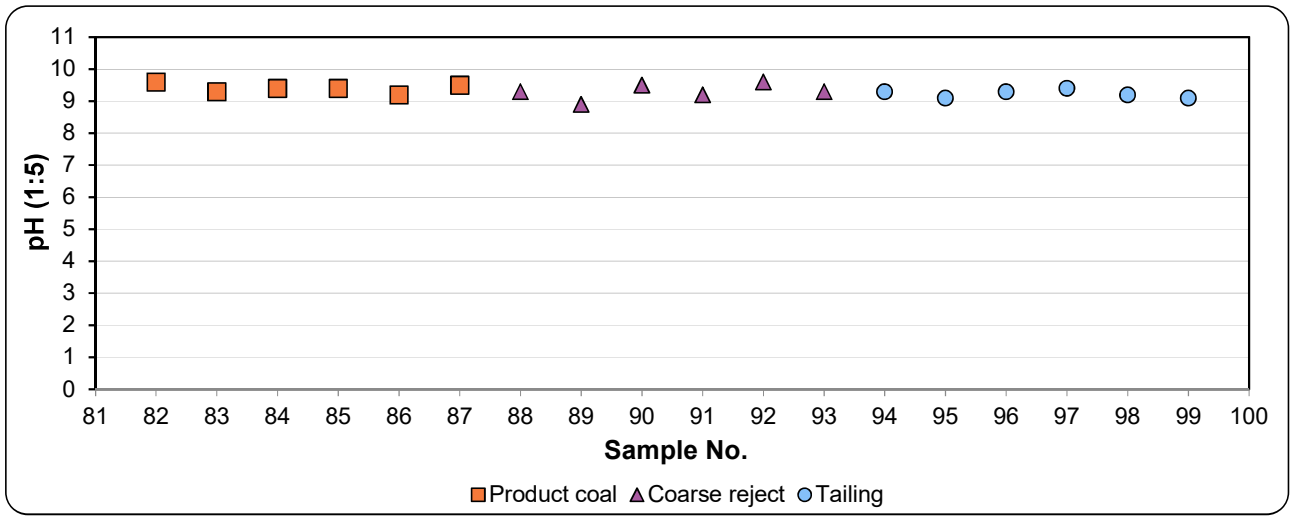


Figure 3-7: $pH_{(1:5)}$ results for coal and coal reject samples

3.2.1.2 Electrical conductivity

The $EC_{(1:5)}$ values for the coal and coal reject samples ranges from 283 to 1,640 µS/cm and has a moderate median value of 661 µS/cm (**Figure 3-8**). The highest $EC_{(1:5)}$ results are associated with the tailing samples and two of the coarse reject samples.

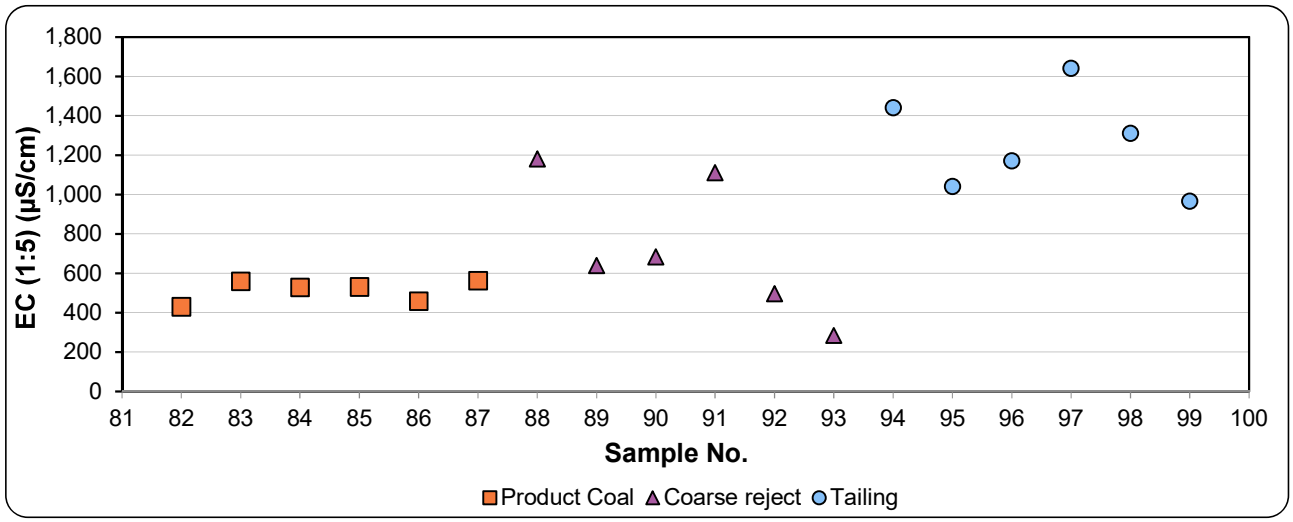


Figure 3-8: $EC_{(1:5)}$ results for coal and coal reject samples

To provide additional context, the $pH_{(1:5)}$ and $EC_{(1:5)}$ results for the coal and coal reject samples are classified against pH and salinity criteria for mining waste materials, as defined by technical guidelines for the environmental management of exploration and mining in Queensland DME (1995) (**Table 3-3**).

Based on the median pH and EC values, the coal and coal reject samples tested are generally regarded as having a 'Very High' soil pH and 'Medium' salinity characteristics, as indicated by the distribution of samples corresponding to each pH and salinity class.

Table 3-3: pH and salinity criteria for assessment of coal and coal reject samples

Waste Rock	Very Low	Low	Medium	High	Very High
$pH_{1:5}$	< 4.5	4.5 – 5.5	5.5 – 7.0	7.0 – 9.0	> 9.0 (Median 9.3)
$EC_{1:5}$ (µS/cm)	< 150	150 – 450	450 – 900 (Median 661)	900 – 2,000	> 2,000

Note: Adapted from DME, 1995. Highlighted cells show the category corresponding to the median pH and EC values for the samples.

The pH and EC tests were completed on pulverised samples (≤ 75 µm) with a large surface area in contact with the leaching solution, thereby providing greater potential for dissolution and reaction, and represent an assumed 'worst case' scenario. It is also expected that the salinity of leachate from low sulfur coal and coal reject materials is expected to diminish with time as salts are flushed from the material matrix and a state of equilibrium develops. At that point, the salinity of seepage/runoff should stabilise at a lower asymptotic concentration relative to the weathering/erosion of the materials. For samples with higher sulfur content, if present as a reactive sulfide, the pH value in contact water has the potential to decrease over time and the level of salinity may increase.

3.2.1.3 Total sulfur

The total sulfur concentration for the coal and coal reject samples ranges from 0.07 to 3.96 %S with a median of 0.45 %. **Figure 3-9** shows that total sulfur concentration results are elevated in the tailing samples compared to the coal and coarse rejects samples.

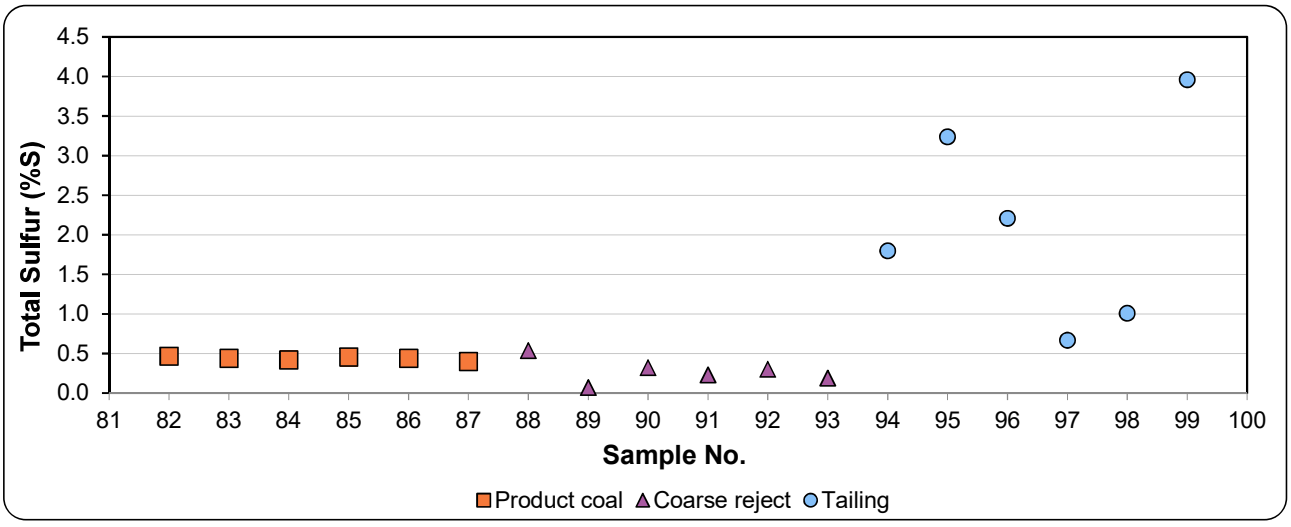


Figure 3-9: Total sulfur concentration results for coal and coal reject samples

3.2.1.4 Chromium reducible sulfur

The sulfide sulfur content of the coal and coal reject samples was verified using the Chromium Reducible Sulfur (S_{CR}) test as described in **Section 2.2.2.1**. The S_{CR} results for the coal and coal reject samples range from 0.016 to 3.570 %S (median 0.191 %S). **Figure 3-10** shows that generally less than half of the total sulfur

in most coal and reject samples is present as sulfide sulfur, while tailings samples have higher sulfide concentration results and contain higher proportions of sulfide.

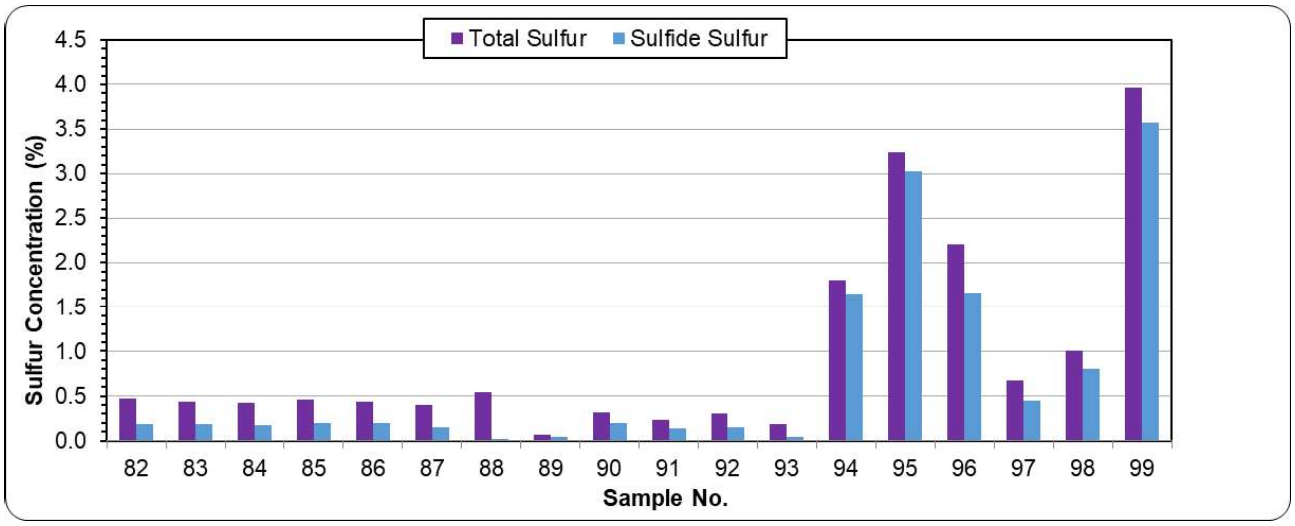


Figure 3-10: Forms of sulfur comparison for coal and coal reject samples

3.2.1.5 MPA and ANC

Based on the S_{CR} values, the MPA that could be generated by the coal and coal reject samples has been calculated and ranges from 0.5 to 109.3 kg H_2SO_4/t, and has a relatively low median value of 5.8 kg H_2SO_4/t.

The ANC measures the amount of acid (as H_2SO_4) that could potentially be neutralised by acid neutralising minerals present in the materials. The ANC values for the coal and coal reject samples range from 7.9 to 58.2 kg H_2SO_4/t and has a median value of 16.0 kg H_2SO_4/t.

3.2.1.6 ANC:MPA ratio

The ANC:MPA ratio measures the proportion of ANC present in the sample compared to the MPA. If the ANC:MPA is 3 or greater, there is an excess of ANC which is likely to buffer any acid produced and there is generally negligible risk of generating acidic drainage (COA, 2016c; INAP, 2022). If, however, ANC:MPA is 1 or less, there are equal or lesser proportions of ANC compared to MPA and there may be insufficient ANC to neutralise the MPA and therefore the samples may have some overall risk of generating acid.

The ANC:MPA ratio for the coal and coal reject samples ranges from 0.4 to 29.2 and has a median value of 1.6. **Figure 3-11** shows a plot of ANC versus MPA for the coal and coal reject samples by material type. ANC:MPA ratio lines have been plotted on the figure to illustrate the factor of safety associated with the samples. Most of the coal and coarse reject samples plot in the negligible to low risk domains and represent materials with a low risk of generating acidic drainage, while the tailing samples plot in the possible to increased risk domains and have a reduced factor of safety with respect to potentially generating acidic drainage.

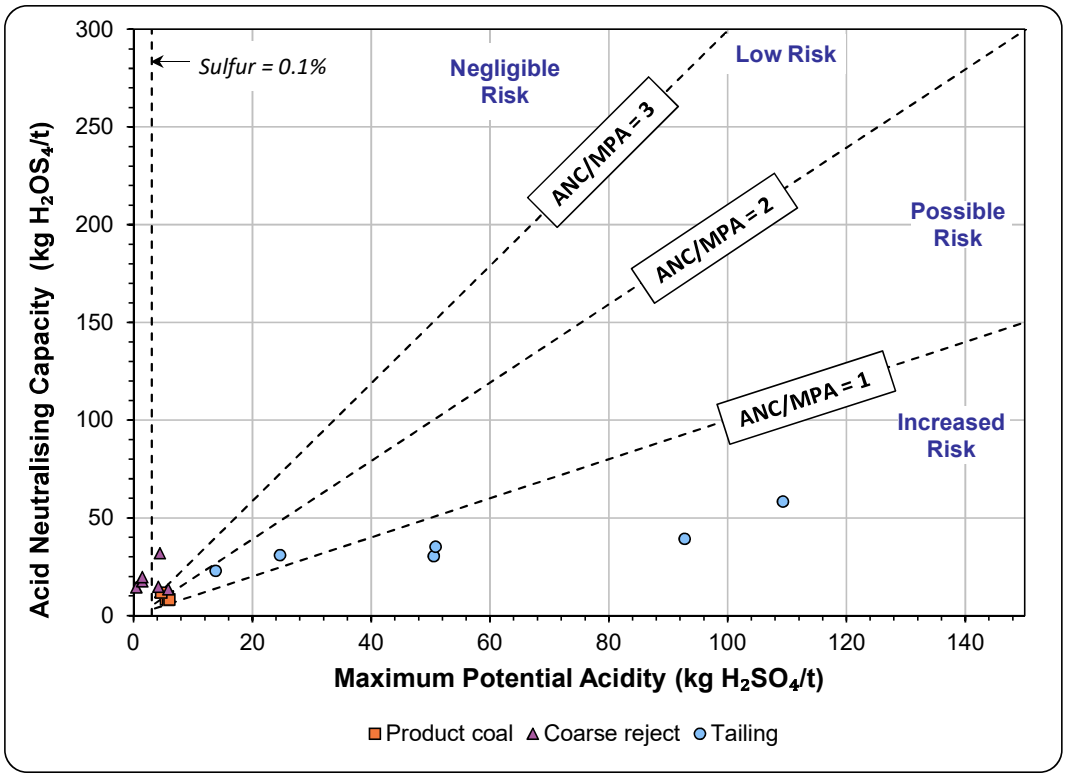


Figure 3-11: ANC vs MPA values for coal and coal reject samples

3.2.1.7 NAPP

The NAPP value for the samples is calculated by subtracting the ANC from the MPA. A positive NAPP value generally indicates that acid may be generated and negative NAPP values indicates that any acid generated may be neutralised; however, NAPP values close to zero (i.e. between -5 and +5 kg H_2SO_4/t) have some inherent uncertainty in terms of material classification.

The NAPP value for the coal and coal reject samples ranges from -27.3 to +53.6 kg H_2SO_4/t and has a median value of -5.0 kg H_2SO_4/t. All coal and coarse reject samples tested have negative NAPP values, while four of the tailings samples have positive NAPP values as illustrated in **Figure 3-12.**

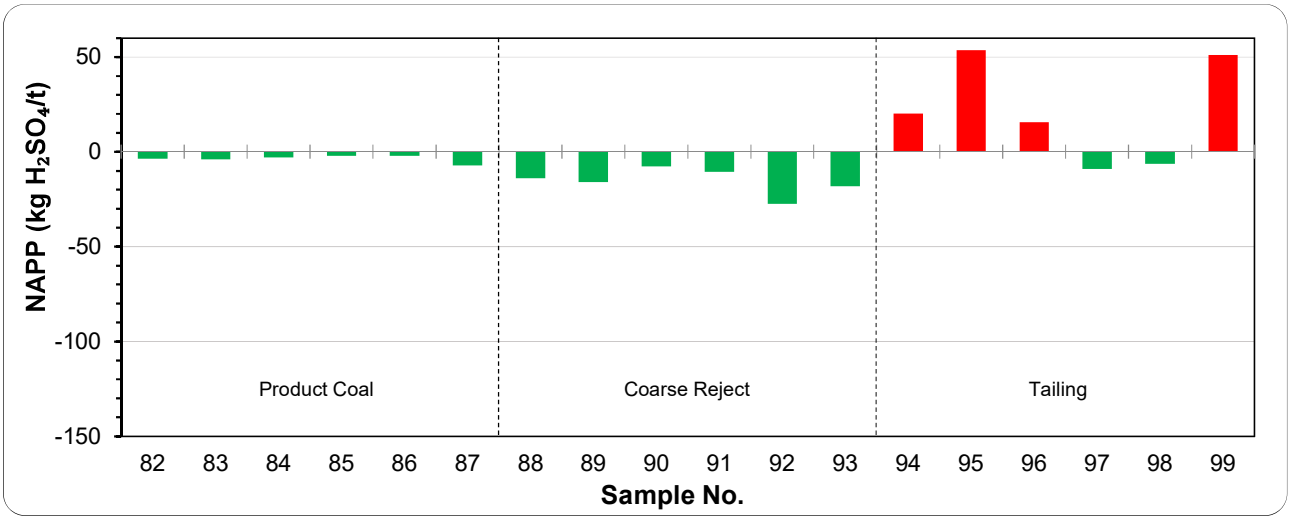


Figure 3-12: NAPP values for coal and coal reject samples

3.2.2 Geochemical classification

The ABA data presented in **Table B1 (Attachment B)** and discussed in this section have been used to classify the acid forming nature of the six coal, six coarse reject, and six tailings samples. These classification criteria generally reflect Australian (COA, 2016c) and international (INAP, 2022) guideline criteria for classification of mine waste materials. **Table 3-4** provides a summary of the criteria used by RGS in this study to classify the acid forming nature of the samples and a breakdown of the number of samples in each classification category.

Half of the samples (nine samples) are classified as NAF and three of these NAF samples have a sufficiently low sulfide sulfur content (≤ 0.1 %) to be considered barren of sulfur. Five samples have ANC and MPA values that are roughly equivalent (coal samples) and so have been classified as Uncertain. Four tailing samples have sufficiently high MPA values (and insufficient ANC) to be classified as PAF. **Figure 3-13** shows the number of samples of each material type assigned to each geochemical classification.

Table 3-4: Geochemical classification criteria for coal and coal reject samples

Sample Classification	Total S	NAPP value	ANC:MPA Ratio	Number of Samples
Non-Acid Forming (Barren)[1]	≤ 0.1	-	-	3
Non-Acid Forming	> 0.1	< - 5	≥ 2	6
Uncertain[2]	> 0.1	> - 5 to ≤ + 5	< 2	5
Potentially Acid Forming - Low Capacity	> 0.1	> + 5 to ≤ + 10	< 2	-
Potentially Acid Forming	> 0.1	> 10	< 2	4

Notes:

1. If total sulfur is less than or equal to 0.1 %, the NAPP, NAG_{pH}, and ANC:MPA ratio are not required for material classification as the sample is essentially barren of oxidisable sulfur and therefore the sample essentially has negligible acid generating capacity.
2. Samples that fall outside the stated NAF/PAF classification categories based on the criteria provided are generally classified as Uncertain.

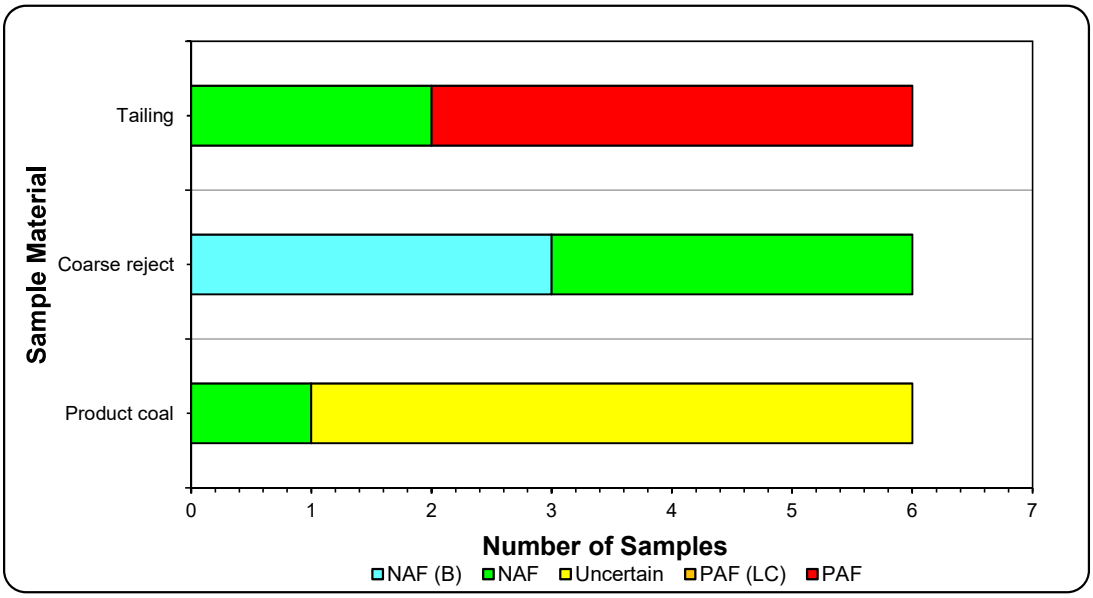


Figure 3-13: Sample classification by material type for coal and coal reject samples

3.3 Multi-element testing

3.3.1.1 Metal/metalloid concentration in whole rock

Multi-element analysis was carried out on 81 individual waste rock samples and six composite coal and coal reject (two coal, two coarse reject and two tailing) samples to identify any elements (metals/metalloids) present in these materials at concentrations that may be of environmental concern with respect to materials handling, storage, and water quality. The results are presented in **Table B2** (**Attachment B**).

To provide context, the multi-element results for the samples were compared to the median background concentration (median crustal abundance) of those elements (metal/metalloids) in unmineralised soils **(Table B3, Attachment B)**. From this comparison, a geochemical abundance index (GAI) was calculated. The GAI quantifies an assay result for a particular element in terms of the median crustal abundance for that element. The index, based on a $\log_2$ scale, is expressed in seven integer increments (0 to 6), which correspond to enrichment factors from 0 to over 96 times average crustal abundance, as shown in **Table 3-5**.

Table 3-5: Geochemical Abundance Index values and enrichment factors

GAI	Enrichment Factor	GAI	Enrichment Factor
0	Less than 3-fold enrichment	**4**	24 – 48-fold enrichment
1	3 – 6-fold enrichment	**5**	48 – 96-fold enrichment
2	6 – 12-fold enrichment	**6**	Greater than 96-fold enrichment
3	12 – 24-fold enrichment		

Generally, a GAI greater than or equal to 3 indicates enrichment to a level that may warrant further investigation. This is the case with some environmentally important 'trace' elements, such as As, Cd, Cu and Zn, rather than with major rock-forming elements, such as Ca, Mg, K, and Na.

Elements identified as enriched may not necessarily be a concern for revegetation, drainage water quality or public health, but their significance should still be evaluated. Similarly, because an element is not enriched does not mean it will never be a concern, because under some conditions (e.g., low pH) the solubility of common environmentally important elements such as Al, Cu, Cd, Fe, and Zn increases significantly.

The GAI results presented in **Table B3** (**Attachment B**) indicate that the overwhelming majority of the samples tested have GAI values less than 3 and are not enriched compared to unmineralised soils (INAP, 2022; Bowen, 1979). The only minor exception is beryllium in one of the siltstone samples which has a GAI value of 3.2 (Sample 42). However, the beryllium concentration in this siltstone sample is only 4 mg/kg and background concentrations in unmineralised soils can be an order of magnitude greater than this value (Bowen, 1979).

In addition, most elements are expected to be relatively immobile in the NAF sample materials and are expected to be sparingly soluble in any water which contacts these materials. For PAF tailing sample materials, the concentration of some metals/metalloids could increase in contact water if these materials are allowed to freely oxidise and generate lower pH conditions.

The potential initial and dynamic solubility and mobility of metals/metalloid into contact water from materials represented by the coal and coal reject materials has been evaluated further using static water extract tests (**Section 3.3.1.2)** and KLC tests. (**Section 3.3.1.3**).

3.3.1.2 Multi-element composition of water extracts

The potential solubility and mobility of the metals/metalloids contained in the six composite coal and coal reject samples were investigated further using water extract tests. The composition of the six composite samples is presented in **Table B1** (**Attachment B**). Using sample pulps (ground to passing 75 µm) provides a very high surface area to solution ratio, which encourages mineral reaction and dissolution of the solid phase. As such,

the results of the water extract solutions are assumed to represent a 'worst case' scenario for initial pore water from sample materials.

It should also be noted that during sample collection and laboratory preparation, the physical agitation and mixing of the samples can affect the physical stability of minerals and increase their solubility in a "first flush" leaching event, such as a static water extract test, which may not reflect the field situation where materials of varying particle sizes will be placed and rainfall/hydrological interaction with these materials is highly variable.

RGS has compared the multi-element test results for water extracts from the six composite coal and coal reject samples with applied ANZG (2018) water quality guideline values. These guidelines are provided for context only and are not intended to be interpreted as "maximum permissible levels" for site water storage or discharge.

It should also be recognised that direct comparison of geochemical data with guideline values can be misleading. For the purposes of this study, guideline values are only provided for broad context and should not be interpreted as arbitrary 'maximum' values or 'trigger' values. Whilst arbitrary comparisons against guideline concentrations can be useful in some situations and help to provide relevant context and potential input into the range of parameters included in field monitoring programs, such comparisons cannot be directly extrapolated to the field situation.

The pH values of the sample leachates are moderately alkaline (pH 9.1 to 9.5, median pH 9.2) and slightly higher than the guideline pH range for freshwater aquatic ecosystems (95 % species protection) of pH 6 to 9. Water extracts from the coal and coarse reject samples have moderate EC values within the applied guideline values for freshwater aquatic ecosystems (1,000 µS/cm) and livestock drinking water (3,580 µS/cm). EC results for water extracts from the composite tailing samples are greater than the applied guideline value for freshwater aquatic ecosystems but are below the guideline value for livestock drinking water (ANZG, 2018).

Water extracts from all six composite coal and coal reject samples have positive net alkalinity values (ranging from 468 to 1,570 mg $CaCO_3$) with titratable acidity results below the laboratory limit of reporting. The alkalinity in all water extracts is primarily dominated by bicarbonate, which is generally present at a concentration an order of magnitude higher than carbonate.

The concentration of major ions in the water extracts are generally low and dominated by sodium, chloride and sulfate. The calcium and sulfate concentrations in the water extracts are within the applied livestock drinking water guideline values for these ions (1,000 mg/L). Fluoride concentrations in the water extracts from the two coarse rejects composite samples are slightly greater than the applied livestock drinking guideline value for this ion (2 mg/L).

The concentrations of trace metals/metalloids tested in the water extracts are generally low, predominantly below the laboratory LoR, and less than the applied guideline values for aquatic freshwater ecosystem (95 % species protection) and livestock drinking water (ANZG, 2018).

3.3.1.3 KLC tests

KLC testing was completed on three composite samples made up from the 18 individual samples of coal, coarse reject and tailing materials using the methodology described in **Section 2.2.2.3** and **Attachment A**. The general classification of the three composite samples used in the KLC tests is summarised in **Table 3-6**. The KLC tests were operated for six months from October 2022 to April 2023 under a monthly watering and leaching regime, following mining industry guidelines for such tests (AMIRA, 2002; COA, 2016c). The detailed KLC result tables and result trends over the six-month testing period are provided in **Attachment C**.

Table 3-6: Initial KLC test results for composite coal and coal reject samples

Sample Description	General Classification	KLC Number
Product Coal	Uncertain	KLC 1
Coarse Reject	Non-Acid Forming	KLC 2
Tailing	Potentially Acid Forming	KLC 3

The leachate results from the KLC test program are presented alongside Australian water quality guideline values for freshwater aquatic ecosystems (95 % species protection) and livestock drinking water quality (ANZG, 2018). These guidelines are provided for context only and are not intended to be interpreted as "maximum permissible levels" for site water storage or discharge. It should be noted that the KLC samples were crushed to pass a 10 mm sieve size, where required, and therefore have a high surface area for potential geochemical reaction. The ratio of sample to water in the KLC tests was approximately 2:1 (w/v) (i.e., concentrated), whereas the ratio of sample to water used in the water extract tests (**Section 6.4**) where results were arbitrarily compared against water quality guideline values to provide some context is an order of magnitude more dilute at 1:5 (w/v). Whilst arbitrary comparisons against guideline concentrations can be helpful in some situations to provide context, such comparisons cannot be directly extrapolated to the field situation at the Project.

The three KLC leach results for the six-month testing period are presented in **Attachment C**.

The KLC test results indicate that:

- The pH of the three KLC samples was circum-neutral and stable across the seven leach events. These results indicate that pH values in pore water within coal, coarse reject and tailing materials represented by these samples, if exposed to idealised weathering conditions, is likely to remain within a circum-neutral pH range for a period of at least six months.
- The EC values in the coarse reject (KLC 2) and tailing (KLC 3) materials were greater than 2,000 µS/cm during the first leach event, and then showed a gradual decreasing trend over the six-month test period. The initial EC in leachate collected from the coal sample (KLC 1) was comparatively lower (< 1,000 µS/cm) and showed only a slight decreasing trend across the six-month test period. These results indicate that the salinity of initial pore water from coarse reject and tailing materials that may interact with surface runoff and seepage at storage facilities is likely to be brackish, may be greater than the applied freshwater aquatic ecosystem guideline value (1,000 µS/cm) but is likely to be less than the applied livestock drinking water guideline (3,580 µS/cm).
- Initial acidity levels in leachate from the three KLCs were ≤ 7 mg/L, as $CaCO_3$ equivalent, and gradually decreased across the six-month test period. The initial alkalinity values in the three KLCs were higher than the acidity levels (> 15 mg/L, as $CaCO_3$ equivalent) leading to a positive net alkalinity (i.e., the alkalinity is greater than the acidity) that was observed across the six-month testing period.
- The concentrations of major ions in leachate from the three KLC tests was low to moderate and dominated by sodium, chloride and sulfate (and bicarbonate). Concentrations of sodium and chloride gradually decreased in the three KLCs across the six-month test period.
- The sulfate release rate in leachate from coarse reject (KLC 2) sample remained relatively stable throughout the six-month test period whereas the sulfate release rate in leachate from coal (KLC 1) and Tailing (KLC3 materials showed a slight increase. The sulfate concentration was highest in leachate from the tailings sample.
- The sulfate concentration in leachate from the three KLC samples was less than the applied livestock drinking water guideline value (1,000 mg/L) over the six-month test period.
- The samples used in the KLC tests retained at least 96 % of their inherent total sulfur content after six months of exposure to idealised oxidising (wetting and drying) conditions, which currently indicates a slow rate of sulfide oxidation for these materials.
- The samples used in the KLC tests retained at least 97.9 % of their inherent ANC value after six months of exposure to oxidising conditions, which reflects the slow release of alkalinity from these materials.
- The concentration of dissolved trace metals/metalloids in leachate from the KLC test samples was low and typically below the laboratory LoR. This suggests that most trace metals/metalloids are sparingly soluble at the current neutral pH of the KLC leachate collected from the sample materials. In addition, the measured dissolved metal/metalloid concentrations are mostly below the applied water quality guideline

values for freshwater aquatic ecosystems (95 % species protection) and livestock drinking water guideline values (ANZG, 2018). The only exception was dissolved selenium which was slightly higher than the freshwater aquatic ecosystem guideline (0.011 mg/L) in some of the leachate collected from the coal (KLC 1) and tailings (KLC 3) samples and was generally greater than the livestock drinking water guideline value (0.02 mg/L) in leachate collected from the coarse reject (KLC 2).

- The sulfate generation rate results obtained for the three KLC samples have been used to determine the rate of sulfide oxidation in these materials. Most sulfate salts generated from sulfide reaction involving materials with a relatively low sulfide sulfur concentration are highly soluble, and therefore will be collected in column leachate. The dissolved sulfate (and calcium) concentrations in the KLC leachate are typically much less than the solubility limit of gypsum ($CaSO_4$), for example, which indicates that sulfate generation is not controlled by gypsum dissolution in the KLC test materials. Therefore, the sulfate concentrations and oxidation rate calculations provide reasonable estimates of these parameters, and the results align well with existing static and dynamic geochemical data derived from a wide range of mine waste materials (AMIRA, 1995). The sulfate generation rate and associated sulfide oxidation rate for the three KLC tests are shown in **Table 3-7**.

Table 3-7: Sulfate Generation and Sulfide Oxidation Rates for KLC Tests materials

KLC Sample Number	Sample Description	Sulfate Generation Rate (mg/kg/week)	Oxidation Rate (kg $O_2/m^3/s$)
KLC 1	Product Coal	23.1	7.7×10^{-9}
KLC 2	Coarse Reject	9.57	2.7×10^{-9}
KLC 3	Tailing	26.0	9.8×10^{-9}

- The sulfate generation rate from the KLC samples ranges from 9.5 to 26.0 mg/kg/week indicating that the rate of sulfide oxidation is currently low in materials represented by these samples. The equivalent oxidation rate ranges from 2.7 to 9.8×10^{-9} kg $O_2/m^3/s$.

  Mine materials with an oxidation rate in the low range (i.e., less than 1×10^{-8} kg $O_2/m^3/s$) and a moderate ANC level generally have an increased factor of safety and are likely to generate leachate that is pH neutral or alkaline and/or has a low level of acidity (AMIRA, 1995; Bennett et al., 2000). All of the KLC composite samples tested fall into this category. Overall, the KLC results generally reflect the range of material characteristics predicted from the static geochemical test results presented in **Section 3.2**, although it would be expected that the sulfide oxidation rate in tailing materials may increase and the pH of leachate may decrease over time if the ANC is diminished through neutralisation of any acid generated by oxidation of inherent sulfide.

4 Conclusions and recommendations

4.1 Conclusions

RGS has completed a geochemical assessment of waste rock, coal and coal reject materials for the Project. The results of the geochemical assessment indicate that:

- Waste rock materials have low sulfur content, excess ANC and are classified as NAF. These materials are expected to have low risk of acid generation and a high factor of safety with respect to AMD.
- Waste rock materials are likely to generate alkaline and brackish pore water with low to moderate concentrations of major ions and low concentrations of dissolved trace metals/metalloids.
- Waste rock materials are not significantly enriched with metals/metalloids compared to median crustal abundance values in unmineralised soils.
- The relatively benign geochemical nature of waste rock materials is typical of mining operations targeting similar strata in this part of the Bowen Basin. This is consistent with the experience of similar mining operations which target the RCM in the east of the Nebo Synclinorium such as Coppabella, Moorvale and Olive Downs mines (Terrenus, 2018).
- Product coal from the Project has low sulfide content balanced by low ANC values and while currently classified as uncertain, static and kinetic geochemical test results indicate that this material has a very low risk of generating any significant acidity.
- Coarse rejects materials have low sulfide content, excess ANC and are classified as NAF. The coarse rejects are expected to have a low risk of acid generation and a high factor of safety with respect to AMD.
- Tailing materials generally contain higher concentrations of sulfide relative to product coal and coarse reject but appear to have a low level of reactivity and sufficient ANC to prevent acid generation when exposed to oxidising conditions for a period of at least six months under idealised oxidising conditions. Notwithstanding, it is expected that there is a risk of acid generation from tailing materials over time if the inherent ANC is consumed through neutralisation of any acid generated by oxidation of inherent sulfide.
- Coal and coal reject materials are not significantly enriched with metals/metalloids compared to median crustal abundance values in unmineralised soils.
- Leachate from coal and coal reject materials is expected to be pH neutral and is likely to be brackish.
- The major ion content of initial leachate from coal and coal reject materials is expected to be low to moderate and dominated by sodium, chloride and sulfate (and bicarbonate).
- Dissolved trace metals/metalloids are expected to occur at relatively low concentrations in initial and ongoing contact water from coal, coarse reject and tailing materials. The concentration of dissolved selenium in pore water and leachate from coarse rejects may be elevated. If tailing materials are exposed to longer term oxidising conditions the pH may decrease and increase the concentration of trace metals/metalloids in pore water and potential leachate.

4.2 Recommendations

As a result of the findings of the geochemical assessment of waste rock, coal and coal reject materials at the Project the following recommendations are made:

- Representative waste rock samples should be collected from future drilling projects for analysis, including soluble multi-element analyses, to verify the expected low risk of any significant impact on water quality from surface runoff and seepage in contact with these materials.
- Coal and coal reject materials derived from the upper coal seams in the stratigraphic profile which have not yet been mined (and subsequently, which are not yet included in the geochemical assessment program) should be geochemically characterised when representative samples of these materials become available in the mining schedule.

- The tailing materials should be emplaced within the Co-disposal Area or preferentially emplaced within in-pit waste rock dumps and covered with NAF waste rock materials. Co-disposal with coarse rejects would provide additional geotechnical stability at designated storage areas.
- Periodic monitoring of major ions (e.g., Ca, Mg, K Na, SO_4 and Cl) and dissolved metals/metalloids (e.g., Al, Cd, Cu, Ni, Pb, Zn and Se) should be included in the water quality monitoring program at waste rock and coarse reject storage areas and at coal stockpiles, as part of the Water Management Plan. If the monitored water pH drops below pH 5.0 and/or the EC increases by more than 100 %, a wider range of water quality parameters should be tested including acidity, alkalinity and the range of soluble metals/metalloids described in **Table B4** (**Attachment B**).
- The management measures for waste rock, coal and coal fine reject and coarse reject would be addressed by a Mine Waste Management Plan.

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6 Attachments

Attachment A: Geochemical Assessment of Mine Materials

ACID GENERATION AND PREDICTION

Acid generation is caused by the exposure of sulfide minerals, most commonly pyrite (FeS_2), to atmospheric oxygen and water. Sulfur assay results are used to calculate the maximum acid that could be generated by the sample by either directly determining the pyritic S content or assuming that all sulfur not present as sulfate occurs as pyrite. Pyrite reacts under oxidising conditions to generate acid according to the following overall reaction:

$$FeS_2 + 15/4\ O_2 + 7/2\ H_2O \ \text{---}> \ Fe(OH)_3 + 2\ H_2SO_4$$

According to this reaction, the maximum potential acidity (MPA) of a sample containing 1 %S as pyrite would be 30.6 kg H_2SO_4/t. The chemical components of the acid generation process consist of the above sulfide oxidation reaction and acid neutralization, which is mainly provided by inherent carbonates and to a lesser extent silicate materials. The amount and rate of acid generation is determined by the interaction and overall balance of the acid generation and neutralisation components.

Net Acid Producing Potential

The net acid producing potential (NAPP) is used as an indicator of materials that may be of concern with respect to acid generation. The NAPP calculation represents the balance between the maximum potential acidity (MPA) of a sample, which is derived from the sulfide sulfur content, and the acid neutralising capacity (ANC) of the material, which is determined experimentally. By convention, the NAPP result is expressed in units of kg H_2SO_4/t sample. If the capacity of the solids to neutralise acid (ANC) exceeds their capacity to generate acid (MPA), then the NAPP of the material is negative. Conversely, if the MPA exceeds the ANC, the NAPP of the material is positive. A NAPP assessment involves a series of analytical tests that include:

Determination of pH and EC

pH and EC measured on 1:5 w/w water extract. This gives an indication of the inherent acidity and salinity of the waste material when initially exposed in a waste emplacement area.

Total sulfur content and Maximum Potential Acidity (MPA)

Total sulfur content is determined by the Leco high temperature combustion method. The total sulfur content is then used to calculate the MPA, which assumes that the entire sulfur content is present as reactive pyrite. Direct determination of the pyritic sulfur content can provide a more accurate estimate of the MPA.

Acid Neutralising Capacity (ANC)

By addition of acid to a known weight of sample, then titration with NaOH to determine the amount of residual acid. The ANC measures the capacity of a sample to react with and neutralise acid. The ANC can be further evaluated by slow acid titration to a set endpoint in the Acid Buffering Characteristic Curve (ABCC) test through calculation of the amount of acid consumed and evaluation of the resultant titration curve.

Net Acid Generation (NAG)

The net acid generation (NAG) test involves the addition of hydrogen peroxide to a sample of mine rock or process residue to oxidise reactive sulfide, then measurement of pH and titration of any net acidity produced by the acid generation and neutralisation reactions occurring in the sample. A significant NAG result (*i.e.* final $NAG_{pH} < 4.5$) indicates that the sample is potentially acid forming (PAF) and the test provides a direct measure of the net amount of acid remaining in the sample after all acid generating and acid neutralising reactions have taken place. A $NAG_{pH} > 4.5$ indicates that the sample is non-acid forming (NAF). The NAG test can provide a direct assessment of the potential for a material to produce acid after a period of exposure and weathering and is used to refine the results of the theoretical NAPP predictions. The NAG test can be used as a stand-alone test but is recommended that this only be considered after site specific calibration work is carried out, especially at coal mining operations where organic carbon can generate false positive results (ACARP, 2008).

ASSESSMENT OF ELEMENT ENRICHMENT AND SOLUBILITY

In mineralised areas it is common to find a suite of enriched elements that have resulted from natural geological processes. Multi-element scans are carried out to identify any elements that are present in a material (or readily leachable from a material) at concentrations that may be of environmental concern with respect to surface water quality, revegetation and public health. The samples are generally analysed for the following elements:

Major elements	Al, Ca, Fe, K, Mg, Na and S.
Minor elements	As, B, Cd, Co, Cr, Cu, F, Hg, Mn, Mo, Ni, Pb, Sb, Se and Zn.

The concentration of these elements in samples can be directly compared with relevant state or national environmental and health-based concentration guideline criteria to determine the level of significance. Water extracts are used to determine the immediate element solubilities under the existing sample pH conditions of the sample. The following tests are normally carried out:

Multi-element composition of solids.

Multi-element composition of solid samples determined using a combination of ICP-mass spectroscopy (ICP-MS), ICP-optical emission spectroscopy (OES), and atomic absorption spectrometry (AAS).

Multi-element composition of water extracts (1:5 sample:deionised water).

Multi-element composition of water extracts from solid samples determined using a combination of ICP-mass spectroscopy (ICP-MS), ICP-optical emission spectroscopy (OES), and atomic absorption spectrometry (AAS).

Under some conditions (e.g., low pH) the solubility and mobility of common environmentally important elements can increase significantly. If element mobility under initial pH conditions is deemed likely and/or subsequent low pH conditions may occur, kinetic leach column test work may be completed on representative samples.

KINETIC LEACH COLUMN TESTS

Kinetic leach column (KLC) tests can be used to provide information on the reaction kinetics of mine waste materials. The major objectives of kinetics tests are to:

- Provide time-dependent data on the kinetics and rate of acid generation and acid neutralising reactions under laboratory controlled (or onsite conditions);
- Investigate metal release and drainage/seepage quality; and
- Assess treatment options such as addition of alkaline materials.

The KLC tests simulate the weathering process that leads to acid and base generation and reaction under laboratory controlled or site conditions. The kinetic tests allow an assessment of the acid forming characteristics and indicate the rate of acid generation, over what period it will occur, and what management controls may be required.

In KLC tests, water is added to a sample and the mixture allowed to leach products and by-products of acid producing and consuming reactions. Samples of leachate are then collected and analysed. Intermittent water application is applied to simulate rainfall and heat lamps are used to simulate sunshine. These tests provide real-time information and may have to continue for months or years. Monitoring includes trends in pH, sulfate, acidity or alkalinity, and metals, for example. The pH of the collected leachate simulates the acid drainage process, acidity or alkalinity levels indicate the rate of acid production and acid neutralisation, and sulfate production can be related to the rate of sulfide oxidation. Metal concentration data provides an assessment of metal solubility and leaching behaviour.

Figure A1 shows the kinetic leach column set up typically used by RGS adapted from AMIRA (2002). The columns are placed under heat lamps to allow the sample to dry between water additions to ensure adequate oxygen ingress into the sample material.

Approximately 2 kg of sample is accurately weighed and used in the leach columns and depending on the physical nature of the material and particle size can be used on an as-received basis (*i.e.,* no crushing as with process residue or drill chip samples) or crushed to nominal 5-10 mm particle size (as with drill core). The sample in the column is initially leached with deionised water at a rate of about 400 ml/kg of sample and the initial leachate from the columns collected and analysed. Subsequent column leaching is carried out at a rate of about 400 ml/kg per month and again collected and analysed. The leaching rate can be varied to better simulate expected site conditions or satisfy test program data requirements. The column must be exposed to drying conditions in between watering events. The residual water content and air void content in the column can be determined by comparing the wet and dry column weights. A heat lamp is generally used above the sample during daylight hours to maintain the leach column surface temperature at about 30 ^{o}C.

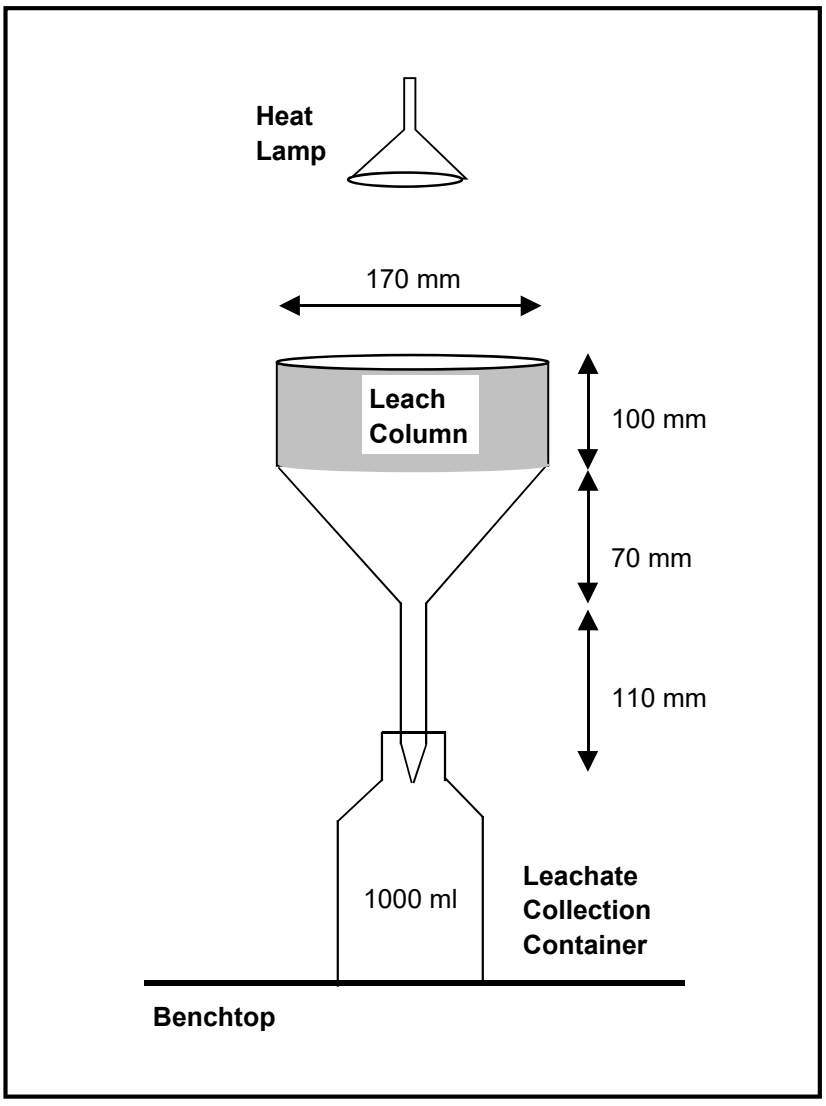


Figure A1: Kinetic leach column setup.

Attachment B: Summary Tables of Static Geochemical Test Results

Table B1: Acid Base Account Results for Samples from the Moorvale South Project

Sample No.	Date	RGS Sample ID	ALS Lab ID	Drill Hole ID	Client Sample ID	Sample Lithology	From	To	Interval	pH (1:5)[1]	EC (1:5)[1]	Total S	Scr	ANC[2]	MPA[2]	NAPP[2]	ANC:MPA Ratio	NAG_{pH}	NAG Capacity (pH 4.5)	NAG Capacity (pH 7)	Sample Classification[3]	Multi-Element Analysis Composite
							(m)				(µS/cm)	(%)	(%)	(kg H_2SO_4/t)					(kg H_2SO_4/t)			
Waste Rock Samples																						
1	15/11/2021	1	EB2202699002	MS0353	MS0353_OB_002	Siltstone	6,0	10,0	4,0	8,70	720	<0,01		72,2	0,2	-72,0	471,5	9,7	<0,1	<0,1	Non-Acid Forming (Barren)	
2	15/11/2021	2	EB2202699003	MS0353	MS0353_OB_003	Siltstone	11,0	15,0	4,0	8,50	1,190	0,08		47,8	2,5	-45,4	19,5	8,7	<0,1	<0,1	Non-Acid Forming (Barren)	
3	15/11/2021	3	EB2202699004	MS0353	MS0353_OB_004	Siltstone	16,0	20,0	4,0	8,60	792	0,01		58,7	0,3	-58,4	191,7	9,4	<0,1	<0,1	Non-Acid Forming (Barren)	
4	15/11/2021	4	EB2202699005	MS0353	MS0353_OB_005	Siltstone	21,0	25,0	4,0	8,70	636	0,08		57,2	2,9	-54,9	23,3	8,8	<0,1	<0,1	Non-Acid Forming (Barren)	
5	15/11/2021	5	EB2202699012	MS0354	MS0354_OB_002	Siltstone	36,0	40,0	4,0	9,40	422	0,02		87,1	0,6	-86,5	142,2	9,7	<0,1	<0,1	Non-Acid Forming (Barren)	
6	15/11/2021	6	EB2202699013	MS0354	MS0354_OB_005	Siltstone	41,0	45,0	4,0	9,40	414	0,02		87,1	0,6	-86,5	142,2	9,8	<0,1	<0,1	Non-Acid Forming (Barren)	
7	15/11/2021	7	EB2202699014	MS0354	MS0354_OB_006	Siltstone	46,0	50,0	4,0	9,30	450	0,02		89,6	0,6	-89,0	146,3	9,6	<0,1	<0,1	Non-Acid Forming (Barren)	
8	15/11/2021	8	EB2202699017	MS0378	MS0378_OB_002	Siltstone	5,0	10,0	5,0	8,90	968	0,01		35,9	0,3	-35,6	117,2	9,0	<0,1	<0,1	Non-Acid Forming (Barren)	
9	15/11/2021	9	EB2202699018	MS0378	MS0378_OB_003	Siltstone	10,0	15,0	5,0	9,40	867	<0,01		24,6	0,2	-24,4	160,7	9,9	<0,1	<0,1	Non-Acid Forming (Barren)	
10	15/11/2021	10	EB2202699019	MS0378	MS0378_OB_004	Siltstone	15,0	20,0	5,0	8,90	913	<0,01		12,2	0,2	-12,0	79,7	8,8	<0,1	<0,1	Non-Acid Forming (Barren)	
11	15/11/2021	11	EB2202699020	MS0378	MS0378_OB_005	Siltstone	20,0	25,0	5,0	9,00	896	<0,01		32,8	0,2	-32,6	214,2	9,7	<0,1	<0,1	Non-Acid Forming (Barren)	
12	15/11/2021	12	EB2202699021	MS0378	MS0378_OB_006	Siltstone	25,0	30,0	5,0	9,30	599	0,01		60,1	0,3	-59,4	198,2	10,2	<0,1	<0,1	Non-Acid Forming (Barren)	
13	15/11/2021	13	EB2202699022	MS0378	MS0378_OB_007	Siltstone	30,0	35,0	5,0	9,30	625	<0,01		54,7	0,2	-54,5	357,2	10,3	<0,1	<0,1	Non-Acid Forming (Barren)	
14	15/11/2021	14	EB2202699023	MS0378	MS0378_OB_008	Siltstone	35,0	40,0	5,0	9,30	635	0,03		40,7	0,9	-39,8	44,3	10,1	<0,1	<0,1	Non-Acid Forming (Barren)	
15	15/11/2021	15	EB2202699024	MS0378	MS0378_OB_009	Siltstone	40,0	45,0	5,0	9,40	567	0,02		43,1	0,6	-42,5	70,4	9,9	<0,1	<0,1	Non-Acid Forming (Barren)	
16	15/11/2021	16	EB2202699025	MS0378	MS0378_OB_010	Siltstone	45,0	50,0	5,0	8,80	635	0,36		92,4	11,0	-81,4	8,4	10,2	<0,1	<0,1	Non-Acid Forming	
17	15/11/2021	17	EB2202699027	MS0378	MS0378_OB_012	Siltstone	55,0	60,0	5,0	9,30	544	0,02		61,7	0,6	-61,1	100,7	10,3	<0,1	<0,1	Non-Acid Forming (Barren)	
18	15/11/2021	18	EB2202699031	MS0378	MS0378_OB_016	Siltstone	80,0	85,0	5,0	9,60	476	0,06		87,5	1,8	-85,7	47,6	10,1	<0,1	<0,1	Non-Acid Forming (Barren)	
19	15/11/2021	19	EB2202699032	MS0378	MS0378_OB_017	Siltstone	85,0	90,0	5,0	9,60	460	0,02		69,3	0,6	-68,7	113,1	10,2	<0,1	<0,1	Non-Acid Forming (Barren)	
20	15/11/2021	20	EB2202699034	MS0378	MS0378_OB_019	Siltstone	95,0	100,0	5,0	9,70	461	0,01		129,0	0,3	-128,7	421,2	10,5	<0,1	<0,1	Non-Acid Forming (Barren)	
21	15/11/2021	21	EB2202699035	MS0378	MS0378_OB_020	Siltstone	100,0	105,0	5,0	9,60	498	0,02		76,5	0,6	-75,9	124,9	10,2	<0,1	<0,1	Non-Acid Forming (Barren)	
22	15/11/2021	22	EB2202699036	MS0378	MS0378_OB_021	Siltstone	105,0	110,0	5,0	9,60	454	0,02		71,4	0,6	-70,8	116,6	10,2	<0,1	<0,1	Non-Acid Forming (Barren)	
23	15/11/2021	23	EB2202699042	MS0379	MS0379_OB_001	Siltstone	2,0	5,0	3,0	8,70	1,290	0,02		12,2	0,6	-11,6	19,9	9,4	<0,1	<0,1	Non-Acid Forming (Barren)	
24	15/11/2021	24	EB2202699043	MS0379	MS0379_OB_002	Siltstone	5,0	10,0	5,0	8,20	1,130	<0,01		6,8	0,2	-6,6	44,4	9,0	<0,1	<0,1	Non-Acid Forming (Barren)	
25	15/11/2021	25	EB2202699044	MS0379	MS0379_OB_003	Siltstone	10,0	15,0	5,0	8,60	1,370	<0,01		6,6	0,2	-6,4	43,1	8,9	<0,1	<0,1	Non-Acid Forming (Barren)	
26	15/11/2021	26	EB2202699045	MS0379	MS0379_OB_004	Siltstone	15,0	20,0	5,0	9,10	1,310	0,01		16,7	0,3	-16,4	54,5	9,7	<0,1	<0,1	Non-Acid Forming (Barren)	
27	15/11/2021	27	EB2202699046	MS0379	MS0379_OB_005	Siltstone	20,0	25,0	5,0	9,20	1,110	<0,01		40,3	0,2	-40,1	263,2	10,2	<0,1	<0,1	Non-Acid Forming (Barren)	
28	15/11/2021	28	EB2202699047	MS0379	MS0379_OB_006	Siltstone	25,0	30,0	5,0	9,50	901	0,02		44,2	0,6	-43,6	72,2	10,3	<0,1	<0,1	Non-Acid Forming (Barren)	
29	15/11/2021	29	EB2202699048	MS0379	MS0379_OB_007	Siltstone	30,0	35,0	5,0	9,70	488	0,01		81,4	0,3	-81,1	265,8	10,5	<0,1	<0,1	Non-Acid Forming (Barren)	
30	15/11/2021	30	EB2202699051	MS0379	MS0379_OB_010	Siltstone	45,0	50,0	5,0	9,50	489	0,05		49,0	1,5	-47,5	32,0	10,0	<0,1	<0,1	Non-Acid Forming (Barren)	
31	15/11/2021	31	EB2202699052	MS0379	MS0379_OB_011	Siltstone	50,0	55,0	5,0	9,50	435	0,06		70,8	1,8	-69,0	38,5	10,2	<0,1	<0,1	Non-Acid Forming (Barren)	
32	15/11/2021	32	EB2202699054	MS0379	MS0379_OB_013	Siltstone	70,0	75,0	5,0	9,10	1,360	0,09		62,5	2,8	-59,7	22,7	9,6	<0,1	<0,1	Non-Acid Forming (Barren)	
33	15/11/2021	33	EB2202699055	MS0379	MS0379_OB_014	Siltstone	75,0	80,0	5,0	9,40	1,120	0,05		97,7	1,5	-96,2	63,8	10,0	<0,1	<0,1	Non-Acid Forming (Barren)	
34	15/11/2021	34	EB2202699056	MS0379	MS0379_OB_015	Siltstone	85,0	90,0	5,0	9,30	1,160	0,04		61,3	1,2	-60,1	50,0	9,5	<0,1	<0,1	Non-Acid Forming (Barren)	
35	15/11/2021	35	EB2202699057	MS0379	MS0379_OB_016	Siltstone	90,0	95,0	5,0	9,30	1,150	0,10		47,1	3,1	-44,0	15,4	9,2	<0,1	<0,1	Non-Acid Forming (Barren)	
36	15/11/2021	36	EB2202699058	MS0379	MS0379_OB_017	Siltstone	95,0	100,0	5,0	9,30	1,110	0,04		68,5	1,2	-67,3	55,9	9,5	<0,1	<0,1	Non-Acid Forming (Barren)	
37	15/11/2021	37	EB2202699059	MS0379	MS0379_OB_018	Siltstone	100,0	105,0	5,0	9,40	1,210	0,02		89,8	0,6	-89,2	146,6	10,5	<0,1	<0,1	Non-Acid Forming (Barren)	
38	15/11/2021	38	EB2202699060	MS0379	MS0379_OB_019	Siltstone	105,0	110,0	5,0	9,00	2,230	0,02		74,3	0,6	-73,7	121,3	10,1	<0,1	<0,1	Non-Acid Forming (Barren)	
39	15/11/2021	39	EB2202699061	MS0379	MS0379_OB_020	Siltstone	110,0	115,0	5,0	9,20	1,020	0,02		55,3	0,6	-54,7	90,3	9,6	<0,1	<0,1	Non-Acid Forming (Barren)	
40	15/11/2021	40	EB2202699066	MS0380	MS0380_OB_005	Siltstone	20,0	25,0	5,0	9,40	782	0,05		81,8	1,5	-80,3	53,4	10,4	<0,1	<0,1	Non-Acid Forming (Barren)	
41	15/11/2021	41	EB2202699067	MS0380	MS0380_OB_006	Siltstone	25,0	30,0	5,0	9,60	590	0,04		79,2	1,2	-78,0	64,7	10,1	<0,1	<0,1	Non-Acid Forming (Barren)	
42	15/11/2021	42	EB2202699069	MS0380	MS0380_OB_008	Siltstone	35,0	40,0	5,0	9,60	558	0,09		56,4	2,8	-53,6	20,5	9,7	<0,1	<0,1	Non-Acid Forming (Barren)	
43	15/11/2021	43	EB2202699070	MS0380	MS0380_OB_009	Siltstone	40,0	45,0	5,0	9,70	554	0,04		86,2	1,2	-85,0	70,4	10,2	<0,1	<0,1	Non-Acid Forming (Barren)	
44	15/11/2021	44	EB2202699071	MS0380	MS0380_OB_010	Siltstone	45,0	50,0	5,0	9,50	584	0,13		48,0	4,0	-44,0	12,1	9,1	<0,1	<0,1	Non-Acid Forming	
45	15/11/2021	45	EB2202699072	MS0380	MS0380_OB_011	Siltstone	50,0	58,0	8,0	9,70	574	0,03		83,5	0,9	-82,6	90,9	10,5	<0,1	<0,1	Non-Acid Forming (Barren)	
46	15/11/2021	46	EB2202699074	MS0380	MS0380_OB_13	Siltstone	65,0	70,0	5,0	9,60	617	0,22		14,4	6,7	-7,7	2,1	7,2	<0,1	<0,1	Non-Acid Forming	
47	15/11/2021	47	EB2202699076	MS0380	MS0380_OB_15	Siltstone	75,0	80,0	5,0	9,70	663	0,02		47,5	0,6	-46,9	77,6	10,5	<0,1	<0,1	Non-Acid Forming (Barren)	
48	15/11/2021	48	EB2202699078	MS0380	MS0380_OB_17	Siltstone	85,0	90,0	5,0	9,70	689	0,02		66,7	0,6	-66,1	108,9	11,0	<0,1	<0,1	Non-Acid Forming (Barren)	
49	15/11/2021	49	EB2202699079	MS0380	MS0380_OB_18	Siltstone	90,0	95,0	5,0	9,80	474	0,01		68,0	0,3	-67,7	222,0	10,0	<0,1	<0,1	Non-Acid Forming (Barren)	
50	15/11/2021	50	EB2202699080	MS0380	MS0380_OB_19	Siltstone	95,0	100,0	5,0	9,80	666	0,02		117,0	0,6	-116,4	191,0	11,0	<0,1	<0,1	Non-Acid Forming (Barren)	
51	15/11/2021	51	EB2202699081	MS0380	MS0380_OB_20	Siltstone	100,0	105,0	5,0	9,70	563	0,13		96,0	4,0	-92,0	24,1	9,9	<0,1	<0,1	Non-Acid Forming	
52	15/11/2021	52	EB2202699006	MS0353	MS0353_OB_006	Sandstone	26,0	30,0	4,0	9,10	500	0,05		104,0	1,5	-102,5	67,9	9,7	<0,1	<0,1	Non-Acid Forming (Barren)	
53	15/11/2021	53	EB2202699007	MS0353	MS0353_OB_007	Sandstone	31,0	35,0	4,0	9,00	527	0,07		53,6	2,1	-51,5	25,0	8,7	<0,1	<0,1	Non-Acid Forming (Barren)	
54	15/11/2021	54	EB2202699008	MS0353	MS0353_OB_008	Sandstone	36,0	39,0	3,0	9,20	407	0,03		135,0	0,9	-134,1	146,9	9,9	<0,1	<0,1	Non-Acid Forming (Barren)	
55	15/11/2021	55	EB2202699016	MS0378	MS0378_OB_001	Sandstone	2,0	5,0	3,0	8,70	755	0,02		10,7	0,6	-10,1	17,5	8,9	<0,1	<0,1	Non-Acid Forming (Barren)	
56	15/11/2021	56	EB2202699026	MS0378	MS0378_OB_011	Sandstone	50,0	55,0	5,0	9,20	608	0,03		110,0	0,9	-109,1	119,7	10,6	<0,1	<0,1	Non-Acid Forming (Barren)	
57	15/11/2021	57	EB2202699033	MS0378	MS0378_OB_018	Sandstone	90,0	95,0	5,0	9,70	471	0,07		97,8	2,1	-95,7	45,6	10,5	<0,1	<0,1	Non-Acid Forming (Barren)	
58	15/11/2021	58	EB2202699049	MS0379	MS0379_OB_008	Sandstone	35,0	40,0	5,0	9,60	474	0,01		61,8	0,3	-61,5	201,8	10,5	<0,1	<0,1	Non-Acid Forming (Barren)	
59	15/11/2021	59	EB2202699050	MS0379	MS0379_OB_009	Sandstone	40,0	45,0	5,0	9,50	412	0,04		86,8	1,2	-84,6	70,0	10,7	<0,1	<0,1	Non-Acid Forming (Barren)	
60	15/11/2021	60	EB2202699077	MS0380	MS0380_OB_16	Sandstone	80,0	85,0	5,0	9,80	663	0,02		21,8	0,6	-21,2	35,6	9,5	<0,1	<0,1	Non-Acid Forming (Barren)	
61	15/11/2021	61	EB2202699015	MS0354	MS0354_OB_007	Carbonaceous Siltstone	50,0	54,0	4,0	9,10	680	0,05		73,1	1,5	-71,6	47,7	9,4	<0,1	<0,1	Non-Acid Forming (Barren)	
62	15/11/2021	62	EB2202699028	MS0378	MS0378_OB_013	Carbonaceous Siltstone	60,0	65,0	5,0	9,00	696	0,08		38,0	2,5	-35,6	15,5	9,5	<0,1	<0,1	Non-Acid Forming (Barren)	
63	15/11/2021	63	EB2202699029	MS0378	MS0378_OB_014	Carbonaceous Siltstone	70,0	75,0	5,0	9,50	482	0,04		59,6	1,2	-58,4	48,7	9,8	<0,1	<0,1	Non-Acid Forming (Barren)	
64	15/11/2021	64	EB2202699030	MS0378	MS0378_OB_015	Carbonaceous Siltstone	75,0	80,0	5,0	9,50	508	0,13		69,4	4,0	-65,4	17,4	10,1	<0,1	<0,1	Non-Acid Forming	
65	15/11/2021	65	EB2202699037	MS0378	MS0378_OB_022	Carbonaceous Siltstone	110,0	115,0	5,0	9,60	470	0,02		74,0	0,6	-73,4	120,8	10,1	<0,1	<0,1	Non-Acid Forming (Barren)	
66	15/11/2021	66	EB2202699038	MS0378	MS0378_OB_023	Carbonaceous Siltstone	115,0	120,0	5,0	9,60	469	0,02		63,4	0,6	-62,8	103,5	10,0	<0,1	<0,1	Non-Acid Forming (Barren)	
67	15/11/2021	67	EB2202699039	MS0378	MS0378_OB_024	Carbonaceous Siltstone	120,0	125,0	5,0	9,40	493	0,08		66,9	2,5	-64,5	27,3	10,0	<0,1	<0,1	Non-Acid Forming (Barren)	
68	15/11/2021	68	EB2202699073	MS0380	MS0380_OB_12	Carbonaceous Siltstone	61,0	65,0	4,0	9,70	559	0,02		71,8	0,6	-70,4	115,9	10,4	<0,1	<0,1	Non-Acid Forming (Barren)	
69	15/11/2021	69	EB2202699062	MS0380	MS0380_OB_001	Clay	2,0	5,0	3,0	8,40	2,240	0,05		24,6	1,5	-23,1	16,1	9,6	<0,1	<0,1	Non-Acid Forming (Barren)	
70	15/11/2021	70	EB2202699063	MS0380	MS0380_OB_002	Clay	5,0	10,0	5,0	8,60	2,090	0,04		30,7	1,2	-29,5	25,1	9,4	<0,1	<0,1	Non-Acid Forming (Barren)	
71	15/11/2021	71	EB2202699064	MS0380	MS0380_OB_003	Clay	10,0	15,0	5,0	9,00	1,540	0,03		90,5	0,9	-89,6	98,5	10,1	<0,1	<0,1	Non-Acid Forming (Barren)	
72	15/11/2021	72	EB2202699065	MS0380	MS0380_OB_004	Clay	15,0	20,0	5,0	9,10	1,140	0,03		65,6	0,9	-64,7	71,4	10,2	<0,1	<0,1	Non-Acid Forming (Barren)	
73	15/11/2021	73	EB2202699001	MS0353	MS0353_OB_001	Clay	0,0	5,0	5,0	8,40	773	0,01		61,5	0,3	-61,2	200,8	9,0	<0,1	<0,1	Non-Acid Forming (Barren)	
74	15/11/2021	74	EB2202699011	MS0354	MS0354_OB_003	Carbonaceous Mudstone	31,0	35,0	4,0	8,60	790	0,19		35,1	5,8	-29,3	6,0	8,4	<0,1	<0,1	Non-Acid Forming	
75	15/11/2021	75	EB2202699053	MS0379	MS0379_OB_012	Carbonaceous Mudstone	55,0	60,0	5,0	7,50	945	0,19		14,1	5,8	-8,3	2,4	4,8	<0,1	7,3	Non-Acid Forming	
76	15/11/2021	76	EB2202699040	MS0378	MS0378_OB_025	Coal	125,0	130,0	5,0	9,30	594	0,50		71,2	15,3	-55,9	4,6	9,7	<0,1	<0,1	Non-Acid Forming	
77	15/11/2021	77	EB2202699041	MS0378	MS0378_OB_026	Coal	130,0	135,0	5,0	9,40	602	0,22		58,2	6,7	-51,5	8,6	9,8	<0,1	<0,1	Non-Acid Forming	
78	15/11/2021	78	EB2202699009	MS0354	MS0354_OB_001	Sandstone/Siltstone	21,0	25,0	4,0	8,80	932	0,03		57,0	0,9	-56,1	62,0	9,4	<0,1	<0,1	Non-Acid Forming (Barren)	
79	15/11/2021	79	EB2202699010	MS0354	MS0354_OB_002	Sandstone/Siltstone	26,0	30,0	4,0	9,00	724	0,05		83,9	1,5	-82,4	54,8	9,7	<0,1	<0,1	Non-Acid Forming (Barren)	
80	15/11/2021	80	EB2202699068	MS0380	MS0380_OB_007	Coaly Mudstone	30,0	35,0	5,0	9,40	612	0,53		56,2	16,2	-40,0	3,5	8,4	<0,1	<0,1	Non-Acid Forming	
81	15/11/2021	81	EB2202699075	MS0380	MS0380_OB_14	Igneous Rock	70,0	75,0	5,0	9,80	682	0,03		40,0	0,9	-39,1	43,5	10,2	<0,1	<0,1	Non-Acid Forming (Barren)	
Product Coal, Coarse Reject and Tailing Samples																						
82	25/10/2022	2022067_001	EB2231587001		MRV_FEED_20221013_0300	Product Coal				9,60	430	0,47	0,187	9,2	5,7	-3,5	1,6				Uncertain	1
83	25/10/2022	2022067_002	EB2231587002		MRV_FEED_20221013_0900	Product Coal				9,30	558	0,44	0,189	9,6	5,8	-3,8	1,7				Uncertain	1
84	25/10/2022	2022067_003	EB2231587003		MRV_FEED_20221013_1500	Product Coal				9,40	528	0,42	0,178	8,3	5,5	-2,8	1,5				Uncertain	1
85	25/10/2022	2022067_004	EB2231587004		MRV_FEED_20221013_2100	Product Coal				9,40	530	0,46	0,192	7,9	5,9	-2,0	1,3				Uncertain	2
86	25/10/2022	2022067_005	EB2231587005		MRV_FEED_20221014_0900	Product Coal				9,20	458	0,44	0,198	8,1	6,1	-2,0	1,3				Uncertain	2
87	25/10/2022	2022067_006	EB2231587006		MRV_FEED_20221014_1500	Product Coal				9,50	562	0,40	0,152	11,7	4,7	-7,0	2,5				Non-Acid Forming	2
88	25/10/2022	2022067_007	EB2231587007		MRV_Coarse Reject_20221013_0300	Reject				9,30	1,180	0,54	0,016	14,3	0,5	-13,8	29,2				Non-Acid Forming (Barren)	3
89	25/10/2022	2022067_008	EB2231587008		MRV_Coarse Reject_20221013_0900	Reject				8,90	639	0,07	0,048	17,4	1,5	-15,9	11,8				Non-Acid Forming (Barren)	3
90	25/10/2022	2022067_009	EB2231587009		MRV_Coarse Reject_20221013_1500	Reject				9,50	683	0,32	0,192	13,4	5,9	-7,5	2,3				Non-Acid Forming	3
91	25/10/2022	2022067_010	EB2231587010		MRV_Coarse Reject_20221013_2100	Reject				9,60	1,110	0,23	0,136	14,6	4,2	-10,4	3,5				Non-Acid Forming	4
92	25/10/2022	2022067_011	EB2231587011		MRV_Coarse Reject_20221014_0900	Reject				9,60	495	0,30	0,146	31,8	4,5	-27,3	7,1				Non-Acid Forming	4
93	25/10/2022	2022067_012	EB2231587012		MRV_Coarse Reject_20221014_1500	Reject				9,30	283	0,19	0,048	19,5	1,5	-18,0	13,3				Non-Acid Forming (Barren)	4
94	25/10/2022	2022067_013	EB2231587013		MRV_Fine Reject_20221013_0300	Tailing				9,30	1,440	1,80	1,650	30,3	50,5	20,2	0,6				Potentially Acid Forming	5
95	25/10/2022	2022067_014	EB2231587014		MRV_Fine Reject_20221013_0900	Tailing				9,10	1,040	3,24	3,030	39,2	92,8	53,6	0,4				Potentially Acid Forming	5
96	25/10/2022	2022067_015	EB2231587015		MRV_Fine Reject_20221013_1500	Tailing				9,30	1,170	2,21	1,660	35,2	50,8	15,6	0,7				Potentially Acid Forming	5
97	25/10/2022	2022067_016	EB2231587016		MRV_Fine Reject_20221013_2100	Tailing				9,40	1,640	0,67	0,451	22,8	13,8	9,0	1,7				Non-Acid Forming	6
98	25/10/2022	2022067_017	EB2231587017		MRV_Fine Reject_20221014_0900	Tailing				9,20	1,310	1,01	0,806	30,9	24,7	6,2	1,3				Non-Acid Forming	6
99	25/10/2022	2022067_018	EB2231587018		MRV_Fine Reject_20221014_1500	Tailing				9,10	965	3,96	3,570	58,2	109,3	51,1	0,5				Potentially Acid Forming	5

Notes:
1. Current pH and EC provided for 1:5 sample:water extracts
2. Scr = Chromium Reducible Sulfur; MPA = Maximum Potential Acidity; ANC = Acid Neutralising Capacity; NAPP = Net Acid Producing Potential; NAG = Net Acid Generation.
3. Sample classification criteria detail provided in report text.

Table B2: Multi-Element Results for Samples the Moorvale South Project

		RGS Sample Number →	1	2	3	4	5	6
		Sampling Date →	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
		ALS Laboratory ID →	EB2202699001	EB2202699002	EB2202699003	EB2202699004	EB2202699005	EB2202699006
		Client ID →	MS0353_OB_001	MS0353_OB_002	MS0353_OB_003	MS0353_OB_004	MS0353_OB_005	MS0353_OB_006
Parameters	**Limit of Reporting**	NEPC[1] Health-Based Investigation Level (HILs)-C	Clay	Siltstone	Siltstone	Siltstone	Siltstone	Sandstone
pH	0.1	-	8.40	8.70	8.50	8.60	8.70	9.10
Electrical Conductivity	1	-	773	720	1,190	792	636	500
Major Cations	All units mg/kg		All units mg/kg					
Calcium (Ca)	50	-	13,400	18,200	9,820	16,400	12,800	31,800
Magnesium (Mg)	50	-	8,050	8,140	11,000	8,100	6,470	8,190
Potassium (K)	50	-	650	910	990	1,000	970	1,080
Sodium (Na)	50	-	1,670	1,410	2,340	1,370	1,000	850
Aluminium (Al)	50	-	6,060	6,740	11,300	10,000	6,390	6,320
Iron (Fe)	50	-	24,000	26,200	27,300	38,000	46,500	44,200
Minor and Trace Elements	All units mg/kg		All units mg/kg					
Arsenic (As)	5	-	<5	<5	<5	5	13	11
Boron (B)	50	-	<50	<50	<50	<50	<50	<50
Barium (Ba)	10	-	140	130	940	170	50	40
Beryllium (Be)	1	-	<1	<1	<1	<1	1	1
Cadmium (Cd)	1	90	<1	<1	<1	<1	<1	<1
Cobalt (Co)	2	300	8	8	17	12	13	11
Chromium (Cr) **	2	300	6	6	38	9	6	7
Copper (Cu)	5	17,000	22	30	50	43	41	45
Mercury (Hg)	0.1	-	<0.1	<0.1	<0.1	<0.1	0	<0.1
Manganese (Mn)	5	-	634	586	280	702	1,140	814
Molybdenum (Mo)	2	-	<2	<2	<2	<2	<2	<2
Nickel (Ni)	2	-	14	16	40	24	20	21
Lead (Pb)	5	-	9	11	9	13	15	13
Antimony (Sb)	5	-	<5	<5	<5	<5	<5	<5
Selenium (Se)	5	700	<5	<5	<5	<5	<5	<5
Thorium (Th)	0.1	-	-	-	-	-	-	-
Uranium (U)	0.1	-	0.7	0.5	0.6	0.5	0.5	0.3
Vanadium (V)	5	-	19	20	50	30	21	31
Zinc (Zn)	5	30,000	42	48	66	70	76	102

Notes: Shaded cells exceed applied guideline limit.
< indicates less than the laboratory limit of reporting.
** Guideline level for Cr(VI) = 300 mg/kg.
1. NEPC (2013). National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM), Amendment of Schedule B1-B7 of 1999 version. Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use.

Table B2: Multi-Element Results for Samples the Moorvale South Project

		RGS Sample Number →	7	8	9	10	11	12
		Sampling Date →	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
		ALS Laboratory ID →	EB2202699007	EB2202699008	EB2202699009	EB2202699010	EB2202699011	EB2202699012
		Client ID →	MS0353_OB_007	MS0353_OB_008	MS0354_OB_001	MS0354_OB_002	MS0354_OB_003	MS0354_OB_004
Parameters	**Limit of Reporting**	NEPC[1] Health-Based Investigation Level (HILs)-C	Sandstone	Sandstone	Sandstone/Siltstone	Sandstone/Siltstone	Carbonaceous Mudston	Siltstone
pH	0.1	-	9.00	9.20	8.80	9.00	8.60	9.40
Electrical Conductivity	1	-	527	407	932	724	790	422
Major Cations	All units mg/kg		All units mg/kg					
Calcium (Ca)	50	-	12,000	33,400	14,200	21,400	7,020	24,200
Magnesium (Mg)	50	-	6,800	11,800	9,880	8,820	5,760	9,060
Potassium (K)	50	-	1,150	920	1,030	1,010	850	920
Sodium (Na)	50	-	920	730	2,300	1,210	1,180	990
Aluminium (Al)	50	-	7,100	4,340	12,800	6,520	7,270	7,580
Iron (Fe)	50	-	41,200	29,400	32,400	34,400	49,500	39,200
Minor and Trace Elements	All units mg/kg		All units mg/kg					
Arsenic (As)	5	-	10	9	7	10	31	6
Boron (B)	50	-	<50	<50	<50	<50	<50	<50
Barium (Ba)	10	-	20	100	200	160	50	20
Beryllium (Be)	1	-	1	<1	<1	<1	1	<1
Cadmium (Cd)	1	90	<1	<1	<1	<1	<1	<1
Cobalt (Co)	2	300	14	9	12	15	16	11
Chromium (Cr) **	2	300	7	5	23	7	6	9
Copper (Cu)	5	17,000	45	33	43	31	45	42
Mercury (Hg)	0.1	-	<0.1	<0.1	<0.1	<0.1	0	<0.1
Manganese (Mn)	5	-	643	652	499	634	1,510	689
Molybdenum (Mo)	2	-	<2	<2	<2	<2	<2	<2
Nickel (Ni)	2	-	24	15	27	24	23	22
Lead (Pb)	5	-	16	10	10	13	18	12
Antimony (Sb)	5	-	<5	<5	<5	<5	<5	<5
Selenium (Se)	5	700	<5	<5	<5	<5	<5	<5
Thorium (Th)	0.1	-	-	-	-	-	-	-
Uranium (U)	0.1	-	0.3	0.3	0.4	0.3	0.5	0.3
Vanadium (V)	5	-	25	19	32	22	22	29
Zinc (Zn)	5	30,000	94	72	65	67	69	63

Notes: Shaded cells exceed applied guideline limit.
< indicates less than the laboratory limit of reporting.
** Guideline level for Cr(VI) = 300 mg/kg.
1. NEPC (2013). National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM), Amendment of Schedule B1-B7 of 1999 version. Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use.

Table B2: Multi-Element Results for Samples the Moorvale South Project

		RGS Sample Number →	13	14	15	16	17	18
		Sampling Date →	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
		ALS Laboratory ID →	EB2202699013	EB2202699014	EB2202699015	EB2202699016	EB2202699017	EB2202699018
		Client ID →	MS0354_OB_005	MS0354_OB_006	MS0354_OB_007	MS0378_OB_001	MS0378_OB_002	MS0378_OB_003
Parameters	**Limit of Reporting**	NEPC[1] Health-Based Investigation Level (HILs)-C	Siltstone	Siltstone	Carbonaceous Siltstone	Sandstone	Siltstone	Siltstone
pH	0.1	-	9.40	9.30	9.10	8.70	8.90	9.40
Electrical Conductivity	1	-	414	450	680	755	968	867
Major Cations	All units mg/kg		All units mg/kg					
Calcium (Ca)	50	-	23,500	26,200	19,100	2,050	7,760	6,930
Magnesium (Mg)	50	-	7,310	9,130	7,710	1,910	4,310	2,640
Potassium (K)	50	-	900	1,020	970	450	780	780
Sodium (Na)	50	-	900	1,050	1,270	1,680	2,280	2,200
Aluminium (Al)	50	-	6,460	5,820	5,380	4,900	5,400	4,940
Iron (Fe)	50	-	37,500	41,700	35,900	29,500	29,400	16,100
Minor and Trace Elements	All units mg/kg		All units mg/kg					
Arsenic (As)	5	-	13	13	9	<5	<5	<5
Boron (B)	50	-	<50	<50	<50	<50	<50	<50
Barium (Ba)	10	-	20	40	210	240	370	250
Beryllium (Be)	1	-	<1	<1	<1	<1	<1	<1
Cadmium (Cd)	1	90	<1	<1	<1	<1	<1	<1
Cobalt (Co)	2	300	12	11	12	10	13	9
Chromium (Cr) **	2	300	8	8	6	32	22	6
Copper (Cu)	5	17,000	44	43	40	13	18	11
Mercury (Hg)	0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese (Mn)	5	-	618	755	640	308	727	375
Molybdenum (Mo)	2	-	<2	<2	<2	<2	<2	<2
Nickel (Ni)	2	-	22	21	19	14	19	14
Lead (Pb)	5	-	13	13	14	8	11	8
Antimony (Sb)	5	-	<5	<5	<5	<5	<5	<5
Selenium (Se)	5	700	<5	<5	<5	<5	<5	<5
Thorium (Th)	0.1	-	-	-	-	-	-	-
Uranium (U)	0.1	-	0.3	0.4	0.3	0.6	0.4	0.1
Vanadium (V)	5	-	26	33	24	52	39	14
Zinc (Zn)	5	30,000	69	68	76	16	43	41

Notes: Shaded cells exceed applied guideline limit.
< indicates less than the laboratory limit of reporting.
** Guideline level for Cr(VI) = 300 mg/kg.
1. NEPC (2013). National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM), Amendment of Schedule B1-B7 of 1999 version. Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use.

Table B2: Multi-Element Results for Samples the Moorvale South Project

		RGS Sample Number →	19	20	21	22	23	24
		Sampling Date →	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
		ALS Laboratory ID →	EB2202699019	EB2202699020	EB2202699021	EB2202699022	EB2202699023	EB2202699024
		Client ID →	MS0378_OB_004	MS0378_OB_005	MS0378_OB_006	MS0378_OB_007	MS0378_OB_008	MS0378_OB_009
Parameters	**Limit of Reporting**	NEPC[1] Health-Based Investigation Level (HILs)-C	Siltstone	Siltstone	Siltstone	Siltstone	Siltstone	Siltstone
pH	0.1	-	8.90	9.00	9.30	9.30	9.30	9.40
Electrical Conductivity	1	-	913	896	599	625	635	567
Major Cations	All units mg/kg		All units mg/kg					
Calcium (Ca)	50	-	2,290	10,000	18,800	17,800	10,500	11,400
Magnesium (Mg)	50	-	3,040	4,450	3,930	4,840	5,630	5,710
Potassium (K)	50	-	690	1,060	1,160	1,200	1,140	1,070
Sodium (Na)	50	-	1,960	2,310	1,500	1,670	1,670	1,620
Aluminium (Al)	50	-	7,000	11,700	9,490	14,000	14,200	12,200
Iron (Fe)	50	-	25,400	41,200	30,700	38,600	46,200	50,000
Minor and Trace Elements	All units mg/kg		All units mg/kg					
Arsenic (As)	5	-	6	<5	<5	<5	<5	<5
Boron (B)	50	-	<50	<50	<50	<50	<50	<50
Barium (Ba)	10	-	140	100	30	30	160	40
Beryllium (Be)	1	-	<1	<1	<1	<1	<1	1
Cadmium (Cd)	1	90	<1	<1	<1	<1	<1	<1
Cobalt (Co)	2	300	10	13	10	12	13	14
Chromium (Cr) **	2	300	11	14	12	14	15	14
Copper (Cu)	5	17,000	16	25	27	36	39	40
Mercury (Hg)	0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese (Mn)	5	-	720	960	854	704	951	1,030
Molybdenum (Mo)	2	-	<2	<2	<2	<2	<2	<2
Nickel (Ni)	2	-	17	21	20	24	26	24
Lead (Pb)	5	-	12	17	13	14	17	18
Antimony (Sb)	5	-	<5	<5	<5	<5	<5	<5
Selenium (Se)	5	700	<5	<5	<5	<5	<5	<5
Thorium (Th)	0.1	-	-	-	-	-	-	-
Uranium (U)	0.1	-	0.2	0.4	0.3	0.3	0.3	0.5
Vanadium (V)	5	-	28	39	27	33	34	40
Zinc (Zn)	5	30,000	49	75	57	66	108	87

Notes: Shaded cells exceed applied guideline limit.
< indicates less than the laboratory limit of reporting.
** Guideline level for Cr(VI) = 300 mg/kg.
1. NEPC (2013). National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM), Amendment of Schedule B1-B7 of 1999 version. Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use.

Table B2: Multi-Element Results for Samples the Moorvale South Project

		RGS Sample Number →	25	26	27	28	29	30
		Sampling Date →	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
		ALS Laboratory ID →	EB2202699025	EB2202699026	EB2202699027	EB2202699028	EB2202699029	EB2202699030
		Client ID →	MS0378_OB_010	MS0378_OB_011	MS0378_OB_012	MS0378_OB_013	MS0378_OB_014	MS0378_OB_015
Parameters	**Limit of Reporting**	NEPC[1] Health-Based Investigation Level (HILs)-C	Siltstone	Sandstone	Siltstone	Carbonaceous Siltstone	Carbonaceous Siltstone	Carbonaceous Siltstone
pH	0.1	-	8.80	9.20	9.30	9.00	9.50	9.50
Electrical Conductivity	1	-	635	608	544	696	482	508
Major Cations	All units mg/kg		All units mg/kg					
Calcium (Ca)	50	-	32,200	40,600	18,800	8,830	13,900	18,500
Magnesium (Mg)	50	-	5,430	5,800	5,270	4,120	7,160	6,770
Potassium (K)	50	-	660	820	940	790	1,270	1,200
Sodium (Na)	50	-	1,000	1,210	1,220	1,240	1,540	1,440
Aluminium (Al)	50	-	14,800	14,900	11,600	6,890	9,680	8,220
Iron (Fe)	50	-	40,100	42,100	39,800	44,600	27,900	27,000
Minor and Trace Elements	All units mg/kg		All units mg/kg					
Arsenic (As)	5	-	10	16	21	21	<5	8
Boron (B)	50	-	<50	<50	<50	<50	<50	<50
Barium (Ba)	10	-	10	20	20	290	20	50
Beryllium (Be)	1	-	<1	<1	1	1	<1	<1
Cadmium (Cd)	1	90	<1	<1	<1	<1	<1	<1
Cobalt (Co)	2	300	12	11	10	11	18	14
Chromium (Cr) **	2	300	19	20	16	11	10	9
Copper (Cu)	5	17,000	17	27	36	36	50	36
Mercury (Hg)	0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese (Mn)	5	-	756	1,040	830	1,090	409	489
Molybdenum (Mo)	2	-	<2	<2	<2	<2	<2	<2
Nickel (Ni)	2	-	18	22	23	19	26	21
Lead (Pb)	5	-	14	15	15	18	18	15
Antimony (Sb)	5	-	<5	<5	<5	<5	<5	<5
Selenium (Se)	5	700	<5	<5	<5	<5	<5	<5
Thorium (Th)	0.1	-	-	-	-	-	-	-
Uranium (U)	0.1	-	0.3	0.3	0.4	0.5	0.3	0.2
Vanadium (V)	5	-	50	51	40	36	25	23
Zinc (Zn)	5	30,000	56	60	67	71	80	69

Notes: Shaded cells exceed applied guideline limit.
< indicates less than the laboratory limit of reporting.
** Guideline level for Cr(VI) = 300 mg/kg.
1. NEPC (2013). National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM), Amendment of Schedule B1-B7 of 1999 version. Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use.

Table B2: Multi-Element Results for Samples the Moorvale South Project

		RGS Sample Number →	31	32	33	34	35	36
		Sampling Date →	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
		ALS Laboratory ID →	EB2202699031	EB2202699032	EB2202699033	EB2202699034	EB2202699035	EB2202699036
		Client ID →	MS0378_OB_016	MS0378_OB_017	MS0378_OB_018	MS0378_OB_019	MS0378_OB_020	MS0378_OB_021
Parameters	**Limit of Reporting**	NEPC[1] Health-Based Investigation Level (HILs)-C	Siltstone	Siltstone	Sandstone	Siltstone	Siltstone	Siltstone
pH	0.1	-	9.60	9.60	9.70	9.70	9.60	9.60
Electrical Conductivity	1	-	476	460	471	461	498	454
Major Cations	All units mg/kg		All units mg/kg					
Calcium (Ca)	50	-	24,100	17,600	28,800	36,000	21,700	18,200
Magnesium (Mg)	50	-	7,730	7,250	7,150	11,600	8,250	7,860
Potassium (K)	50	-	950	1,010	870	1,020	1,160	1,070
Sodium (Na)	50	-	1,390	1,270	1,220	1,250	1,510	1,280
Aluminium (Al)	50	-	9,300	9,070	9,190	10,100	12,200	11,000
Iron (Fe)	50	-	30,900	31,100	36,500	39,200	40,000	39,700
Minor and Trace Elements	All units mg/kg		All units mg/kg					
Arsenic (As)	5	-	9	7	<5	5	11	6
Boron (B)	50	-	<50	<50	<50	<50	<50	<50
Barium (Ba)	10	-	30	160	40	30	40	40
Beryllium (Be)	1	-	<1	<1	<1	<1	<1	<1
Cadmium (Cd)	1	90	<1	<1	<1	<1	<1	<1
Cobalt (Co)	2	300	9	12	10	11	12	12
Chromium (Cr) **	2	300	9	12	12	12	14	13
Copper (Cu)	5	17,000	36	22	22	23	38	32
Mercury (Hg)	0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese (Mn)	5	-	554	585	685	849	631	638
Molybdenum (Mo)	2	-	<2	2	<2	<2	<2	<2
Nickel (Ni)	2	-	17	23	20	20	25	24
Lead (Pb)	5	-	13	11	10	10	13	11
Antimony (Sb)	5	-	<5	<5	<5	<5	<5	<5
Selenium (Se)	5	700	<5	<5	<5	<5	<5	<5
Thorium (Th)	0.1	-	-	-	-	-	-	-
Uranium (U)	0.1	-	0.2	0.2	0.2	0.2	0.3	0.2
Vanadium (V)	5	-	26	28	28	33	33	32
Zinc (Zn)	5	30,000	63	66	59	56	70	65

Notes: Shaded cells exceed applied guideline limit.
< indicates less than the laboratory limit of reporting.
** Guideline level for Cr(VI) = 300 mg/kg.
1. NEPC (2013). National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM), Amendment of Schedule B1-B7 of 1999 version. Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use.

Table B2: Multi-Element Results for Samples the Moorvale South Project

		RGS Sample Number →	37	38	39	40	41	42
		Sampling Date →	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
		ALS Laboratory ID →	EB2202699037	EB2202699038	EB2202699039	EB2202699040	EB2202699041	EB2202699042
		Client ID →	MS0378_OB_022	MS0378_OB_023	MS0378_OB_024	MS0378_OB_025	MS0378_OB_026	MS0379_OB_001
Parameters	**Limit of Reporting**	NEPC[1] Health-Based Investigation Level (HILs)-C	Carbonaceous Siltstone	Carbonaceous Siltstone	Carbonaceous Siltstone	Coal	Coal	Siltstone
pH	0.1	-	9.60	9.60	9.40	9.30	9.40	8.70
Electrical Conductivity	1	-	470	469	493	594	602	1,290
Major Cations	All units mg/kg		All units mg/kg					
Calcium (Ca)	50	-	20,200	16,500	17,200	13,400	13,400	3,260
Magnesium (Mg)	50	-	8,740	8,090	8,890	16,500	10,400	2,770
Potassium (K)	50	-	970	1,060	1,150	1,180	1,180	1,170
Sodium (Na)	50	-	1,360	1,410	1,310	1,660	1,440	2,920
Aluminium (Al)	50	-	11,200	12,200	15,800	14,900	11,700	8,050
Iron (Fe)	50	-	47,500	45,600	40,900	31,500	23,300	33,000
Minor and Trace Elements	All units mg/kg		All units mg/kg					
Arsenic (As)	5	-	7	10	10	<5	<5	<5
Boron (B)	50	-	<50	<50	<50	<50	<50	<50
Barium (Ba)	10	-	50	50	290	390	250	270
Beryllium (Be)	1	-	<1	<1	<1	<1	<1	4
Cadmium (Cd)	1	90	<1	<1	<1	<1	<1	<1
Cobalt (Co)	2	300	13	13	13	11	10	18
Chromium (Cr) **	2	300	14	14	16	55	46	18
Copper (Cu)	5	17,000	31	43	40	30	36	31
Mercury (Hg)	0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese (Mn)	5	-	798	781	695	287	233	396
Molybdenum (Mo)	2	-	<2	<2	<2	<2	<2	<2
Nickel (Ni)	2	-	24	26	22	24	25	56
Lead (Pb)	5	-	10	14	12	9	11	13
Antimony (Sb)	5	-	<5	<5	<5	<5	<5	<5
Selenium (Se)	5	700	<5	<5	<5	<5	<5	<5
Thorium (Th)	0.1	-	-	-	-	-	-	-
Uranium (U)	0.1	-	0.2	0.3	0.3	0.5	0.3	0.6
Vanadium (V)	5	-	38	37	37	64	53	39
Zinc (Zn)	5	30,000	67	67	65	48	59	71

Notes: Shaded cells exceed applied guideline limit.
< indicates less than the laboratory limit of reporting.
** Guideline level for Cr(VI) = 300 mg/kg.
1. NEPC (2013). National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM), Amendment of Schedule B1-B7 of 1999 version. Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use.

Table B2: Multi-Element Results for Samples the Moorvale South Project

		RGS Sample Number →	43	44	45	46	47	48
		Sampling Date →	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
		ALS Laboratory ID →	EB2202699043	EB2202699044	EB2202699045	EB2202699046	EB2202699047	EB2202699048
		Client ID →	MS0379_OB_002	MS0379_OB_003	MS0379_OB_004	MS0379_OB_005	MS0379_OB_006	MS0379_OB_007
Parameters	**Limit of Reporting**	NEPC[1] Health-Based Investigation Level (HILs)-C	Siltstone	Siltstone	Siltstone	Siltstone	Siltstone	Siltstone
pH	0.1	-	8.20	8.60	9.10	9.20	9.40	9.70
Electrical Conductivity	1	-	1,130	1,370	1,310	1,110	901	488
Major Cations	All units mg/kg		All units mg/kg					
Calcium (Ca)	50	-	930	1,600	5,080	14,400	13,600	26,900
Magnesium (Mg)	50	-	3,220	3,080	3,000	3,450	4,850	5,740
Potassium (K)	50	-	1,380	1,250	1,040	1,170	1,150	740
Sodium (Na)	50	-	3,470	3,490	2,860	2,710	2,360	1,190
Aluminium (Al)	50	-	9,890	9,840	7,700	8,770	11,600	13,200
Iron (Fe)	50	-	33,600	31,400	23,300	25,400	30,500	36,000
Minor and Trace Elements	All units mg/kg		All units mg/kg					
Arsenic (As)	5	-	<5	<5	<5	<5	<5	7
Boron (B)	50	-	<50	<50	<50	<50	<50	<50
Barium (Ba)	10	-	240	150	220	160	30	20
Beryllium (Be)	1	-	1	<1	<1	<1	<1	<1
Cadmium (Cd)	1	90	<1	<1	<1	<1	<1	<1
Cobalt (Co)	2	300	20	15	12	12	13	12
Chromium (Cr) **	2	300	16	17	11	11	11	19
Copper (Cu)	5	17,000	33	30	24	26	36	18
Mercury (Hg)	0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese (Mn)	5	-	619	1,280	785	753	622	889
Molybdenum (Mo)	2	-	<2	<2	<2	<2	<2	<2
Nickel (Ni)	2	-	37	23	19	23	22	19
Lead (Pb)	5	-	10	14	11	13	14	13
Antimony (Sb)	5	-	<5	<5	<5	<5	<5	<5
Selenium (Se)	5	700	<5	<5	<5	<5	<5	<5
Thorium (Th)	0.1	-	-	-	-	-	-	-
Uranium (U)	0.1	-	0.4	0.4	0.3	0.2	0.4	0.2
Vanadium (V)	5	-	32	36	21	22	31	45
Zinc (Zn)	5	30,000	72	56	49	56	67	70

Notes: Shaded cells exceed applied guideline limit.
< indicates less than the laboratory limit of reporting.
** Guideline level for Cr(VI) = 300 mg/kg.
1. NEPC (2013). National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM), Amendment of Schedule B1-B7 of 1999 version. Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use.

Table B2: Multi-Element Results for Samples the Moorvale South Project

		RGS Sample Number →	49	50	51	52	53	54
		Sampling Date →	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
		ALS Laboratory ID →	EB2202699049	EB2202699050	EB2202699051	EB2202699052	EB2202699053	EB2202699054
		Client ID →	MS0379_OB_008	MS0379_OB_009	MS0379_OB_010	MS0379_OB_011	MS0379_OB_012	MS0379_OB_013
Parameters	**Limit of Reporting**	NEPC[1] Health-Based Investigation Level (HILs)-C	Sandstone	Sandstone	Siltstone	Siltstone	Carbonaceous Mudston	Siltstone
pH	0.1	-	9.60	9.50	9.50	9.50	7.50	9.10
Electrical Conductivity	1	-	474	412	489	435	945	1,360
Major Cations	All units mg/kg		All units mg/kg					
Calcium (Ca)	50	-	19,300	28,600	13,600	23,400	3,290	16,300
Magnesium (Mg)	50	-	6,190	6,150	5,200	5,220	1,550	6,940
Potassium (K)	50	-	920	910	900	890	560	1,120
Sodium (Na)	50	-	1,280	960	1,110	1,060	1,160	2,230
Aluminium (Al)	50	-	12,000	10,400	8,810	6,420	3,810	5,160
Iron (Fe)	50	-	40,100	44,300	38,000	38,200	36,200	22,900
Minor and Trace Elements	All units mg/kg		All units mg/kg					
Arsenic (As)	5	-	10	16	25	24	44	7
Boron (B)	50	-	<50	<50	<50	<50	<50	<50
Barium (Ba)	10	-	20	20	210	120	50	610
Beryllium (Be)	1	-	<1	<1	<1	1	<1	<1
Cadmium (Cd)	1	90	<1	<1	<1	<1	<1	<1
Cobalt (Co)	2	300	13	12	11	10	10	8
Chromium (Cr) **	2	300	19	19	14	10	3	5
Copper (Cu)	5	17,000	29	22	37	38	47	46
Mercury (Hg)	0.1	-	<0.1	<0.1	<0.1	<0.1	0	0
Manganese (Mn)	5	-	682	832	689	848	1,220	332
Molybdenum (Mo)	2	-	<2	<2	<2	<2	<2	<2
Nickel (Ni)	2	-	27	25	22	18	16	17
Lead (Pb)	5	-	15	13	16	18	30	15
Antimony (Sb)	5	-	<5	<5	<5	<5	<5	<5
Selenium (Se)	5	700	<5	<5	<5	<5	<5	<5
Thorium (Th)	0.1	-	-	-	-	-	-	-
Uranium (U)	0.1	-	0.3	0.3	0.4	0.5	1.1	0.3
Vanadium (V)	5	-	51	54	37	34	18	17
Zinc (Zn)	5	30,000	61	88	77	66	51	72

Notes: Shaded cells exceed applied guideline limit.
< indicates less than the laboratory limit of reporting.
** Guideline level for Cr(VI) = 300 mg/kg.
1. NEPC (2013). National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM), Amendment of Schedule B1-B7 of 1999 version. Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use.

Table B2: Multi-Element Results for Samples the Moorvale South Project

Parameters	Limit of Reporting	NEPC[1] Health-Based Investigation Level (HILs)-C	RGS Sample Number →	55	56	57	58	59	60
			Sampling Date →	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
			ALS Laboratory ID →	EB2202699055	EB2202699056	EB2202699057	EB2202699058	EB2202699059	EB2202699060
			Client ID →	MS0379_OB_014	MS0379_OB_015	MS0379_OB_016	MS0379_OB_017	MS0379_OB_018	MS0379_OB_019
				Siltstone	Siltstone	Siltstone	Siltstone	Siltstone	Siltstone
pH	0.1	-		9.40	9.30	9.30	9.30	9.40	9.00
Electrical Conductivity	1	-		1,120	1,160	1,150	1,110	1,210	2,230
Major Cations	All units mg/kg			All units mg/kg					
Calcium (Ca)	50	-		25,600	14,700	10,900	18,700	27,600	21,600
Magnesium (Mg)	50	-		9,110	7,020	5,740	7,940	8,330	7,910
Potassium (K)	50	-		850	980	900	1,160	1,080	1,090
Sodium (Na)	50	-		1,960	2,060	2,030	2,080	2,140	3,100
Aluminium (Al)	50	-		4,520	5,810	5,360	7,050	6,120	7,420
Iron (Fe)	50	-		28,800	33,700	33,900	43,800	36,200	42,900
Minor and Trace Elements	All units mg/kg			All units mg/kg					
Arsenic (As)	5	-		10	6	10	14	6	<5
Boron (B)	50	-		<50	<50	<50	<50	<50	<50
Barium (Ba)	10	-		240	130	120	110	90	100
Beryllium (Be)	1	-		<1	<1	<1	<1	<1	<1
Cadmium (Cd)	1	90		<1	<1	<1	<1	<1	<1
Cobalt (Co)	2	300		14	11	15	15	11	12
Chromium (Cr) **	2	300		5	6	6	9	8	10
Copper (Cu)	5	17,000		40	48	41	36	21	25
Mercury (Hg)	0.1	-		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese (Mn)	5	-		493	596	538	735	716	739
Molybdenum (Mo)	2	-		<2	<2	<2	<2	<2	<2
Nickel (Ni)	2	-		22	18	24	27	19	21
Lead (Pb)	5	-		13	15	13	13	11	10
Antimony (Sb)	5	-		<5	<5	<5	<5	<5	<5
Selenium (Se)	5	700		<5	<5	<5	<5	<5	<5
Thorium (Th)	0.1	-		-	-	-	-	-	-
Uranium (U)	0.1	-		0.3	0.3	0.2	0.3	0.2	0.2
Vanadium (V)	5	-		18	21	20	30	26	31
Zinc (Zn)	5	30,000		76	81	73	71	61	66

Notes: Shaded cells exceed applied guideline limit.
< indicates less than the laboratory limit of reporting.
** Guideline level for Cr(VI) = 300 mg/kg.
1. NEPC (2013). National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM), Amendment of Schedule B1-B7 of 1999 version. Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use.

Table B2: Multi-Element Results for Samples the Moorvale South Project

		RGS Sample Number →	61	62	63	64	65	66
		Sampling Date →	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
		ALS Laboratory ID →	EB2202699061	EB2202699062	EB2202699063	EB2202699064	EB2202699065	EB2202699066
		Client ID →	MS0379_OB_020	MS0380_OB_001	MS0380_OB_002	MS0380_OB_003	MS0380_OB_004	MS0380_OB_005
Parameters	**Limit of Reporting**	NEPC[1] Health-Based Investigation Level (HILs)-C	Siltstone	Clay	Clay	Clay	Clay	Siltstone
pH	0.1	-	9.20	8.40	8.60	9.00	9.10	9.40
Electrical Conductivity	1	-	1,020	2,240	2,090	1,540	1,140	782
Major Cations	All units mg/kg		All units mg/kg					
Calcium (Ca)	50	-	13,000	8,650	9,460	30,000	18,200	27,500
Magnesium (Mg)	50	-	6,330	5,390	6,930	6,680	6,710	8,280
Potassium (K)	50	-	1,150	1,320	1,160	1,060	1,270	1,150
Sodium (Na)	50	-	1,790	4,270	3,990	2,860	2,360	1,960
Aluminium (Al)	50	-	7,700	11,600	13,400	11,100	11,900	13,600
Iron (Fe)	50	-	36,400	37,900	32,200	37,200	34,300	38,200
Minor and Trace Elements	All units mg/kg		All units mg/kg					
Arsenic (As)	5	-	5	6	11	8	8	9
Boron (B)	50	-	<50	<50	<50	<50	<50	<50
Barium (Ba)	10	-	90	700	150	140	130	60
Beryllium (Be)	1	-	<1	1	<1	<1	<1	<1
Cadmium (Cd)	1	90	<1	<1	<1	<1	<1	<1
Cobalt (Co)	2	300	11	13	11	10	10	10
Chromium (Cr) **	2	300	10	23	12	12	12	12
Copper (Cu)	5	17,000	26	31	42	36	40	43
Mercury (Hg)	0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese (Mn)	5	-	561	675	530	763	556	656
Molybdenum (Mo)	2	-	<2	<2	<2	<2	<2	<2
Nickel (Ni)	2	-	20	20	23	20	20	20
Lead (Pb)	5	-	10	20	17	13	14	15
Antimony (Sb)	5	-	<5	<5	<5	<5	<5	<5
Selenium (Se)	5	700	<5	<5	<5	<5	<5	<5
Thorium (Th)	0.1	-	-	-	-	-	-	-
Uranium (U)	0.1	-	0.2	0.7	0.4	0.4	0.3	0.3
Vanadium (V)	5	-	28	46	33	33	31	35
Zinc (Zn)	5	30,000	67	52	68	62	64	74

Notes: Shaded cells exceed applied guideline limit.
< indicates less than the laboratory limit of reporting.
** Guideline level for Cr(VI) = 300 mg/kg.
1. NEPC (2013). National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM), Amendment of Schedule B1-B7 of 1999 version. Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use.

Table B2: Multi-Element Results for Samples the Moorvale South Project

		RGS Sample Number →	67	68	69	70	71	72
		Sampling Date →	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
		ALS Laboratory ID →	EB2202699067	EB2202699068	EB2202699069	EB2202699070	EB2202699071	EB2202699072
		Client ID →	MS0380_OB_006	MS0380_OB_007	MS0380_OB_008	MS0380_OB_009	MS0380_OB_010	MS0380_OB_011
Parameters	**Limit of Reporting**	NEPC[1] Health-Based Investigation Level (HILs)-C	Siltstone	Coaly Mudstone	Siltstone	Siltstone	Siltstone	Siltstone
pH	0.1	-	9.60	9.40	9.60	9.70	9.60	9.70
Electrical Conductivity	1	-	590	612	558	554	584	574
Major Cations	All units mg/kg		All units mg/kg					
Calcium (Ca)	50	-	24,800	15,200	15,700	24,600	11,800	24,100
Magnesium (Mg)	50	-	8,250	5,460	7,940	8,560	6,530	7,130
Potassium (K)	50	-	1,100	1,010	1,130	1,100	1,140	1,060
Sodium (Na)	50	-	1,790	1,780	1,760	1,710	1,720	1,620
Aluminium (Al)	50	-	11,800	8,630	11,200	9,620	9,550	6,930
Iron (Fe)	50	-	37,700	33,700	40,100	36,200	39,500	32,600
Minor and Trace Elements	All units mg/kg		All units mg/kg					
Arsenic (As)	5	-	13	32	6	14	12	11
Boron (B)	50	-	<50	<50	<50	<50	<50	<50
Barium (Ba)	10	-	110	280	170	80	160	80
Beryllium (Be)	1	-	<1	<1	1	<1	<1	<1
Cadmium (Cd)	1	90	<1	<1	<1	<1	<1	<1
Cobalt (Co)	2	300	12	7	12	11	13	10
Chromium (Cr) **	2	300	12	6	10	11	9	9
Copper (Cu)	5	17,000	45	43	48	41	46	28
Mercury (Hg)	0.1	-	<0.1	0	<0.1	<0.1	<0.1	<0.1
Manganese (Mn)	5	-	770	448	889	765	759	726
Molybdenum (Mo)	2	-	<2	<2	<2	<2	<2	<2
Nickel (Ni)	2	-	20	13	21	20	20	19
Lead (Pb)	5	-	14	14	16	14	14	11
Antimony (Sb)	5	-	<5	<5	<5	<5	<5	<5
Selenium (Se)	5	700	<5	<5	<5	<5	<5	<5
Thorium (Th)	0.1	-	-	-	-	-	-	-
Uranium (U)	0.1	-	0.4	0.4	0.4	0.4	0.3	0.3
Vanadium (V)	5	-	32	18	33	32	28	27
Zinc (Zn)	5	30,000	78	83	71	97	86	72

Notes: Shaded cells exceed applied guideline limit.
< indicates less than the laboratory limit of reporting.
** Guideline level for Cr(VI) = 300 mg/kg.
1. NEPC (2013). National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM), Amendment of Schedule B1-B7 of 1999 version. Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use.

Table B2: Multi-Element Results for Samples the Moorvale South Project

		RGS Sample Number →	73	74	75	76	77	78
		Sampling Date →	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
		ALS Laboratory ID →	EB2202699073	EB2202699074	EB2202699075	EB2202699076	EB2202699077	EB2202699078
		Client ID →	MS0380_OB_12	MS0380_OB_13	MS0380_OB_14	MS0380_OB_15	MS0380_OB_16	MS0380_OB_17
Parameters	**Limit of Reporting**	NEPC[1] Health-Based Investigation Level (HILs)-C	Carbonaceous Siltstone	Siltstone	Igneous Rock	Siltstone	Sandstone	Siltstone
pH	0.1	-	9.70	9.60	9.80	9.70	9.80	9.70
Electrical Conductivity	1	-	559	617	682	663	563	689
Major Cations	All units mg/kg		All units mg/kg					
Calcium (Ca)	50	-	18,400	3,800	9,770	13,200	6,510	22,400
Magnesium (Mg)	50	-	6,490	2,680	4,640	6,560	6,440	6,170
Potassium (K)	50	-	1,020	920	1,240	1,230	1,160	820
Sodium (Na)	50	-	1,580	2,000	2,360	2,110	2,270	1,640
Aluminium (Al)	50	-	6,130	6,030	8,170	12,400	13,700	13,400
Iron (Fe)	50	-	32,700	15,800	20,000	33,200	41,500	33,100
Minor and Trace Elements	All units mg/kg		All units mg/kg					
Arsenic (As)	5	-	11	<5	6	8	<5	6
Boron (B)	50	-	<50	<50	<50	<50	<50	<50
Barium (Ba)	10	-	40	140	120	130	210	260
Beryllium (Be)	1	-	<1	<1	<1	<1	1	<1
Cadmium (Cd)	1	90	<1	<1	<1	<1	<1	<1
Cobalt (Co)	2	300	10	4	9	10	13	11
Chromium (Cr) **	2	300	8	5	5	8	11	15
Copper (Cu)	5	17,000	37	44	21	37	42	15
Mercury (Hg)	0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese (Mn)	5	-	752	136	281	478	853	557
Molybdenum (Mo)	2	-	<2	<2	<2	<2	<2	<2
Nickel (Ni)	2	-	20	11	14	17	22	19
Lead (Pb)	5	-	13	21	22	14	17	11
Antimony (Sb)	5	-	<5	<5	<5	<5	<5	<5
Selenium (Se)	5	700	<5	<5	<5	<5	<5	<5
Thorium (Th)	0.1	-	-	-	-	-	-	-
Uranium (U)	0.1	-	0.3	0.2	0.4	0.2	0.2	0.2
Vanadium (V)	5	-	25	12	13	24	32	38
Zinc (Zn)	5	30,000	68	64	68	77	74	80

Notes: Shaded cells exceed applied guideline limit.
< indicates less than the laboratory limit of reporting.
** Guideline level for Cr(VI) = 300 mg/kg.
1. NEPC (2013). National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM), Amendment of Schedule B1-B7 of 1999 version. Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use.

Table B2: Multi-Element Results for Samples the Moorvale South Project

		RGS Sample Number →	79	80	81	2022067_C001	2022067_C002	2022067_C003
		Sampling Date →	15/11/2021	15/11/2021	15/11/2021	25/10/2022	25/10/2022	25/10/2022
		ALS Laboratory ID →	EB2202699079	EB2202699080	EB2202699081	EB2233059019	EB2233059020	EB2233059021
		Client ID →	MS0380_OB_18	MS0380_OB_19	MS0380_OB_20	MRV_FEED	MRV_FEED	MRV_Coarse Reject
Parameters	**Limit of Reporting**	NEPC[1] Health-Based Investigation Level (HILs)-C	Siltstone	Siltstone	Siltstone	Product coal	Product coal	Coarse reject
pH	0.1	-	9.80	9.80	9.70	9.2	9.2	9.3
Electrical Conductivity	1	-	474	666	563	472	468	775
Major Cations	All units mg/kg		All units mg/kg					
Calcium (Ca)	50	-	21,400	40,300	23,200	3,540	3,550	4,230
Magnesium (Mg)	50	-	5,960	7,040	11,900	1,100	1,240	2,190
Potassium (K)	50	-	730	910	1,130	290	320	620
Sodium (Na)	50	-	1,220	1,780	1,900	800	760	1,770
Aluminium (Al)	50	-	12,500	10,400	10,200	2,130	2,300	3,940
Iron (Fe)	50	-	29,300	26,900	28,500	5,310	5,680	5,930
Minor and Trace Elements	All units mg/kg		All units mg/kg					
Arsenic (As)	5	-	<5	9	12	0.5	0.9	0.8
Boron (B)	50	-	<50	<50	<50	<50	<50	<50
Barium (Ba)	10	-	110	150	210	86	117	117
Beryllium (Be)	1	-	<1	<1	<1	0.4	0.4	1.4
Cadmium (Cd)	1	90	<1	<1	<1	<0.1	<0.1	<0.1
Cobalt (Co)	2	300	10	13	9	1.1	1.6	1.2
Chromium (Cr) **	2	300	13	10	29	1.3	1.5	1.2
Copper (Cu)	5	17,000	16	28	44	14	17	14
Mercury (Hg)	0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese (Mn)	5	-	539	784	412	64	76	55
Molybdenum (Mo)	2	-	<2	<2	<2	0.5	0.6	0.6
Nickel (Ni)	2	-	18	20	19	2.3	2.2	2.1
Lead (Pb)	5	-	10	12	13	9	9	35
Antimony (Sb)	5	-	<5	<5	<5	<0.1	<0.1	<0.1
Selenium (Se)	5	700	<5	<5	<5	<1	<1	1
Thorium (Th)	0.1	-	-	-	-	2.4	3.0	13.7
Uranium (U)	0.1	-	0.1	0.2	0.3	0.7	0.7	1.4
Vanadium (V)	5	-	37	28	34	4	5	6
Zinc (Zn)	5	30,000	48	62	58	11.3	13.6	16.7

Notes: Shaded cells exceed applied guideline limit.
< indicates less than the laboratory limit of reporting.
** Guideline level for Cr(VI) = 300 mg/kg.
1. NEPC (2013). National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM), Amendment of Schedule B1-B7 of 1999 version. Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use.

Table B2: Multi-Element Results for Samples the Moorvale South Project

	RGS Sample Number →		2022067_C004	2022067_C005	2022067_C006
	Sampling Date →		25/10/2022	25/10/2022	25/10/2022
	ALS Laboratory ID →		EB2233059022	EB2233059023	EB2233059024
	Client ID →		MRV_Coarse Reject	MRV_Fine Reject	MRV_Fine Reject
Parameters	**Limit of Reporting**	NEPC[1] Health-Based Investigation Level (HILs)-C	Coarse Reject	Tailing	Tailing
pH	0.1	-	9.5	9.1	9.1
Electrical Conductivity	1	-	582	1,150	1,570
Major Cations	All units mg/kg		All units mg/kg		
Calcium (Ca)	50	-	6,680	13,000	7,820
Magnesium (Mg)	50	-	2,060	2,360	2,480
Potassium (K)	50	-	510	610	640
Sodium (Na)	50	-	1,380	1,950	2,620
Aluminium (Al)	50	-	3,590	3,220	3,360
Iron (Fe)	50	-	4,790	37,000	15,300
Minor and Trace Elements	All units mg/kg		All units mg/kg		
Arsenic (As)	5	-	0.5	1.8	1.7
Boron (B)	50	-	<50	<50	<50
Barium (Ba)	10	-	118	97	220
Beryllium (Be)	1	-	1.3	0.8	1.0
Cadmium (Cd)	1	90	<0.1	0.1	0.1
Cobalt (Co)	2	300	1.0	5.0	3.9
Chromium (Cr) **	2	300	1.8	2.1	2.0
Copper (Cu)	5	17,000	17	20	21
Mercury (Hg)	0.1	-	<0.1	0.2	0.1
Manganese (Mn)	5	-	74	341	173
Molybdenum (Mo)	2	-	0.7	1.5	1.5
Nickel (Ni)	2	-	1.8	11.3	5.2
Lead (Pb)	5	-	23	31	23
Antimony (Sb)	5	-	<0.1	0.1	0.1
Selenium (Se)	5	700	<1	1.0	<1
Thorium (Th)	0.1	-	6.3	6.9	7.9
Uranium (U)	0.1	-	0.8	1.1	1.1
Vanadium (V)	5	-	5	7	7
Zinc (Zn)	5	30,000	27.0	39.0	30.4

Notes: Shaded cells exceed applied guideline limit.
< indicates less than the laboratory limit of reporting.
** Guideline level for Cr(VI) = 300 mg/kg.
1. NEPC (2013). National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM), Amendment of Schedule B1-B7 of 1999 version. Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use.

Table B3: Geochemical Abundance Index (GAI) Results for Samples from the Moorvale South Project

	RGS Sample Number →		1	2	3	4	5	6
	Sampling Date →		15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
	ALS Laboratory ID →		EB2202699001	EB2202699002	EB2202699003	EB2202699004	EB2202699005	EB2202699006
	Client ID →		MS0353_OB_001	MS0353_OB_002	MS0353_OB_003	MS0353_OB_004	MS0353_OB_005	MS0353_OB_006
Parameters	**Limit of Reporting**	Median Crustal Abundance[1,2,3]	Clay	Siltstone	Siltstone	Siltstone	Siltstone	Sandstone
Major Cations	(All units in mg/kg)		Geochemical Abundance Index					
Calcium (Ca)	50	15,000	0.0	0.0	0.0	0.0	0.0	0.5
Magnesium (Mg)	50	5,000	0.1	0.1	0.6	0.1	0.0	0.1
Potassium (K)	50	14,000	0.0	0.0	0.0	0.0	0.0	0.0
Sodium (Na)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Aluminium (Al)	50	71,000	0.0	0.0	0.0	0.0	0.0	0.0
Iron (Fe)	50	40,000	0.0	0.0	0.0	0.0	0.0	0.0
Minor and Trace Elements	(All units in mg/kg)		Geochemical Abundance Index					
Arsenic (As)	5	6	0.0	0.0	0.0	0.0	0.5	0.3
Boron (B)	50	20	0.0	0.0	0.0	0.0	0.0	0.0
Barium (Ba)	10	500	0.0	0.0	0.3	0.0	0.0	0.0
Beryllium (Be)	1	0.3	0.2	0.2	0.2	0.2	1.2	1.2
Cadmium (Cd)	1	0.35	0.0	0.0	0.0	0.0	0.0	0.0
Cobalt (Co)	2	8	0.0	0.0	0.5	0.0	0.1	0.0
Chromium (Cr)	2	70	0.0	0.0	0.0	0.0	0.0	0.0
Copper (Cu)	5	30	0.0	0.0	0.2	0.0	0.0	0.0
Mercury (Hg)	0.1	0.06	0.0	0.0	0.0	0.0	0.2	0.0
Manganese (Mn)	5	1000	0.0	0.0	0.0	0.0	0.0	0.0
Molybdenum (Mo)	2	1.2	0.0	0.0	0.0	0.0	0.0	0.0
Nickel (Ni)	2	50	0.0	0.0	0.0	0.0	0.0	0.0
Lead (Pb)	5	35	0.0	0.0	0.0	0.0	0.0	0.0
Antimony (Sb)	5	1	0.7	0.7	0.7	0.7	0.7	0.7
Selenium (Se)	5	0.4	2.1	2.1	2.1	2.1	2.1	2.1
Thorium (Th)	0.1	9	---	---	---	---	---	---
Uranium (U)	0.1	2	0.0	0.0	0.0	0.0	0.0	0.0
Vanadium (V)	5	90	0.0	0.0	0.0	0.0	0.0	0.0
Zinc (Zn)	5	90	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Notes: GAI's greater than or equal to 3 are highlighted.
1. Median Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009).
2. When no GARD Guide value is available for particular element, then values are taken from Bowen (1979) Environmental Chemistry of the Elements, p 60-61.
3. If no guide value from GARD or Bowen H.J.M. (1979) exists, up to date, curated data is provided by CRC Handbook of Chemistry and Physics (2000).

Table B3: Geochemical Abundance Index (GAI) Results for Samples from the Moorvale South Project

	RGS Sample Number →		7	8	9	10	11	12
	Sampling Date →		15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
	ALS Laboratory ID →		EB2202699007	EB2202699008	EB2202699009	EB2202699010	EB2202699011	EB2202699012
	Client ID →		MS0353_OB_007	MS0353_OB_008	MS0354_OB_001	MS0354_OB_002	MS0354_OB_003	MS0354_OB_004
Parameters	**Limit of Reporting**	Median Crustal Abundance[1,2,3]	Sandstone	Sandstone	Sandstone/Siltstone	Sandstone/Siltstone	Carbonaceous Mudstone	Siltstone
Major Cations	(All units in mg/kg)		Geochemical Abundance Index					
Calcium (Ca)	50	15,000	0.0	0.6	0.0	0.0	0.0	0.1
Magnesium (Mg)	50	5,000	0.0	0.7	0.4	0.2	0.0	0.3
Potassium (K)	50	14,000	0.0	0.0	0.0	0.0	0.0	0.0
Sodium (Na)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Aluminium (Al)	50	71,000	0.0	0.0	0.0	0.0	0.0	0.0
Iron (Fe)	50	40,000	0.0	0.0	0.0	0.0	0.0	0.0
Minor and Trace Elements	(All units in mg/kg)		Geochemical Abundance Index					
Arsenic (As)	5	6	0.2	0.0	0.0	0.2	1.8	0.0
Boron (B)	50	20	0.0	0.0	0.0	0.0	0.0	0.0
Barium (Ba)	10	500	0.0	0.0	0.0	0.0	0.0	0.0
Beryllium (Be)	1	0.3	1.2	0.2	0.2	0.2	1.2	0.2
Cadmium (Cd)	1	0.35	0.0	0.0	0.0	0.0	0.0	0.0
Cobalt (Co)	2	8	0.2	0.0	0.0	0.3	0.4	0.0
Chromium (Cr)	2	70	0.0	0.0	0.0	0.0	0.0	0.0
Copper (Cu)	5	30	0.0	0.0	0.0	0.0	0.0	0.0
Mercury (Hg)	0.1	0.06	0.0	0.0	0.0	0.0	1.2	0.0
Manganese (Mn)	5	1000	0.0	0.0	0.0	0.0	0.0	0.0
Molybdenum (Mo)	2	1.2	0.0	0.0	0.0	0.0	0.0	0.0
Nickel (Ni)	2	50	0.0	0.0	0.0	0.0	0.0	0.0
Lead (Pb)	5	35	0.0	0.0	0.0	0.0	0.0	0.0
Antimony (Sb)	5	1	0.7	0.7	0.7	0.7	0.7	0.7
Selenium (Se)	5	0.4	2.1	2.1	2.1	2.1	2.1	2.1
Thorium (Th)	0.1	9	----	----	----	----	----	----
Uranium (U)	0.1	2	0.0	0.0	0.0	0.0	0.0	0.0
Vanadium (V)	5	90	0.0	0.0	0.0	0.0	0.0	0.0
Zinc (Zn)	5	90	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Notes: GAI's greater than or equal to 3 are highlighted.
1. Median Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009).
2. When no GARD Guide value is available for particular element, then values are taken from Bowen (1979) Environmental Chemistry of the Elements, p 60-61.
3. If no guide value from GARD or Bowen H.J.M. (1979) exists, up to date, curated data is provided by CRC Handbook of Chemistry and Physics (2000).

Table B3: Geochemical Abundance Index (GAI) Results for Samples from the Moorvale South Project

	RGS Sample Number →		13	14	15	16	17	18
	Sampling Date →		15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
	ALS Laboratory ID →		EB2202699013	EB2202699014	EB2202699015	EB2202699016	EB2202699017	EB2202699018
	Client ID →		MS0354_OB_005	MS0354_OB_006	MS0354_OB_007	MS0378_OB_001	MS0378_OB_002	MS0378_OB_003
Parameters	**Limit of Reporting**	Median Crustal Abundance[1,2,3]	Siltstone	Siltstone	Carbonaceous Siltstone	Sandstone	Siltstone	Siltstone
Major Cations	(All units in mg/kg)		Geochemical Abundance Index					
Calcium (Ca)	50	15,000	0.1	0.2	0.0	0.0	0.0	0.0
Magnesium (Mg)	50	5,000	0.0	0.3	0.0	0.0	0.0	0.0
Potassium (K)	50	14,000	0.0	0.0	0.0	0.0	0.0	0.0
Sodium (Na)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Aluminium (Al)	50	71,000	0.0	0.0	0.0	0.0	0.0	0.0
Iron (Fe)	50	40,000	0.0	0.0	0.0	0.0	0.0	0.0
Minor and Trace Elements	(All units in mg/kg)		Geochemical Abundance Index					
Arsenic (As)	5	6	0.5	0.5	0.0	0.0	0.0	0.0
Boron (B)	50	20	0.0	0.0	0.0	0.0	0.0	0.0
Barium (Ba)	10	500	0.0	0.0	0.0	0.0	0.0	0.0
Beryllium (Be)	1	0.3	0.2	0.2	0.2	0.2	0.2	0.2
Cadmium (Cd)	1	0.35	0.0	0.0	0.0	0.0	0.0	0.0
Cobalt (Co)	2	8	0.0	0.0	0.0	0.0	0.1	0.0
Chromium (Cr)	2	70	0.0	0.0	0.0	0.0	0.0	0.0
Copper (Cu)	5	30	0.0	0.0	0.0	0.0	0.0	0.0
Mercury (Hg)	0.1	0.06	0.0	0.0	0.0	0.0	0.0	0.0
Manganese (Mn)	5	1000	0.0	0.0	0.0	0.0	0.0	0.0
Molybdenum (Mo)	2	1.2	0.0	0.0	0.0	0.0	0.0	0.0
Nickel (Ni)	2	50	0.0	0.0	0.0	0.0	0.0	0.0
Lead (Pb)	5	35	0.0	0.0	0.0	0.0	0.0	0.0
Antimony (Sb)	5	1	0.7	0.7	0.7	0.7	0.7	0.7
Selenium (Se)	5	0.4	2.1	2.1	2.1	2.1	2.1	2.1
Thorium (Th)	0.1	9	---	---	---	---	---	---
Uranium (U)	0.1	2	0.0	0.0	0.0	0.0	0.0	0.0
Vanadium (V)	5	90	0.0	0.0	0.0	0.0	0.0	0.0
Zinc (Zn)	5	90	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Notes: GAI's greater than or equal to 3 are highlighted.
1. Median Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009).
2. When no GARD Guide value is available for particular element, then values are taken from Bowen (1979) Environmental Chemistry of the Elements, p 60-61.
3. If no guide value from GARD or Bowen H.J.M. (1979) exists, up to date, curated data is provided by CRC Handbook of Chemistry and Physics (2000).

Table B3: Geochemical Abundance Index (GAI) Results for Samples from the Moorvale South Project

	RGS Sample Number →		19	20	21	22	23	24
	Sampling Date →		15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
	ALS Laboratory ID →		EB2202699019	EB2202699020	EB2202699021	EB2202699022	EB2202699023	EB2202699024
	Client ID →		MS0378_OB_004	MS0378_OB_005	MS0378_OB_006	MS0378_OB_007	MS0378_OB_008	MS0378_OB_009
Parameters	**Limit of Reporting**	Median Crustal Abundance[1,2,3]	Siltstone	Siltstone	Siltstone	Siltstone	Siltstone	Siltstone
Major Cations	(All units in mg/kg)		Geochemical Abundance Index					
Calcium (Ca)	50	15,000	0.0	0.0	0.0	0.0	0.0	0.0
Magnesium (Mg)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Potassium (K)	50	14,000	0.0	0.0	0.0	0.0	0.0	0.0
Sodium (Na)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Aluminium (Al)	50	71,000	0.0	0.0	0.0	0.0	0.0	0.0
Iron (Fe)	50	40,000	0.0	0.0	0.0	0.0	0.0	0.0
Minor and Trace Elements	(All units in mg/kg)		Geochemical Abundance Index					
Arsenic (As)	5	6	0.0	0.0	0.0	0.0	0.0	0.0
Boron (B)	50	20	0.0	0.0	0.0	0.0	0.0	0.0
Barium (Ba)	10	500	0.0	0.0	0.0	0.0	0.0	0.0
Beryllium (Be)	1	0.3	0.2	0.2	0.2	0.2	0.2	1.2
Cadmium (Cd)	1	0.35	0.0	0.0	0.0	0.0	0.0	0.0
Cobalt (Co)	2	8	0.0	0.1	0.0	0.0	0.1	0.2
Chromium (Cr)	2	70	0.0	0.0	0.0	0.0	0.0	0.0
Copper (Cu)	5	30	0.0	0.0	0.0	0.0	0.0	0.0
Mercury (Hg)	0.1	0.06	0.0	0.0	0.0	0.0	0.0	0.0
Manganese (Mn)	5	1000	0.0	0.0	0.0	0.0	0.0	0.0
Molybdenum (Mo)	2	1.2	0.0	0.0	0.0	0.0	0.0	0.0
Nickel (Ni)	2	50	0.0	0.0	0.0	0.0	0.0	0.0
Lead (Pb)	5	35	0.0	0.0	0.0	0.0	0.0	0.0
Antimony (Sb)	5	1	0.7	0.7	0.7	0.7	0.7	0.7
Selenium (Se)	5	0.4	2.1	2.1	2.1	2.1	2.1	2.1
Thorium (Th)	0.1	9	----	----	----	----	----	----
Uranium (U)	0.1	2	0.0	0.0	0.0	0.0	0.0	0.0
Vanadium (V)	5	90	0.0	0.0	0.0	0.0	0.0	0.0
Zinc (Zn)	5	90	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Notes: GAI's greater than or equal to 3 are highlighted.

1. Median Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009).
2. When no GARD Guide value is available for particular element, then values are taken from Bowen (1979) Environmental Chemistry of the Elements, p 60-61.
3. If no guide value from GARD or Bowen H.J.M. (1979) exists, up to date, curated data is provided by CRC Handbook of Chemistry and Physics (2000).

Table B3: Geochemical Abundance Index (GAI) Results for Samples from the Moorvale South Project

	RGS Sample Number →		25	26	27	28	29	30
	Sampling Date →		15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
	ALS Laboratory ID →		EB2202699025	EB2202699026	EB2202699027	EB2202699028	EB2202699029	EB2202699030
	Client ID →		MS0378_OB_010	MS0378_OB_011	MS0378_OB_012	MS0378_OB_013	MS0378_OB_014	MS0378_OB_015
Parameters	**Limit of Reporting**	Median Crustal Abundance[1,2,3]	Siltstone	Sandstone	Siltstone	Carbonaceous Siltstone	Carbonaceous Siltstone	Carbonaceous Siltstone
Major Cations	(All units in mg/kg)		Geochemical Abundance Index					
Calcium (Ca)	50	15,000	0.5	0.9	0.0	0.0	0.0	0.0
Magnesium (Mg)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Potassium (K)	50	14,000	0.0	0.0	0.0	0.0	0.0	0.0
Sodium (Na)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Aluminium (Al)	50	71,000	0.0	0.0	0.0	0.0	0.0	0.0
Iron (Fe)	50	40,000	0.0	0.0	0.0	0.0	0.0	0.0
Minor and Trace Elements	(All units in mg/kg)		Geochemical Abundance Index					
Arsenic (As)	5	6	0.2	0.8	1.2	1.2	0.0	0.0
Boron (B)	50	20	0.0	0.0	0.0	0.0	0.0	0.0
Barium (Ba)	10	500	0.0	0.0	0.0	0.0	0.0	0.0
Beryllium (Be)	1	0.3	0.2	0.2	1.2	1.2	0.2	0.2
Cadmium (Cd)	1	0.35	0.0	0.0	0.0	0.0	0.0	0.0
Cobalt (Co)	2	8	0.0	0.0	0.0	0.0	0.6	0.2
Chromium (Cr)	2	70	0.0	0.0	0.0	0.0	0.0	0.0
Copper (Cu)	5	30	0.0	0.0	0.0	0.0	0.2	0.0
Mercury (Hg)	0.1	0.06	0.0	0.0	0.0	0.0	0.0	0.0
Manganese (Mn)	5	1000	0.0	0.0	0.0	0.0	0.0	0.0
Molybdenum (Mo)	2	1.2	0.0	0.0	0.0	0.0	0.0	0.0
Nickel (Ni)	2	50	0.0	0.0	0.0	0.0	0.0	0.0
Lead (Pb)	5	35	0.0	0.0	0.0	0.0	0.0	0.0
Antimony (Sb)	5	1	0.7	0.7	0.7	0.7	0.7	0.7
Selenium (Se)	5	0.4	2.1	2.1	2.1	2.1	2.1	2.1
Thorium (Th)	0.1	9	----	----	----	----	----	----
Uranium (U)	0.1	2	0.0	0.0	0.0	0.0	0.0	0.0
Vanadium (V)	5	90	0.0	0.0	0.0	0.0	0.0	0.0
Zinc (Zn)	5	90	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Notes: GAI's greater than or equal to 3 are highlighted.
1. Median Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009).
2. When no GARD Guide value is available for particular element, then values are taken from Bowen (1979) Environmental Chemistry of the Elements, p 60-61.
3. If no guide value from GARD or Bowen H.J.M. (1979) exists, up to date, curated data is provided by CRC Handbook of Chemistry and Physics (2000).

Table B3: Geochemical Abundance Index (GAI) Results for Samples from the Moorvale South Project

	RGS Sample Number →		31	32	33	34	35	36
	Sampling Date →		15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
	ALS Laboratory ID →		EB2202699031	EB2202699032	EB2202699033	EB2202699034	EB2202699035	EB2202699036
	Client ID →		MS0378_OB_016	MS0378_OB_017	MS0378_OB_018	MS0378_OB_019	MS0378_OB_020	MS0378_OB_021
Parameters	**Limit of Reporting**	Median Crustal Abundance[1,2,3]	Siltstone	Siltstone	Sandstone	Siltstone	Siltstone	Siltstone
Major Cations	(All units in mg/kg)		Geochemical Abundance Index					
Calcium (Ca)	50	15,000	0.1	0.0	0.4	0.7	0.0	0.0
Magnesium (Mg)	50	5,000	0.0	0.0	0.0	0.6	0.1	0.1
Potassium (K)	50	14,000	0.0	0.0	0.0	0.0	0.0	0.0
Sodium (Na)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Aluminium (Al)	50	71,000	0.0	0.0	0.0	0.0	0.0	0.0
Iron (Fe)	50	40,000	0.0	0.0	0.0	0.0	0.0	0.0
Minor and Trace Elements	(All units in mg/kg)		Geochemical Abundance Index					
Arsenic (As)	5	6	0.0	0.0	0.0	0.0	0.3	0.0
Boron (B)	50	20	0.0	0.0	0.0	0.0	0.0	0.0
Barium (Ba)	10	500	0.0	0.0	0.0	0.0	0.0	0.0
Beryllium (Be)	1	0.3	0.2	0.2	0.2	0.2	0.2	0.2
Cadmium (Cd)	1	0.35	0.0	0.0	0.0	0.0	0.0	0.0
Cobalt (Co)	2	8	0.0	0.0	0.0	0.0	0.0	0.0
Chromium (Cr)	2	70	0.0	0.0	0.0	0.0	0.0	0.0
Copper (Cu)	5	30	0.0	0.0	0.0	0.0	0.0	0.0
Mercury (Hg)	0.1	0.06	0.0	0.0	0.0	0.0	0.0	0.0
Manganese (Mn)	5	1000	0.0	0.0	0.0	0.0	0.0	0.0
Molybdenum (Mo)	2	1.2	0.0	0.2	0.0	0.0	0.0	0.0
Nickel (Ni)	2	50	0.0	0.0	0.0	0.0	0.0	0.0
Lead (Pb)	5	35	0.0	0.0	0.0	0.0	0.0	0.0
Antimony (Sb)	5	1	0.7	0.7	0.7	0.7	0.7	0.7
Selenium (Se)	5	0.4	2.1	2.1	2.1	2.1	2.1	2.1
Thorium (Th)	0.1	9	---	---	---	---	---	---
Uranium (U)	0.1	2	0.0	0.0	0.0	0.0	0.0	0.0
Vanadium (V)	5	90	0.0	0.0	0.0	0.0	0.0	0.0
Zinc (Zn)	5	90	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Notes: GAI's greater than or equal to 3 are highlighted.
1. Median Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009).
2. When no GARD Guide value is available for particular element, then values are taken from Bowen (1979) Environmental Chemistry of the Elements, p 60-61.
3. If no guide value from GARD or Bowen H.J.M. (1979) exists, up to date, curated data is provided by CRC Handbook of Chemistry and Physics (2000).

Table B3: Geochemical Abundance Index (GAI) Results for Samples from the Moorvale South Project

	RGS Sample Number →		37	38	39	40	41	42
	Sampling Date →		15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
	ALS Laboratory ID →		EB2202699037	EB2202699038	EB2202699039	EB2202699040	EB2202699041	EB2202699042
	Client ID →		MS0378_OB_022	MS0378_OB_023	MS0378_OB_024	MS0378_OB_025	MS0378_OB_026	MS0379_OB_001
Parameters	**Limit of Reporting**	Median Crustal Abundance[1,2,3]	Carbonaceous Siltstone	Carbonaceous Siltstone	Carbonaceous Siltstone	Coal	Coal	Siltstone
Major Cations	(All units in mg/kg)		Geochemical Abundance Index					
Calcium (Ca)	50	15,000	0.0	0.0	0.0	0.0	0.0	0.0
Magnesium (Mg)	50	5,000	0.2	0.1	0.2	1.1	0.5	0.0
Potassium (K)	50	14,000	0.0	0.0	0.0	0.0	0.0	0.0
Sodium (Na)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Aluminium (Al)	50	71,000	0.0	0.0	0.0	0.0	0.0	0.0
Iron (Fe)	50	40,000	0.0	0.0	0.0	0.0	0.0	0.0
Minor and Trace Elements	(All units in mg/kg)		Geochemical Abundance Index					
Arsenic (As)	5	6	0.0	0.2	0.2	0.0	0.0	0.0
Boron (B)	50	20	0.0	0.0	0.0	0.0	0.0	0.0
Barium (Ba)	10	500	0.0	0.0	0.0	0.0	0.0	0.0
Beryllium (Be)	1	0.3	0.2	0.2	0.2	0.2	0.2	3.2
Cadmium (Cd)	1	0.35	0.0	0.0	0.0	0.0	0.0	0.0
Cobalt (Co)	2	8	0.1	0.1	0.1	0.0	0.0	0.6
Chromium (Cr)	2	70	0.0	0.0	0.0	0.0	0.0	0.0
Copper (Cu)	5	30	0.0	0.0	0.0	0.0	0.0	0.0
Mercury (Hg)	0.1	0.06	0.0	0.0	0.0	0.0	0.0	0.0
Manganese (Mn)	5	1000	0.0	0.0	0.0	0.0	0.0	0.0
Molybdenum (Mo)	2	1.2	0.0	0.0	0.0	0.0	0.0	0.0
Nickel (Ni)	2	50	0.0	0.0	0.0	0.0	0.0	0.0
Lead (Pb)	5	35	0.0	0.0	0.0	0.0	0.0	0.0
Antimony (Sb)	5	1	0.7	0.7	0.7	0.7	0.7	0.7
Selenium (Se)	5	0.4	2.1	2.1	2.1	2.1	2.1	2.1
Thorium (Th)	0.1	9	---	---	---	---	---	---
Uranium (U)	0.1	2	0.0	0.0	0.0	0.0	0.0	0.0
Vanadium (V)	5	90	0.0	0.0	0.0	0.0	0.0	0.0
Zinc (Zn)	5	90	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Notes: GAI's greater than or equal to 3 are highlighted.
1. Median Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009).
2. When no GARD Guide value is available for particular element, then values are taken from Bowen (1979) Environmental Chemistry of the Elements, p 60-61.
3. If no guide value from GARD or Bowen H.J.M. (1979) exists, up to date, curated data is provided by CRC Handbook of Chemistry and Physics (2000).

Table B3: Geochemical Abundance Index (GAI) Results for Samples from the Moorvale South Project

	RGS Sample Number →		43	44	45	46	47	48
	Sampling Date →		15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
	ALS Laboratory ID →		EB2202699043	EB2202699044	EB2202699045	EB2202699046	EB2202699047	EB2202699048
	Client ID →		MS0379_OB_002	MS0379_OB_003	MS0379_OB_004	MS0379_OB_005	MS0379_OB_006	MS0379_OB_007
Parameters	**Limit of Reporting**	Median Crustal Abundance[1,2,3]	Siltstone	Siltstone	Siltstone	Siltstone	Siltstone	Siltstone
Major Cations	(All units in mg/kg)		Geochemical Abundance Index					
Calcium (Ca)	50	15,000	0.0	0.0	0.0	0.0	0.0	0.3
Magnesium (Mg)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Potassium (K)	50	14,000	0.0	0.0	0.0	0.0	0.0	0.0
Sodium (Na)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Aluminium (Al)	50	71,000	0.0	0.0	0.0	0.0	0.0	0.0
Iron (Fe)	50	40,000	0.0	0.0	0.0	0.0	0.0	0.0
Minor and Trace Elements	(All units in mg/kg)		Geochemical Abundance Index					
Arsenic (As)	5	6	0.0	0.0	0.0	0.0	0.0	0.0
Boron (B)	50	20	0.0	0.0	0.0	0.0	0.0	0.0
Barium (Ba)	10	500	0.0	0.0	0.0	0.0	0.0	0.0
Beryllium (Be)	1	0.3	1.2	0.2	0.2	0.2	0.2	0.2
Cadmium (Cd)	1	0.35	0.0	0.0	0.0	0.0	0.0	0.0
Cobalt (Co)	2	8	0.7	0.3	0.0	0.0	0.1	0.0
Chromium (Cr)	2	70	0.0	0.0	0.0	0.0	0.0	0.0
Copper (Cu)	5	30	0.0	0.0	0.0	0.0	0.0	0.0
Mercury (Hg)	0.1	0.06	0.0	0.0	0.0	0.0	0.0	0.0
Manganese (Mn)	5	1000	0.0	0.0	0.0	0.0	0.0	0.0
Molybdenum (Mo)	2	1.2	0.0	0.0	0.0	0.0	0.0	0.0
Nickel (Ni)	2	50	0.0	0.0	0.0	0.0	0.0	0.0
Lead (Pb)	5	35	0.0	0.0	0.0	0.0	0.0	0.0
Antimony (Sb)	5	1	0.7	0.7	0.7	0.7	0.7	0.7
Selenium (Se)	5	0.4	2.1	2.1	2.1	2.1	2.1	2.1
Thorium (Th)	0.1	9	---	---	---	---	---	---
Uranium (U)	0.1	2	0.0	0.0	0.0	0.0	0.0	0.0
Vanadium (V)	5	90	0.0	0.0	0.0	0.0	0.0	0.0
Zinc (Zn)	5	90	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Notes: GAI's greater than or equal to 3 are highlighted.
1. Median Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009).
2. When no GARD Guide value is available for particular element, then values are taken from Bowen (1979) Environmental Chemistry of the Elements, p 60-61.
3. If no guide value from GARD or Bowen H.J.M. (1979) exists, up to date, curated data is provided by CRC Handbook of Chemistry and Physics (2000).

Table B3: Geochemical Abundance Index (GAI) Results for Samples from the Moorvale South Project

	RGS Sample Number →		49	50	51	52	53	54
	Sampling Date →		15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
	ALS Laboratory ID →		EB2202699049	EB2202699050	EB2202699051	EB2202699052	EB2202699053	EB2202699054
	Client ID →		MS0379_OB_008	MS0379_OB_009	MS0379_OB_010	MS0379_OB_011	MS0379_OB_012	MS0379_OB_013
Parameters	**Limit of Reporting**	Median Crustal Abundance[1,2,3]	Sandstone	Sandstone	Siltstone	Siltstone	Carbonaceous Mudstone	Siltstone
Major Cations	(All units in mg/kg)		Geochemical Abundance Index					
Calcium (Ca)	50	15,000	0.0	0.3	0.0	0.1	0.0	0.0
Magnesium (Mg)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Potassium (K)	50	14,000	0.0	0.0	0.0	0.0	0.0	0.0
Sodium (Na)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Aluminium (Al)	50	71,000	0.0	0.0	0.0	0.0	0.0	0.0
Iron (Fe)	50	40,000	0.0	0.0	0.0	0.0	0.0	0.0
Minor and Trace Elements	(All units in mg/kg)		Geochemical Abundance Index					
Arsenic (As)	5	6	0.2	0.8	1.5	1.4	2.3	0.0
Boron (B)	50	20	0.0	0.0	0.0	0.0	0.0	0.0
Barium (Ba)	10	500	0.0	0.0	0.0	0.0	0.0	0.0
Beryllium (Be)	1	0.3	0.2	0.2	0.2	1.2	0.2	0.2
Cadmium (Cd)	1	0.35	0.0	0.0	0.0	0.0	0.0	0.0
Cobalt (Co)	2	8	0.1	0.0	0.0	0.0	0.0	0.0
Chromium (Cr)	2	70	0.0	0.0	0.0	0.0	0.0	0.0
Copper (Cu)	5	30	0.0	0.0	0.0	0.0	0.1	0.0
Mercury (Hg)	0.1	0.06	0.0	0.0	0.0	0.0	1.2	0.2
Manganese (Mn)	5	1000	0.0	0.0	0.0	0.0	0.0	0.0
Molybdenum (Mo)	2	1.2	0.0	0.0	0.0	0.0	0.0	0.0
Nickel (Ni)	2	50	0.0	0.0	0.0	0.0	0.0	0.0
Lead (Pb)	5	35	0.0	0.0	0.0	0.0	0.0	0.0
Antimony (Sb)	5	1	0.7	0.7	0.7	0.7	0.7	0.7
Selenium (Se)	5	0.4	2.1	2.1	2.1	2.1	2.1	2.1
Thorium (Th)	0.1	9	----	----	----	----	----	----
Uranium (U)	0.1	2	0.0	0.0	0.0	0.0	0.0	0.0
Vanadium (V)	5	90	0.0	0.0	0.0	0.0	0.0	0.0
Zinc (Zn)	5	90	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Notes: GAI's greater than or equal to 3 are highlighted.
1. Median Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009).
2. When no GARD Guide value is available for particular element, then values are taken from Bowen (1979) Environmental Chemistry of the Elements, p 60-61.
3. If no guide value from GARD or Bowen H.J.M. (1979) exists, up to date, curated data is provided by CRC Handbook of Chemistry and Physics (2000).

Table B3: Geochemical Abundance Index (GAI) Results for Samples from the Moorvale South Project

	RGS Sample Number →		55	56	57	58	59	60
	Sampling Date →		15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
	ALS Laboratory ID →		EB2202699055	EB2202699056	EB2202699057	EB2202699058	EB2202699059	EB2202699060
	Client ID →		MS0379_OB_014	MS0379_OB_015	MS0379_OB_016	MS0379_OB_017	MS0379_OB_018	MS0379_OB_019
Parameters	**Limit of Reporting**	Median Crustal Abundance[1,2,3]	Siltstone	Siltstone	Siltstone	Siltstone	Siltstone	Siltstone
Major Cations	(All units in mg/kg)		Geochemical Abundance Index					
Calcium (Ca)	50	15,000	0.2	0.0	0.0	0.0	0.3	0.0
Magnesium (Mg)	50	5,000	0.3	0.0	0.0	0.1	0.2	0.1
Potassium (K)	50	14,000	0.0	0.0	0.0	0.0	0.0	0.0
Sodium (Na)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Aluminium (Al)	50	71,000	0.0	0.0	0.0	0.0	0.0	0.0
Iron (Fe)	50	40,000	0.0	0.0	0.0	0.0	0.0	0.0
Minor and Trace Elements	(All units in mg/kg)		Geochemical Abundance Index					
Arsenic (As)	5	6	0.2	0.0	0.2	0.6	0.0	0.0
Boron (B)	50	20	0.0	0.0	0.0	0.0	0.0	0.0
Barium (Ba)	10	500	0.0	0.0	0.0	0.0	0.0	0.0
Beryllium (Be)	1	0.3	0.2	0.2	0.2	0.2	0.2	0.2
Cadmium (Cd)	1	0.35	0.0	0.0	0.0	0.0	0.0	0.0
Cobalt (Co)	2	8	0.2	0.0	0.3	0.3	0.0	0.0
Chromium (Cr)	2	70	0.0	0.0	0.0	0.0	0.0	0.0
Copper (Cu)	5	30	0.0	0.1	0.0	0.0	0.0	0.0
Mercury (Hg)	0.1	0.06	0.0	0.0	0.0	0.0	0.0	0.0
Manganese (Mn)	5	1000	0.0	0.0	0.0	0.0	0.0	0.0
Molybdenum (Mo)	2	1.2	0.0	0.0	0.0	0.0	0.0	0.0
Nickel (Ni)	2	50	0.0	0.0	0.0	0.0	0.0	0.0
Lead (Pb)	5	35	0.0	0.0	0.0	0.0	0.0	0.0
Antimony (Sb)	5	1	0.7	0.7	0.7	0.7	0.7	0.7
Selenium (Se)	5	0.4	2.1	2.1	2.1	2.1	2.1	2.1
Thorium (Th)	0.1	9	---	---	---	---	---	---
Uranium (U)	0.1	2	0.0	0.0	0.0	0.0	0.0	0.0
Vanadium (V)	5	90	0.0	0.0	0.0	0.0	0.0	0.0
Zinc (Zn)	5	90	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Notes: GAI's greater than or equal to 3 are highlighted.
1. Median Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009).
2. When no GARD Guide value is available for particular element, then values are taken from Bowen (1979) Environmental Chemistry of the Elements, p 60-61.
3. If no guide value from GARD or Bowen H.J.M. (1979) exists, up to date, curated data is provided by CRC Handbook of Chemistry and Physics (2000).

Table B3: Geochemical Abundance Index (GAI) Results for Samples from the Moorvale South Project

	RGS Sample Number →		61	62	63	64	65	66
	Sampling Date →		15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
	ALS Laboratory ID →		EB2202699061	EB2202699062	EB2202699063	EB2202699064	EB2202699065	EB2202699066
	Client ID →		MS0379_OB_020	MS0380_OB_001	MS0380_OB_002	MS0380_OB_003	MS0380_OB_004	MS0380_OB_005
Parameters	**Limit of Reporting**	Median Crustal Abundance[1,2,3]	Siltstone	Clay	Clay	Clay	Clay	Siltstone
Major Cations	(All units in mg/kg)		Geochemical Abundance Index					
Calcium (Ca)	50	15,000	0.0	0.0	0.0	0.4	0.0	0.3
Magnesium (Mg)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.1
Potassium (K)	50	14,000	0.0	0.0	0.0	0.0	0.0	0.0
Sodium (Na)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Aluminium (Al)	50	71,000	0.0	0.0	0.0	0.0	0.0	0.0
Iron (Fe)	50	40,000	0.0	0.0	0.0	0.0	0.0	0.0
Minor and Trace Elements	(All units in mg/kg)		Geochemical Abundance Index					
Arsenic (As)	5	6	0.0	0.0	0.3	0.0	0.0	0.0
Boron (B)	50	20	0.0	0.0	0.0	0.0	0.0	0.0
Barium (Ba)	10	500	0.0	0.0	0.0	0.0	0.0	0.0
Beryllium (Be)	1	0.3	0.2	1.2	0.2	0.2	0.2	0.2
Cadmium (Cd)	1	0.35	0.0	0.0	0.0	0.0	0.0	0.0
Cobalt (Co)	2	8	0.0	0.1	0.0	0.0	0.0	0.0
Chromium (Cr)	2	70	0.0	0.0	0.0	0.0	0.0	0.0
Copper (Cu)	5	30	0.0	0.0	0.0	0.0	0.0	0.0
Mercury (Hg)	0.1	0.06	0.0	0.0	0.0	0.0	0.0	0.0
Manganese (Mn)	5	1000	0.0	0.0	0.0	0.0	0.0	0.0
Molybdenum (Mo)	2	1.2	0.0	0.0	0.0	0.0	0.0	0.0
Nickel (Ni)	2	50	0.0	0.0	0.0	0.0	0.0	0.0
Lead (Pb)	5	35	0.0	0.0	0.0	0.0	0.0	0.0
Antimony (Sb)	5	1	0.7	0.7	0.7	0.7	0.7	0.7
Selenium (Se)	5	0.4	2.1	2.1	2.1	2.1	2.1	2.1
Thorium (Th)	0.1	9	---	---	---	---	---	---
Uranium (U)	0.1	2	0.0	0.0	0.0	0.0	0.0	0.0
Vanadium (V)	5	90	0.0	0.0	0.0	0.0	0.0	0.0
Zinc (Zn)	5	90	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Notes: GAI's greater than or equal to 3 are highlighted.
1. Median Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009).
2. When no GARD Guide value is available for particular element, then values are taken from Bowen (1979) Environmental Chemistry of the Elements, p 60-61.
3. If no guide value from GARD or Bowen H.J.M. (1979) exists, up to date, curated data is provided by CRC Handbook of Chemistry and Physics (2000).

Table B3: Geochemical Abundance Index (GAI) Results for Samples from the Moorvale South Project

	RGS Sample Number →		67	68	69	70	71	72
	Sampling Date →		15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
	ALS Laboratory ID →		EB2202699067	EB2202699068	EB2202699069	EB2202699070	EB2202699071	EB2202699072
	Client ID →		MS0380_OB_006	MS0380_OB_007	MS0380_OB_008	MS0380_OB_009	MS0380_OB_010	MS0380_OB_011
Parameters	**Limit of Reporting**	Median Crustal Abundance[1,2,3]	Siltstone	Coaly Mudstone	Siltstone	Siltstone	Siltstone	Siltstone
Major Cations	(All units in mg/kg)		Geochemical Abundance Index					
Calcium (Ca)	50	15,000	0.1	0.0	0.0	0.1	0.0	0.1
Magnesium (Mg)	50	5,000	0.1	0.0	0.1	0.2	0.0	0.0
Potassium (K)	50	14,000	0.0	0.0	0.0	0.0	0.0	0.0
Sodium (Na)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Aluminium (Al)	50	71,000	0.0	0.0	0.0	0.0	0.0	0.0
Iron (Fe)	50	40,000	0.0	0.0	0.0	0.0	0.0	0.0
Minor and Trace Elements	(All units in mg/kg)		Geochemical Abundance Index					
Arsenic (As)	5	6	0.5	1.8	0.0	0.6	0.4	0.3
Boron (B)	50	20	0.0	0.0	0.0	0.0	0.0	0.0
Barium (Ba)	10	500	0.0	0.0	0.0	0.0	0.0	0.0
Beryllium (Be)	1	0.3	0.2	0.2	1.2	0.2	0.2	0.2
Cadmium (Cd)	1	0.35	0.0	0.0	0.0	0.0	0.0	0.0
Cobalt (Co)	2	8	0.0	0.0	0.0	0.0	0.1	0.0
Chromium (Cr)	2	70	0.0	0.0	0.0	0.0	0.0	0.0
Copper (Cu)	5	30	0.0	0.0	0.1	0.0	0.0	0.0
Mercury (Hg)	0.1	0.06	0.0	0.2	0.0	0.0	0.0	0.0
Manganese (Mn)	5	1000	0.0	0.0	0.0	0.0	0.0	0.0
Molybdenum (Mo)	2	1.2	0.0	0.0	0.0	0.0	0.0	0.0
Nickel (Ni)	2	50	0.0	0.0	0.0	0.0	0.0	0.0
Lead (Pb)	5	35	0.0	0.0	0.0	0.0	0.0	0.0
Antimony (Sb)	5	1	0.7	0.7	0.7	0.7	0.7	0.7
Selenium (Se)	5	0.4	2.1	2.1	2.1	2.1	2.1	2.1
Thorium (Th)	0.1	9	---	---	---	---	---	---
Uranium (U)	0.1	2	0.0	0.0	0.0	0.0	0.0	0.0
Vanadium (V)	5	90	0.0	0.0	0.0	0.0	0.0	0.0
Zinc (Zn)	5	90	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Notes: GAI's greater than or equal to 3 are highlighted.
1. Median Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009).
2. When no GARD Guide value is available for particular element, then values are taken from Bowen (1979) Environmental Chemistry of the Elements, p 60-61.
3. If no guide value from GARD or Bowen H.J.M. (1979) exists, up to date, curated data is provided by CRC Handbook of Chemistry and Physics (2000).

Table B3: Geochemical Abundance Index (GAI) Results for Samples from the Moorvale South Project

	RGS Sample Number →		73	74	75	76	77	78
	Sampling Date →		15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021	15/11/2021
	ALS Laboratory ID →		EB2202699073	EB2202699074	EB2202699075	EB2202699076	EB2202699077	EB2202699078
	Client ID →		MS0380_OB_12	MS0380_OB_13	MS0380_OB_14	MS0380_OB_15	MS0380_OB_16	MS0380_OB_17
Parameters	**Limit of Reporting**	Median Crustal Abundance[1,2,3]	Carbonaceous Siltstone	Siltstone	Igneous Rock	Siltstone	Sandstone	Siltstone
Major Cations	(All units in mg/kg)		Geochemical Abundance Index					
Calcium (Ca)	50	15,000	0.0	0.0	0.0	0.0	0.0	0.0
Magnesium (Mg)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Potassium (K)	50	14,000	0.0	0.0	0.0	0.0	0.0	0.0
Sodium (Na)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Aluminium (Al)	50	71,000	0.0	0.0	0.0	0.0	0.0	0.0
Iron (Fe)	50	40,000	0.0	0.0	0.0	0.0	0.0	0.0
Minor and Trace Elements	(All units in mg/kg)		Geochemical Abundance Index					
Arsenic (As)	5	6	0.3	0.0	0.0	0.0	0.0	0.0
Boron (B)	50	20	0.0	0.0	0.0	0.0	0.0	0.0
Barium (Ba)	10	500	0.0	0.0	0.0	0.0	0.0	0.0
Beryllium (Be)	1	0.3	0.2	0.2	0.2	0.2	1.2	0.2
Cadmium (Cd)	1	0.35	0.0	0.0	0.0	0.0	0.0	0.0
Cobalt (Co)	2	8	0.0	0.0	0.0	0.0	0.1	0.0
Chromium (Cr)	2	70	0.0	0.0	0.0	0.0	0.0	0.0
Copper (Cu)	5	30	0.0	0.0	0.0	0.0	0.0	0.0
Mercury (Hg)	0.1	0.06	0.0	0.0	0.0	0.0	0.0	0.0
Manganese (Mn)	5	1000	0.0	0.0	0.0	0.0	0.0	0.0
Molybdenum (Mo)	2	1.2	0.0	0.0	0.0	0.0	0.0	0.0
Nickel (Ni)	2	50	0.0	0.0	0.0	0.0	0.0	0.0
Lead (Pb)	5	35	0.0	0.0	0.0	0.0	0.0	0.0
Antimony (Sb)	5	1	0.7	0.7	0.7	0.7	0.7	0.7
Selenium (Se)	5	0.4	2.1	2.1	2.1	2.1	2.1	2.1
Thorium (Th)	0.1	9	----	----	----	----	----	----
Uranium (U)	0.1	2	0.0	0.0	0.0	0.0	0.0	0.0
Vanadium (V)	5	90	0.0	0.0	0.0	0.0	0.0	0.0
Zinc (Zn)	5	90	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Notes: GAI's greater than or equal to 3 are highlighted.

1. Median Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009).
2. When no GARD Guide value is available for particular element, then values are taken from Bowen (1979) Environmental Chemistry of the Elements, p 60-61.
3. If no guide value from GARD or Bowen H.J.M. (1979) exists, up to date, curated data is provided by CRC Handbook of Chemistry and Physics (2000).

Table B3: Geochemical Abundance Index (GAI) Results for Samples from the Moorvale South Project

	RGS Sample Number →		79	80	81	2022067_C001	2022067_C002	2022067_C003
	Sampling Date →		15/11/2021	15/11/2021	15/11/2021	25/10/2022	25/10/2022	25/10/2022
	ALS Laboratory ID →		EB2202699079	EB2202699080	EB2202699081	EB2233059019	EB2233059020	EB2233059021
	Client ID →		MS0380_OB_18	MS0380_OB_19	MS0380_OB_20	MRV_FEED	MRV_FEED	MRV_Coarse Reject
Parameters	**Limit of Reporting**	Median Crustal Abundance[1,2,3]	Siltstone	Siltstone	Siltstone	Product coal	Product coal	Coarse reject
Major Cations	(All units in mg/kg)		Geochemical Abundance Index					
Calcium (Ca)	50	15,000	0.0	0.8	0.0	0.0	0.0	0.0
Magnesium (Mg)	50	5,000	0.0	0.0	0.7	0.0	0.0	0.0
Potassium (K)	50	14,000	0.0	0.0	0.0	0.0	0.0	0.0
Sodium (Na)	50	5,000	0.0	0.0	0.0	0.0	0.0	0.0
Aluminium (Al)	50	71,000	0.0	0.0	0.0	0.0	0.0	0.0
Iron (Fe)	50	40,000	0.0	0.0	0.0	0.0	0.0	0.0
Minor and Trace Elements	(All units in mg/kg)		Geochemical Abundance Index					
Arsenic (As)	5	6	0.0	0.0	0.4	0.0	0.0	0.0
Boron (B)	50	20	0.0	0.0	0.0	0.0	0.0	0.0
Barium (Ba)	10	500	0.0	0.0	0.0	0.0	0.0	0.0
Beryllium (Be)	1	0.3	0.2	0.2	0.2	0.0	0.0	1.6
Cadmium (Cd)	1	0.35	0.0	0.0	0.0	0.0	0.0	0.0
Cobalt (Co)	2	8	0.0	0.1	0.0	0.0	0.0	0.0
Chromium (Cr)	2	70	0.0	0.0	0.0	0.0	0.0	0.0
Copper (Cu)	5	30	0.0	0.0	0.0	0.0	0.0	0.0
Mercury (Hg)	0.1	0.06	0.0	0.0	0.0	0.0	0.0	0.0
Manganese (Mn)	5	1000	0.0	0.0	0.0	0.0	0.0	0.0
Molybdenum (Mo)	2	1.2	0.0	0.0	0.0	0.0	0.0	0.0
Nickel (Ni)	2	50	0.0	0.0	0.0	0.0	0.0	0.0
Lead (Pb)	5	35	0.0	0.0	0.0	0.0	0.0	0.0
Antimony (Sb)	5	1	0.7	0.7	0.7	0.0	0.0	0.0
Selenium (Se)	5	0.4	2.1	2.1	2.1	0.0	0.0	0.7
Thorium (Th)	0.1	9	----	----	----	0.0	0.0	0.0
Uranium (U)	0.1	2	0.0	0.0	0.0	0.0	0.0	0.0
Vanadium (V)	5	90	0.0	0.0	0.0	0.0	0.0	0.0
Zinc (Zn)	5	90	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Notes: GAI's greater than or equal to 3 are highlighted.

1. Median Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009).
2. When no GARD Guide value is available for particular element, then values are taken from Bowen (1979) Environmental Chemistry of the Elements, p 60-61.
3. If no guide value from GARD or Bowen H.J.M. (1979) exists, up to date, curated data is provided by CRC Handbook of Chemistry and Physics (2000).

Table B3: Geochemical Abundance Index (GAI) Results for Samples from the Moorvale South Project

Parameters	Limit of Reporting	Median Crustal Abundance[1,2,3]	RGS Sample Number → 2022067_C004	2022067_C005	2022067_C006
			Sampling Date → 25/10/2022	25/10/2022	25/10/2022
			ALS Laboratory ID → EB2233059022	EB2233059023	EB2233059024
			Client ID → MRV_Coarse Reject	MRV_Fine Reject	MRV_Fine Reject
			Coarse Reject	Tailing	Tailing
Major Cations	(All units in mg/kg)		Geochemical Abundance Index		
Calcium (Ca)	50	15,000	0.0	0.0	0.0
Magnesium (Mg)	50	5,000	0.0	0.0	0.0
Potassium (K)	50	14,000	0.0	0.0	0.0
Sodium (Na)	50	5,000	0.0	0.0	0.0
Aluminium (Al)	50	71,000	0.0	0.0	0.0
Iron (Fe)	50	40,000	0.0	0.0	0.0
Minor and Trace Elements	(All units in mg/kg)		Geochemical Abundance Index		
Arsenic (As)	5	6	0.0	0.0	0.0
Boron (B)	50	20	0.0	0.0	0.0
Barium (Ba)	10	500	0.0	0.0	0.0
Beryllium (Be)	1	0.3	1.5	0.8	1.2
Cadmium (Cd)	1	0.35	0.0	0.0	0.0
Cobalt (Co)	2	8	0.0	0.0	0.0
Chromium (Cr)	2	70	0.0	0.0	0.0
Copper (Cu)	5	30	0.0	0.0	0.0
Mercury (Hg)	0.1	0.06	0.0	1.2	0.2
Manganese (Mn)	5	1000	0.0	0.0	0.0
Molybdenum (Mo)	2	1.2	0.0	0.0	0.0
Nickel (Ni)	2	50	0.0	0.0	0.0
Lead (Pb)	5	35	0.0	0.0	0.0
Antimony (Sb)	5	1	0.0	0.0	0.0
Selenium (Se)	5	0.4	0.0	0.7	0.0
Thorium (Th)	0.1	9	0.0	0.0	0.0
Uranium (U)	0.1	2	0.0	0.0	0.0
Vanadium (V)	5	90	0.0	0.0	0.0
Zinc (Zn)	5	90	0.0	0.0	0.0

Notes: Notes: GAI's greater than or equal to 3 are highlighted.
1. Median Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009).
2. When no GARD Guide value is available for particular element, then values are taken from Bowen (1979) Environmental Chemistry of the Elements, p 60-61.
3. If no guide value from GARD or Bowen H.J.M. (1979) exists, up to date, curated data is provided by CRC Handbook of Chemistry and Physics (2000).

Table B4: Multi-Element Test Results for Water Extracts from Samples from the Moorvale South Project

		RGS Sample Number →		2022067_C001	2022067_C002	2022067_C003	2022067_C004	2022067_C005	2022067_C006
		Sample Date →		25/10/2022	25/10/2022	25/10/2022	25/10/2022	25/10/2022	25/10/2022
		ALS Laboratory ID →		EB2233059019	EB2233059020	EB2233059021	EB2233059022	EB2233059023	EB2233059024
		Client Sample ID →		MRV_FEED	MRV_FEED	MRV_Coarse Reject	MRV_Coarse Reject	MRV_Fine Reject	MRV_Fine Reject
Parameters	**Limit of Reporting**	Aquatic Ecosystems (freshwater)[1]	Livestock Drinking Water[2]	Product coal	Product coal	Coarse reject	Coarse reject	Tailing	Tailing
pH	0.01 pH unit	6 to 9	-	9.2	9.2	9.3	9.5	9.1	9.1
Electrical Conductivity[3]	1 µS/cm	<1,000#	3,580^	472	468	775	582	1,150	1,570
Carbonate Alkalinity (mg $CaCO_3$ /L)	1 mg/L	-	-	7	7	36	54	18	36
Bicarbonate Alkalinity (mg $CaCO_3$ /L)	1 mg/L	-	-	460	388	738	1,584	1,944	1,612
Total Alkalinity (mg $CaCO_3$ /L)	1 mg/L	-	-	468	396	774	1,638	1,962	1,648
Acidity (mg $CaCO_3$ /L)[3]	1 mg/L	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Net Alkalinity (mg $CaCO_3$ /L)	1 mg/L	-	-	468	396	774	1,638	1,962	1,648
Major Ions		All units mg/L		All units mg/L					
Calcium (Ca)	2	-	1,000	4	4	2	<2	6	8
Magnesium (Mg)	2	-	-	4	4	<2	<2	6	8
Potassium (K)	2	-	-	2	2	2	<2	4	6
Sodium (Na)	2	-	-	100	100	154	122	232	338
Chloride (Cl)	2	-	-	118	102	168	104	264	434
Fluoride (F)[4]	0.2	-	2	1.0	1.0	3.2	2.8	1.4	1.2
Sulfate (SO_4^{2-})	2	-	1,000	54	56	62	46	174	178
Silica (Si)	0.2	-	-	3	3	5	5	5	4
Reactive Phosphorus (P)	0.02	-	-	<0.02	<0.02	0.08	0.06	<0.02	<0.02
Trace Metals/Metalloids		All units mg/L		All units mg/L					
Aluminium (Al)	0.02	0.055	5	0.02	<0.02	0.02	0.02	<0.02	<0.02
Arsenic (As)	0.002	0.024 *	0.5	<0.002	<0.002	<0.002	0.004	<0.002	0.004
Boron (B)	0.2	0.37	5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Barium (Ba)	0.002	-	-	0.016	0.014	0.008	0.006	0.036	0.032
Beryllium (Be)	0.002	-	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium (Cd)	0.002	0.0002	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cobalt (Co)	0.002	-	1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium (Cr)	0.002	0.001 **	1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Copper (Cu)	0.002	0.0014	1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Iron (Fe)	0.2	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Mercury (Hg)	0.0001	0.0006	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Manganese (Mn)	0.002	1.9	-	0.002	0.002	<0.002	<0.002	0.006	0.006
Molybdenum (Mo)	0.002	-	0.15	0.014	0.014	0.024	0.024	0.020	0.046
Nickel (Ni)	0.002	0.011	1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Lead (Pb)	0.002	0.0034	0.1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Antimony (Sb)	0.002	-	-	<0.002	<0.002	<0.002	<0.002	0.002	0.002
Selenium (Se)	0.02	0.011	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Thorium (Th)	0.002	-	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Uranium (U)	0.002	-	0.1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Vanadium (V)	0.02	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Zinc (Zn)	0.01	0.008	20	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Notes: Shaded cells exceed applied guideline values.
< indicates concentration less than the detection limit.
* 0.013 mg/L for pentavalent Arsenic (V). ** Hexavalent Chromium (VI).
# for still water bodies only, moving rivers at low flow rates should not exceed 2,200 µS/cm. ^ calculated based on total dissolved solids (TDS) conversion rate of 0.67 % of EC.
TDS is an approximate measure of inorganic dissolved salts and should not exceed 2,400 mg/L for livestock drinking water. pH and EC of composites are median pH and EC values of individual samples reported in Table B2.
1. ANZG (2018). Trigger values for freshwater aquatic ecosystems (95% species protection level)
2. ANZG (2018). Recommended guideline limits for Livestock Drinking Water.

Attachment C: Summary Tables and Trends for Kinetic Geochemical Test Results

KLC 1: Product Coal

				Weight (kg)	1.56	Total S (%)	0.440	ANC	9.1				
				pH (1:5)	9.40	Scr (%)	0.183	NAPP	-3.5				
				EC (µS/cm)	511	MPA	5.6	ANC:MPA	1.6				
Date					27-Oct-22	24-Nov-22	21-Dec-22	19-Jan-23	16-Feb-23	16-Mar-23	14-Apr-23		
Number of Weeks					0	4	8	12	16	20	24		
Leach Number					1	2	3	4	5	6	7		
ALS Laboratory Number					EB2231815001	EB2235216001	EB2238425001	EB2301568001	EB2304579001	EB2307965001	EB2311240001		
Volume On (L)					1.0	1.0	1.0	1.0	1.0	1.0	1.0		
Volume Off (L)					0.619	0.656	0.686	0.694	0.675	0.695	0.670		
Cum. Volume (L)					0.619	1.275	1.961	2.655	3.330	4.025	4.695		
Pore Volumes			Water Quality Guidelines		0.459	0.944	1.453	1.967	2.467	2.981	3.478		
pH (RGS Measurement)			6 to 9	-	7.72	6.93	7.20	6.15	6.03	6.98	6.25		
pH (ALS Measurement)					7.01	6.74	6.46	7.00	6.68	6.97	6.65		
pH (deionised water used in test)				-	6.70	5.38	5.93	5.28	6.24	6.24	5.38		
EC (RGS Measurement) (µS/cm)			<1,000 #	3,580^	878	1,024	918	828	910	767	595		
EC (ALS Measurement) (µS/cm)					845	954	919	800	897	742	584		
Acidity (mg/L as CaCO)*			-	-	4	7	4	6	3.0	2.0	2.0		
Alkalinity (mg/L as CaCO)*			-	-	17	9	16	7	7.0	4.0	4.0		
Net Alkalinity (mg/L as CaCO)*					13	2	12	1	4.0	2.0	2.0		
Major Ions (mg/L)	Elements	LoR	Aquatic Ecosystems (Freshwater)[1]	Livestock Drinking Water[2]									
Calcium	Ca	1	-	1,000	9	9	12	12	14	16	13		
Potassium	K	1	-	-	1	1	<1	<1	2	1	<1		
Magnesium	Mg	1	-	-	7	8	9	7	9	9	8		
Sodium	Na	1	-	-	146	177	164	133	169	129	94		
Chloride	Cl	1	-	-	225	271	179	136	85	49	24		
Fluoride	F[4]	0.1	-	2	0.5	0.4	0.4	0.5	0.6	0.5	<0.1		
Sulfate	SO	1	-	1,000	75	89	134	182	269	273	210		
Trace metals/ metalloids (mg/L)	Elements	LoR	Aquatic Ecosystems (Freshwater)[1]	Livestock Drinking Water[2]									
Aluminium	Al	0.01	0.055	5	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	0.02		
Arsenic	As	0.001	0.024	0.5	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Boron	B	0.05	0.37	5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		
Barium	Ba	0.001	-	-	0.02	0.02	0.015	0.01	0.011	0.008	0.007		
Beryllium	Be	0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Cadmium	Cd	0.0001	0.0002	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		
Cobalt	Co	0.001	-	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Chromium	Cr	0.001	0.001	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Copper	Cu	0.001	0.0014	1	<0.001	<0.001	<0.001	<0.001	0.001	0.001	0.001		
Iron	Fe	0.05	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		
Mercury	Hg	0.0001	0.0006	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		
Manganese	Mn	0.001	1.9	-	0.007	0.013	0.018	0.017	0.024	0.018	0.016		
Molybdenum	Mo	0.001	-	0.15	0.008	0.010	0.013	0.013	0.015	0.01	0.009		
Nickel	Ni	0.001	0.011	1	<0.001	<0.001	<0.001	0.001	0.001	0.001	<0.001		
Lead	Pb	0.001	0.0034	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Antimony	Sb	0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Selenium	Se	0.01	0.011	0.02	<0.01	<0.01	0.01	0.02	0.02	0.02	0.01		
Thorium	Th	0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Uranium	U	0.001	-	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Vanadium	V	0.01	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Zinc	Zn	0.005	0.008	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		
Calculations**	Elements												
SO Release Rate	SO				30	37	59	81	116	121	90		
Cumulative SO Release	Cum. SO				30	67	126	207	323	444	534		
Ca Release Rate	Ca				3.6	3.8	5.3	5.3	6.04	7.11	5.57		
Cumulative Ca Release	Cum. Ca				3.6	7.3	12.6	17.9	23.97	31.08	36.65		
Mg Release Rate	Mg				2.8	3.4	3.9	3.1	3.88	4.00	3.43		
Cumulative Mg Release	Cum. Mg				2.8	6.1	10.1	13.2	17.06	21.06	24.49		
Residual ANC (%)	Res. ANC				99.8	99.5	99.2	98.9	98.6	98.2	97.9		
Residual Sulfur (%)	Res. S				99.8	99.5	99.0	98.4	97.6	96.6	96.0		
SO /(Ca+Mg) molar ratio	SO /(Ca+Mg)				1.5	1.7	2.1	3.2	3.9	3.7	3.3		

Notes: ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines 1. Trigger values for aquatic ecosystems (95% species protection level). 2. Recommended guideline limits for Livestock Drinking Water.

< indicates less than the laboratory limit of reporting. * Acidity and alkalinity data calculated in mg CaCO /L.
Shaded cells exceed applied guideline values. (tri)* 0.024 g/L for trivalent Arsenic (III) and 0.013 g/L for pentavalent Arsenic (V). (hex)* Cr (VI) = hexavalent.
for still water bodies only, moving rivers at low flow rates should not exceed 2,200 µS/cm.
^ calculated based on total dissolved solids (TDS) conversion rate of 0.67 % of EC. TDS is an approximate measure of inorganic dissolved salts and should not exceed 2,400 mg/L for livestock drinking water.
** SO_4, Ca and Mg release rates calculated in mg/kg/flush. Residual ANC assumes that all leached Mg and Ca is due to dissolution of calcite or dolomite.
Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity. MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential.

KLC 2: Coarse Reject

	Weight (kg)	2.00	Total S (%)	0.280	ANC	18.5	
	pH (1:5)	9.30	Scr (%)	0.098	NAPP	-15.5	
	EC (µS/cm)	732	MPA	3.0	ANC:MPA	6.2	

Date			27-Oct-22	24-Nov-22	21-Dec-22	19-Jan-23	15-Feb-23	16-Mar-23	14-Apr-23
Number of Weeks			0	4	8	12	16	20	24
Leach Number			1	2	3	4	5	6	7
ALS Laboratory Number			EB2231815002	EB2235216002	EB2238425002	EB2301568002	EB2304579002	EB2307965002	EB2311240002
Volume On (L)			1.0	1.0	1.0	1.0	1.0	1.0	1.0
Volume Off (L)			0.454	0.539	0.520	0.531	0.527	0.567	0.595
Cum. Volume (L)			0.454	0.993	1.513	2.044	2.571	3.138	3.733
Pore Volumes	Water Quality Guidelines		0.336	0.736	1.121	1.514	1.904	2.324	2.765
pH (RGS Measurement)	6 to 9	-	6.87	6.89	7.09	6.84	6.26	6.96	6.43
pH (ALS Measurement)			6.96	6.78	6.46	7.17	6.81	7.08	7.10
pH (deionised water used in test)		-	6.70	5.38	5.93	5.28	6.24	6.24	5.38
EC (RGS Measurement) (µS/cm)	<1,000 #	3,580^	2,470	1,632	1,844	1,263	951	794	948
EC (ALS Measurement) (µS/cm)			2,390	1,520	1,400	1,220	957	774	914
Acidity (mg/L as CaCO)*	-	-	6	6	5	5	3.0	3.0	2.0
Alkalinity (mg/L as CaCO)*	-	-	22	12	16	21	10.0	8.0	14.0
Net Alkalinity (mg/L as CaCO)*			16	6	11	16	7.0	5.0	12.0

Major Ions (mg/L)	Elements	LoR	Aquatic Ecosystems (Freshwater)[1]	Livestock Drinking Water[2]						
Calcium	Ca	1	-	1,000	30	12	17	11	6	7	6
Potassium	K	1	-	-	3	1	1	1	1	<1	<1
Magnesium	Mg	1	-	-	24	11	13	9	6	5	5
Sodium	Na	1	-	-	408	287	329	203	189	148	170
Chloride	Cl	1	-	-	724	488	472	324	202	147	158
Fluoride	F[4]	0.1	-	2	1.4	1.0	1.1	1.1	1.1	0.9	<0.1
Sulfate	SO	1	-	1,000	157	80	127	135	119	146	174
Trace metals/ metalloids (mg/L)	**Elements**	**LoR**	**Aquatic Ecosystems (Freshwater)[1]**	**Livestock Drinking Water[2]**						
Aluminium	Al	0.01	0.055	5	<0.01	<0.01	<0.01	<0.01	0.01	0.04	0.02
Arsenic	As	0.001	0.024	0.5	0.002	0.001	0.001	<0.001	<0.001	0.001	<0.001
Boron	B	0.05	0.37	5	<0.05	0.07	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	Ba	0.001	-	-	0.02	0.01	0.011	0.008	0.005	0.004	0.004
Beryllium	Be	0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	Cd	0.0001	0.0002	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	Co	0.001	-	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium	Cr	0.001	0.001	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	Cu	0.001	0.0014	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Iron	Fe	0.05	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury	Hg	0.0001	0.0006	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Manganese	Mn	0.001	1.9	-	0.017	0.008	0.01	0.006	0.004	0.003	0.003
Molybdenum	Mo	0.001	-	0.15	0.028	0.042	0.053	0.044	0.033	0.03	0.039
Nickel	Ni	0.001	0.011	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	Pb	0.001	0.0034	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Antimony	Sb	0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	Se	0.01	0.011	0.02	0.01	0.04	0.08	0.08	0.09	0.08	0.08
Thorium	Th	0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	U	0.001	-	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	V	0.01	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	Zn	0.005	0.008	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

Calculations**	Elements							
SO_4 Release Rate	SO_4	36	22	33	36	31	41	52
Cumulative SO_4 Release	Cum. SO_4	36	57	90	126	157	199	251
Ca Release Rate	Ca	6.8	3.2	4.4	2.9	1.58	1.98	1.79
Cumulative Ca Release	Cum. Ca	6.8	10.0	14.5	17.4	18.97	20.95	22.74
Mg Release Rate	Mg	5.4	3.0	3.4	2.4	1.58	1.42	1.49
Cumulative Mg Release	Cum. Mg	5.4	8.4	11.8	14.2	15.76	17.18	18.67
Residual ANC (%)	Res. ANC	99.8	99.7	99.6	99.5	99.4	99.3	99.3
Residual Sulfur (%)	Res. S_4	99.6	99.3	98.9	98.5	98.1	97.6	97.0
SO_4 /(Ca+Mg) molar ratio	SO_4 /(Ca+Mg)	0.9	1.1	1.4	2.2	3.1	4.0	5.1

Notes: ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines 1. Trigger values for aquatic ecosystems (95% species protection level). 2. Recommended guideline limits for Livestock Drinking Water.

< indicates less than the laboratory limit of reporting. * Acidity and alkalinity data calculated in mg CaCO /L.
Shaded cells exceed applied guideline values. (tri)* 0.024 g/L for trivalent Arsenic (III) and 0.013 g/L for pentavalent Arsenic (V). (hex)* Cr (VI) = hexavalent.
for still water bodies only, moving rivers at low flow rates should not exceed 2,200 µS/cm.
^ calculated based on total dissolved solids (TDS) conversion rate of 0.67 % of EC. TDS is an approximate measure of inorganic dissolved salts and should not exceed 2,400 mg/L for livestock drinking water.
** SO_4, Ca and Mg release rates calculated in mg/kg/flush. Residual ANC assumes that all leached Mg and Ca is due to dissolution of calcite or dolomite.
Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity. MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential.

KLC 3: Tailing

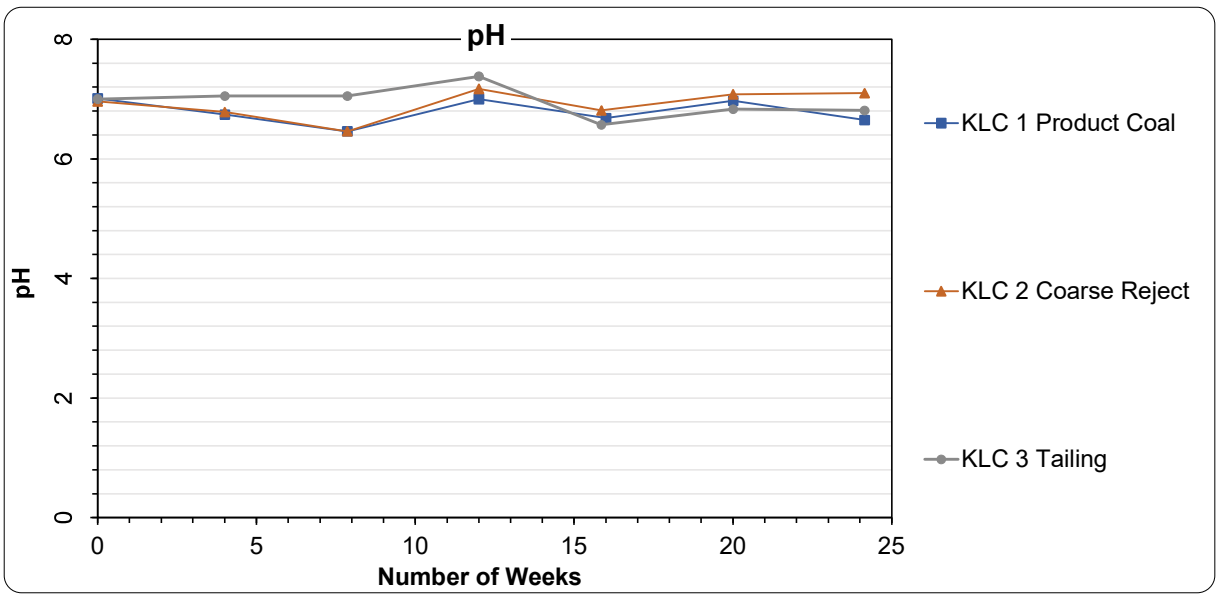
	Weight (kg)	1.92	Total S (%)	2.130	ANC	36.1	
	pH (1:5)	9.20	Scr (%)	1.861	NAPP	20.9	
	EC (µS/cm)	1,261	MPA	57.0	ANC:MPA	0.6	

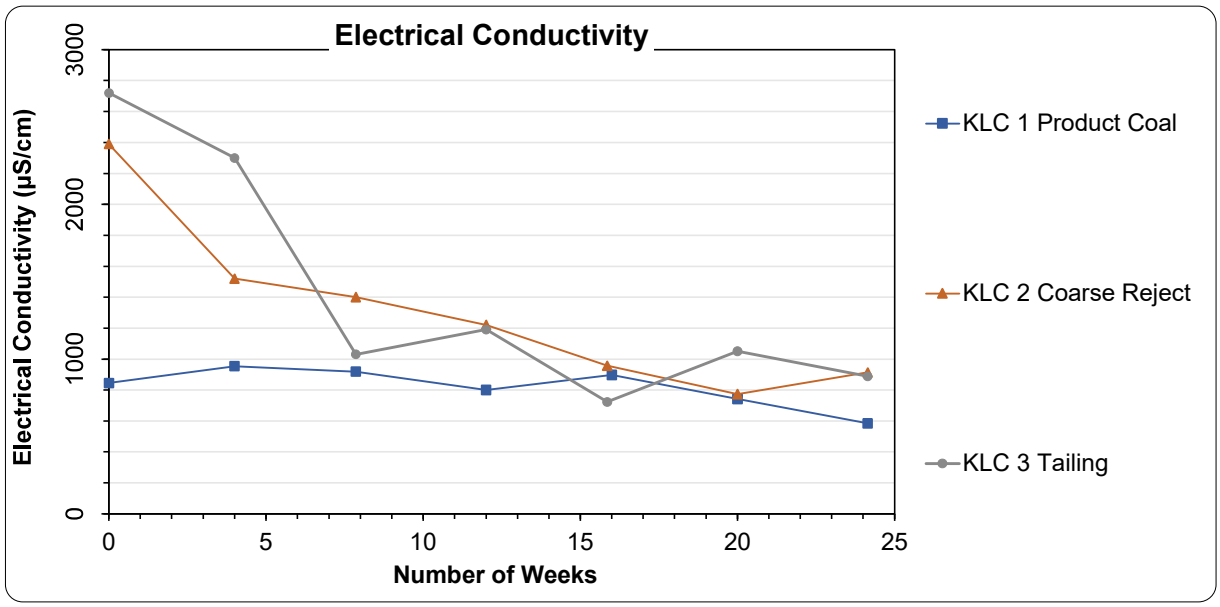
Date					27-Oct-22	24-Nov-22	21-Dec-22	19-Jan-23	15-Feb-23	16-Mar-23	14-Apr-23
Number of Weeks					0	4	8	12	16	20	24
Leach Number					1	2	3	4	5	6	7
ALS Laboratory Number					EB2231815003	EB2235216003	EB2238425003	EB2301568003	EB2304579003	EB2307965003	EB2311240003
Volume On (L)					1.0	1.0	1.0	1.0	1.0	1.0	1.0
Volume Off (L)					0.540	0.358	0.428	0.640	0.593	0.743	0.773
Cum. Volume (L)					0.540	0.898	1.326	1.966	2.559	3.302	4.075
Pore Volumes	Water Quality Guidelines				0.400	0.665	0.982	1.456	1.896	2.446	3.019
pH (RGS Measurement)	6 to 9	-			7.09	6.98	7.66	6.60	6.31	7.04	6.73
pH (ALS Measurement)					7.00	7.05	7.05	7.38	6.57	6.83	6.81
pH (deionised water used in test)		-			6.70	5.38	5.93	5.28	6.24	6.24	5.38
EC (RGS Measurement) (µS/cm)	<1,000 #	3,580^			2,840	2,480	1,064	1,225	750	1,119	943
EC (ALS Measurement) (µS/cm)					2,720	2,300	1,030	1,190	723	1,050	888
Acidity (mg/L as CaCO)*	-	-			6	7	4	6	3.0	1.0	2.0
Alkalinity (mg/L as CaCO)*	-	-			28	21	18	14	6.0	6.0	4.0
Net Alkalinity (mg/L as CaCO)*					22	14	14	8	3.0	5.0	2.0
Major Ions (mg/L)	Elements	LoR	Aquatic Ecosystems (Freshwater)[1]	Livestock Drinking Water[2]							
Calcium	Ca	1	-	1,000	21	35	23	17	18	17	11
Potassium	K	1	-	-	3	2	<1	<1	<1	<1	<1
Magnesium	Mg	1	-	-	17	26	21	38	19	28	20
Sodium	Na	1	-	-	517	423	172	163	104	157	124
Chloride	Cl	1	-	-	757	488	142	123	50	113	89
Fluoride	F[4]	0.1	-	2	1.0	0.7	0.2	0.1	0.1	0.1	0.1
Sulfate	SO	1	-	1,000	292	536	278	426	241	361	277
Trace metals/ metalloids (mg/L)	Elements	LoR	Aquatic Ecosystems (Freshwater)[1]	Livestock Drinking Water[2]							
Aluminium	Al	0.01	0.055	5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	As	0.001	0.024	0.5	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	B	0.05	0.37	5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	Ba	0.001	-	-	0.026	0.013	0.011	0.007	0.01	0.009	0.008
Beryllium	Be	0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	Cd	0.0001	0.0002	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	Co	0.001	-	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium	Cr	0.001	0.001	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	Cu	0.001	0.0014	1	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	Fe	0.05	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury	Hg	0.0001	0.0006	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Manganese	Mn	0.001	1.9	-	0.032	0.026	0.016	0.021	0.041	0.024	0.031
Molybdenum	Mo	0.001	-	0.15	0.028	0.008	0.005	0.005	0.001	0.004	0.002
Nickel	Ni	0.001	0.011	1	<0.001	0.001	<0.001	<0.01	<0.001	<0.001	<0.001
Lead	Pb	0.001	0.0034	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Antimony	Sb	0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	Se	0.01	0.011	0.02	0.01	0.02	<0.01	0.01	<0.01	0.01	<0.01
Thorium	Th	0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	U	0.001	-	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	V	0.01	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	Zn	0.005	0.008	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calculations**	Elements										
SO Release Rate	SO				82	100	62	142	74	139	111
Cumulative SO Release	Cum. SO				82	182	244	385	460	599	711
Ca Release Rate	Ca				5.9	6.5	5.1	5.7	5.55	6.57	4.42
Cumulative Ca Release	Cum. Ca				5.9	12.4	17.5	23.2	28.74	35.31	39.73
Mg Release Rate	Mg				4.8	4.8	4.7	12.6	5.86	10.82	8.04
Cumulative Mg Release	Cum. Mg				4.8	9.6	14.3	26.9	32.79	43.61	51.65
Residual ANC (%)	Res. ANC				99.9	99.8	99.7	99.5	99.4	99.3	99.2
Residual Sulfur (%)	Res. S				99.9	99.7	99.6	99.4	99.3	99.1	98.9
SO /(Ca+Mg) molar ratio	SO /(Ca+Mg)				2.5	2.9	2.0	2.2	2.0	2.4	2.6

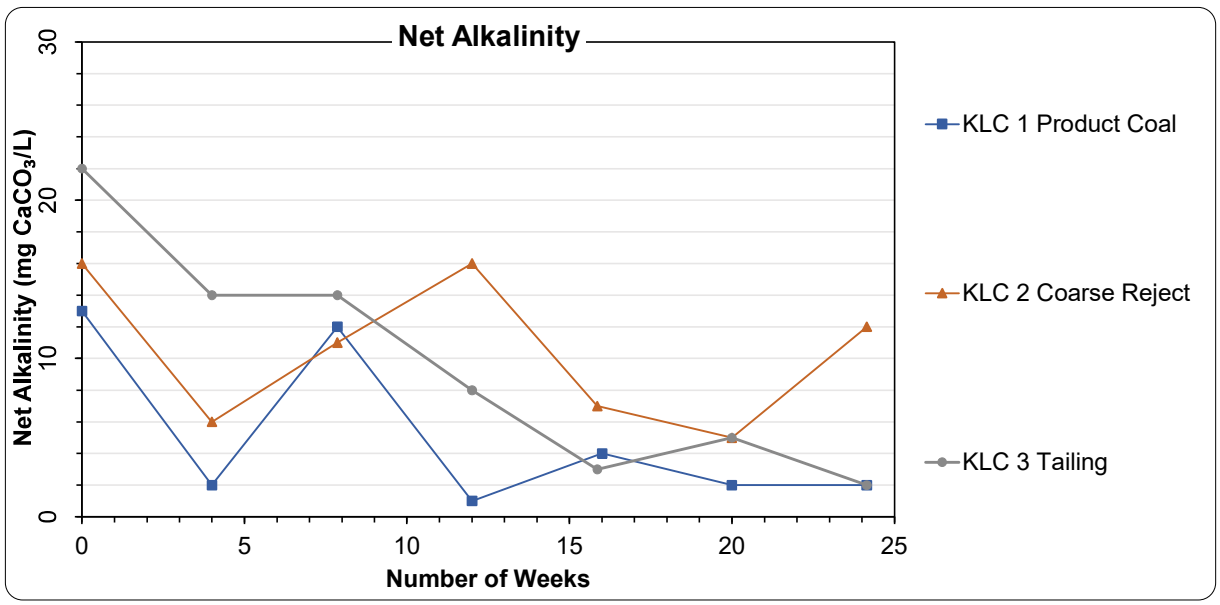
Notes: ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines 1. Trigger values for aquatic ecosystems (95% species protection level). 2. Recommended guideline limits for Livestock Drinking Water.

< indicates less than the laboratory limit of reporting. * Acidity and alkalinity data calculated in mg CaCO /L.
Shaded cells exceed applied guideline values. (tri)* 0.024 g/L for trivalent Arsenic (III) and 0.013 g/L for pentavalent Arsenic (V). (hex)* Cr (VI) = hexavalent.
for still water bodies only, moving rivers at low flow rates should not exceed 2,200 µS/cm.
^ calculated based on total dissolved solids (TDS) conversion rate of 0.67 % of EC. TDS is an approximate measure of inorganic dissolved salts and should not exceed 2,400 mg/L for livestock drinking water.
** SO_4, Ca and Mg release rates calculated in mg/kg/flush. Residual ANC assumes that all leached Mg and Ca is due to dissolution of calcite or dolomite.
Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity. MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential.

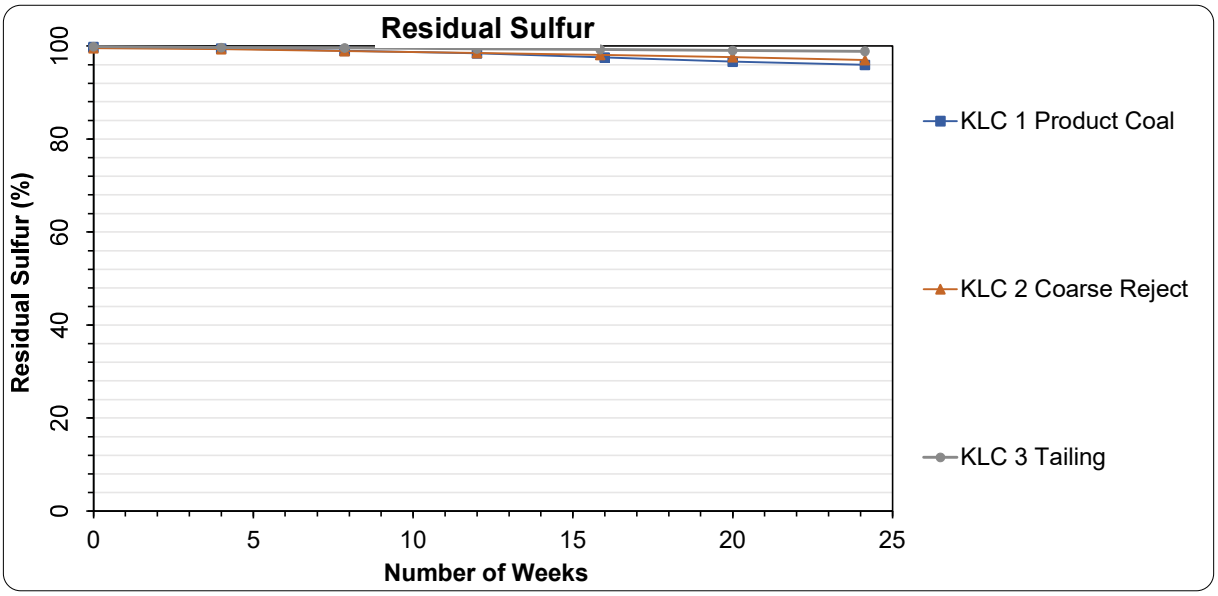
KLC Trends

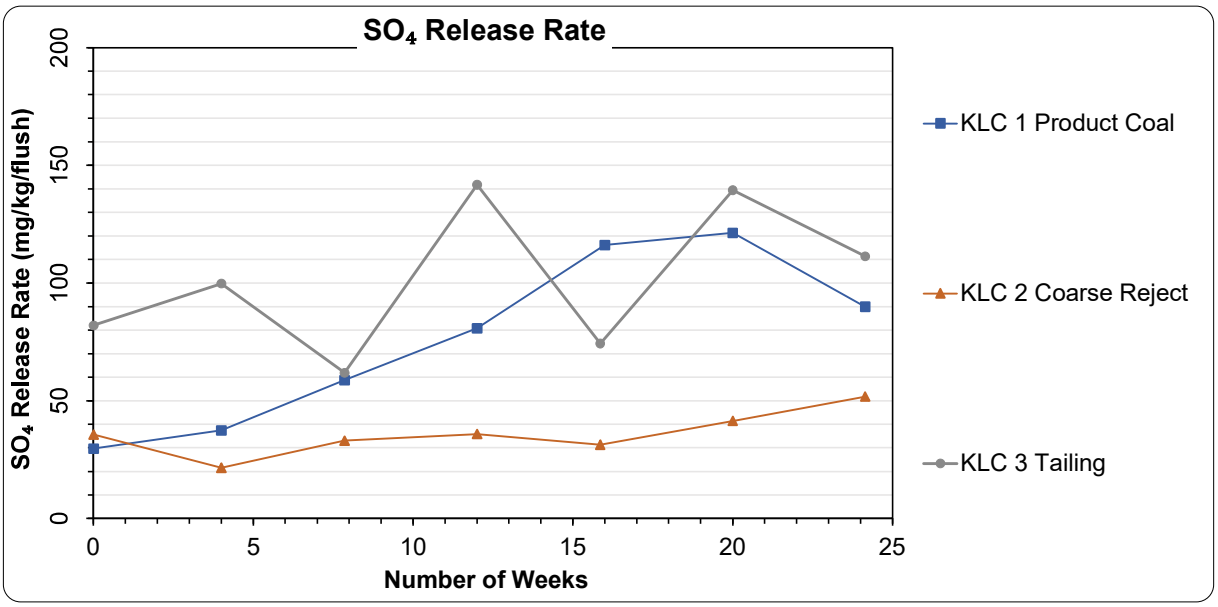

pH
pH
0
2
4
6
8
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

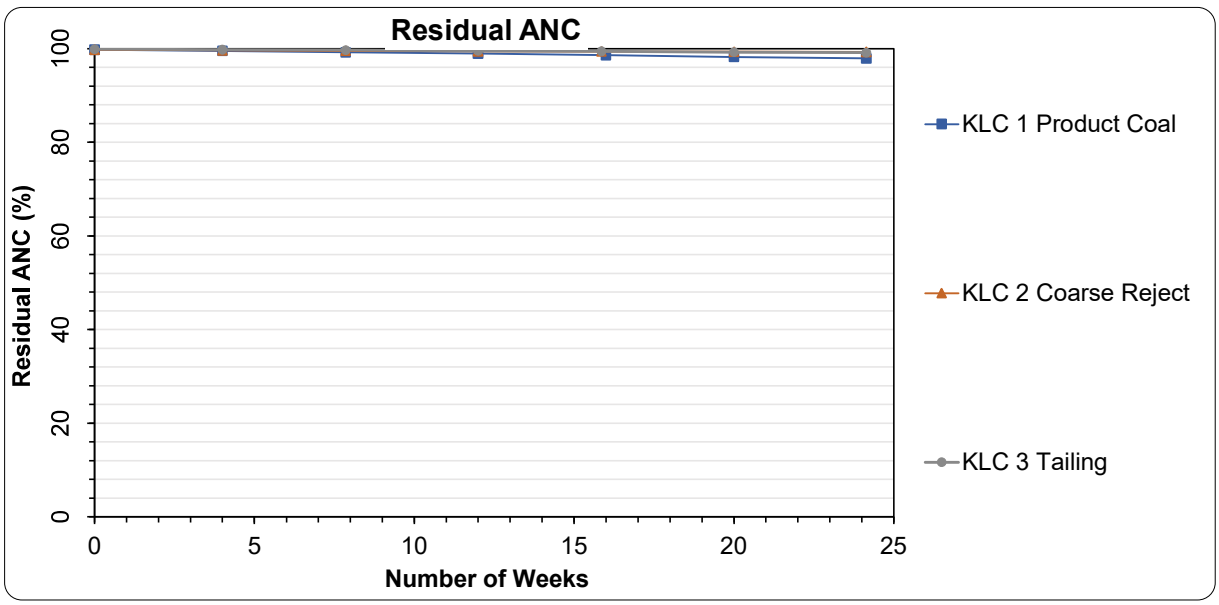

Electrical Conductivity
Electrical Conductivity (µS/cm)
0
1000
2000
3000
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing


Net Alkalinity
Net Alkalinity (mg CaCO3/L)
0
10
20
30
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

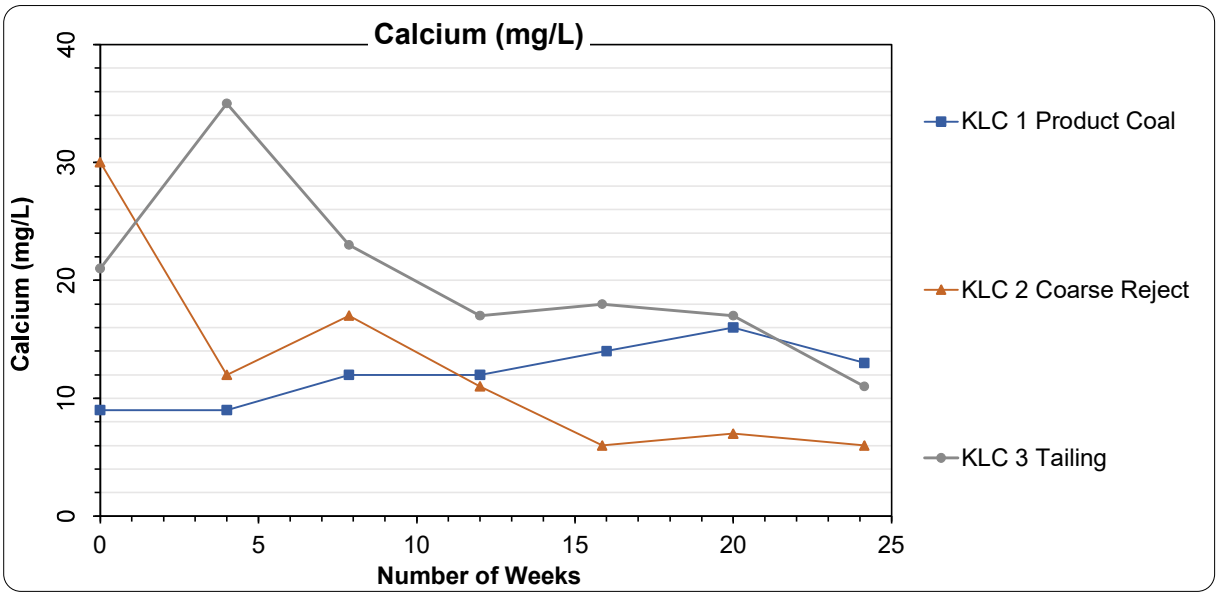
KLC Trends

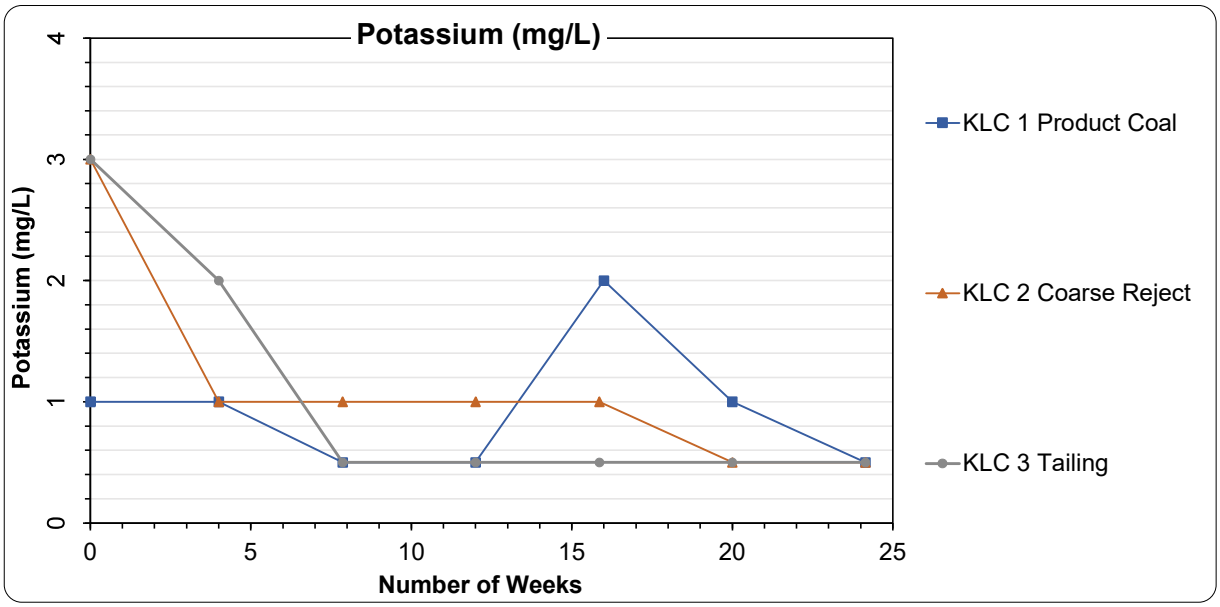

Residual Sulfur
Residual Sulfur (%)
0
20
40
60
80
100
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

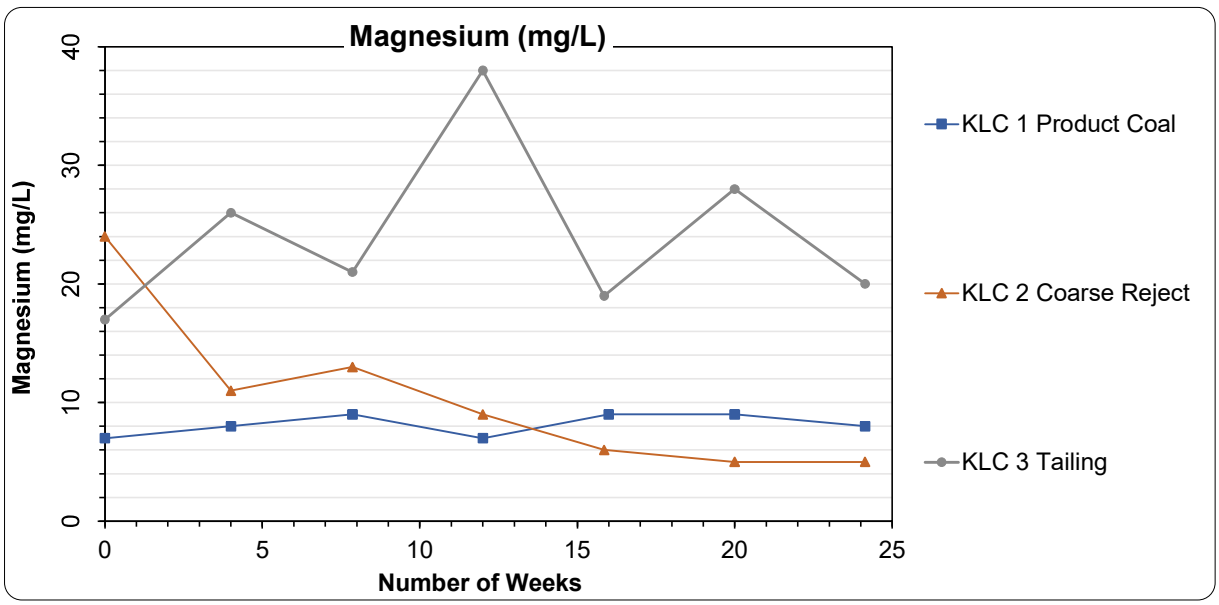

SO4 Release Rate
SO4 Release Rate (mg/kg/flush)
0
50
100
150
200
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing


Residual ANC
Residual ANC (%)
0
20
40
60
80
100
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

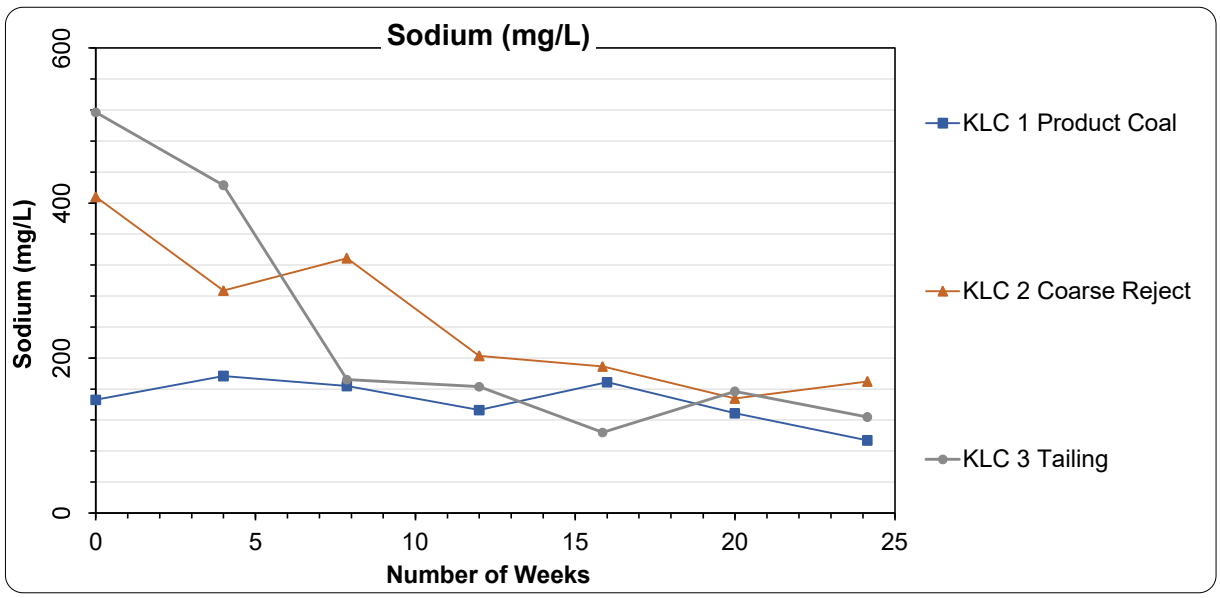
KLC Trends

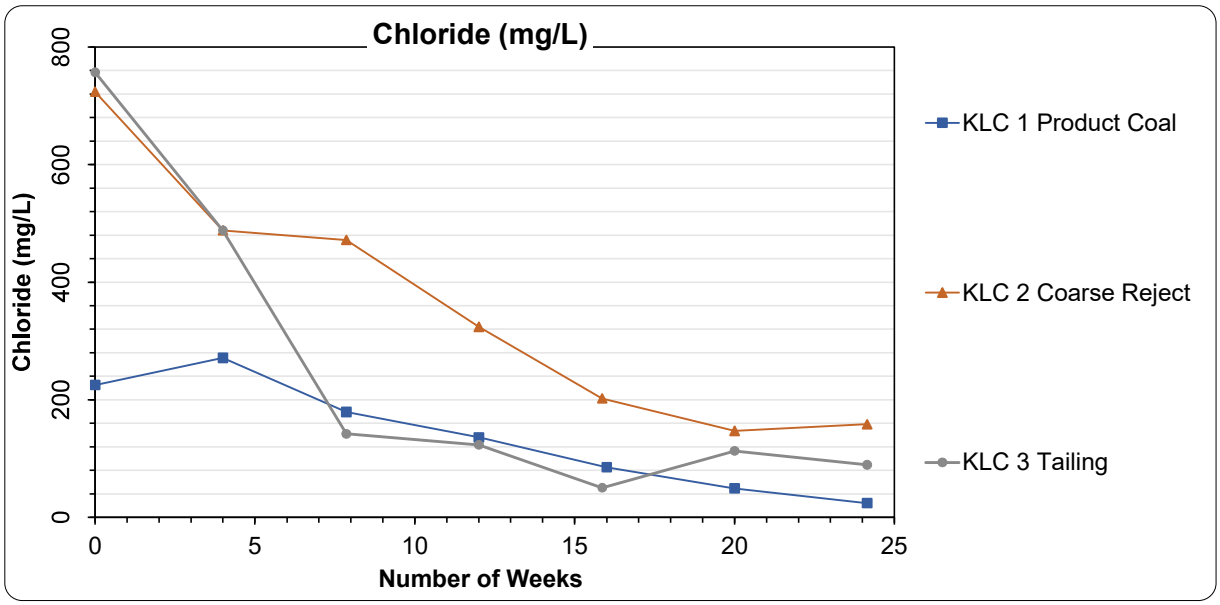

Calcium (mg/L)
Calcium (mg/L)
0
10
20
30
40
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

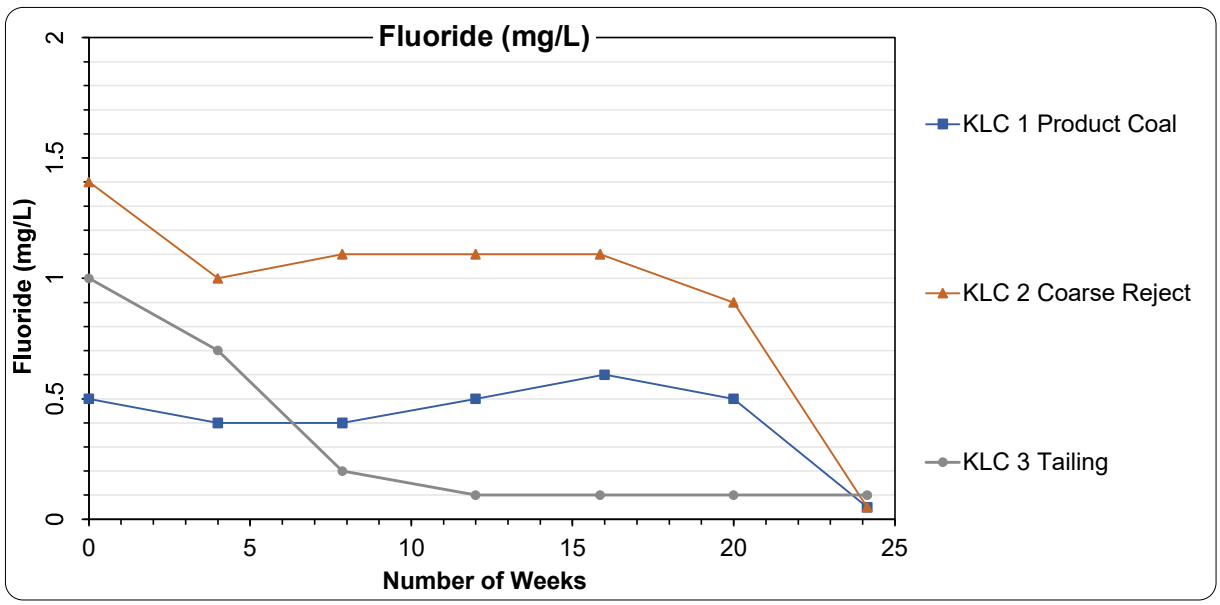

Potassium (mg/L)
Potassium (mg/L)
0
1
2
3
4
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing


Magnesium (mg/L)
Magnesium (mg/L)
0
10
20
30
40
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

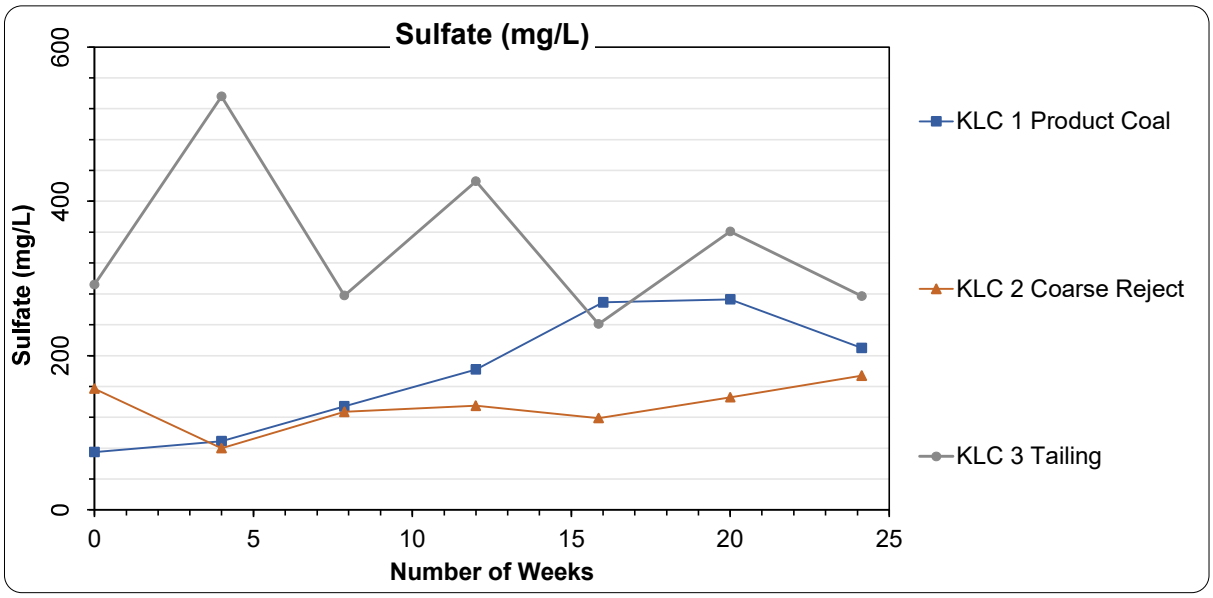
KLC Trends

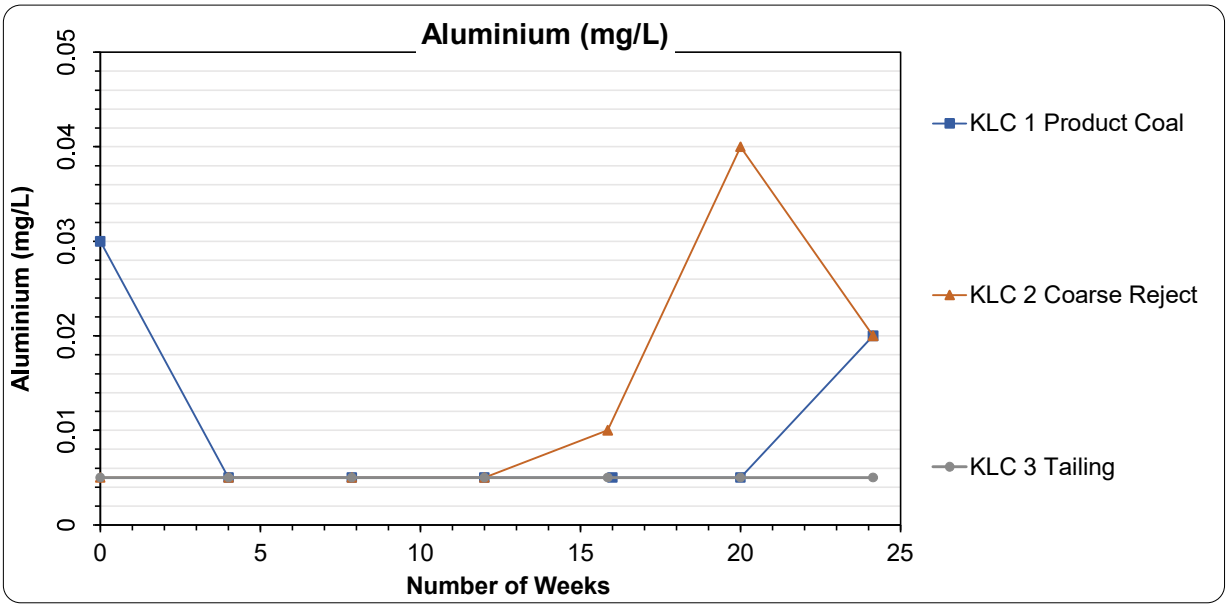

Sodium (mg/L)
Sodium (mg/L)
0
200
400
600
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

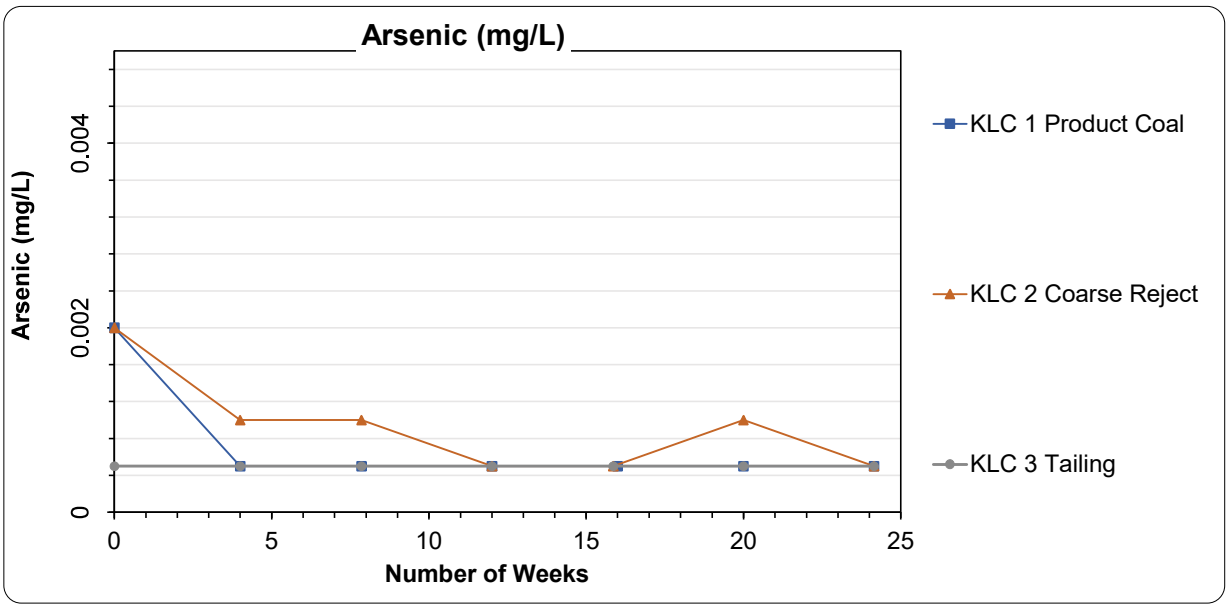

Chloride (mg/L)
Chloride (mg/L)
0
200
400
600
800
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing


Fluoride (mg/L)
Fluoride (mg/L)
0
0.5
1
1.5
2
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

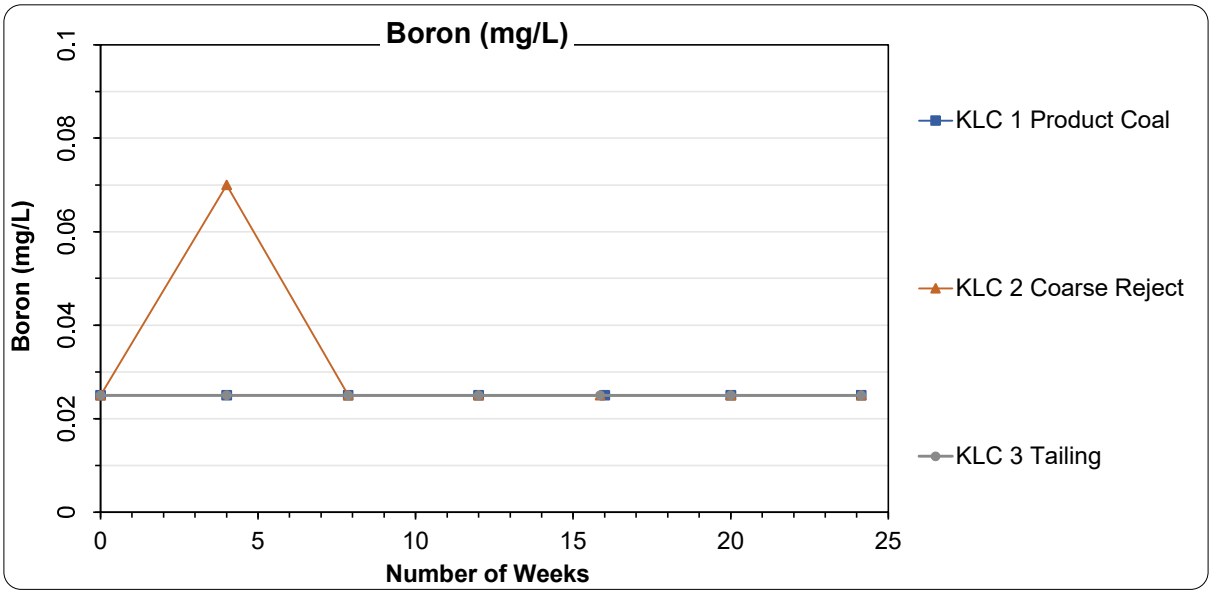
KLC Trends

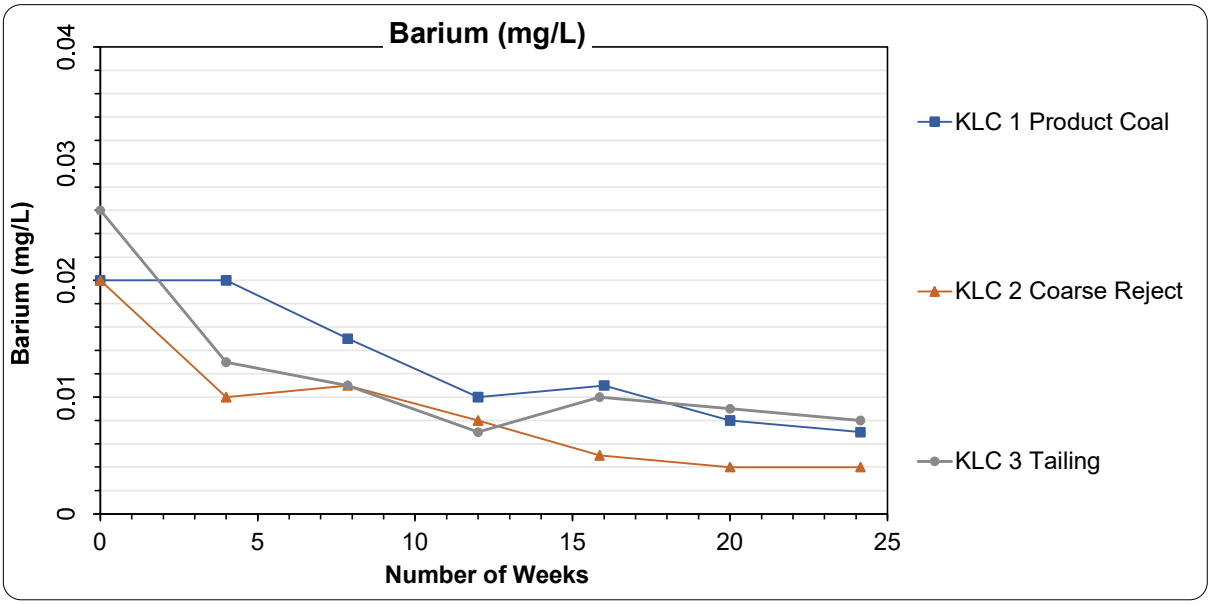

Sulfate (mg/L)
Sulfate (mg/L)
0
200
400
600
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

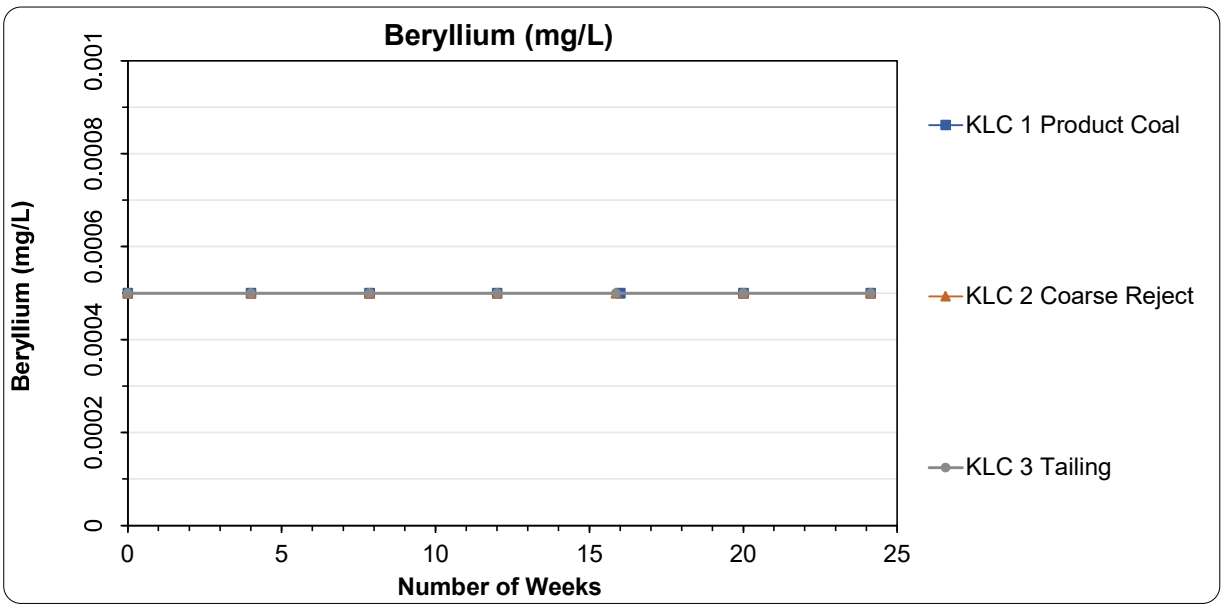

Aluminium (mg/L)
Aluminium (mg/L)
0
0.01
0.02
0.03
0.04
0.05
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing


Arsenic (mg/L)
Arsenic (mg/L)
0
0.002
0.004
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

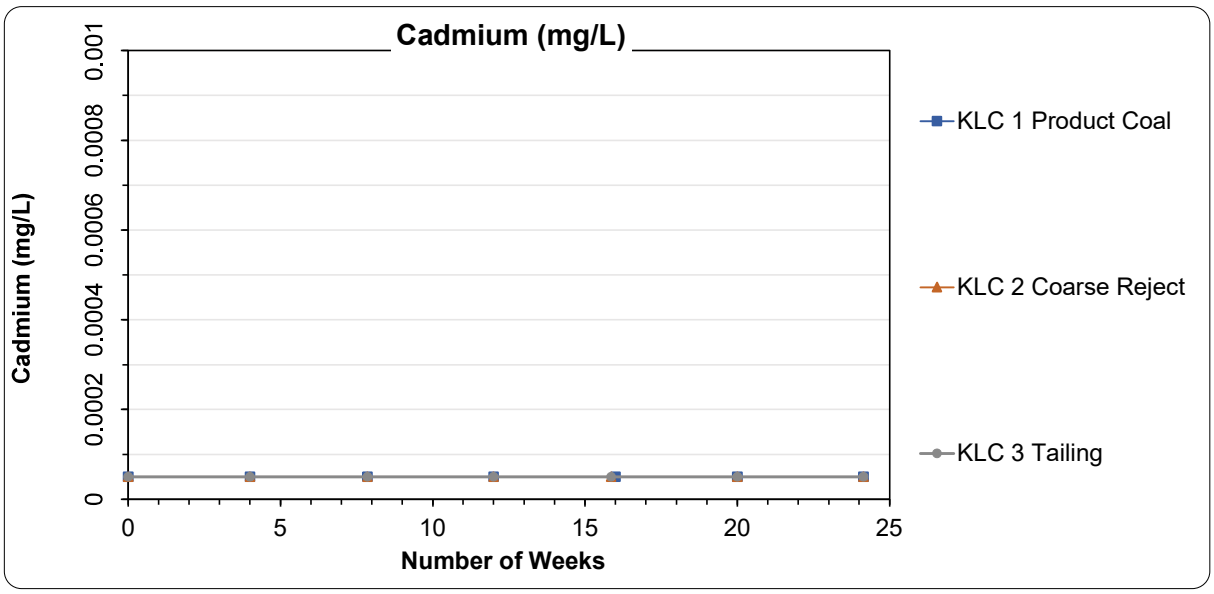
KLC Trends

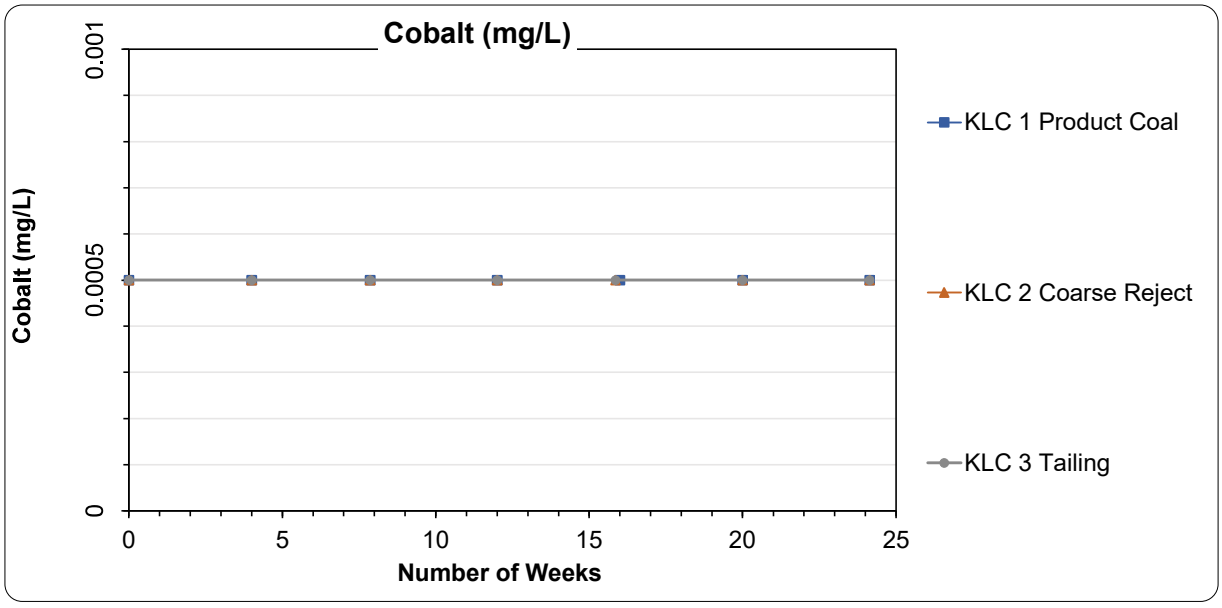

Boron (mg/L)
Boron (mg/L)
0
0.02
0.04
0.06
0.08
0.1
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

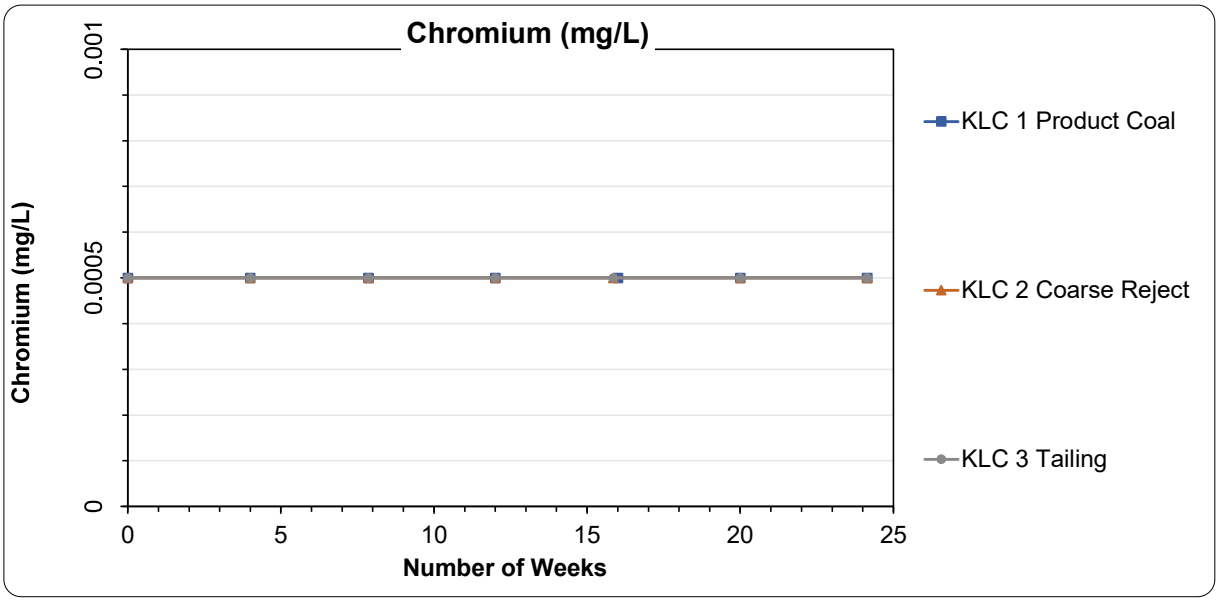

Barium (mg/L)
Barium (mg/L)
0
0.01
0.02
0.03
0.04
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing


Beryllium (mg/L)
Beryllium (mg/L)
0
0.0002
0.0004
0.0006
0.0008
0.001
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

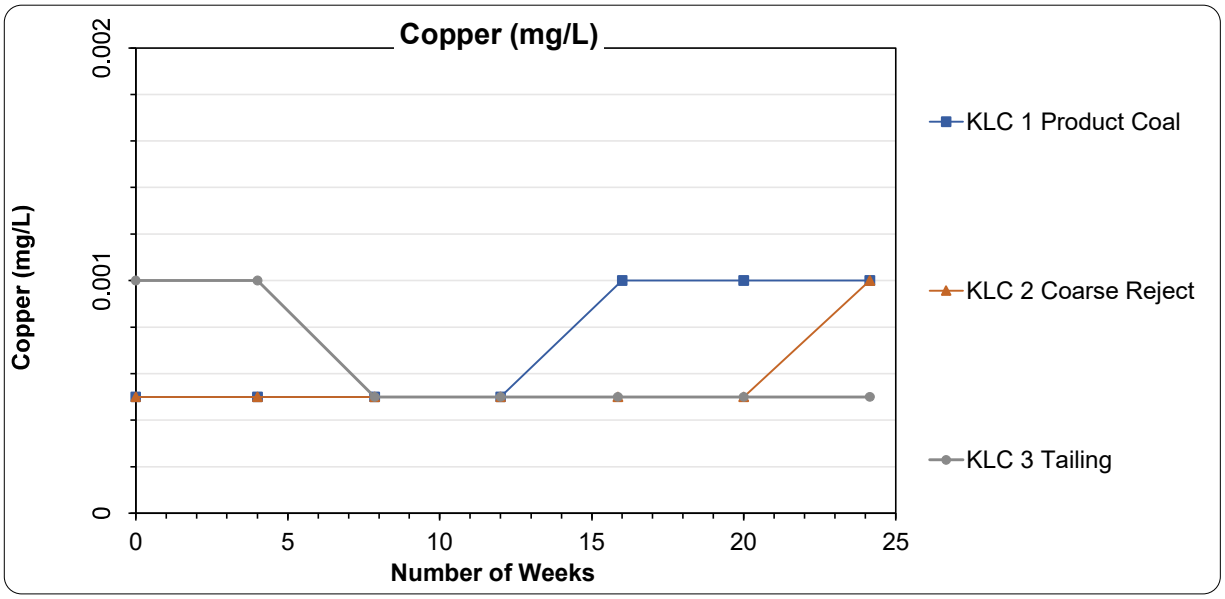
KLC Trends

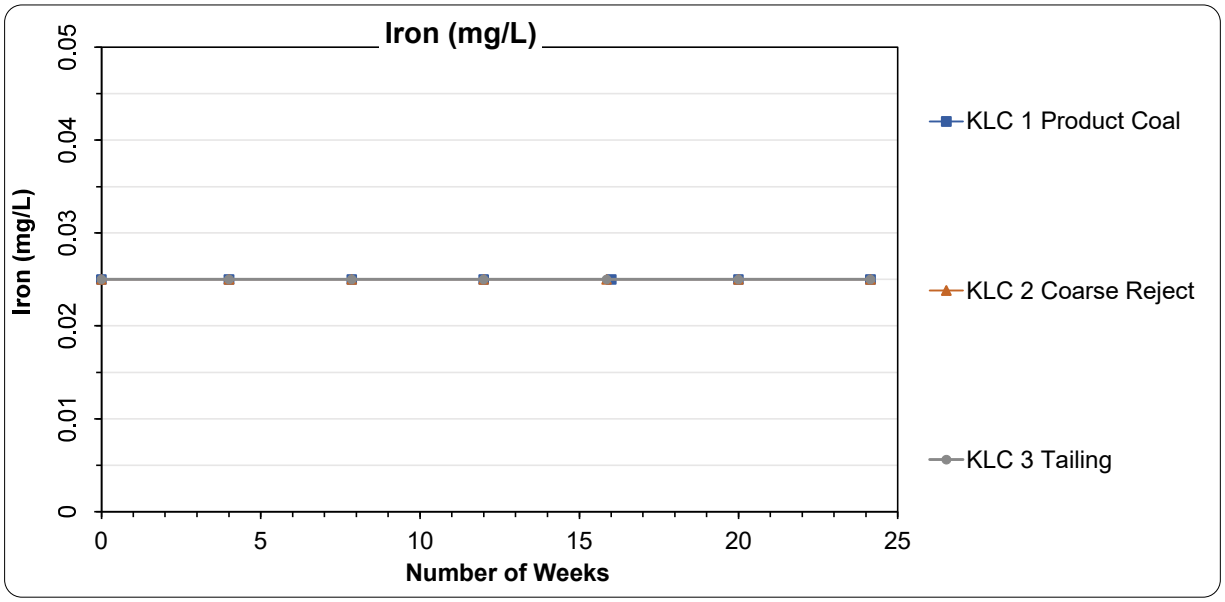

Cadmium (mg/L)
Cadmium (mg/L)
0
0.0002
0.0004
0.0006
0.0008
0.001
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

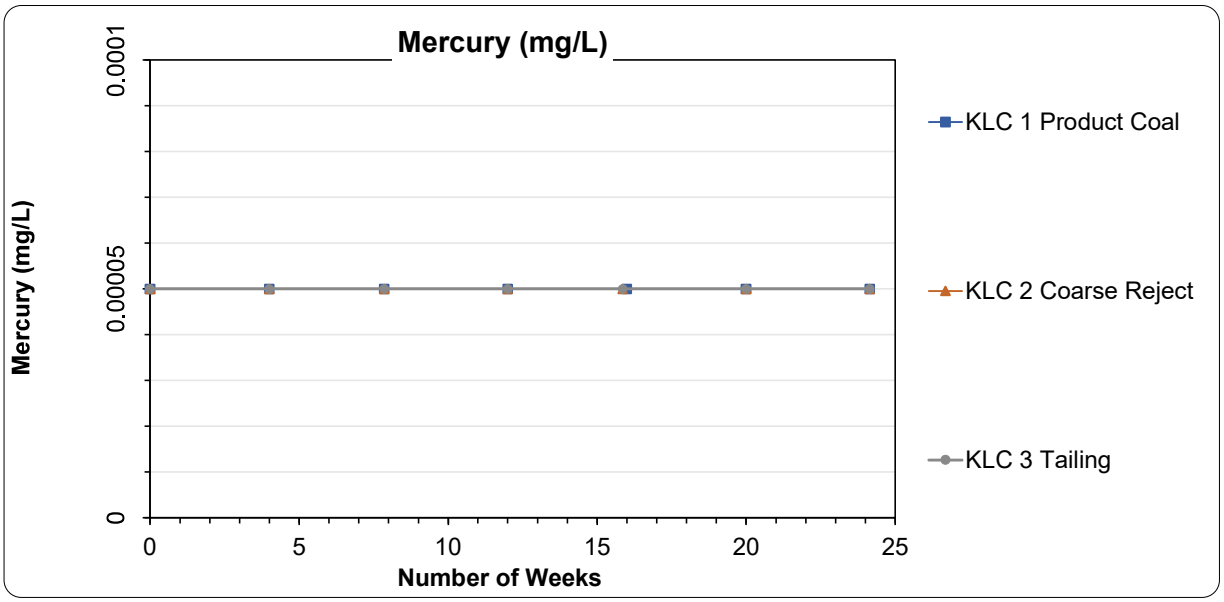

Cobalt (mg/L)
Cobalt (mg/L)
0
0.0005
0.001
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing


Chromium (mg/L)
Chromium (mg/L)
0
0.0005
0.001
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

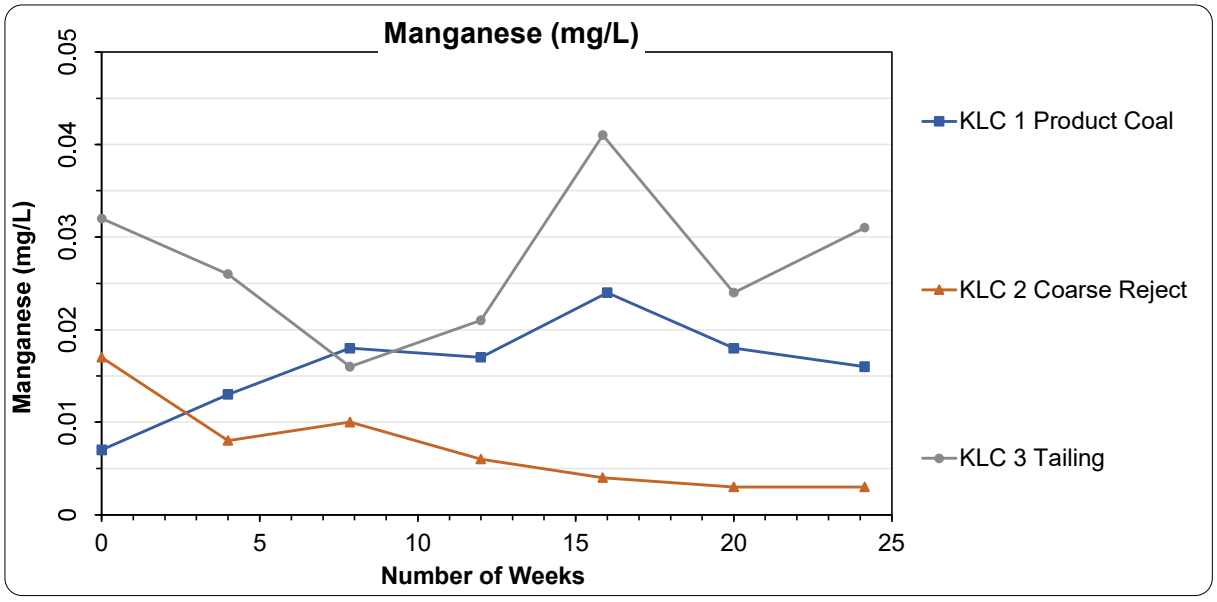
KLC Trends

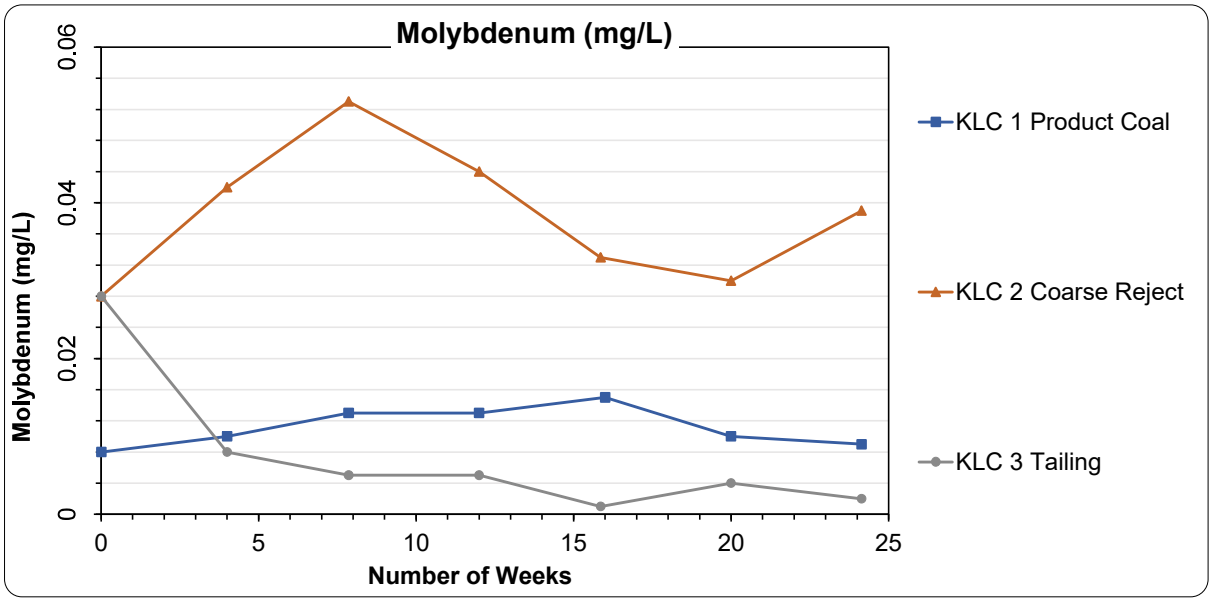

Copper (mg/L)
Copper (mg/L)
0.002
0.001
0
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

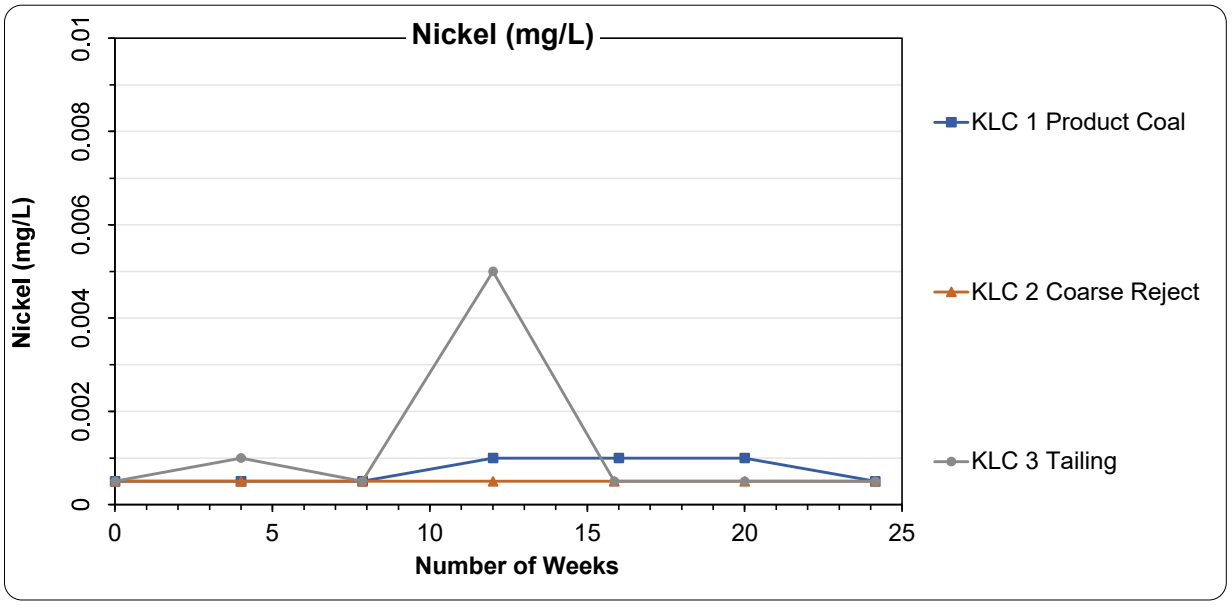

Iron (mg/L)
Iron (mg/L)
0.05
0.04
0.03
0.02
0.01
0
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing


Mercury (mg/L)
Mercury (mg/L)
0.0001
0.00005
0
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

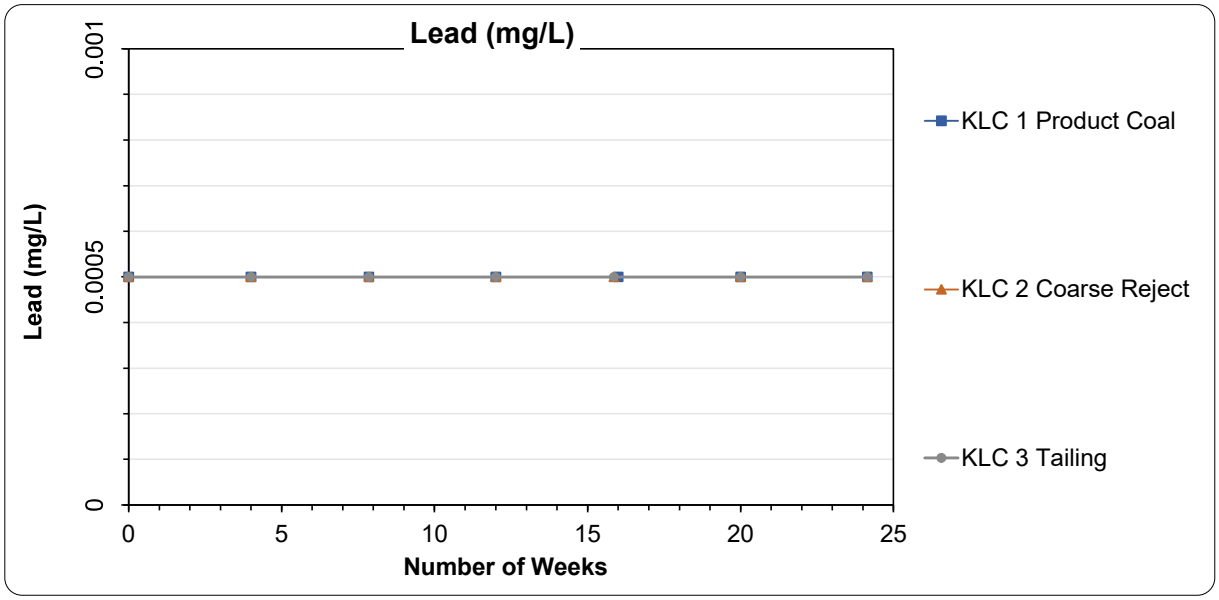
KLC Trends

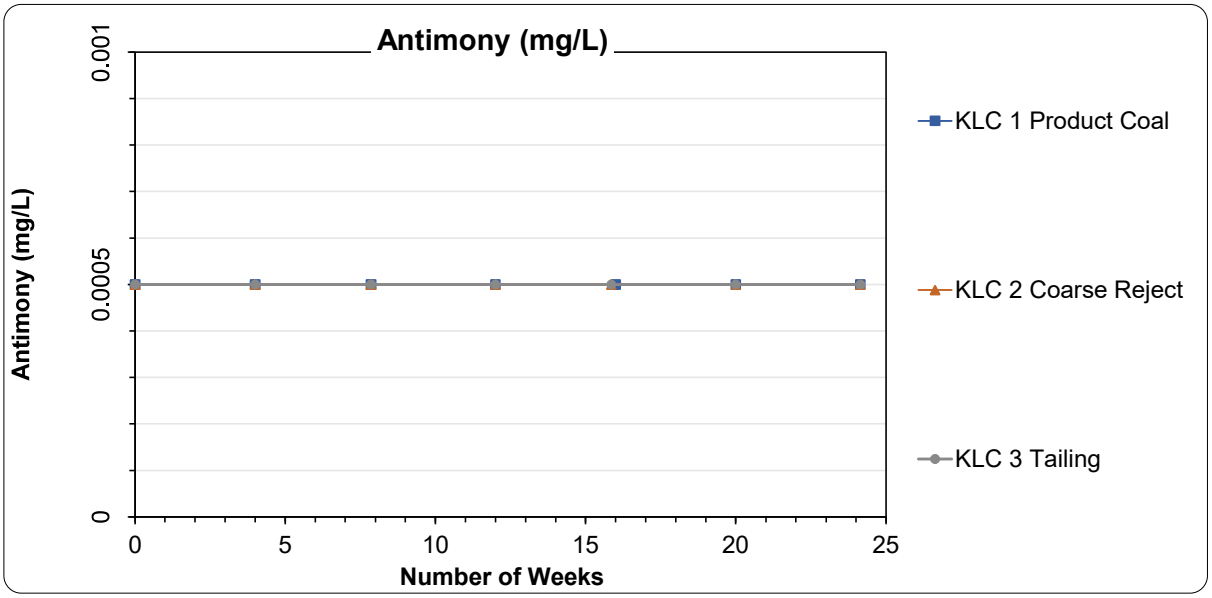

Manganese (mg/L)
Manganese (mg/L)
0
0.01
0.02
0.03
0.04
0.05
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

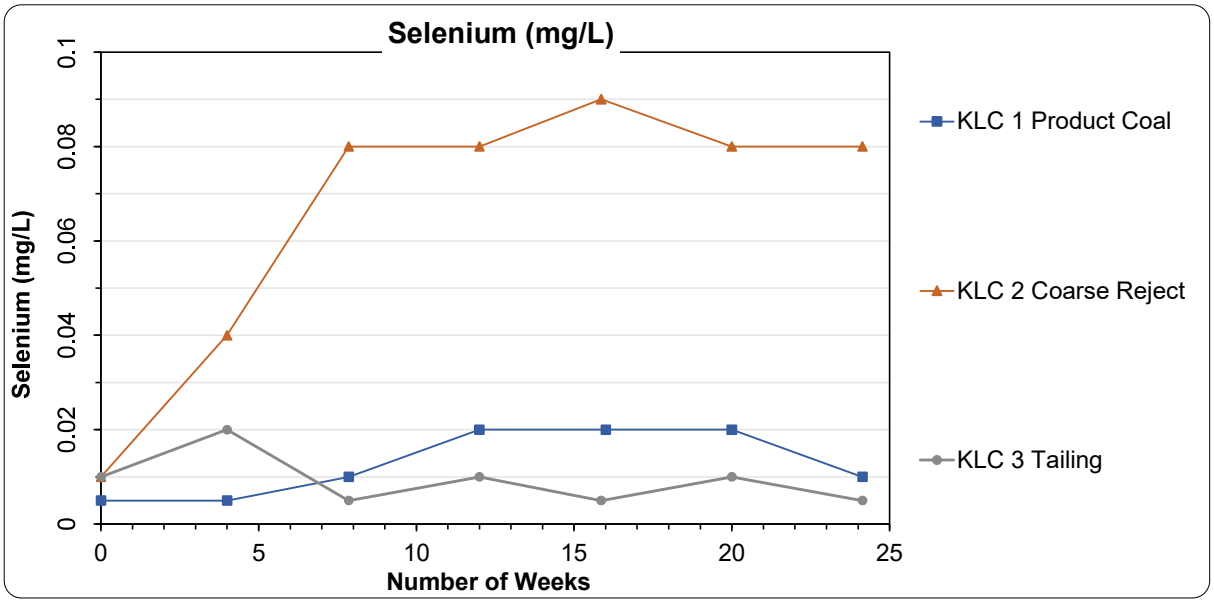

Molybdenum (mg/L)
Molybdenum (mg/L)
0
0.02
0.04
0.06
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing


Nickel (mg/L)
Nickel (mg/L)
0
0.002
0.004
0.006
0.008
0.01
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

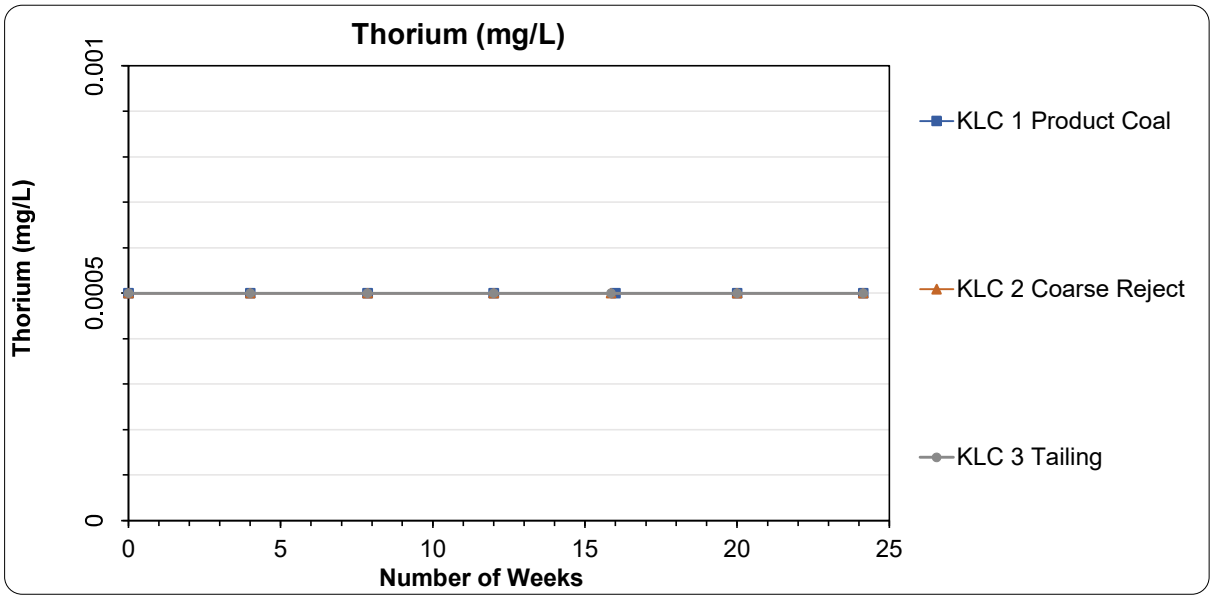
KLC Trends

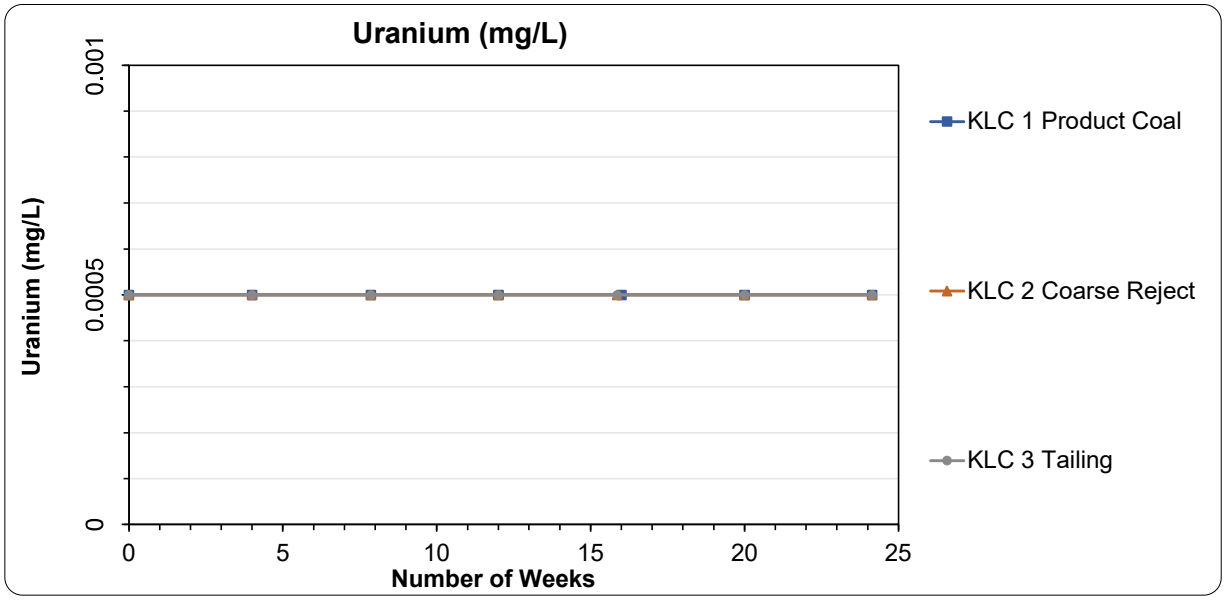

Lead (mg/L)
Lead (mg/L)
0.001
0.0005
0
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

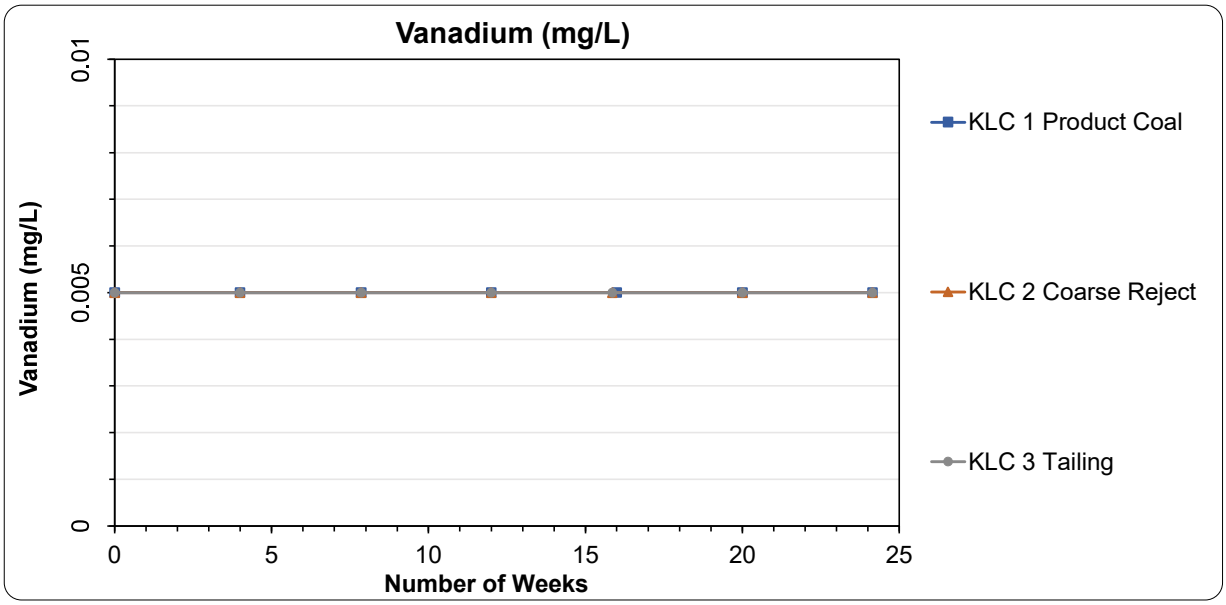

Antimony (mg/L)
Antimony (mg/L)
0.001
0.0005
0
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing


Selenium (mg/L)
Selenium (mg/L)
0.1
0.08
0.06
0.04
0.02
0
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

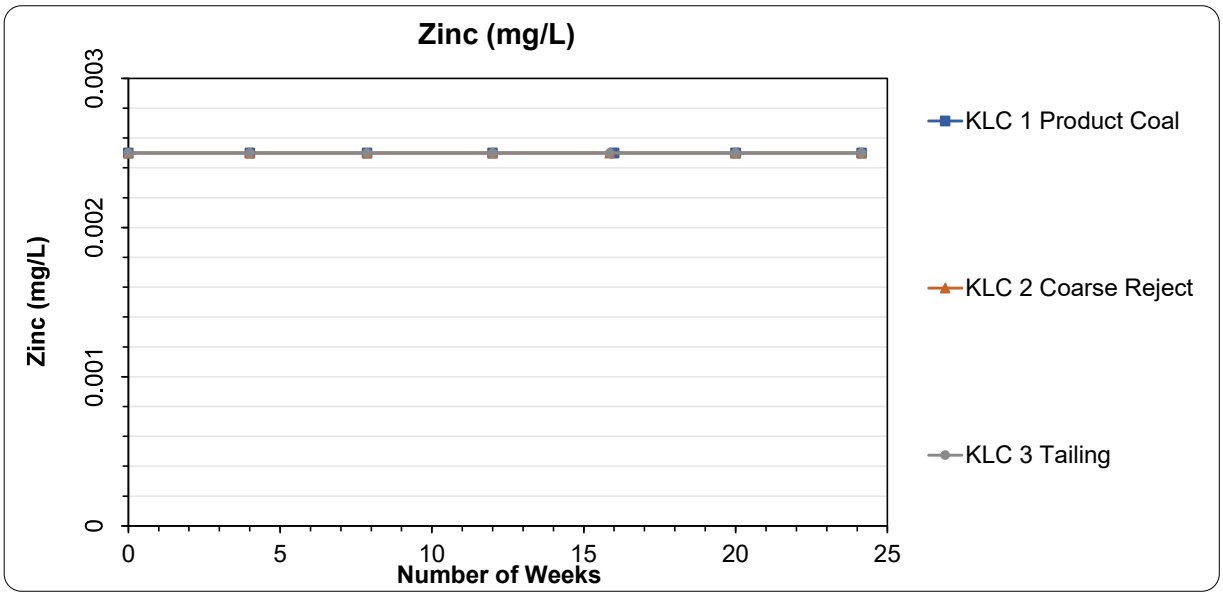
KLC Trends


Thorium (mg/L)
Thorium (mg/L)
0.001
0.0005
0
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing


Uranium (mg/L)
Uranium (mg/L)
0.001
0.0005
0
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing


Vanadium (mg/L)
Vanadium (mg/L)
0.01
0.005
0
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

KLC Trends


Zinc (mg/L)
Zinc (mg/L)
0.003
0.002
0.001
0
0
5
10
15
20
25
Number of Weeks
KLC 1 Product Coal
KLC 2 Coarse Reject
KLC 3 Tailing

Attachment D: ALS Laboratory Results Tables

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2202699**	Page	: 1 of 36
Amendment	: **1**		
Client	: **Peabody Energy Australia PCI (C&M Management) Pty Ltd**	Laboratory	: Environmental Division Brisbane
Contact	: SPENCER SUMMERS	Contact	: John Pickering
Address	: PEAK DOWNS HIGHWAY ABN 65077890932 PO BOX 193 NEBO QLD, AUSTRALIA 4742	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 7 3552 8634
Project	: Moorvale South	Date Samples Received	: 15-Nov-2021 12:00
Order number	: 453180351	Date Analysis Commenced	: 21-Feb-2022
C-O-C number	: ----	Issue Date	: 27-Sep-2022 10:56
Sampler	: ----		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 87		
No. of samples analysed	: 81		

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*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, 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.

- EG048G (Hexavalent Chromium by Alkaline Digestion): Some samples were diluted due to matrix interference. LOR adjusted accordingly.
- EG048G (Hexavalent Chromium by Alkaline Digest):Some samples were diluted due to matrix inteference. LOR adjusted accordingly.
- Amendment (15/9/22): This report has been amended and re-released to allow the reporting of additional analytical data, specifically method EG005 for Al, Sb, B, Be, Ba, Co, Fe, Mn, Mo, Se, V plus Cations. This applies to all samples.
- EG005T (Total Metals by ICP-AES): MS0353_OB_002 (EB2202699-002) shows poor matrix spike recovery due to sample heterogeneity. This has been confirmed by re-extraction and re-analysis.
- EG005T (Total Metals by ICP-AES): MS0379_OB_001 (EB2202699-042) shows poor matrix spike recovery due to sample heterogeneity. This has been confirmed by re-extraction and re-analysis.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0353_OB_001	MS0353_OB_002	MS0353_OB_003	MS0353_OB_004	MS0353_OB_005
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-001	EB2202699-002	EB2202699-003	EB2202699-004	EB2202699-005
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.4	8.7	8.5	8.6	8.7
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-61.2	-72.2	-45.4	-58.4	-54.8
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	773	720	1190	792	636
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	9.0	9.7	8.7	9.4	8.8
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	61.5	72.2	47.8	58.7	57.2
ANC as CaCO3	----	0.1	% CaCO3	6.3	7.4	4.9	6.0	5.8
Fizz Rating	----	0	Fizz Unit	2	2	2	2	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.01	<0.01	0.08	0.01	0.08
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	6060	6740	11300	10000	6390
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	140	130	940	170	50
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cobalt	7440-48-4	2	mg/kg	8	8	17	12	13
Iron	7439-89-6	50	mg/kg	24000	26200	27300	38000	46500
Manganese	7439-96-5	5	mg/kg	634	586	280	702	1140
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	19	20	50	30	21
Calcium	7440-70-2	50	mg/kg	13400	18200	9820	16400	12800
Magnesium	7439-95-4	50	mg/kg	8050	8140	11000	8100	6470
Sodium	7440-23-5	50	mg/kg	1670	1410	2340	1370	1000
Potassium	7440-09-7	50	mg/kg	650	910	990	1000	970
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	5	13
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0353_OB_001	MS0353_OB_002	MS0353_OB_003	MS0353_OB_004	MS0353_OB_005
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-001	EB2202699-002	EB2202699-003	EB2202699-004	EB2202699-005
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Chromium	7440-47-3	2	mg/kg	6	6	38	9	6
Copper	7440-50-8	5	mg/kg	22	30	50	43	41
Lead	7439-92-1	5	mg/kg	9	11	9	13	15
Nickel	7440-02-0	2	mg/kg	14	16	40	24	20
Zinc	7440-66-6	5	mg/kg	42	48	66	70	76
EG020T: Total Metals by ICP-MS								
Uranium	7440-61-1	0.1	mg/kg	0.7	0.5	0.6	0.5	0.5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	0.1
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<4.0	<4.0	<4.1	<4.0	<4.0
EG049: Trivalent Chromium								
Trivalent Chromium	16065-83-1	2	mg/kg	6	6	38	9	6

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0353_OB_006	MS0353_OB_007	MS0353_OB_008	MS0354_OB_001	MS0354_OB_002
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-006	EB2202699-007	EB2202699-008	EB2202699-009	EB2202699-010
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.1	9.0	9.2	8.8	9.0
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-102	-51.4	-134	-56.1	-82.4
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	500	527	407	932	724
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	9.7	8.7	9.9	9.4	9.7
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	104	53.6	135	57.0	83.9
ANC as CaCO3	----	0.1	% CaCO3	10.6	5.5	13.7	5.8	8.6
Fizz Rating	----	0	Fizz Unit	2	2	2	2	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.05	0.07	0.03	0.03	0.05
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	6320	7100	4340	12800	6520
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	40	20	100	200	160
Beryllium	7440-41-7	1	mg/kg	1	1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cobalt	7440-48-4	2	mg/kg	11	14	9	12	15
Iron	7439-89-6	50	mg/kg	44200	41200	29400	32400	34400
Manganese	7439-96-5	5	mg/kg	814	643	652	499	634
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	31	25	19	32	22
Calcium	7440-70-2	50	mg/kg	31800	12000	33400	14200	21400
Magnesium	7439-95-4	50	mg/kg	8190	6800	11800	9880	8820
Sodium	7440-23-5	50	mg/kg	850	920	730	2300	1210
Potassium	7440-09-7	50	mg/kg	1080	1150	920	1030	1010
Arsenic	7440-38-2	5	mg/kg	11	10	9	7	10
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0353_OB_006	MS0353_OB_007	MS0353_OB_008	MS0354_OB_001	MS0354_OB_002
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-006	EB2202699-007	EB2202699-008	EB2202699-009	EB2202699-010
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Chromium	7440-47-3	2	mg/kg	7	7	5	23	7
Copper	7440-50-8	5	mg/kg	45	45	33	43	31
Lead	7439-92-1	5	mg/kg	13	16	10	10	13
Nickel	7440-02-0	2	mg/kg	21	24	15	27	24
Zinc	7440-66-6	5	mg/kg	102	94	72	65	67
EG020T: Total Metals by ICP-MS								
Uranium	7440-61-1	0.1	mg/kg	0.3	0.3	0.3	0.4	0.3
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<4.1	<3.9	<3.9	<4.0	<4.0
EG049: Trivalent Chromium								
Trivalent Chromium	16065-83-1	2	mg/kg	7	7	5	23	7

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0354_OB_003	MS0354_OB_004	MS0354_OB_005	MS0354_OB_006	MS0354_OB_007
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-011	EB2202699-012	EB2202699-013	EB2202699-014	EB2202699-015
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.6	9.4	9.4	9.3	9.1
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-29.3	-86.5	-86.5	-89.0	-71.6
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	790	422	414	450	680
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	8.4	9.7	9.8	9.6	9.4
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	35.1	87.1	87.1	89.6	73.1
ANC as CaCO3	----	0.1	% CaCO3	3.6	8.9	8.9	9.1	7.4
Fizz Rating	----	0	Fizz Unit	2	2	2	2	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.19	0.02	0.02	0.02	0.05
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	7270	7580	6460	5820	5380
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	50	20	20	40	210
Beryllium	7440-41-7	1	mg/kg	1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cobalt	7440-48-4	2	mg/kg	16	11	12	11	12
Iron	7439-89-6	50	mg/kg	49500	39200	37500	41700	35900
Manganese	7439-96-5	5	mg/kg	1510	689	618	755	640
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	22	29	26	33	24
Calcium	7440-70-2	50	mg/kg	7020	24200	23500	26200	19100
Magnesium	7439-95-4	50	mg/kg	5760	9060	7310	9130	7710
Sodium	7440-23-5	50	mg/kg	1180	990	900	1050	1270
Potassium	7440-09-7	50	mg/kg	850	920	900	1020	970
Arsenic	7440-38-2	5	mg/kg	31	6	13	13	9
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	MS0354_OB_003	MS0354_OB_004	MS0354_OB_005	MS0354_OB_006	MS0354_OB_007
				Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit		EB2202699-011	EB2202699-012	EB2202699-013	EB2202699-014	EB2202699-015
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Chromium	7440-47-3	2	mg/kg		6	9	8	8	6
Copper	7440-50-8	5	mg/kg		45	42	44	43	40
Lead	7439-92-1	5	mg/kg		18	12	13	13	14
Nickel	7440-02-0	2	mg/kg		23	22	22	21	19
Zinc	7440-66-6	5	mg/kg		69	63	69	68	76
EG020T: Total Metals by ICP-MS									
Uranium	7440-61-1	0.1	mg/kg		0.5	0.3	0.3	0.4	0.3
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		0.2	<0.1	<0.1	<0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<4.1	<4.0	<4.1	<4.1	<4.1
EG049: Trivalent Chromium									
Trivalent Chromium	16065-83-1	2	mg/kg		6	9	8	8	6

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0378_OB_001	MS0378_OB_002	MS0378_OB_003	MS0378_OB_004	MS0378_OB_005
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-016	EB2202699-017	EB2202699-018	EB2202699-019	EB2202699-020
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.7	8.9	9.4	8.9	9.0
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-10.1	-35.6	-24.6	-12.2	-32.8
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	755	968	867	913	896
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	8.9	9.0	9.9	8.8	9.7
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	10.7	35.9	24.6	12.2	32.8
ANC as CaCO3	----	0.1	% CaCO3	1.1	3.7	2.5	1.2	3.3
Fizz Rating	----	0	Fizz Unit	1	2	1	1	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.01	<0.01	<0.01	<0.01
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	4900	5400	4940	7000	11700
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	240	370	250	140	100
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cobalt	7440-48-4	2	mg/kg	10	13	9	10	13
Iron	7439-89-6	50	mg/kg	29500	29400	16100	25400	41200
Manganese	7439-96-5	5	mg/kg	308	727	375	720	960
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	52	39	14	28	39
Calcium	7440-70-2	50	mg/kg	2050	7760	6930	2290	10000
Magnesium	7439-95-4	50	mg/kg	1910	4310	2640	3040	4450
Sodium	7440-23-5	50	mg/kg	1680	2280	2200	1960	2310
Potassium	7440-09-7	50	mg/kg	450	780	780	690	1060
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	6	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	MS0378_OB_001	MS0378_OB_002	MS0378_OB_003	MS0378_OB_004	MS0378_OB_005
				Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit		EB2202699-016	EB2202699-017	EB2202699-018	EB2202699-019	EB2202699-020
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Chromium	7440-47-3	2	mg/kg		**32**	**22**	**6**	**11**	**14**
Copper	7440-50-8	5	mg/kg		**13**	**18**	**11**	**16**	**25**
Lead	7439-92-1	5	mg/kg		**8**	**11**	**8**	**12**	**17**
Nickel	7440-02-0	2	mg/kg		**14**	**19**	**14**	**17**	**21**
Zinc	7440-66-6	5	mg/kg		**16**	**43**	**41**	**49**	**75**
EG020T: Total Metals by ICP-MS									
Uranium	7440-61-1	0.1	mg/kg		**0.6**	**0.4**	**0.1**	**0.2**	**0.4**
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<3.8	<4.1	<4.1	<3.9	<3.9
EG049: Trivalent Chromium									
Trivalent Chromium	16065-83-1	2	mg/kg		**32**	**22**	**6**	**11**	**14**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0378_OB_006	MS0378_OB_007	MS0378_OB_008	MS0378_OB_009	MS0378_OB_010
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-021	EB2202699-022	EB2202699-023	EB2202699-024	EB2202699-025
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.3	9.3	9.3	9.4	8.8
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-60.4	-54.7	-39.8	-42.5	-81.4
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	599	625	635	567	635
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	10.2	10.3	10.1	9.9	10.2
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	60.7	54.7	40.7	43.1	92.4
ANC as CaCO3	----	0.1	% CaCO3	6.2	5.6	4.2	4.4	9.4
Fizz Rating	----	0	Fizz Unit	2	2	2	2	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.01	<0.01	0.03	0.02	0.36
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	9490	14000	14200	12200	14800
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	30	30	160	40	10
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cobalt	7440-48-4	2	mg/kg	10	12	13	14	12
Iron	7439-89-6	50	mg/kg	30700	38600	46200	50000	40100
Manganese	7439-96-5	5	mg/kg	854	704	951	1030	756
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	27	33	34	40	50
Calcium	7440-70-2	50	mg/kg	18800	17800	10500	11400	32200
Magnesium	7439-95-4	50	mg/kg	3930	4840	5630	5710	5430
Sodium	7440-23-5	50	mg/kg	1500	1670	1670	1620	1000
Potassium	7440-09-7	50	mg/kg	1160	1200	1140	1070	660
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	10
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	MS0378_OB_006	MS0378_OB_007	MS0378_OB_008	MS0378_OB_009	MS0378_OB_010
				Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit		EB2202699-021	EB2202699-022	EB2202699-023	EB2202699-024	EB2202699-025
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Chromium	7440-47-3	2	mg/kg		**12**	**14**	**15**	**14**	**19**
Copper	7440-50-8	5	mg/kg		**27**	**36**	**39**	**40**	**17**
Lead	7439-92-1	5	mg/kg		**13**	**14**	**17**	**18**	**14**
Nickel	7440-02-0	2	mg/kg		**20**	**24**	**26**	**24**	**18**
Zinc	7440-66-6	5	mg/kg		**57**	**66**	**108**	**87**	**56**
EG020T: Total Metals by ICP-MS									
Uranium	7440-61-1	0.1	mg/kg		**0.3**	**0.3**	**0.3**	**0.5**	**0.3**
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<4.1	<4.1	<4.0	<3.9	<4.1
EG049: Trivalent Chromium									
Trivalent Chromium	16065-83-1	2	mg/kg		**12**	**14**	**15**	**14**	**19**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0378_OB_011	MS0378_OB_012	MS0378_OB_013	MS0378_OB_014	MS0378_OB_015
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-026	EB2202699-027	EB2202699-028	EB2202699-029	EB2202699-030
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.2	9.3	9.0	9.5	9.5
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-109	-61.1	-35.6	-58.4	-65.4
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	608	544	696	482	508
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	10.6	10.3	9.5	9.8	10.1
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	110	61.7	38.0	59.6	69.4
ANC as CaCO3	----	0.1	% CaCO3	11.2	6.3	3.9	6.1	7.1
Fizz Rating	----	0	Fizz Unit	2	2	2	2	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.03	0.02	0.08	0.04	0.13
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	14900	11600	6890	9680	8220
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	20	20	290	20	50
Beryllium	7440-41-7	1	mg/kg	<1	1	1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cobalt	7440-48-4	2	mg/kg	11	10	11	18	14
Iron	7439-89-6	50	mg/kg	42100	39800	44600	27900	27000
Manganese	7439-96-5	5	mg/kg	1040	830	1090	409	489
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	51	40	36	25	23
Calcium	7440-70-2	50	mg/kg	40600	18800	8830	13900	18500
Magnesium	7439-95-4	50	mg/kg	5800	5270	4120	7160	6770
Sodium	7440-23-5	50	mg/kg	1210	1220	1240	1540	1440
Potassium	7440-09-7	50	mg/kg	820	940	790	1270	1200
Arsenic	7440-38-2	5	mg/kg	16	21	21	<5	8
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0378_OB_011	MS0378_OB_012	MS0378_OB_013	MS0378_OB_014	MS0378_OB_015
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-026	EB2202699-027	EB2202699-028	EB2202699-029	EB2202699-030
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Chromium	7440-47-3	2	mg/kg	**20**	**16**	**11**	**10**	**9**
Copper	7440-50-8	5	mg/kg	**27**	**36**	**36**	**50**	**36**
Lead	7439-92-1	5	mg/kg	**15**	**15**	**18**	**18**	**15**
Nickel	7440-02-0	2	mg/kg	**22**	**23**	**19**	**26**	**21**
Zinc	7440-66-6	5	mg/kg	**60**	**67**	**71**	**80**	**69**
EG020T: Total Metals by ICP-MS								
Uranium	7440-61-1	0.1	mg/kg	**0.3**	**0.4**	**0.5**	**0.3**	**0.2**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<3.9	<4.0	<4.0	<3.9	<4.0
EG049: Trivalent Chromium								
Trivalent Chromium	16065-83-1	2	mg/kg	**20**	**16**	**11**	**10**	**9**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0378_OB_016	MS0378_OB_017	MS0378_OB_018	MS0378_OB_019	MS0378_OB_020
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-031	EB2202699-032	EB2202699-033	EB2202699-034	EB2202699-035
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.6	9.6	9.7	9.7	9.6
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-85.7	-68.7	-95.6	-129	-75.9
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	476	460	471	461	498
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	10.1	10.2	10.5	10.5	10.2
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	87.5	69.3	97.8	129	76.5
ANC as CaCO3	----	0.1	% CaCO3	8.9	7.1	10.0	13.1	7.8
Fizz Rating	----	0	Fizz Unit	2	2	2	2	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.06	0.02	0.07	0.01	0.02
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	9300	9070	9190	10100	12200
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	30	160	40	30	40
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cobalt	7440-48-4	2	mg/kg	9	12	10	11	12
Iron	7439-89-6	50	mg/kg	30900	31100	36500	39200	40000
Manganese	7439-96-5	5	mg/kg	554	585	685	849	631
Molybdenum	7439-98-7	2	mg/kg	<2	2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	26	28	28	33	33
Calcium	7440-70-2	50	mg/kg	24100	17600	28800	36000	21700
Magnesium	7439-95-4	50	mg/kg	7730	7250	7150	11600	8250
Sodium	7440-23-5	50	mg/kg	1390	1270	1220	1250	1510
Potassium	7440-09-7	50	mg/kg	950	1010	870	1020	1160
Arsenic	7440-38-2	5	mg/kg	9	7	<5	5	11
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0378_OB_016	MS0378_OB_017	MS0378_OB_018	MS0378_OB_019	MS0378_OB_020
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-031	EB2202699-032	EB2202699-033	EB2202699-034	EB2202699-035
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Chromium	7440-47-3	2	mg/kg	9	12	12	12	14
Copper	7440-50-8	5	mg/kg	36	22	22	23	38
Lead	7439-92-1	5	mg/kg	13	11	10	10	13
Nickel	7440-02-0	2	mg/kg	17	23	20	20	25
Zinc	7440-66-6	5	mg/kg	63	66	59	56	70
EG020T: Total Metals by ICP-MS								
Uranium	7440-61-1	0.1	mg/kg	0.2	0.2	0.2	0.2	0.3
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<3.9	<4.0	<4.0	<4.0	<4.0
EG049: Trivalent Chromium								
Trivalent Chromium	16065-83-1	2	mg/kg	9	12	12	12	14

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0378_OB_021	MS0378_OB_022	MS0378_OB_023	MS0378_OB_024	MS0378_OB_025
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-036	EB2202699-037	EB2202699-038	EB2202699-039	EB2202699-040
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.6	9.6	9.6	9.4	9.3
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-70.8	-73.4	-62.8	-64.4	-55.9
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	454	470	469	493	594
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	10.2	10.1	10.0	10.0	9.7
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	71.4	74.0	63.4	66.9	71.2
ANC as CaCO3	----	0.1	% CaCO3	7.3	7.6	6.5	6.8	7.3
Fizz Rating	----	0	Fizz Unit	2	2	2	2	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.02	0.02	0.08	0.50
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	11000	11200	12200	15800	14900
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	40	50	50	290	390
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cobalt	7440-48-4	2	mg/kg	12	13	13	13	11
Iron	7439-89-6	50	mg/kg	39700	47500	45600	40900	31500
Manganese	7439-96-5	5	mg/kg	638	798	781	695	287
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	32	38	37	37	64
Calcium	7440-70-2	50	mg/kg	18200	20200	16500	17200	13400
Magnesium	7439-95-4	50	mg/kg	7860	8740	8090	8890	16500
Sodium	7440-23-5	50	mg/kg	1280	1360	1410	1310	1660
Potassium	7440-09-7	50	mg/kg	1070	970	1060	1150	1180
Arsenic	7440-38-2	5	mg/kg	6	7	10	10	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0378_OB_021	MS0378_OB_022	MS0378_OB_023	MS0378_OB_024	MS0378_OB_025
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-036	EB2202699-037	EB2202699-038	EB2202699-039	EB2202699-040
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Chromium	7440-47-3	2	mg/kg	**13**	**14**	**14**	**16**	**55**
Copper	7440-50-8	5	mg/kg	**32**	**31**	**43**	**40**	**30**
Lead	7439-92-1	5	mg/kg	**11**	**10**	**14**	**12**	**9**
Nickel	7440-02-0	2	mg/kg	**24**	**24**	**26**	**22**	**24**
Zinc	7440-66-6	5	mg/kg	**65**	**67**	**67**	**65**	**48**
EG020T: Total Metals by ICP-MS								
Uranium	7440-61-1	0.1	mg/kg	**0.2**	**0.2**	**0.3**	**0.3**	**0.5**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<4.0	<3.9	<3.9	<4.1	<4.1
EG049: Trivalent Chromium								
Trivalent Chromium	16065-83-1	2	mg/kg	**13**	**14**	**14**	**16**	**55**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0378_OB_026	MS0379_OB_001	MS0379_OB_002	MS0379_OB_003	MS0379_OB_004
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-041	EB2202699-042	EB2202699-043	EB2202699-044	EB2202699-045
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.4	8.7	8.2	8.6	9.1
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-51.5	-11.6	-6.8	-6.6	-16.4
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	602	1290	1130	1370	1310
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	9.8	9.4	9.0	8.9	9.7
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	58.2	12.2	6.8	6.6	16.7
ANC as CaCO3	----	0.1	% CaCO3	5.9	1.2	0.7	0.7	1.7
Fizz Rating	----	0	Fizz Unit	2	1	1	1	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.22	0.02	<0.01	<0.01	0.01
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	11700	8050	9890	9840	7700
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	250	270	240	150	220
Beryllium	7440-41-7	1	mg/kg	<1	4	1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cobalt	7440-48-4	2	mg/kg	10	18	20	15	12
Iron	7439-89-6	50	mg/kg	23300	33000	33600	31400	23300
Manganese	7439-96-5	5	mg/kg	233	396	619	1280	785
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	53	39	32	36	21
Calcium	7440-70-2	50	mg/kg	13400	3260	930	1600	5080
Magnesium	7439-95-4	50	mg/kg	10400	2770	3220	3080	3000
Sodium	7440-23-5	50	mg/kg	1440	2920	3470	3490	2860
Potassium	7440-09-7	50	mg/kg	1180	1170	1380	1250	1040
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0378_OB_026	MS0379_OB_001	MS0379_OB_002	MS0379_OB_003	MS0379_OB_004
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-041	EB2202699-042	EB2202699-043	EB2202699-044	EB2202699-045
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Chromium	7440-47-3	2	mg/kg	**46**	**18**	**16**	**17**	**11**
Copper	7440-50-8	5	mg/kg	**36**	**31**	**33**	**30**	**24**
Lead	7439-92-1	5	mg/kg	**11**	**13**	**10**	**14**	**11**
Nickel	7440-02-0	2	mg/kg	**25**	**56**	**37**	**23**	**19**
Zinc	7440-66-6	5	mg/kg	**59**	**71**	**72**	**56**	**49**
EG020T: Total Metals by ICP-MS								
Uranium	7440-61-1	0.1	mg/kg	**0.3**	**0.6**	**0.4**	**0.4**	**0.3**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<3.9	<4.1	<3.8	<4.0	<4.0
EG049: Trivalent Chromium								
Trivalent Chromium	16065-83-1	2	mg/kg	**46**	**18**	**16**	**17**	**11**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0379_OB_005	MS0379_OB_006	MS0379_OB_007	MS0379_OB_008	MS0379_OB_009
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-046	EB2202699-047	EB2202699-048	EB2202699-049	EB2202699-050
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.2	9.4	9.7	9.6	9.5
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-40.3	-43.6	-81.1	-61.5	-84.6
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	1110	901	488	474	412
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	10.2	10.3	10.5	10.5	10.7
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	40.3	44.2	81.4	61.8	85.8
ANC as CaCO3	----	0.1	% CaCO3	4.1	4.5	8.3	6.3	8.8
Fizz Rating	----	0	Fizz Unit	2	2	2	2	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	0.02	0.01	0.01	0.04
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	8770	11600	13200	12000	10400
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	160	30	20	20	20
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cobalt	7440-48-4	2	mg/kg	12	13	12	13	12
Iron	7439-89-6	50	mg/kg	25400	30500	36000	40100	44300
Manganese	7439-96-5	5	mg/kg	753	622	889	682	832
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	22	31	45	51	54
Calcium	7440-70-2	50	mg/kg	14400	13600	26900	19300	28600
Magnesium	7439-95-4	50	mg/kg	3450	4850	5740	6190	6150
Sodium	7440-23-5	50	mg/kg	2710	2360	1190	1280	960
Potassium	7440-09-7	50	mg/kg	1170	1150	740	920	910
Arsenic	7440-38-2	5	mg/kg	<5	<5	7	10	16
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0379_OB_005	MS0379_OB_006	MS0379_OB_007	MS0379_OB_008	MS0379_OB_009
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-046	EB2202699-047	EB2202699-048	EB2202699-049	EB2202699-050
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Chromium	7440-47-3	2	mg/kg	**11**	**11**	**19**	**19**	**19**
Copper	7440-50-8	5	mg/kg	**26**	**36**	**18**	**29**	**22**
Lead	7439-92-1	5	mg/kg	**13**	**14**	**13**	**15**	**13**
Nickel	7440-02-0	2	mg/kg	**23**	**22**	**19**	**27**	**25**
Zinc	7440-66-6	5	mg/kg	**56**	**67**	**70**	**61**	**88**
EG020T: Total Metals by ICP-MS								
Uranium	7440-61-1	0.1	mg/kg	**0.2**	**0.4**	**0.2**	**0.3**	**0.3**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<4.0	<3.9	<4.0	<3.9	<4.1
EG049: Trivalent Chromium								
Trivalent Chromium	16065-83-1	2	mg/kg	**11**	**11**	**19**	**19**	**19**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0379_OB_010	MS0379_OB_011	MS0379_OB_012	MS0379_OB_013	MS0379_OB_014
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-051	EB2202699-052	EB2202699-053	EB2202699-054	EB2202699-055
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.5	9.5	7.5	9.1	9.4
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-47.5	-69.0	-8.3	-59.7	-96.2
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	489	435	945	1360	1120
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	10.0	10.2	4.8	9.6	10.0
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	7.3	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	49.0	70.8	14.1	62.5	97.7
ANC as CaCO3	----	0.1	% CaCO3	5.0	7.2	1.4	6.4	10.0
Fizz Rating	----	0	Fizz Unit	2	2	1	2	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.05	0.06	0.19	0.09	0.05
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	8810	6420	3810	5160	4520
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	210	120	50	610	240
Beryllium	7440-41-7	1	mg/kg	<1	1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cobalt	7440-48-4	2	mg/kg	11	10	10	8	14
Iron	7439-89-6	50	mg/kg	38000	38200	36200	22900	28800
Manganese	7439-96-5	5	mg/kg	689	848	1220	332	493
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	37	34	18	17	18
Calcium	7440-70-2	50	mg/kg	13600	23400	3290	16300	25600
Magnesium	7439-95-4	50	mg/kg	5200	5220	1550	6940	9110
Sodium	7440-23-5	50	mg/kg	1110	1060	1160	2230	1960
Potassium	7440-09-7	50	mg/kg	900	890	560	1120	850
Arsenic	7440-38-2	5	mg/kg	25	24	44	7	10
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	MS0379_OB_010	MS0379_OB_011	MS0379_OB_012	MS0379_OB_013	MS0379_OB_014
				Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit		EB2202699-051	EB2202699-052	EB2202699-053	EB2202699-054	EB2202699-055
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Chromium	7440-47-3	2	mg/kg		**14**	**10**	**3**	**5**	**5**
Copper	7440-50-8	5	mg/kg		**37**	**38**	**47**	**46**	**40**
Lead	7439-92-1	5	mg/kg		**16**	**18**	**30**	**15**	**13**
Nickel	7440-02-0	2	mg/kg		**22**	**18**	**16**	**17**	**22**
Zinc	7440-66-6	5	mg/kg		**77**	**66**	**51**	**72**	**76**
EG020T: Total Metals by ICP-MS									
Uranium	7440-61-1	0.1	mg/kg		**0.4**	**0.5**	**1.1**	**0.3**	**0.3**
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	**0.2**	**0.1**	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<3.8	<4.0	<4.1	<4.1	<4.1
EG049: Trivalent Chromium									
Trivalent Chromium	16065-83-1	2	mg/kg		**14**	**10**	<4	**5**	**5**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0379_OB_015	MS0379_OB_016	MS0379_OB_017	MS0379_OB_018	MS0379_OB_019
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-056	EB2202699-057	EB2202699-058	EB2202699-059	EB2202699-060
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.3	9.3	9.3	9.4	9.0
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-60.1	-44.0	-67.3	-89.2	-73.7
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	1160	1150	1110	1210	2230
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	9.5	9.2	9.5	10.5	10.1
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	61.3	47.1	68.5	89.8	74.3
ANC as CaCO3	----	0.1	% CaCO3	6.2	4.8	7.0	9.2	7.6
Fizz Rating	----	0	Fizz Unit	2	2	2	2	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.04	0.10	0.04	0.02	0.02
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	5810	5360	7050	6120	7420
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	130	120	110	90	100
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cobalt	7440-48-4	2	mg/kg	11	15	15	11	12
Iron	7439-89-6	50	mg/kg	33700	33900	43800	36200	42900
Manganese	7439-96-5	5	mg/kg	596	538	735	716	739
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	21	20	30	26	31
Calcium	7440-70-2	50	mg/kg	14700	10900	18700	27600	21600
Magnesium	7439-95-4	50	mg/kg	7020	5740	7940	8330	7910
Sodium	7440-23-5	50	mg/kg	2060	2030	2080	2140	3100
Potassium	7440-09-7	50	mg/kg	980	900	1160	1080	1090
Arsenic	7440-38-2	5	mg/kg	6	10	14	6	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	MS0379_OB_015	MS0379_OB_016	MS0379_OB_017	MS0379_OB_018	MS0379_OB_019
				Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit		EB2202699-056	EB2202699-057	EB2202699-058	EB2202699-059	EB2202699-060
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Chromium	7440-47-3	2	mg/kg		**6**	**6**	**9**	**8**	**10**
Copper	7440-50-8	5	mg/kg		**48**	**41**	**36**	**21**	**25**
Lead	7439-92-1	5	mg/kg		**15**	**13**	**13**	**11**	**10**
Nickel	7440-02-0	2	mg/kg		**18**	**24**	**27**	**19**	**21**
Zinc	7440-66-6	5	mg/kg		**81**	**73**	**71**	**61**	**66**
EG020T: Total Metals by ICP-MS									
Uranium	7440-61-1	0.1	mg/kg		**0.3**	**0.2**	**0.3**	**0.2**	**0.2**
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<3.9	<4.0	<4.1	<4.1	<3.9
EG049: Trivalent Chromium									
Trivalent Chromium	16065-83-1	2	mg/kg		**6**	**6**	**9**	**8**	**10**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0379_OB_020	MS0380_OB_001	MS0380_OB_002	MS0380_OB_003	MS0380_OB_004
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-061	EB2202699-062	EB2202699-063	EB2202699-064	EB2202699-065
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.2	8.4	8.6	9.0	9.1
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-54.7	-23.1	-29.5	-89.6	-64.7
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	1020	2240	2090	1540	1140
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	9.6	9.6	9.4	10.1	10.2
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	55.3	24.6	30.7	90.5	65.6
ANC as CaCO3	----	0.1	% CaCO3	5.6	2.5	3.1	9.2	6.7
Fizz Rating	----	0	Fizz Unit	2	1	1	2	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.05	0.04	0.03	0.03
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	7700	11600	13400	11100	11900
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	90	700	150	140	130
Beryllium	7440-41-7	1	mg/kg	<1	1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cobalt	7440-48-4	2	mg/kg	11	13	11	10	10
Iron	7439-89-6	50	mg/kg	36400	37900	32200	37200	34300
Manganese	7439-96-5	5	mg/kg	561	675	530	763	556
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	28	46	33	33	31
Calcium	7440-70-2	50	mg/kg	13000	8650	9460	30000	18200
Magnesium	7439-95-4	50	mg/kg	6330	5390	6930	6680	6710
Sodium	7440-23-5	50	mg/kg	1790	4270	3990	2860	2360
Potassium	7440-09-7	50	mg/kg	1150	1320	1160	1060	1270
Arsenic	7440-38-2	5	mg/kg	5	6	11	8	8
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	MS0379_OB_020	MS0380_OB_001	MS0380_OB_002	MS0380_OB_003	MS0380_OB_004
				Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit		EB2202699-061	EB2202699-062	EB2202699-063	EB2202699-064	EB2202699-065
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Chromium	7440-47-3	2	mg/kg		**10**	**23**	**12**	**12**	**12**
Copper	7440-50-8	5	mg/kg		**26**	**31**	**42**	**36**	**40**
Lead	7439-92-1	5	mg/kg		**10**	**20**	**17**	**13**	**14**
Nickel	7440-02-0	2	mg/kg		**20**	**20**	**23**	**20**	**20**
Zinc	7440-66-6	5	mg/kg		**67**	**52**	**68**	**62**	**64**
EG020T: Total Metals by ICP-MS									
Uranium	7440-61-1	0.1	mg/kg		**0.2**	**0.7**	**0.4**	**0.4**	**0.3**
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<4.0	<4.0	<3.8	<3.9	<4.1
EG049: Trivalent Chromium									
Trivalent Chromium	16065-83-1	2	mg/kg		**10**	**23**	**12**	**12**	**12**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0380_OB_005	MS0380_OB_006	MS0380_OB_007	MS0380_OB_008	MS0380_OB_009
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-066	EB2202699-067	EB2202699-068	EB2202699-069	EB2202699-070
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.4	9.6	9.4	9.6	9.7
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-80.3	-78.0	-40.0	-53.6	-85.0
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	782	590	612	558	554
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	10.4	10.1	8.4	9.7	10.2
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	81.8	79.2	56.2	56.4	86.2
ANC as CaCO3	----	0.1	% CaCO3	8.3	8.1	5.7	5.8	8.8
Fizz Rating	----	0	Fizz Unit	2	2	2	2	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.05	0.04	0.53	0.09	0.04
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	13600	11800	8630	11200	9620
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	60	110	280	170	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
Cobalt	7440-48-4	2	mg/kg	10	12	7	12	11
Iron	7439-89-6	50	mg/kg	38200	37700	33700	40100	36200
Manganese	7439-96-5	5	mg/kg	656	770	448	889	765
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	35	32	18	33	32
Calcium	7440-70-2	50	mg/kg	27500	24800	15200	15700	24600
Magnesium	7439-95-4	50	mg/kg	8280	8250	5460	7940	8560
Sodium	7440-23-5	50	mg/kg	1960	1790	1780	1760	1710
Potassium	7440-09-7	50	mg/kg	1150	1100	1010	1130	1100
Arsenic	7440-38-2	5	mg/kg	9	13	32	6	14
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	MS0380_OB_005	MS0380_OB_006	MS0380_OB_007	MS0380_OB_008	MS0380_OB_009
				Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit		EB2202699-066	EB2202699-067	EB2202699-068	EB2202699-069	EB2202699-070
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Chromium	7440-47-3	2	mg/kg		12	12	6	10	11
Copper	7440-50-8	5	mg/kg		43	45	43	48	41
Lead	7439-92-1	5	mg/kg		15	14	14	16	14
Nickel	7440-02-0	2	mg/kg		20	20	13	21	20
Zinc	7440-66-6	5	mg/kg		74	78	83	71	97
EG020T: Total Metals by ICP-MS									
Uranium	7440-61-1	0.1	mg/kg		0.3	0.4	0.4	0.4	0.4
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	0.1	<0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<3.9	<4.1	<4.1	<4.1	<3.9
EG049: Trivalent Chromium									
Trivalent Chromium	16065-83-1	2	mg/kg		12	12	6	10	11

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0380_OB_010	MS0380_OB_011	MS0380_OB_12	MS0380_OB_13	MS0380_OB_14
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-071	EB2202699-072	EB2202699-073	EB2202699-074	EB2202699-075
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.6	9.7	9.7	9.6	9.8
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-44.0	-82.6	-70.4	-7.7	-39.1
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	584	574	559	617	682
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	9.1	10.5	10.4	7.2	10.2
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	48.0	83.5	71.0	14.4	40.0
ANC as CaCO3	----	0.1	% CaCO3	4.9	8.5	7.2	1.5	4.1
Fizz Rating	----	0	Fizz Unit	2	2	2	1	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.13	0.03	0.02	0.22	0.03
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	9550	6930	6130	6030	8170
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	160	80	40	140	120
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cobalt	7440-48-4	2	mg/kg	13	10	10	4	9
Iron	7439-89-6	50	mg/kg	39500	32600	32700	15800	20000
Manganese	7439-96-5	5	mg/kg	759	726	752	136	281
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	28	27	25	12	13
Calcium	7440-70-2	50	mg/kg	11800	24100	18400	3800	9770
Magnesium	7439-95-4	50	mg/kg	6530	7130	6490	2680	4640
Sodium	7440-23-5	50	mg/kg	1720	1620	1580	2000	2360
Potassium	7440-09-7	50	mg/kg	1140	1060	1020	920	1240
Arsenic	7440-38-2	5	mg/kg	12	11	11	<5	6
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	MS0380_OB_010	MS0380_OB_011	MS0380_OB_12	MS0380_OB_13	MS0380_OB_14
				Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit		EB2202699-071	EB2202699-072	EB2202699-073	EB2202699-074	EB2202699-075
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Chromium	7440-47-3	2	mg/kg		9	9	8	5	5
Copper	7440-50-8	5	mg/kg		46	28	37	44	21
Lead	7439-92-1	5	mg/kg		14	11	13	21	22
Nickel	7440-02-0	2	mg/kg		20	19	20	11	14
Zinc	7440-66-6	5	mg/kg		86	72	68	64	68
EG020T: Total Metals by ICP-MS									
Uranium	7440-61-1	0.1	mg/kg		0.3	0.3	0.3	0.2	0.4
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<4.0	<3.9	<4.0	<4.2	<4.1
EG049: Trivalent Chromium									
Trivalent Chromium	16065-83-1	2	mg/kg		9	9	8	5	5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0380_OB_15	MS0380_OB_16	MS0380_OB_17	MS0380_OB_18	MS0380_OB_19
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-076	EB2202699-077	EB2202699-078	EB2202699-079	EB2202699-080
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.7	9.8	9.7	9.8	9.8
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-46.9	-21.2	-66.1	-67.7	-116
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	663	563	689	474	666
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	10.5	9.5	11.0	10.0	11.0
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	47.5	21.8	66.7	68.0	117
ANC as CaCO3	----	0.1	% CaCO3	4.8	2.2	6.8	6.9	11.9
Fizz Rating	----	0	Fizz Unit	2	1	2	2	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.02	0.02	0.01	0.02
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	12400	13700	13400	12500	10400
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	130	210	260	110	150
Beryllium	7440-41-7	1	mg/kg	<1	1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cobalt	7440-48-4	2	mg/kg	10	13	11	10	13
Iron	7439-89-6	50	mg/kg	33200	41500	33100	29300	26900
Manganese	7439-96-5	5	mg/kg	478	853	557	539	784
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	24	32	38	37	28
Calcium	7440-70-2	50	mg/kg	13200	6510	22400	21400	40300
Magnesium	7439-95-4	50	mg/kg	6560	6440	6170	5960	7040
Sodium	7440-23-5	50	mg/kg	2110	2270	1640	1220	1780
Potassium	7440-09-7	50	mg/kg	1230	1160	820	730	910
Arsenic	7440-38-2	5	mg/kg	8	<5	6	<5	9
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0380_OB_15	MS0380_OB_16	MS0380_OB_17	MS0380_OB_18	MS0380_OB_19
			Sampling date / time	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00	15-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2202699-076	EB2202699-077	EB2202699-078	EB2202699-079	EB2202699-080
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Chromium	7440-47-3	2	mg/kg	8	11	15	13	10
Copper	7440-50-8	5	mg/kg	37	42	15	16	28
Lead	7439-92-1	5	mg/kg	14	17	11	10	12
Nickel	7440-02-0	2	mg/kg	17	22	19	18	20
Zinc	7440-66-6	5	mg/kg	77	74	80	48	62
EG020T: Total Metals by ICP-MS								
Uranium	7440-61-1	0.1	mg/kg	0.2	0.2	0.2	0.1	0.2
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<4.1	<3.8	<4.0	<3.9	<4.3
EG049: Trivalent Chromium								
Trivalent Chromium	16065-83-1	2	mg/kg	8	11	15	13	10

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	MS0380_OB_20	----	----	----	----
			Sampling date / time	15-Nov-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2202699-081	--------	--------	--------	--------
				Result	----	----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**9.7**	----	----	----	----
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-92.0**	----	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**563**	----	----	----	----
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**9.9**	----	----	----	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	----	----	----	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	----	----	----	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**96.0**	----	----	----	----
ANC as CaCO3	----	0.1	% CaCO3	**9.8**	----	----	----	----
Fizz Rating	----	0	Fizz Unit	**2**	----	----	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.13**	----	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**10200**	----	----	----	----
Antimony	7440-36-0	5	mg/kg	<5	----	----	----	----
Barium	7440-39-3	10	mg/kg	**210**	----	----	----	----
Beryllium	7440-41-7	1	mg/kg	<1	----	----	----	----
Boron	7440-42-8	50	mg/kg	<50	----	----	----	----
Cobalt	7440-48-4	2	mg/kg	**9**	----	----	----	----
Iron	7439-89-6	50	mg/kg	**28500**	----	----	----	----
Manganese	7439-96-5	5	mg/kg	**412**	----	----	----	----
Molybdenum	7439-98-7	2	mg/kg	<2	----	----	----	----
Selenium	7782-49-2	5	mg/kg	<5	----	----	----	----
Vanadium	7440-62-2	5	mg/kg	**34**	----	----	----	----
Calcium	7440-70-2	50	mg/kg	**23200**	----	----	----	----
Magnesium	7439-95-4	50	mg/kg	**11900**	----	----	----	----
Sodium	7440-23-5	50	mg/kg	**1900**	----	----	----	----
Potassium	7440-09-7	50	mg/kg	**1130**	----	----	----	----
Arsenic	7440-38-2	5	mg/kg	**12**	----	----	----	----
Cadmium	7440-43-9	1	mg/kg	<1	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	MS0380_OB_20	----	----	----	----
				Sampling date / time	15-Nov-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EB2202699-081	--------	--------	--------	--------
					Result	----	----	----	----
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Chromium	7440-47-3	2	mg/kg		**29**	----	----	----	----
Copper	7440-50-8	5	mg/kg		**44**	----	----	----	----
Lead	7439-92-1	5	mg/kg		**13**	----	----	----	----
Nickel	7440-02-0	2	mg/kg		**19**	----	----	----	----
Zinc	7440-66-6	5	mg/kg		**58**	----	----	----	----
EG020T: Total Metals by ICP-MS									
Uranium	7440-61-1	0.1	mg/kg		**0.3**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	----	----	----	----
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<4.0	----	----	----	----
EG049: Trivalent Chromium									
Trivalent Chromium	16065-83-1	2	mg/kg		**29**	----	----	----	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2231587**	Page	: 1 of 6
Client	: **RGS ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: PETER LONG	Contact	: Customer Services EB
Address	: 3/30 LENSWORTH STREET COOPERS PLAINS 4108	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: 07 3344 1222	Telephone	: +61-7-3243 7222
Project	: 2022067 - Moorvale South Project	Date Samples Received	: 26-Oct-2022 16:23
Order number	: ----	Date Analysis Commenced	: 31-Oct-2022
C-O-C number	: ----	Issue Date	: 04-Nov-2022 12:12
Sampler	: VERONICA CANALES		
Site	:		
Quote number	: EN/222		
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*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, 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.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Sample ID	2022067_001 MRV_FEED_20221013 _0300	2022067_002 MRV_FEED_20221013 _0900	2022067_003 MRV_FEED_20221013 _1500	2022067_004 MRV_FEED_20221013 _2100	2022067_005 MRV_FEED_20221014 _0900
				Sampling date / time	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00
					EB2231587-001	EB2231587-002	EB2231587-003	EB2231587-004	EB2231587-005
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		**9.6**	**9.3**	**9.4**	**9.4**	**9.2**
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		**5.2**	**3.9**	**4.6**	**6.2**	**5.4**
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		**430**	**558**	**528**	**530**	**458**
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		**9.2**	**9.6**	**8.3**	**7.9**	**8.1**
ANC as CaCO3	----	0.1	% CaCO3		**0.9**	**1.0**	**0.8**	**0.8**	**0.8**
Fizz Rating	----	0	Fizz Unit		**1**	**1**	**1**	**1**	**1**
EA026 : Chromium Reducible Sulfur									
Chromium Reducible Sulphur	----	0.005	%		**0.187**	**0.189**	**0.178**	**0.192**	**0.198**
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		**0.47**	**0.44**	**0.42**	**0.46**	**0.44**

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Sample ID: 2022067_006 MRV_FEED_20221014_1500	2022067_007 MRV_Coarse Rejects_20221013_0300	2022067_008 MRV_Coarse Rejects_20221013_0900	2022067_009 MRV_Coarse Rejects_20221013_1500	2022067_010 MRV_Coarse Rejects_20221013_2100
Sampling date / time				25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00
				EB2231587-006	**EB2231587-007**	**EB2231587-008**	**EB2231587-009**	**EB2231587-010**
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**9.5**	**9.3**	**8.9**	**9.5**	**9.2**
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**0.5**	**2.2**	**-15.2**	**-3.6**	**-7.6**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**562**	**1180**	**639**	**683**	**1110**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**11.7**	**14.3**	**17.4**	**13.4**	**14.6**
ANC as CaCO3	----	0.1	% CaCO3	**1.2**	**1.4**	**1.8**	**1.4**	**1.5**
Fizz Rating	----	0	Fizz Unit	**1**	**1**	**1**	**1**	**1**
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.152**	**0.016**	**0.048**	**0.192**	**0.136**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.40**	**0.54**	**0.07**	**0.32**	**0.23**

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Sample ID	2022067_011 MRV_Coarse Rejects_20221014_0900	2022067_012 MRV_Coarse Rejects_20221014_1500	2022067_013 MRV_Fine Rejects_20221013_0300	2022067_014 MRV_Fine Rejects_20221013_0900	2022067_015 MRV_Fine Rejects_20221013_1500
				Sampling date / time	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00
					EB2231587-011	EB2231587-012	EB2231587-013	EB2231587-014	EB2231587-015
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		**9.6**	**9.3**	**9.3**	**9.1**	**9.3**
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		**-22.6**	**-13.7**	**24.8**	**59.9**	**32.4**
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		**495**	**283**	**1440**	**1040**	**1170**
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		**31.8**	**19.5**	**30.3**	**39.2**	**35.2**
ANC as CaCO3	----	0.1	% CaCO3		**3.2**	**2.0**	**3.1**	**4.0**	**3.6**
Fizz Rating	----	0	Fizz Unit		**1**	**1**	**1**	**2**	**2**
EA026 : Chromium Reducible Sulfur									
Chromium Reducible Sulphur	----	0.005	%		**0.146**	**0.048**	**1.65**	**3.03**	**1.66**
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		**0.30**	**0.19**	**1.80**	**3.24**	**2.21**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	2022067_016 MRV_Fine Rejects_20221013_2100	2022067_017 MRV_Fine Rejects_20221014_0900	2022067_018 MRV_Fine Rejects_20221014_1500	pH and EC of DI water	----
			Sampling date / time	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	----
Compound	CAS Number	LOR	Unit	EB2231587-016	EB2231587-017	EB2231587-018	EB2231587-019	--------
				Result	Result	Result	Result	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**9.4**	**9.2**	**9.1**	**5.6**	**----**
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-2.3**	<0.5	**63.0**	**----**	**----**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**1640**	**1310**	**965**	<1	**----**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**22.8**	**30.9**	**58.2**	**----**	**----**
ANC as CaCO3	----	0.1	% CaCO3	**2.3**	**3.1**	**5.9**	**----**	**----**
Fizz Rating	----	0	Fizz Unit	**1**	**2**	**2**	**----**	**----**
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.451**	**0.806**	**3.57**	**----**	**----**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.67**	**1.01**	**3.96**	**----**	**----**

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2233059**	Page	: 1 of 9
Client	: **RGS ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: PETER LONG	Contact	: Customer Services EB
Address	: 3/30 LENSWORTH STREET COOPERS PLAINS 4108	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: 07 3344 1222	Telephone	: +61-7-3243 7222
Project	: 2022067 - Moorvale South Project	Date Samples Received	: 08-Nov-2022 09:00
Order number	: ----	Date Analysis Commenced	: 08-Nov-2022
C-O-C number	: ----	Issue Date	: 15-Nov-2022 10:22
Sampler	: VERONICA CANALES		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 25		
No. of samples analysed	: 7		

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*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, 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.

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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.

- ED037 (Alkalinity): NATA accreditation does not cover the performance of this service.
- ED038 (Acidity): NATA accreditation does not cover the performance of this service.
- EG005T (Total Metals by ICP-AES): EB2232858-003 shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): EB2232897-001 shows poor matrix spike recovery due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): EB2232897-010 shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	2022067_C001	2022067_C002	2022067_C003	2022067_C004	2022067_C005
			Sampling date / time	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00
Compound	CAS Number	LOR	Unit	EB2233059-019	EB2233059-020	EB2233059-021	EB2233059-022	EB2233059-023
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.2	9.2	9.3	9.5	9.1
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	472	468	775	582	1150
ED037: Alkalinity								
ø Total Alkalinity as CaCO3	----	1	mg/kg	2340	1980	3870	8190	9810
ø Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	2300	1940	3690	7920	9720
ø Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	36	36	180	270	90
ED038A: Acidity								
Acidity	----	1	mg/kg	<5	<5	<5	<5	<5
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	270	280	310	230	870
Silica	7631-86-9	1	mg/kg	16	16	25	24	23
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	590	510	840	520	1320
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	20	20	10	<10	30
Magnesium	7439-95-4	10	mg/kg	20	20	<10	<10	30
Sodium	7440-23-5	10	mg/kg	500	500	770	610	1160
Potassium	7440-09-7	10	mg/kg	10	10	10	<10	20
ED093T: Total Major Cations								
Sodium	7440-23-5	50	mg/kg	800	760	1770	1380	1950
Potassium	7440-09-7	50	mg/kg	290	320	620	510	610
Calcium	7440-70-2	50	mg/kg	3540	3550	4230	6680	13000
Magnesium	7439-95-4	50	mg/kg	1100	1240	2190	2060	2360
EG005(ED093)S : Soluble Metals by ICPAES								
Boron	7440-42-8	1	mg/kg	<1	<1	<1	<1	<1
Iron	7439-89-6	1	mg/kg	<1	<1	<1	<1	<1
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	2130	2300	3940	3590	3220
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Iron	7439-89-6	50	mg/kg	5310	5680	5930	4790	37000
EG020S: Soluble Metals by ICPMS								
Arsenic	7440-38-2	0.01	mg/kg	<0.01	<0.01	<0.01	0.02	<0.01

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	2022067_C001	2022067_C002	2022067_C003	2022067_C004	2022067_C005
			Sampling date / time	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00
Compound	CAS Number	LOR	Unit	EB2233059-019	EB2233059-020	EB2233059-021	EB2233059-022	EB2233059-023
				Result	Result	Result	Result	Result
EG020S: Soluble Metals by ICPMS - Continued								
Selenium	7782-49-2	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Barium	7440-39-3	0.01	mg/kg	**0.08**	**0.07**	**0.04**	**0.03**	**0.18**
Beryllium	7440-41-7	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	7440-43-9	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	7440-48-4	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	7440-47-3	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium	7440-29-1	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	7440-50-8	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Manganese	7439-96-5	0.01	mg/kg	**0.01**	**0.01**	<0.01	<0.01	**0.03**
Molybdenum	7439-98-7	0.01	mg/kg	**0.07**	**0.07**	**0.12**	**0.12**	**0.10**
Nickel	7440-02-0	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	7439-92-1	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony	7440-36-0	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	**0.01**
Uranium	7440-61-1	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Vanadium	7440-62-2	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aluminium	7429-90-5	0.1	mg/kg	**0.1**	<0.1	**0.1**	**0.1**	<0.1
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.1	mg/kg	**0.5**	**0.9**	**0.8**	**0.5**	**1.8**
Selenium	7782-49-2	1	mg/kg	<1	<1	**1**	<1	**1**
Barium	7440-39-3	0.1	mg/kg	**86.2**	**117**	**117**	**118**	**96.8**
Beryllium	7440-41-7	0.1	mg/kg	**0.4**	**0.4**	**1.4**	**1.3**	**0.8**
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	**1.1**	**1.6**	**1.2**	**1.0**	**5.0**
Chromium	7440-47-3	0.1	mg/kg	**1.3**	**1.5**	**1.2**	**1.8**	**2.1**
Copper	7440-50-8	0.1	mg/kg	**14.3**	**16.8**	**13.5**	**16.5**	**20.3**
Thorium	7440-29-1	0.1	mg/kg	**2.4**	**3.0**	**13.7**	**6.3**	**6.9**
Manganese	7439-96-5	0.1	mg/kg	**64.3**	**75.7**	**54.5**	**74.2**	**341**
Molybdenum	7439-98-7	0.1	mg/kg	**0.5**	**0.6**	**0.6**	**0.7**	**1.5**
Nickel	7440-02-0	0.1	mg/kg	**2.3**	**2.2**	**2.1**	**1.8**	**11.3**
Lead	7439-92-1	0.1	mg/kg	**8.5**	**9.0**	**35.3**	**23.0**	**31.4**
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**	**0.7**	**1.4**	**0.8**	**1.1**
Zinc	7440-66-6	0.5	mg/kg	**11.3**	**13.6**	**16.7**	**27.0**	**39.0**
Vanadium	7440-62-2	1	mg/kg	**4**	**5**	**6**	**5**	**7**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	2022067_C001	2022067_C002	2022067_C003	2022067_C004	2022067_C005
			Sampling date / time	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00
Compound	CAS Number	LOR	Unit	EB2233059-019	EB2233059-020	EB2233059-021	EB2233059-022	EB2233059-023
				Result	Result	Result	Result	Result
EG035S: Soluble Mercury by FIMS								
Mercury	7439-97-6	0.0005	mg/kg	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	**0.2**
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	**5**	**5**	**16**	**14**	**7**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	<0.1	<0.1	**0.4**	**0.3**	<0.1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	2022067_C006	----	----	----	----
			Sampling date / time	25-Oct-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2233059-024	--------	--------	--------	--------
				Result	----	----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**9.1**	----	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**1570**	----	----	----	----
ED037: Alkalinity								
ø **Total Alkalinity as CaCO3**	----	1	mg/kg	**8240**	----	----	----	----
ø **Bicarbonate Alkalinity as CaCO3**	71-52-3	1	mg/kg	**8060**	----	----	----	----
ø **Carbonate Alkalinity as CaCO3**	3812-32-6	1	mg/kg	**180**	----	----	----	----
ED038A: Acidity								
Acidity	----	1	mg/kg	<5	----	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**890**	----	----	----	----
Silica	7631-86-9	1	mg/kg	**20**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**2170**	----	----	----	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	**40**	----	----	----	----
Magnesium	7439-95-4	10	mg/kg	**40**	----	----	----	----
Sodium	7440-23-5	10	mg/kg	**1690**	----	----	----	----
Potassium	7440-09-7	10	mg/kg	**30**	----	----	----	----
ED093T: Total Major Cations								
Sodium	7440-23-5	50	mg/kg	**2620**	----	----	----	----
Potassium	7440-09-7	50	mg/kg	**640**	----	----	----	----
Calcium	7440-70-2	50	mg/kg	**7820**	----	----	----	----
Magnesium	7439-95-4	50	mg/kg	**2480**	----	----	----	----
EG005(ED093)S : Soluble Metals by ICPAES								
Boron	7440-42-8	1	mg/kg	<1	----	----	----	----
Iron	7439-89-6	1	mg/kg	<1	----	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**3360**	----	----	----	----
Boron	7440-42-8	50	mg/kg	<50	----	----	----	----
Iron	7439-89-6	50	mg/kg	**15300**	----	----	----	----
EG020S: Soluble Metals by ICPMS								
Arsenic	7440-38-2	0.01	mg/kg	**0.02**	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	2022067_C006	----	----	----	----
			Sampling date / time	25-Oct-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2233059-024	--------	--------	--------	--------
				Result	----	----	----	----
EG020S: Soluble Metals by ICPMS - Continued								
Selenium	7782-49-2	0.1	mg/kg	<0.1	----	----	----	----
Barium	7440-39-3	0.01	mg/kg	**0.16**	----	----	----	----
Beryllium	7440-41-7	0.01	mg/kg	<0.01	----	----	----	----
Cadmium	7440-43-9	0.01	mg/kg	<0.01	----	----	----	----
Cobalt	7440-48-4	0.01	mg/kg	<0.01	----	----	----	----
Chromium	7440-47-3	0.01	mg/kg	<0.01	----	----	----	----
Thorium	7440-29-1	0.01	mg/kg	<0.01	----	----	----	----
Copper	7440-50-8	0.01	mg/kg	<0.01	----	----	----	----
Manganese	7439-96-5	0.01	mg/kg	**0.03**	----	----	----	----
Molybdenum	7439-98-7	0.01	mg/kg	**0.23**	----	----	----	----
Nickel	7440-02-0	0.01	mg/kg	<0.01	----	----	----	----
Lead	7439-92-1	0.01	mg/kg	<0.01	----	----	----	----
Antimony	7440-36-0	0.01	mg/kg	**0.01**	----	----	----	----
Uranium	7440-61-1	0.01	mg/kg	<0.01	----	----	----	----
Zinc	7440-66-6	0.05	mg/kg	<0.05	----	----	----	----
Vanadium	7440-62-2	0.1	mg/kg	<0.1	----	----	----	----
Aluminium	7429-90-5	0.1	mg/kg	<0.1	----	----	----	----
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.1	mg/kg	**1.7**	----	----	----	----
Selenium	7782-49-2	1	mg/kg	<1	----	----	----	----
Barium	7440-39-3	0.1	mg/kg	**220**	----	----	----	----
Beryllium	7440-41-7	0.1	mg/kg	**1.0**	----	----	----	----
Cadmium	7440-43-9	0.1	mg/kg	**0.1**	----	----	----	----
Cobalt	7440-48-4	0.1	mg/kg	**3.9**	----	----	----	----
Chromium	7440-47-3	0.1	mg/kg	**2.0**	----	----	----	----
Copper	7440-50-8	0.1	mg/kg	**20.5**	----	----	----	----
Thorium	7440-29-1	0.1	mg/kg	**7.9**	----	----	----	----
Manganese	7439-96-5	0.1	mg/kg	**173**	----	----	----	----
Molybdenum	7439-98-7	0.1	mg/kg	**1.5**	----	----	----	----
Nickel	7440-02-0	0.1	mg/kg	**5.2**	----	----	----	----
Lead	7439-92-1	0.1	mg/kg	**22.9**	----	----	----	----
Antimony	7440-36-0	0.1	mg/kg	**0.1**	----	----	----	----
Uranium	7440-61-1	0.1	mg/kg	**1.1**	----	----	----	----
Zinc	7440-66-6	0.5	mg/kg	**30.4**	----	----	----	----
Vanadium	7440-62-2	1	mg/kg	**7**	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	2022067_C006	----	----	----	----
				Sampling date / time	25-Oct-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EB2233059-024	--------	--------	--------	--------
					Result	----	----	----	----
EG035S: Soluble Mercury by FIMS									
Mercury	7439-97-6	0.0005	mg/kg		<0.0005	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		**0.1**	----	----	----	----
EK040S: Fluoride Soluble									
Fluoride	16984-48-8	1	mg/kg		**6**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.1	mg/kg		<0.1	----	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **SOIL**)			Sample ID	**pH and EC of DI water**	----	----	----	----
			Sampling date / time	25-Oct-2022 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2233059-025**	--------	--------	--------	--------
				Result	----	----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**6.2**	----	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	<1	----	----	----	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2231587**	Page	: 1 of 6
Client	: **RGS ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: PETER LONG	Contact	: Customer Services EB
Address	: 3/30 LENSWORTH STREET COOPERS PLAINS 4108	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: 07 3344 1222	Telephone	: +61-7-3243 7222
Project	: 2022067 - Moorvale South Project	Date Samples Received	: 26-Oct-2022 16:23
Order number	: ----	Date Analysis Commenced	: 31-Oct-2022
C-O-C number	: ----	Issue Date	: 04-Nov-2022 12:12
Sampler	: VERONICA CANALES		
Site	:		
Quote number	: EN/222		
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*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, 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.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Sample ID	2022067_001 MRV_FEED_20221013 _0300	2022067_002 MRV_FEED_20221013 _0900	2022067_003 MRV_FEED_20221013 _1500	2022067_004 MRV_FEED_20221013 _2100	2022067_005 MRV_FEED_20221014 _0900
				Sampling date / time	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00
					EB2231587-001	EB2231587-002	EB2231587-003	EB2231587-004	EB2231587-005
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		**9.6**	**9.3**	**9.4**	**9.4**	**9.2**
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		**5.2**	**3.9**	**4.6**	**6.2**	**5.4**
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		**430**	**558**	**528**	**530**	**458**
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		**9.2**	**9.6**	**8.3**	**7.9**	**8.1**
ANC as CaCO3	----	0.1	% CaCO3		**0.9**	**1.0**	**0.8**	**0.8**	**0.8**
Fizz Rating	----	0	Fizz Unit		**1**	**1**	**1**	**1**	**1**
EA026 : Chromium Reducible Sulfur									
Chromium Reducible Sulphur	----	0.005	%		**0.187**	**0.189**	**0.178**	**0.192**	**0.198**
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		**0.47**	**0.44**	**0.42**	**0.46**	**0.44**

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Sample ID: 2022067_006 MRV_FEED_20221014_1500	2022067_007 MRV_Coarse Rejects_20221013_0300	2022067_008 MRV_Coarse Rejects_20221013_0900	2022067_009 MRV_Coarse Rejects_20221013_1500	2022067_010 MRV_Coarse Rejects_20221013_2100
Sampling date / time				25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00
				EB2231587-006	**EB2231587-007**	**EB2231587-008**	**EB2231587-009**	**EB2231587-010**
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**9.5**	**9.3**	**8.9**	**9.5**	**9.2**
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**0.5**	**2.2**	**-15.2**	**-3.6**	**-7.6**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**562**	**1180**	**639**	**683**	**1110**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**11.7**	**14.3**	**17.4**	**13.4**	**14.6**
ANC as CaCO3	----	0.1	% CaCO3	**1.2**	**1.4**	**1.8**	**1.4**	**1.5**
Fizz Rating	----	0	Fizz Unit	**1**	**1**	**1**	**1**	**1**
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.152**	**0.016**	**0.048**	**0.192**	**0.136**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.40**	**0.54**	**0.07**	**0.32**	**0.23**

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Sample ID	2022067_011 MRV_Coarse Rejects_20221014_0900	2022067_012 MRV_Coarse Rejects_20221014_1500	2022067_013 MRV_Fine Rejects_20221013_0300	2022067_014 MRV_Fine Rejects_20221013_0900	2022067_015 MRV_Fine Rejects_20221013_1500
				Sampling date / time	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00
					EB2231587-011	EB2231587-012	EB2231587-013	EB2231587-014	EB2231587-015
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		**9.6**	**9.3**	**9.3**	**9.1**	**9.3**
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		**-22.6**	**-13.7**	**24.8**	**59.9**	**32.4**
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		**495**	**283**	**1440**	**1040**	**1170**
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		**31.8**	**19.5**	**30.3**	**39.2**	**35.2**
ANC as CaCO3	----	0.1	% CaCO3		**3.2**	**2.0**	**3.1**	**4.0**	**3.6**
Fizz Rating	----	0	Fizz Unit		**1**	**1**	**1**	**2**	**2**
EA026 : Chromium Reducible Sulfur									
Chromium Reducible Sulphur	----	0.005	%		**0.146**	**0.048**	**1.65**	**3.03**	**1.66**
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		**0.30**	**0.19**	**1.80**	**3.24**	**2.21**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	2022067_016 MRV_Fine Rejects_20221013_2100	2022067_017 MRV_Fine Rejects_20221014_0900	2022067_018 MRV_Fine Rejects_20221014_1500	pH and EC of DI water	----
			Sampling date / time	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	25-Oct-2022 00:00	----
Compound	CAS Number	LOR	Unit	EB2231587-016	EB2231587-017	EB2231587-018	EB2231587-019	--------
				Result	Result	Result	Result	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**9.4**	**9.2**	**9.1**	**5.6**	**----**
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-2.3**	<0.5	**63.0**	**----**	**----**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**1640**	**1310**	**965**	<1	**----**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**22.8**	**30.9**	**58.2**	**----**	**----**
ANC as CaCO3	----	0.1	% CaCO3	**2.3**	**3.1**	**5.9**	**----**	**----**
Fizz Rating	----	0	Fizz Unit	**1**	**2**	**2**	**----**	**----**
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.451**	**0.806**	**3.57**	**----**	**----**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.67**	**1.01**	**3.96**	**----**	**----**

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2235216**	Page	: 1 of 4
Client	: **RGS ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: PETER LONG	Contact	: Carsten Emrich
Address	: 3/30 LENSWORTH STREET COOPERS PLAINS 4108	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: 07 3344 1222	Telephone	: +61 7 3552 8616
Project	: 2022067 Moorvale South	Date Samples Received	: 24-Nov-2022 16:11
Order number	: ----	Date Analysis Commenced	: 25-Nov-2022
C-O-C number	: ----	Issue Date	: 02-Dec-2022 14:17
Sampler	: Le Xi K ng		
Site	:		
Quote number	: BN/1234/19		
No. of samples received	: 3		
No. of samples analysed	: 3		

Accreditation No. 825
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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	Senior Inorganic Chemist	Brisbane Inorganics, 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.

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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.
- 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	2022067_WKLC1 Coal L2	2022067_WKLC2 Coarse Rejects L2	2022067_WKLC3 Fine Rejects (Tailings) L2	----	----
			Sampling date / time	24-Nov-2022 00:00	24-Nov-2022 00:00	24-Nov-2022 00:00	----	----
Compound	CAS Number	LOR	Unit	EB2235216-001	EB2235216-002	EB2235216-003	--------	--------
				Result	Result	Result	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	6.74	6.78	7.05	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	954	1520	2300	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	9	12	21	----	----
Total Alkalinity as CaCO3	----	1	mg/L	9	12	21	----	----
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	7	6	7	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	89	80	536	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	271	488	488	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	9	12	35	----	----
Magnesium	7439-95-4	1	mg/L	8	11	26	----	----
Sodium	7440-23-5	1	mg/L	177	287	423	----	----
Potassium	7440-09-7	1	mg/L	1	1	2	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	0.001	<0.001	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Barium	7440-39-3	0.001	mg/L	0.020	0.010	0.013	----	----
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	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.001	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L	0.013	0.008	0.026	----	----
Molybdenum	7439-98-7	0.001	mg/L	0.010	0.042	0.008	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.001	----	----

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	2022067_WKLC1 Coal L2	2022067_WKLC2 Coarse Rejects L2	2022067_WKLC3 Fine Rejects (Tailings) L2	----	----
				Sampling date / time	24-Nov-2022 00:00	24-Nov-2022 00:00	24-Nov-2022 00:00	----	----
					EB2235216-001	EB2235216-002	EB2235216-003	--------	--------
					Result	Result	Result	----	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Selenium	7782-49-2	0.01	mg/L		<0.01	**0.04**	**0.02**	----	----
Thorium	7440-29-1	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Uranium	7440-61-1	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L		<0.005	<0.005	<0.005	----	----
Boron	7440-42-8	0.05	mg/L		<0.05	**0.07**	<0.05	----	----
Iron	7439-89-6	0.05	mg/L		<0.05	<0.05	<0.05	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.4**	**1.0**	**0.7**	----	----
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**9.68**	**15.7**	**25.3**	----	----
ø Total Cations	----	0.01	meq/L		**8.83**	**14.0**	**22.3**	----	----
ø Ionic Balance	----	0.01	%		**4.57**	**5.58**	**6.31**	----	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2238425**	Page	: 1 of 4
Client	: **RGS ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: PETER LONG	Contact	: Carsten Emrich
Address	: 3/30 LENSWORTH STREET COOPERS PLAINS 4108	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: 07 3344 1222	Telephone	: +61 7 3552 8616
Project	: 2022067 Moorvale South	Date Samples Received	: 21-Dec-2022 15:00
Order number	: ----	Date Analysis Commenced	: 21-Dec-2022
C-O-C number	: ----	Issue Date	: 05-Jan-2023 11:04
Sampler	: LE XI K NG		
Site	:		
Quote number	: BN/1234/19		
No. of samples received	: 3		
No. of samples analysed	: 3		

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Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

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- 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	2022067_WKLC1 Coal - L3	2022067_WKLC2 Course Rejects - L3	2022067_WKLC3 Fine Rejects (Tailings) - L3	----	----
			Sampling date / time	21-Dec-2022 00:00	21-Dec-2022 00:00	21-Dec-2022 00:00	----	----
Compound	CAS Number	LOR	Unit	EB2238425-001	EB2238425-002	EB2238425-003	--------	--------
				Result	Result	Result	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	6.46	6.46	7.05	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	919	1400	1030	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	16	16	18	----	----
Total Alkalinity as CaCO3	----	1	mg/L	16	16	18	----	----
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	4	5	4	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	134	127	278	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	179	472	142	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	12	17	23	----	----
Magnesium	7439-95-4	1	mg/L	9	13	21	----	----
Sodium	7440-23-5	1	mg/L	164	329	172	----	----
Potassium	7440-09-7	1	mg/L	<1	1	<1	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	0.001	<0.001	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Barium	7440-39-3	0.001	mg/L	0.015	0.011	0.011	----	----
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	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L	0.018	0.010	0.016	----	----
Molybdenum	7439-98-7	0.001	mg/L	0.013	0.053	0.005	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	2022067_WKLC1 Coal - L3	2022067_WKLC2 Course Rejects - L3	2022067_WKLC3 Fine Rejects (Tailings) - L3	----	----
				Sampling date / time	21-Dec-2022 00:00	21-Dec-2022 00:00	21-Dec-2022 00:00	----	----
					EB2238425-001	EB2238425-002	EB2238425-003	--------	--------
					Result	Result	Result	----	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Selenium	7782-49-2	0.01	mg/L		**0.01**	**0.08**	<0.01	----	----
Thorium	7440-29-1	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Uranium	7440-61-1	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L		<0.005	<0.005	<0.005	----	----
Boron	7440-42-8	0.05	mg/L		<0.05	<0.05	<0.05	----	----
Iron	7439-89-6	0.05	mg/L		<0.05	<0.05	<0.05	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.4**	**1.1**	**0.2**	----	----
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**8.16**	**16.3**	**10.2**	----	----
ø Total Cations	----	0.01	meq/L		**8.47**	**16.2**	**10.4**	----	----
ø Ionic Balance	----	0.01	%		**1.89**	**0.07**	**1.00**	----	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2301568**	Page	: 1 of 4
Client	: **RGS ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: PETER LONG	Contact	: Carsten Emrich
Address	: 3/30 LENSWORTH STREET COOPERS PLAINS 4108	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: 07 3344 1222	Telephone	: +61 7 3552 8616
Project	: 2022067 Moorvale South	Date Samples Received	: 19-Jan-2023 16:26
Order number	: ----	Date Analysis Commenced	: 21-Jan-2023
C-O-C number	: ----	Issue Date	: 27-Jan-2023 14:15
Sampler	: LE XI K NG		
Site	: ----		
Quote number	: BN/1234/19		
No. of samples received	: 3		
No. of samples analysed	: 3		

Accreditation No. 825
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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.

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- General Comments
- Analytical Results

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Signatories

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Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

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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.
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- 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.
- 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	2022067_WKLC1 Coal	2022067_WKLC2 Coarse rejects	2022067_WKLC3 Fine rejects (tailings)	----	----
			Sampling date / time	19-Jan-2023 00:00	19-Jan-2023 00:00	19-Jan-2023 00:00	----	----
Compound	CAS Number	LOR	Unit	EB2301568-001	EB2301568-002	EB2301568-003	--------	--------
				Result	Result	Result	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.00**	**7.17**	**7.38**	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**800**	**1220**	**1190**	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**7**	**21**	**14**	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**7**	**21**	**14**	----	----
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	**6**	**5**	**6**	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**182**	**135**	**426**	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**136**	**324**	**123**	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**12**	**11**	**17**	----	----
Magnesium	7439-95-4	1	mg/L	**7**	**9**	**38**	----	----
Sodium	7440-23-5	1	mg/L	**133**	**203**	**163**	----	----
Potassium	7440-09-7	1	mg/L	<1	**1**	<1	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Barium	7440-39-3	0.001	mg/L	**0.010**	**0.008**	**0.007**	----	----
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	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L	**0.017**	**0.006**	**0.021**	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.013**	**0.044**	**0.005**	----	----
Nickel	7440-02-0	0.001	mg/L	**0.001**	<0.001	<0.001	----	----
Selenium	7782-49-2	0.01	mg/L	**0.02**	**0.08**	**0.01**	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	2022067_WKLC1 Coal	2022067_WKLC2 Coarse rejects	2022067_WKLC3 Fine rejects (tailings)	----	----
				Sampling date / time	19-Jan-2023 00:00	19-Jan-2023 00:00	19-Jan-2023 00:00	----	----
Compound	CAS Number	LOR	Unit		EB2301568-001	EB2301568-002	EB2301568-003	--------	--------
					Result	Result	Result	----	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Thorium	7440-29-1	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Uranium	7440-61-1	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L		<0.005	<0.005	<0.005	----	----
Boron	7440-42-8	0.05	mg/L		<0.05	<0.05	<0.05	----	----
Iron	7439-89-6	0.05	mg/L		<0.05	<0.05	<0.05	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.5**	**1.1**	**0.1**	----	----
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**7.76**	**12.4**	**12.6**	----	----
ø Total Cations	----	0.01	meq/L		**6.96**	**10.1**	**11.1**	----	----
ø Ionic Balance	----	0.01	%		**5.47**	**9.88**	**6.56**	----	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2304579**	Page	: 1 of 4
Client	: **RGS ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: PETER LONG	Contact	: Carsten Emrich
Address	: 3/30 LENSWORTH STREET COOPERS PLAINS 4108	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: 07 3344 1222	Telephone	: +61 7 3552 8616
Project	: 2022067 Moorvale South	Date Samples Received	: 16-Feb-2023 13:40
Order number	: ----	Date Analysis Commenced	: 18-Feb-2023
C-O-C number	: ----	Issue Date	: 24-Feb-2023 09:59
Sampler	: PRIYA RAJENDRAN		
Site	:		
Quote number	: BN/1234/19		
No. of samples received	: 3		
No. of samples analysed	: 3		

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
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, 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.

- EG020-F (Dissolved Metals by ICP-MS): Sample EB2304481-001 shows poor matrix spike recovery due to matrix interference. Confirmed by re-extraction and re-analysis.
- 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.
- 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	2022067_WKLC1 Coal L5	2022067_WKLC2 Coarse Rejects L5	2022067_WKLC3 Fine Rejects (Tailings) L5	----	----
			Sampling date / time	16-Feb-2023 00:00	16-Feb-2023 00:00	16-Feb-2023 00:00	----	----
Compound	CAS Number	LOR	Unit	EB2304579-001	EB2304579-002	EB2304579-003	--------	--------
				Result	Result	Result	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**6.68**	**6.81**	**6.57**	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**897**	**957**	**723**	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**7**	**10**	**6**	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**7**	**10**	**6**	----	----
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	**3**	**3**	**3**	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**269**	**119**	**241**	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**85**	**202**	**50**	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**14**	**6**	**18**	----	----
Magnesium	7439-95-4	1	mg/L	**9**	**6**	**19**	----	----
Sodium	7440-23-5	1	mg/L	**169**	**189**	**104**	----	----
Potassium	7440-09-7	1	mg/L	**2**	**1**	<1	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	**0.01**	<0.01	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Barium	7440-39-3	0.001	mg/L	**0.011**	**0.005**	**0.010**	----	----
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	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	**0.001**	<0.001	<0.001	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L	**0.024**	**0.004**	**0.041**	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.015**	**0.033**	**0.001**	----	----
Nickel	7440-02-0	0.001	mg/L	**0.001**	<0.001	<0.001	----	----

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	2022067_WKLC1 Coal L5	2022067_WKLC2 Coarse Rejects L5	2022067_WKLC3 Fine Rejects (Tailings) L5	----	----
				Sampling date / time	16-Feb-2023 00:00	16-Feb-2023 00:00	16-Feb-2023 00:00	----	----
					EB2304579-001	**EB2304579-002**	**EB2304579-003**	**--------**	**--------**
					Result	Result	Result	----	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Selenium	7782-49-2	0.01	mg/L		**0.02**	**0.09**	<0.01	**----**	**----**
Thorium	7440-29-1	0.001	mg/L		<0.001	<0.001	<0.001	**----**	**----**
Uranium	7440-61-1	0.001	mg/L		<0.001	<0.001	<0.001	**----**	**----**
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	**----**	**----**
Zinc	7440-66-6	0.005	mg/L		<0.005	<0.005	<0.005	**----**	**----**
Boron	7440-42-8	0.05	mg/L		<0.05	<0.05	<0.05	**----**	**----**
Iron	7439-89-6	0.05	mg/L		<0.05	<0.05	<0.05	**----**	**----**
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	**----**	**----**
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.6**	**1.1**	**0.1**	**----**	**----**
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**8.14**	**8.38**	**6.55**	**----**	**----**
ø Total Cations	----	0.01	meq/L		**8.84**	**9.04**	**6.98**	**----**	**----**
ø Ionic Balance	----	0.01	%		**4.14**	**3.81**	**3.23**	**----**	**----**

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2307965**	Page	: 1 of 4
Client	: **RGS ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: PETER LONG	Contact	: Carsten Emrich
Address	: 3/30 LENSWORTH STREET COOPERS PLAINS 4108	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: 07 3344 1222	Telephone	: +61 7 3552 8616
Project	: 2022067 Moorvale South	Date Samples Received	: 16-Mar-2023 16:58
Order number	: ----	Date Analysis Commenced	: 17-Mar-2023
C-O-C number	: ----	Issue Date	: 27-Mar-2023 10:47
Sampler	: PRIYA RAJENDRAN		
Site	:		
Quote number	: BN/1234/19		
No. of samples received	: 3		
No. of samples analysed	: 3		

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- Analytical Results

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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	Senior Inorganic Chemist	Brisbane Inorganics, 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.

- 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.
- 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	202267_WKLC1 Coal L6	202267_WKLC2 Coarse Rejects L6	202267_WKLC3 Fine Rejects (Tailinga) L6	----	----
			Sampling date / time	16-Mar-2023 00:00	16-Mar-2023 00:00	16-Mar-2023 00:00	----	----
Compound	CAS Number	LOR	Unit	EB2307965-001	EB2307965-002	EB2307965-003	--------	--------
				Result	Result	Result	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**6.97**	**7.08**	**6.83**	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**742**	**774**	**1050**	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**4**	**8**	**6**	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**4**	**8**	**6**	----	----
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	**2**	**2**	**1**	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**273**	**146**	**361**	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**49**	**147**	**113**	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**16**	**7**	**17**	----	----
Magnesium	7439-95-4	1	mg/L	**9**	**5**	**28**	----	----
Sodium	7440-23-5	1	mg/L	**129**	**148**	**157**	----	----
Potassium	7440-09-7	1	mg/L	**1**	<1	<1	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	**0.04**	<0.01	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	**0.001**	<0.001	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Barium	7440-39-3	0.001	mg/L	**0.008**	**0.004**	**0.009**	----	----
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	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	**0.001**	<0.001	<0.001	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L	**0.018**	**0.003**	**0.024**	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.010**	**0.030**	**0.004**	----	----
Nickel	7440-02-0	0.001	mg/L	**0.001**	<0.001	<0.001	----	----

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	202267_WKLC1 Coal L6	202267_WKLC2 Coarse Rejects L6	202267_WKLC3 Fine Rejects (Tailinga) L6	----	----
				Sampling date / time	16-Mar-2023 00:00	16-Mar-2023 00:00	16-Mar-2023 00:00	----	----
					EB2307965-001	EB2307965-002	EB2307965-003	--------	--------
					Result	Result	Result	----	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Selenium	7782-49-2	0.01	mg/L		**0.02**	**0.08**	**0.01**	----	----
Thorium	7440-29-1	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Uranium	7440-61-1	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L		<0.005	<0.005	<0.005	----	----
Boron	7440-42-8	0.05	mg/L		<0.05	<0.05	<0.05	----	----
Iron	7439-89-6	0.05	mg/L		<0.05	<0.05	<0.05	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.5**	**0.9**	**0.1**	----	----
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**7.15**	**7.35**	**10.8**	----	----
ø Total Cations	----	0.01	meq/L		**7.18**	**7.20**	**9.98**	----	----
ø Ionic Balance	----	0.01	%		**0.21**	**1.02**	**4.04**	----	----

CERTIFICATE OF ANALYSIS

Work Order	: **EB2311240**	Page	: 1 of 4
Client	: **RGS ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: PETER LONG	Contact	: Carsten Emrich
Address	: 3/30 LENSWORTH STREET COOPERS PLAINS 4108	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: 07 3344 1222	Telephone	: +61 7 3552 8616
Project	: 2022067 Moorvale South	Date Samples Received	: 14-Apr-2023 14:49
Order number	: ----	Date Analysis Commenced	: 17-Apr-2023
C-O-C number	: ----	Issue Date	: 24-Apr-2023 13:10
Sampler	: PRIYA RAJENDRAN		
Site	:		
Quote number	: BN/1234/19		
No. of samples received	: 3		
No. of samples analysed	: 3		

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- Analytical Results

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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	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

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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.

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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.
- 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	2022067_WKLC1 Coal - L7	2022067_WKLC2 Coarse Rejects - L7	2022067_WKLC3 Fine Rejects (Tailings) - L7	----	----
			Sampling date / time	14-Apr-2023 00:00	14-Apr-2023 00:00	14-Apr-2023 00:00	----	----
Compound	CAS Number	LOR	Unit	EB2311240-001	EB2311240-002	EB2311240-003	--------	--------
				Result	Result	Result	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**6.65**	**7.10**	**6.81**	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**584**	**914**	**888**	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**4**	**14**	**4**	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**4**	**14**	**4**	----	----
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	**2**	**2**	**2**	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**210**	**174**	**277**	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**24**	**158**	**89**	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**13**	**6**	**11**	----	----
Magnesium	7439-95-4	1	mg/L	**8**	**5**	**20**	----	----
Sodium	7440-23-5	1	mg/L	**94**	**170**	**124**	----	----
Potassium	7440-09-7	1	mg/L	<1	<1	<1	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.02**	**0.02**	<0.01	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Barium	7440-39-3	0.001	mg/L	**0.007**	**0.004**	**0.008**	----	----
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	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	**0.001**	**0.001**	<0.001	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L	**0.016**	**0.003**	**0.031**	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.009**	**0.039**	**0.002**	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	2022067_WKLC1 Coal - L7	2022067_WKLC2 Coarse Rejects - L7	2022067_WKLC3 Fine Rejects (Tailings) - L7	----	----
				Sampling date / time	14-Apr-2023 00:00	14-Apr-2023 00:00	14-Apr-2023 00:00	----	----
Compound	CAS Number	LOR	Unit		EB2311240-001	EB2311240-002	EB2311240-003	--------	--------
					Result	Result	Result	----	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Nickel	7440-02-0	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Selenium	7782-49-2	0.01	mg/L		**0.01**	**0.08**	<0.01	----	----
Thorium	7440-29-1	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Uranium	7440-61-1	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L		<0.005	<0.005	<0.005	----	----
Boron	7440-42-8	0.05	mg/L		<0.05	<0.05	<0.05	----	----
Iron	7439-89-6	0.05	mg/L		<0.05	<0.05	<0.05	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		<0.1	<0.1	**0.1**	----	----
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**5.13**	**8.36**	**8.36**	----	----
ø Total Cations	----	0.01	meq/L		**5.40**	**8.10**	**7.59**	----	----
ø Ionic Balance	----	0.01	%		**2.53**	**1.54**	**4.82**	----	----



MINE WASTE AND
WATER MANAGEMENT

CARTLEDGE
MINING AND GEOTECHNICS

Moorvale South Project

PRCP Final Void Assessment

Report No.: PEA040008-AA_Rev 0
19 March 2023

PEABODY ENERGY AUSTRALIA

PRCP FINAL VOID ASSESSMENT

Cartledge Mining and Geotechnics

Report No.: PEA040008-AA_Rev 0

Date: 19 March 2023

Rev	Date	Author	RPEQ No.	Reviewer	RPEQ No.	Description
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1 Introduction

Cartledge Mining and Geotechnics (CM&G) has undertaken geotechnical assessments of the Moorvale South Mine (MVS) Open Pit, as part of the Progressive Rehabilitation and Closure Plan (PRCP) Guideline which is a critical component of the rehabilitation policy under the Queensland Government's Mine Land Rehabilitation Policy (DES, 2021).

The geotechnical assessments followed individual studies for all the infrastructures that were analysed. Geotechnical stability was assessed for post-closure and long-term stability as indicated by the landform modelling results. For the open pit, the geotechnical stability considered the effects of long-term erosion and weathering of the pit wall.

According to the PRCP Guidelines, the "geotechnical report should focus on how the void will achieve post-closure slopes that will exhibit stability characteristics consistent with the planning and design of the post-closure mine void". The requirement of the Guidelines has been undertaken in this report in the analysis of the provided post-closure final void slopes.

1.1 Purpose

The purpose of this report is to provide guidance to Peabody for geotechnical closure requirements for the Moorvale South Project as part of the PRCP process.

1.2 Scope of work

The scope of work involved in this assessment was to address the PRCP Guideline requirements for mine site voids post-closure. From this, the detailed scope of work is outlined below:

- Address the PRCP Guideline requirements and feedback from the Department of Environment & Science, which requires the following to be captured within a high-level geotechnical report:
- Geotechnical modelling predicting long-term stability (factor of safety etc.) of the pit void.
- Information about the void (pit) wall geotechnical stability and a 3D void design and consideration of the effects of long-term erosion and weathering of the pit wall and the effects of significant hydrological events (where possible/practicable/relevant), and
- The description of how the void will achieve post-closure slopes that will exhibit stability characteristics consistent with the planning and design of the post-closure mine void. Mechanisms for achieving acceptable geotechnical stability must be detailed in the plan. This includes any void filling, partial void filling, reshaping and void configuration through earthwork methods such as backfilling, regrading, buttressing, and benching. Where applicable, methods and techniques for achieving safe slopes must be detailed.

1.3 Background

The Moorvale South Project, formerly referred to as Olive Downs North, is located adjacent to existing operational mines in the eastern region of the Northern Bowen Basin. It lies within the Nebo Synclinorium, and links to the Moorvale mine through an infrastructure mining lease (ML 70354/70355), as shown below in Figure 1. Moorvale South mine is situated on the Isaac River flood plain, with the Isaac River approximately 400 m from the southern boundary of the mining lease. The eastern boundary of the mining lease runs adjacent to north creek, which is a tributary that feeds into the Isaac River.

The two operational pits at Moorvale South are Y Pit and Z Pit. Y Pit is mined using conventional open cut strip mining with excavator truck fleets. Z pit applies an open cut terrace mining method due to the steeper dipping stratigraphy. Another pit named X Pit, north of the Z Pit final wall within the Moorvale South mining lease is also planned, which will be shallower and significantly smaller than the Y and Z Pits.

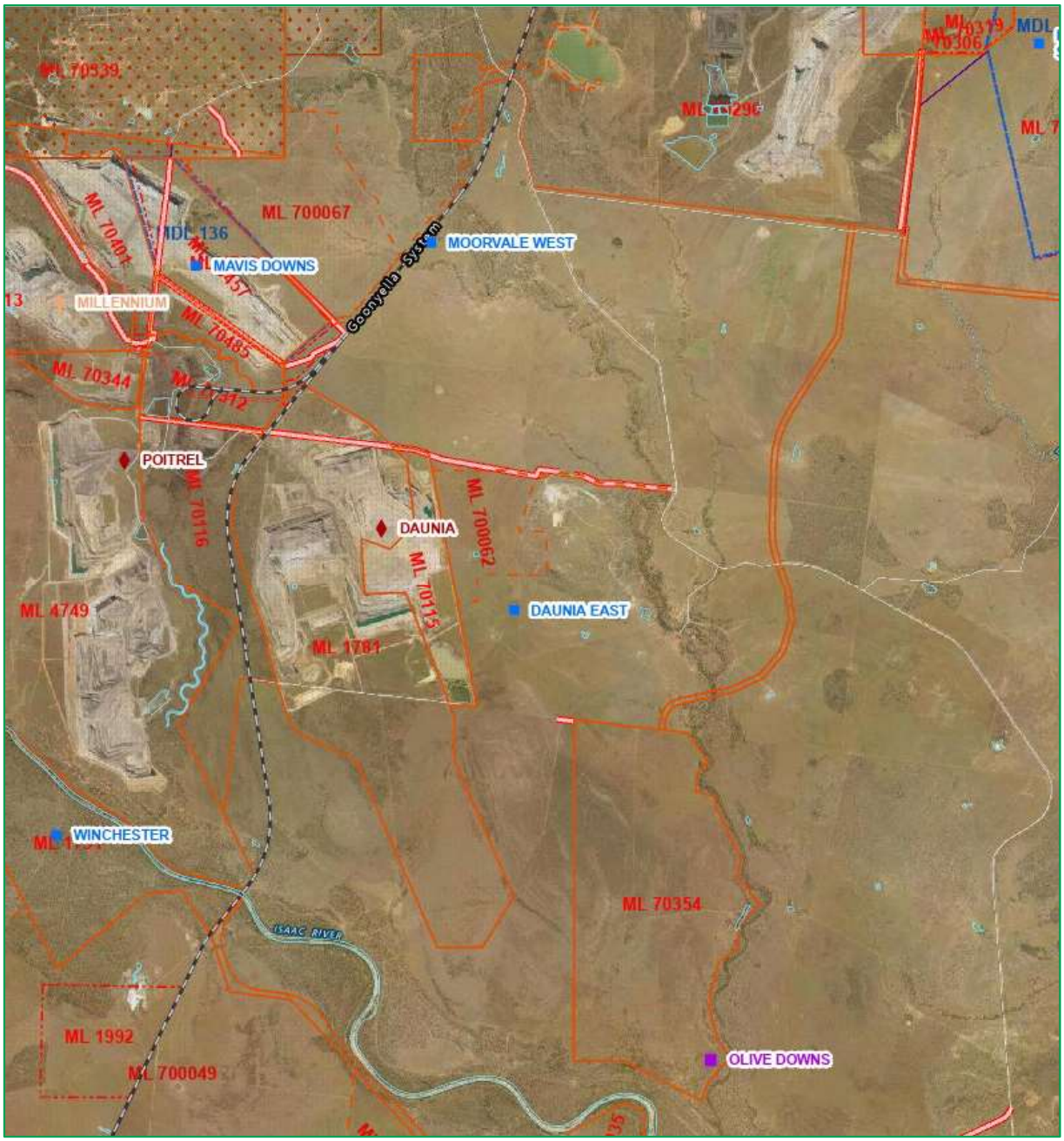


Figure 1: Moorvale South (Olive Downs) Operation mining lease location

1.4 Information Provided

- Coppabella Moorvale Joint Venture (CMJV) Geotechnical Management Plan – Peabody, December 2021,
- Isaac River and North Creek Flood Study for Olive Downs Levee Impact Assessment – Parsons Brinckerhoff, May 2007,
- Moorvale South Concept Study – Peabody, September 2018,
- Moorvale South Feasibility Geotechnical Study – Peabody, May 2019,
- Moorvale South Project Groundwater Assessment – SLR, August 2019,
- Olive Downs Opencut Conceptual Geotechnical Study – IMC, February 2014,
- Olive Downs Project Haul Road and Geomaterials Geotechnical Investigation – Parsons Brinckerhoff, July 2006,
- Technical Report Summary Coppabella-Moorvale Joint Venture (CMJV) – Peabody, February 2022,

- Geology Grids, November 2022, and
- Fault Triangulations, October 2021.
- Final landforms and water levels – Z and X Pit, March 2023

1.5 Relevant Information

The following reports are relevant to this study and should be read in conjunction with this report:

- Peabody Report, Moorvale South – Feasibility Geotechnical Study', dated Wednesday, 15 May 2019

2 Geotechnical Model

The geotechnical analysis is comprised of four constituent models, these are:

- Geology
- Geological Structure
- Rockmass
- Hydrogeology

The Geotechnical Model is formed from the outputs of these models considering their influence on the geotechnical behaviour of the rock mass.

The geotechnical model used in this study was taken from the Peabody (2019) feasibility report.

2.1 Geology

Coal resources in the Moorvale South tenements are predominantly hosted in the Leichardt Seam package with lesser contributions from the Vermont Seam. The Leichardt Seam comprises 2 seams; the LL2 and the LL3, both Rangal Coal Measures, while the Vermont Seam comprises the VU of the Rangal Coal Measures and the VL1 of the Fort Cooper Coal Measures.

The LL2 is composed of the LL2T and LL2B plies which together range from 2.8 to 4.8 m thick. The LL3 comprises interbedded carbonaceous mudstone and bright coal bands averaging 1.5 m thick. The Vermont Seam occurs approximately 40 m below the LL3 and comprises the Vermont Upper and the Vermont Lower, separated by the Yarrabee Tuff. The VU comprises 3 plies and ranges from 2.5 m to 3.7 m thick. In the southern half of the lease, the VU seam is heavily intruded and cindered. The Vermont Lower is divided into 3 plies, with the upper ply (VL1) the only ply contributing to the MVS resource in the Y Pit and Z Pit north areas only. The VL1 averages 1.3 m thick.

Fine-grained sedimentary rocks dominate with sandstone more abundant in Y Pit and west of Z Pit. A review of coal quality boreholes has suggested that similar distributions occur throughout Z Pit with variable thicknesses of sandstone and finer grained sedimentary units. The top of the Permian strata is weathered to a depth of between 20 mbgl and 30 mbgl. The easily recognised Yarrabee tuff is observed to underlie the Vermont Upper seam and is interpreted at the base of the Rangal Coal Measures. There are generally no significant superficial or Tertiary deposits covering the mining area, except for some unconsolidated alluvium in the southern part of the lease, close to the Isaac River.

The Moorvale South tenements are dominated by a series of Cretaceous intrusions formed along east-northeast trending lineament. Exploration drilling identified local intrusions within the Leichardt and Vermont seams that have caused the seams to be heat-affected and partially replaced by the intrusion.

2.2 Structure

A series of faults have been identified through exploration drilling, geophysical surveys, and geological modelling. Thrust, reverse, and normal faults have been interpreted. Thrust faults are the dominant fault mode, strike northwest-southeast and possess displacements of up to ≥30 m. Fore-thrusts dip to the northeast and back-thrusts dip to the southwest. Normal and reverse thrusting is identified striking normal to the thrust faults and in several cases is inferred to truncate the thrust faulting.

Within Y Pit, modelled thrust faults have generally been considered low risk for the highwalls, as they are all currently fore-thrusts and, thus, dip into the pit wall. Several fore-thrusts have been interpreted near the low wall, which creates a potential for planar sliding risk along these sections of the pit wall. An anti-form bisects the pit striking approximately north-south with seam dips typically 6° to 10° to the west and east. Localised steepening is associated with thrust faulting near the low wall crest line.

Between Y and Z pits, there is a nest of thrust faults which may indicate a zone of increased ground disturbance.

The orientation of thrust faults in Z Pit is more favourable due to the higher angle of intersection with the east-west orientation of the pit wall due to the terrace mining. The current interpretation of the normal faults suggests that the dip direction of these structures will typically be towards the northwest, which will largely mitigate any potential wedge failures between fore-thrusts and normal faults. There is a risk of complex wedge-type failures around the intersections of fore-thrusts and normal faults due to the rock mass disturbance.

Current interpretations indicate that the fault orientations rotate approximately halfway along Z pit (north-south direction). This results in the modelled seam dip steepening from ~12° in the southern end of Z Pit up to ~23° in the northern half of the pit.

Results from defect data indicate relatively clean walls in terms of jointing.

The presence of carbonaceous mudstone which will form the final pit floor can deteriorate over time due to exposure following extraction. Planar failure is expected, owing to the sedimentary formation and final pit floor angles.

2.3 Rock Mass

Boreholes drilled to assess the defect data at MVS indicate that bedding planes are the dominant defect type. While structural discontinuities (joints, fractures, etc.) are present, the surfaces assessed were relatively clean. The Rock Quality Designation (RQD) results typically indicated good (>75%) to excellent (>90%) rock conditions. However, RQD values proximal to the coal seams and in the floor typically indicate very poor (<25%) to poor (<50%) conditions, consistent with expectations considering the degree of seam disturbance interpreted at the site. Similar disturbance (and poor RQD values) is expected where faults are intersected, particularly in areas where multiple faults intersect.

2.4 Hydrogeology

Moorvale South lies within the catchment area of the Connors and Isaac Rivers. The mine is located along the northern side of the Isaac River and the western side of North Creek. The confluence of the two is located to the southeast of the southern ML boundary. Both are ephemeral streams that only flow for short periods following rainfall.

The long-term water-levels for the final voids are presented in Table 1.

Table 1: Final void modelling results summary (AARC Environmental Solutions Pty Ltd.)

Void	Final landform floor level	Overflow level	Modelled average 95% long-term water level	Modelled peak 95% long-term water level
Z Pit	66	190	122.3	127.5
X Pit	119	194	145.3	147.7

2.5 Geotechnical Model

Rock mass parameters adopted from the Moorvale South Geotechnical Feasibility Study (2019) have been applied in this analysis. Hoek-Brown parameters and Mohr-Coulomb parameters are summarised below in Table 2 and Table 3. Spoil non-linear shear strength properties for the unsaturated dumped spoil material (CAT2) as per (Simmons and McManus, 2004) were included as a more appropriate parameters for waste material and used in Slide 3 modelling of the final landforms.

Table 2: Hoek-Brown rock mass parameters used for stability analysis

Lithotype	Unit Weight (kN/m^3)	UCS (KPa)	GSI	m_i
Sedimentary Rock	20	8,800	50	7

Table 3: Mohr-Coulomb rock mass parameters used for stability analysis

Lithotype	Unit Weight (kN/m^3)	Friction Angle (°)	Cohesion (kPa)
Weathered Rock	22	30	60
Coal	15	30	35

Simmon's and McManus provides a matrix for the determination of the spoil category. Based on this methodology CAT2 material is encountered at Moorvale South. However, this material will experience time-dependent changes in characteristics. Therefore, long-term shear strength parameters were developed using the methodology. Table 4 presents the attributes and weighting applied (Simmon's & McManus, 2004) and Table 5 provides the results of the determination of the long-term shear strength parameters presented in Table 6.

Table 4: Spoil categories and attributes for structure control ranking. (Simmons and McManus, 2004)

Spoil Category		1	2	3	4
Description Attributes	Weighting (excl. Age)	Fine-grained clay rich high plasticity	Fine grained low plasticity with larger clasts	Larger clasts with fine matrix low plasticity	Large blocks, minor fines, minor slaking
Predominant Particle Size	3/31=9.7% (11.6%)	Clay	Sand	Gravel	Cobbles
Consistency Cohesive Cohesionless	7/31=22.6% (26.9%)	Soft to Firm loose	Stiff Med. Dense	Hard Dense	Extremely low strength or higher rock, very dense
Structure	7/31=22.6% (26.9%)	Matrix only	Matrix supported	Framework supported	Framework only
Liquid Limit	9/31=29.0% (34.6%)	High (>50)	Intermediate (35 – 50)	Low (20 – 35)	Not Plastic (,20)
Age	5/31=16.1%	0 -2y	2- 10y	10 -30y	>30y

Table 5: Results of the spoil category determination for long-term spoil Category type after Simmons McManus, (2004)

Category		Spoil Material – Final landform	Weighted Value
Predominant Particle Size	3/31=9.7% (11.6%)	3	0.291
Consistency Cohesive Cohesionless	7/31=22.6% (26.9%)	2.5	0.565
Structure	7/31=22.6% (26.9%)	2	0.452
Liquid Limit	9/31=29.0% (34.6%)	3	0.87
Age	5/31=16.1%	4	0.644
Category			2.822

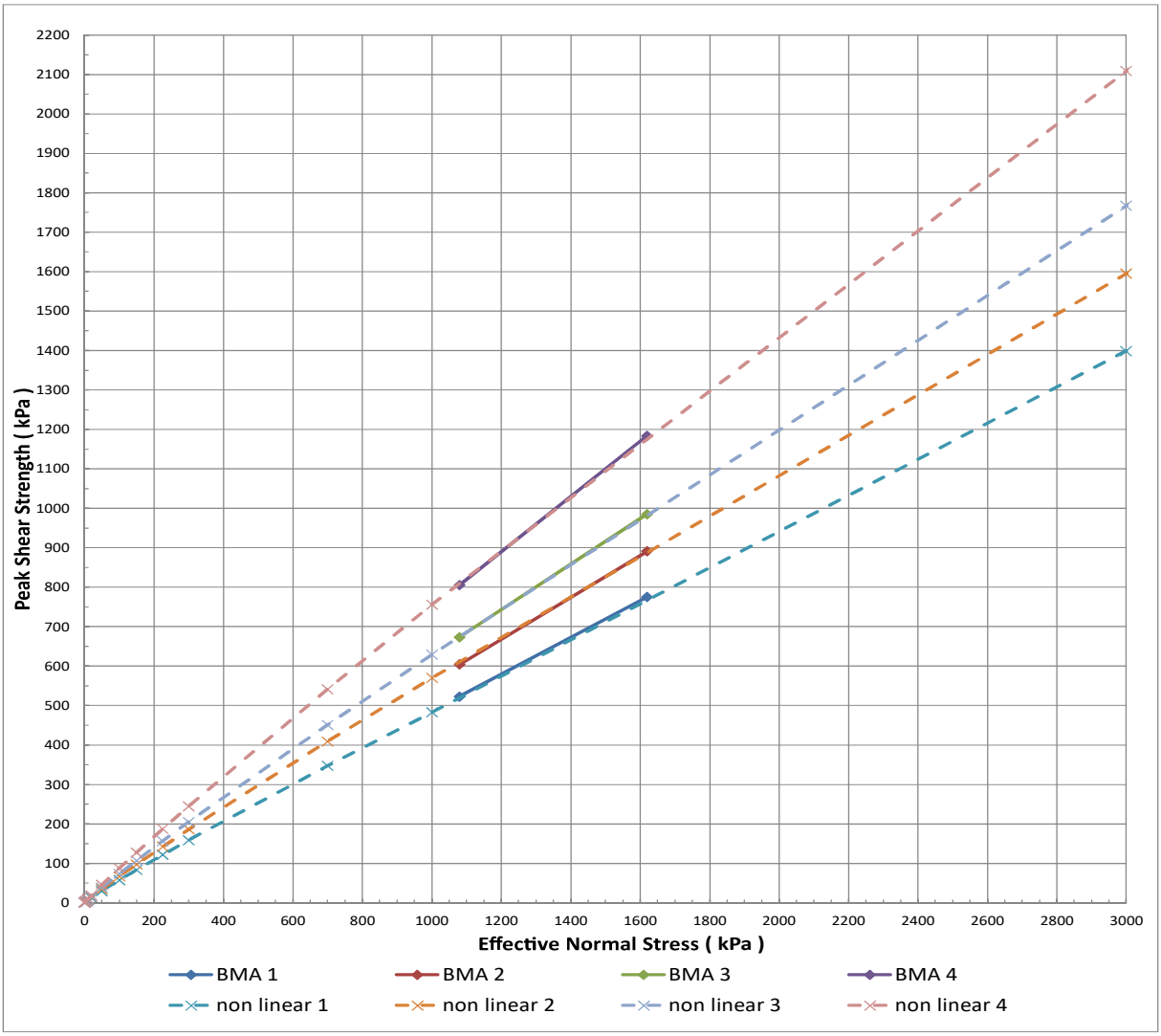
Table 6: Summary of spoil shear strength parameters and types

Lithotype	Unit Weight (kN/m^3)	Friction Angle (°)	Cohesion (kPa)
CAT2 Saturated Spoil	20	24.6	19

CM&G has developed non-linear shear strength profiles for the unsaturated spoil materials after Simmons & McManus (2004). The non-linear strength profiles were developed from empirical means to curve fit the widely adopted and validated spoil categories.

Figure 2 presents the plot of the four spoil categories. As the long-term shear strength parameters were determined to be CAT2.8, the CAT3 unsaturated non-linear strength profile was adopted for analysis.

Figure 2: Shear-Normal function showing non-linear strength profiles for various spoil categories after Simmons & McManus, (2004)



3 Final Void Stability Assessment

The PRCP Guideline (DES,2021) requires that the assessment of voids for closure planning must include the following:

- Pit wall geotechnical stability considering the effects of long-term erosion and weathering of pit walls and the effects of significant hydrological events,
- Proposed final slope angles of highwalls of each void,
- A geotechnical report focussing on how the voids will achieve post-closure slopes that will exhibit stability characteristics consistent with planning and design of post-closure mine voids, and
- Mechanisms for achieving acceptable geotechnical stability must be detailed in the plan. This includes void filling, partial void filling, reshaping and void configuration through earthwork methods such as backfilling, regrading, buttressing, and benching. Where applicable, methods and techniques for achieving safe slopes must be detailed.

Rocscience software Slide3 (Version 3.011) and Slide2 (Version 9.025) were used to analyse the factor of safety (FoS) and deformation of the final void conditions.

Two analysis methods were applied: the Spencer and Morgenstern-Price Global Limit Equilibrium (GLE) in Slide3, whilst an additional method (Sarma) was applied in the Slide2 analysis. The Sarma non-vertical method using a non-circular block search with 15 slices and the slice angles were User Defined under the bisection method.

Erosion and weathering modelling of pit walls has not been considered in this geotechnical assessment. Rather, recommendations for preventing uncontrolled and significant erosion through proper drainage practices and operational compliance will be provided. While the void walls are expected to deteriorate through erosion and weathering mechanisms, adequate drainage is aimed to ensure that the deterioration is isolated to the pit void and does not extend beyond the void limit. The final landforms where the placement of spoil material is conducted will limit and reduce the erosional effects.

A copy of select analysis results outputs are provided in Appendix A.

3.1 Design Assessment Criteria

The adopted assessment criteria for the slope stability analysis are based on the overall slope scale and the high consequence of failure, as listed in Read and Stacey, 2009 (Table 7). A minimum Factor of Safety (FoS) of 1.5 has been adopted for static analyses.

Table 7: Typical FoS and PoF acceptance criteria values (Read & Stacey, 2009)

		Acceptance criteria[a]		
Slope scale	Consequences of failure	FoS (min) (static)	FoS (min) (dynamic)	PoF (max) P[FoS ≤ 1]
Bench	Low–high[b]	1.1	NA	25–50%
Inter-ramp	Low	1.15–1.2	1.0	25%
	Moderate	1.2	1.0	20%
	High	1.2–1.3	1.1	10%
Overall	Low	1.2–1.3	1.0	15–20%
	Moderate	1.3	1.05	10%
	High	1.3–1.5	1.1	5%

a: Needs to meet all acceptance criteria
b: Semi-quantitatively evaluated

3.2 Modelling Assumptions

The following design assumptions were adopted to analyse the final void for the open pit.

- All deleterious and weak materials are removed from the pavement, e.g. mudstone, sheared floor strata, etc.
- Erosion of the pit slope crests is completed by others.
- No seismic loading was included as Moorvale South is not considered a high seismic risk area.

3.3 Recommended Design Geometry

An initial stability analysis of the model provided was completed using Slide 3. The results did not return an adequate FoS. Following this initial assessment, Slide 2 was used to modify slope geometries to obtain a suitable FoS.

The results indicate that the short-term (i.e. at the end of mine-life) design geometries are stable post-mining. However, the long-term stability requirements will change due to time-dependent behaviour of the slope and in-pit and subsurface water conditions. Based on the current assessment, a slope angle of 22° is considered suitable for the long-term but this will need to be confirmed as mining approaches the final void positions.

Table 8 provides the recommended slope geometries for long-term stability.

Table 8: Recommended slope geometries to satisfy long-term stability requirements

Lithotype	Friction Angle (°)
Highwall (intact slope)	• 46° cut slope within weathered over burden with 15 m wide berms every 20 m vertical • 20 m wide berm at the base of weathering • 65° pre-split slope within fresh Permian with 20 m wide berms every 30 m vertically
Spoil slopes	22° Overall slope angle

4 Discussion

The results of the analysis indicate the intact pit slope will return an FoS of >1.5. However, there are several considerations and/or limitations to this study that need to be addressed during the mining life to ensure the design provided herein is suitable. These considerations are discussed further below.

4.1 Behaviour of Mine Waste

The slope angle for spoil had to be reduced from the natural angle of repose due to the influence of inundation and time-dependent changes to the geomechanical behaviour of the waste rock. It is expected that consolidation of the spoil material will occur due to aging (creep consolidation) and inundation (crushing and particle re-orientation). This could result in the surficial presentation of this, such as tension cracking and deformation. This is a natural phenomenon and will not influence the long-term stability of the structure.

Inundation of the spoil material will have a significant influence on the geomechanical behaviour of the waste material. Progressive inundation of the spoil material will result in the slope experiencing a variable FoS as the in-pit water level increases. The lowest FoS typically occurs when the water level is slightly higher than the toe of the slope, i.e. the toe is inundated. As the water level continues to rise, the water load provides passive support to the slope, resulting in an increase in the slope FoS.

As spoil material is inundated, the particles (rock fragments) will become saturated and weaken. This will result in the edges of these particles breaking and densification of the waste material will occur. However, frequent wetting and drying of this material are likely to result in further degradation to its constituent materials, e.g. clay, silt, sand, etc. Saturation combined with oxygenation will result in weathering (slaking due to wetting and drying of clay-rich materials) of the fragments resulting in further degradation of the constituent materials of the rock. As the rock at Moorvale South is predominantly siltstone, the rock will weather to clay and silt. This phenomenon is only expected to affect part of the spoil profile and have a relatively minor influence on long-term stability.

As described above, inundation will have multiple effects on the mine spoil. This will result in changes in the volume of the spoil and the geomechanical behaviour. As the spoil is inundated, the combination of these phenomena is likely to result in surface expressions such as tension cracking and changes in slope profile due to the uncontrolled backfilling of the waste material, i.e. siltstone will breakdown more than sandstone and will therefore result in greater volume changes and potential slope deformation.

4.2 Geological Structures

The long-term strength of the in-situ rock mass is sufficient to retain the design slope geometry. However, no consideration of potential geological structures (i.e. faults and persistent joints) was considered in this analysis due to the lack of data at the time of publishing. The influence of structure on the wall geometry will have to be assessed as mining approached the final void and sufficient data is available.

There was insufficient information to assess the potential for geological structure to present a risk to geotechnical stability. Further assessment will be required as mining approaches the final void.

4.3 Pavement Material

It is understood that coal, weak carbonaceous material and/or bedding parallel shears may be present below the target seam in the final voids for Z and X Pits. All these deleterious materials are susceptible to time-dependent changes in their geomechanical behaviour and/or their stress condition. Consequently, these where they are left in-situ they will present a stability hazard to the pit slopes. The potential hazards are discussed below.

4.3.1 Lowwall Pavement Failure

A common stability issue for steeply dipping (i.e. >15^{o}) lowwall pavements is detachment and sliding of weak carbonaceous material. These types of material commonly detach due to:

- Relaxation due to unloading,
- Sliding due to floor dip and/or shearing within the pavement,
- Detachment due to ingress of surface water (e.g. rainfall).

This is not a significant hazard and typically results in slow, progressive failure of the lowwall, it does require treatment for long-term stability.

4.3.2 Waste Dump Instability

Due to the presence of the deleterious materials (i.e. coal, carbonaceous siltstones and mudstones) and structure (i.e. pavement shears). These factors can present varying risks during coal mining, however, the risk of failure will increase with time due to deterioration of these materials, that are not usually experienced during mining. Time-dependent deterioration can result in slaking of mudstones, positive pore-pressures resulting in critical reduction in normal stresses, crushing of coal causing a strength reduction. Due to these potential factors, waste dump instability can occur sometime after mining is complete.

4.3.3 Floor Treatment

Due to the factors described above, floor treatment to remove any deleterious materials from below the waste dump and exposed lowwall is required to ensure long-term stability.

4.4 Surface Water Management

Erosion and slaking of soils, weathered material and intact material can influence the long-term stability of mine voids. To reduce this impact, surface water drainage is recommended around the pit crest to prevent water ponding behind and/or flowing directly over pit crests.

5 Conclusion

Based on the available information, the final void will be stable at the end of the mine-life. Further, the intact pit slope will be suitable for long-term stability, but the slopes formed from mine waste will have to be flattened to achieve the required FoS. While the long-term stability requirement is achieved, the interim FoS may be lower due to changes in the in-pit and subsurface water conditions and this may present as surficial expressions of instability, such as tension cracking and volume change. These phenomena are due to transient conditions and are not expected to affect the long-term stability FoS.

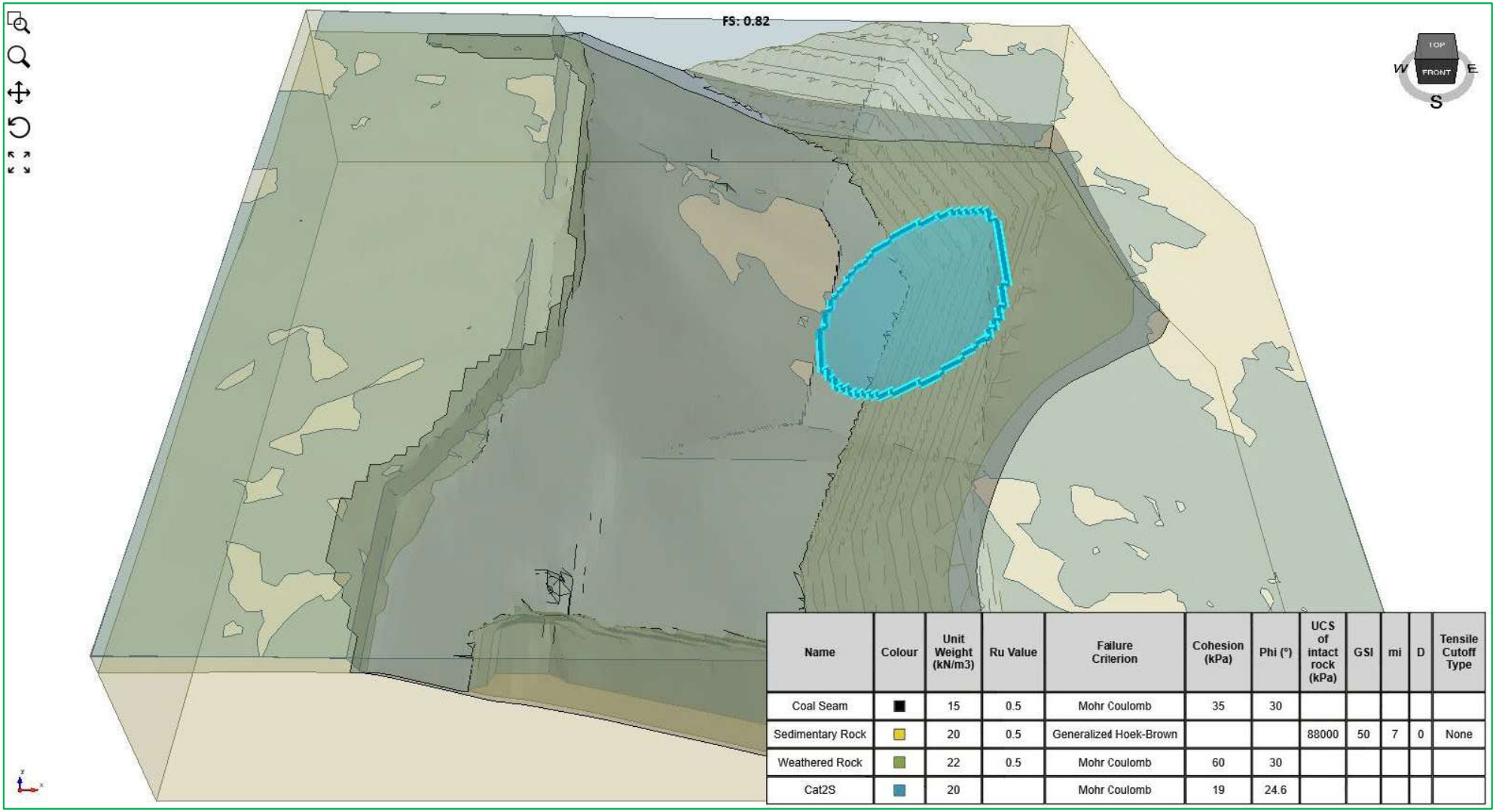
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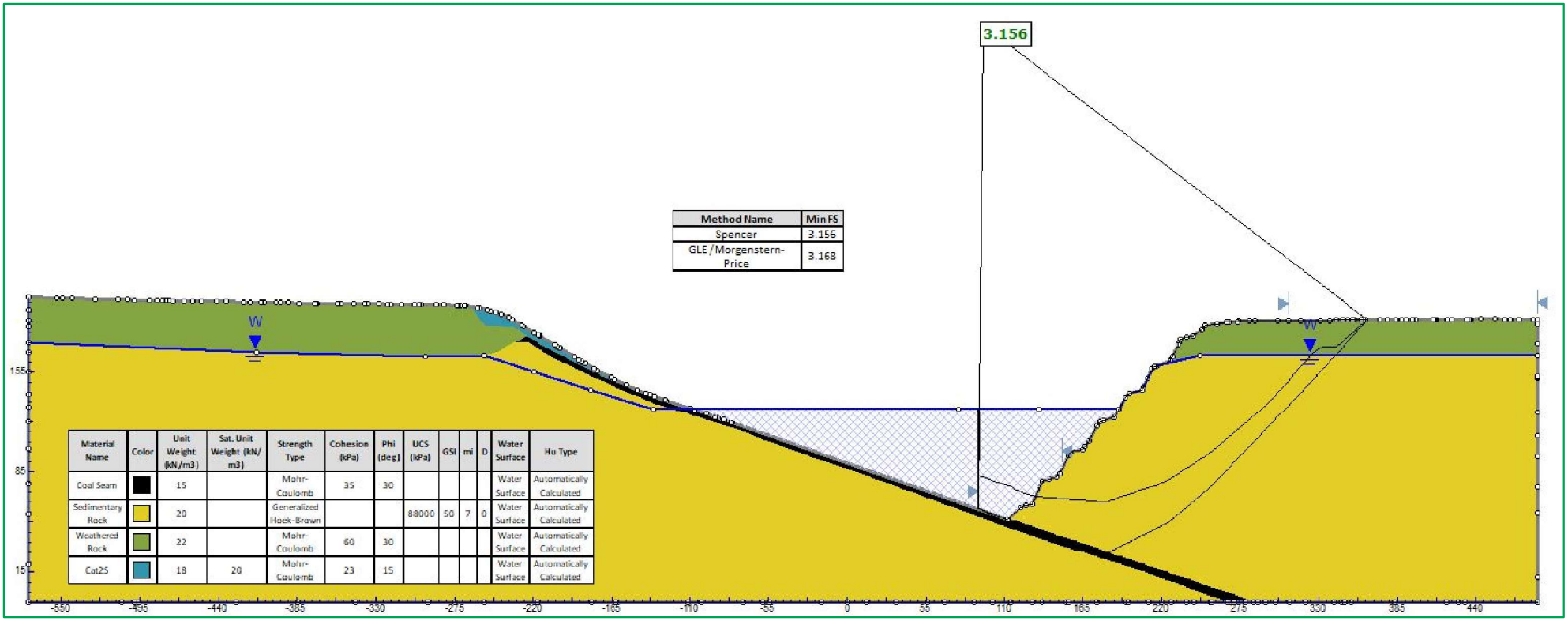
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Appendix A – Copy of Analysis Results Outputs

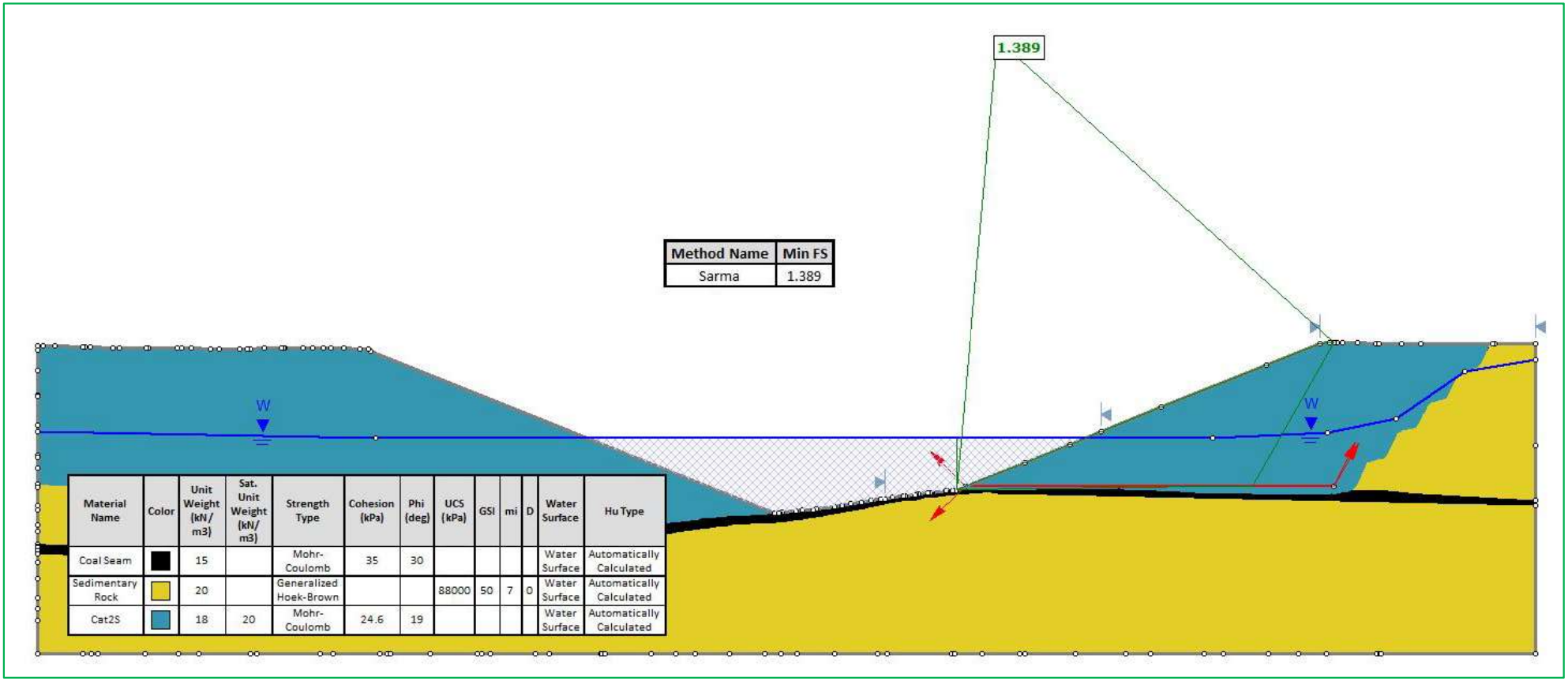


Name	Colour	Unit Weight (kN/m3)	Ru Value	Failure Criterion	Cohesion (kPa)	Phi (°)	UCS of intact rock (kPa)	GSI	mi	D	Tensile Cutoff Type
Coal Seam		15	0.5	Mohr Coulomb	35	30					
Sedimentary Rock		20	0.5	Generalized Hoek-Brown			88000	50	7	0	None
Weathered Rock		22	0.5	Mohr Coulomb	60	30					
Cat2S		20		Mohr Coulomb	19	24.6					

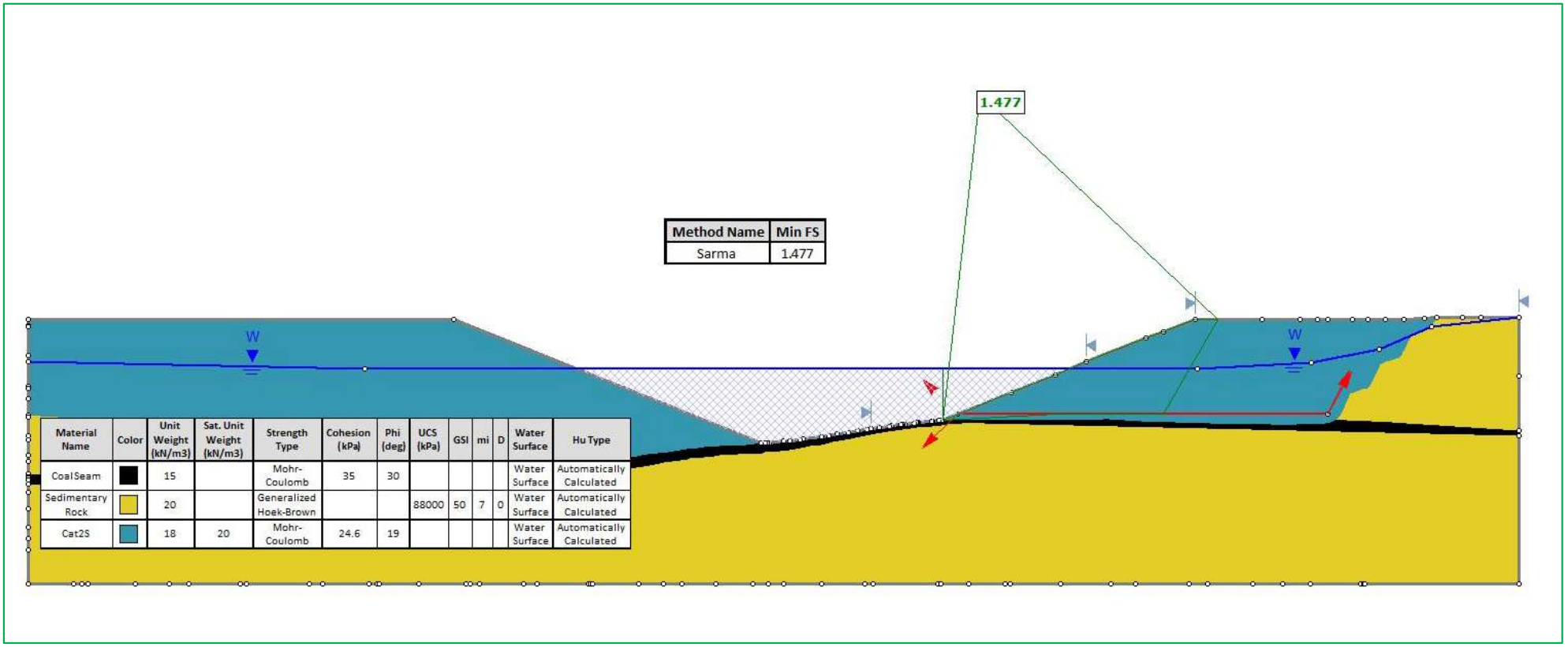
3D LE analysis results for long-term stability for design geometry provided.

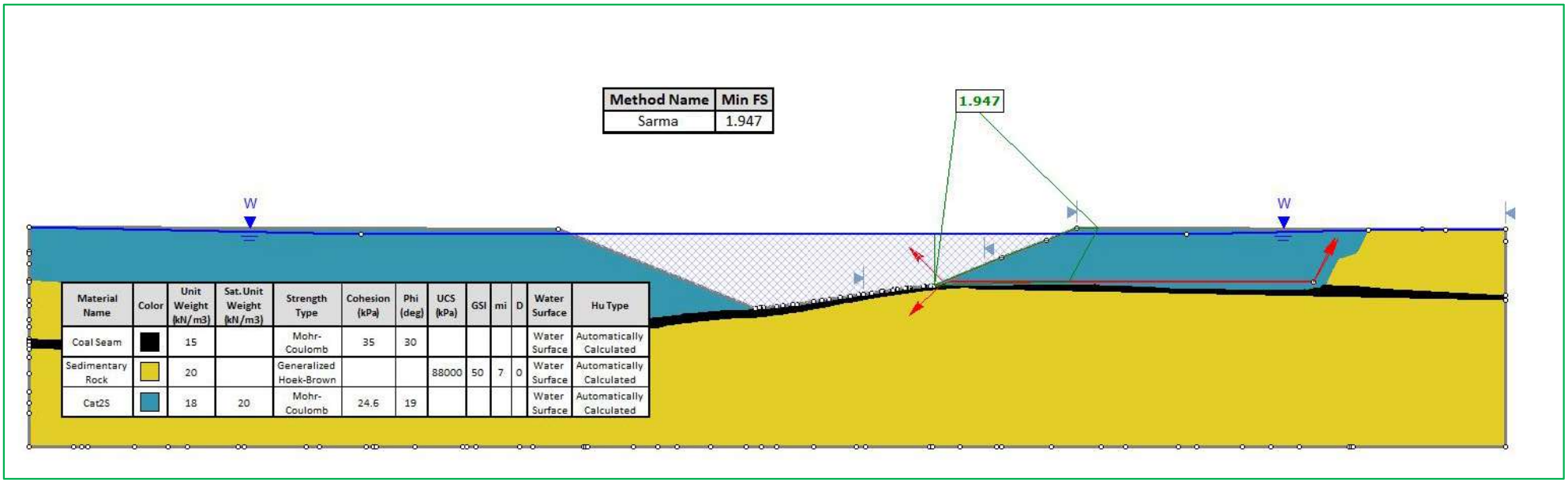


2D LE results output for recommended highwall slope geometry.



2D LE results output for recommended spoil geometry.


1.477
Method Name
Min FS
Sarma
1.477
W
W
Material Name
Color
Unit Weight (kN/m3)
Sat. Unit Weight (kN/m3)
Strength Type
Cohesion (kPa)
Phi (deg)
UCS (kPa)
GSI
mi
D
Water Surface
Hu Type
CoalSeam
15
Mohr-Coulomb
35
30
Water Surface
Automatically Calculated
Sedimentary Rock
20
Generalized Hoek-Brown
88000
50
7
0
Water Surface
Automatically Calculated
Cat2S
18
20
Mohr-Coulomb
24.6
19
Water Surface
Automatically Calculated



Material Name	Color	Unit Weight (kN/m3)	Sat. Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	UCS (kPa)	GSI	mi	D	Water Surface	Hu Type
Coal Seam		15		Mohr-Coulomb	35	30					Water Surface	Automatically Calculated
Sedimentary Rock		20		Generalized Hoek-Brown			88000	50	7	0	Water Surface	Automatically Calculated
Cat2S		18	20	Mohr-Coulomb	24.6	19					Water Surface	Automatically Calculated

Moorvale South Mine Progressive Rehabilitation and Closure Plan

Flood risk assessment

AARC Environmental Solutions Pty Ltd
0849-09-C4, 10 May 2023

Report Title	Moorvale South Mine Progressive Rehabilitation and Closure Plan, Flood risk assessment
Client	AARC Environmental Solutions Pty Ltd
Report Number	0849-09-C4

Revision Number	Report Date	Report Author	Reviewer
0 [DRAFT]	27 Feb 2023	MPB	MGB
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2 [DRAFT]	7 March 2023	MPB	MGB
3	9 March 2023	MPB	MGB
4	10 May 2023	MPB	MGB

For and on behalf of WRM Water & Environment Pty Ltd
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NOTE: This report has been prepared on the assumption that all information, data and reports provided to us by our client, on behalf of our client, or by third parties (e.g. government agencies) is complete and accurate and on the basis that such other assumptions we have identified (whether or not those assumptions have been identified in this advice) are correct. You must inform us if any of the assumptions are not complete or accurate. We retain ownership of all copyright in this report. Except where you obtain our prior written consent, this report may only be used by our client for the purpose for which it has been provided by us.

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1 Introduction

Moorvale South (MVS) is a satellite pit of Moorvale Mine (MVL), located 15 km south of MVL operations. The operational area is located approximately 30 km southeast of Moranbah and 260 km northwest of Rockhampton. The site is located immediately to the west of North Creek and to the north of the Isaac River. The MVS site is within mine lease ML 70354 as shown in Figure 1.1. The haul road connecting MVS to MVL is located on mine lease ML70355. A previous study has addressed flooding in this area (WRM, 2018).

Peabody Energy Australia (PEA) commenced open cut coal mining in 2022 at MVS and will operate for approximately 10 years. PEA is preparing a Progressive Rehabilitation and Closure Plan (PRCP) for the mine and has engaged WRM to identify the extent of North Creek and Isaac River flooding in the vicinity of non-use management areas (NUMAs) proposed within the post-mining landform.

For the purposes of a PRCP, a void is considered in a floodplain if modelling shows that, when all relevant activities carried out on the land have ended, the land is the same height as, or lower than, the peak 1 in 1,000 Annual Exceed Probability (AEP) flood level.

This report outlines the investigations undertaken to determine if the proposed final voids will be located within the floodplain, and the extent to which they would be protected from inundation by the proposed final landform.

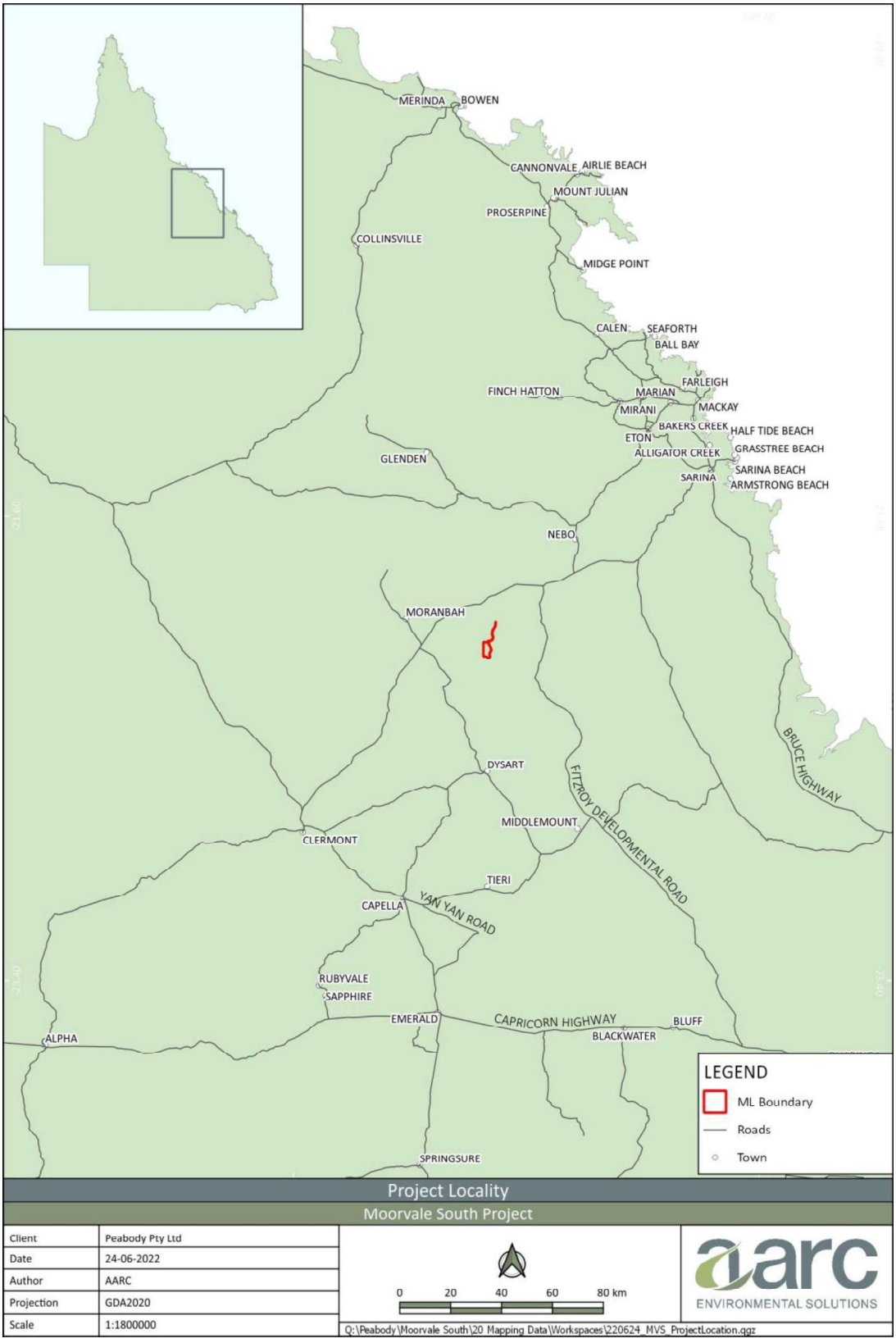


Figure 1.1 – Locality plan

2 Modelling approach

The proposed rehabilitated landform (shown in Figure 2.1) incorporates two residual voids near the North Creek floodplain (Z Pit and X Pit) and an elevated rehabilitated overburden dump. Both voids have a safety bund around their perimeter to prevent ingress of flood water.

Design flow hydrographs derived from a hydrological model were used in the hydraulic model to map flood conditions over the floodplains of North Creek and the Isaac River.

Details of the hydrological and hydraulic model development are provided in Section 5 and Section 6.

The proposed rehabilitated landform was incorporated into the hydraulic model to estimate design flood levels and velocities near the voids for the 1 in 100 AEP, 1 in 1,000 AEP and PMF flood events under post-closure conditions.

The model results are presented in the following sections.

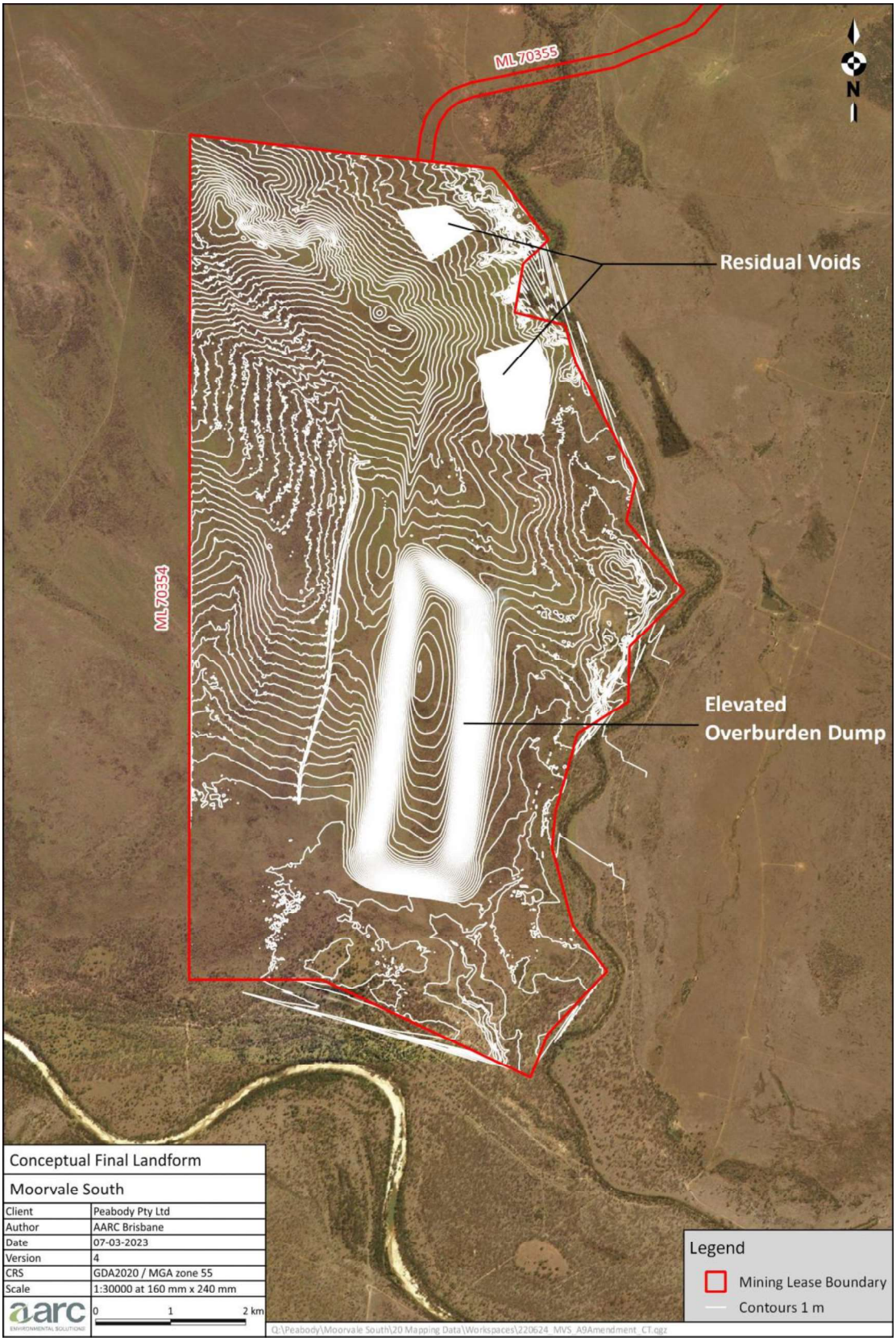


Figure 2.1 – Proposed MVS final landform configuration

3 Modelled flood conditions

3.1 1 IN 1,000 AEP DESIGN FLOOD

Figure 3.1 overlays the estimated pre-mine extent of flooding for the 1 in 1,000 AEP event in the North Creek floodplain adjacent to the Z Pit and X Pit final voids. Figure 3.2 shows the estimated extent of flooding for the 1 in 1,000 AEP event in the vicinity of the southern extent of the final landform which is located in the floodplains of North Creek and the Isaac River. An early configuration of the final landform located the Z Pit slightly within the1 in 1,000 AEP floodplain. As a result of the flood modelling analysis, Z Pit's location was adjusted to move it outside the 1 in 1,000 AEP floodplain. The results show predicted flooding does not extend onto the proposed Z Pit and X Pit final void footprints.

Figure 3.3 shows the estimated extent of flooding for the 1,000 AEP event in the North Creek floodplain adjacent to the Z Pit and X Pit final voids in post closure conditions. Figure 3.4 shows the estimated extent of flooding for the 1 in 1,000 AEP event in the vicinity of the southern extent of the final landform in post closure conditions.

The proposed final landform is outside the estimated extent of flooding in this event in the location of the final voids.

Flow velocities adjacent to the final landform adjacent to the Z Pit and X Pit final voids and the southern extent of the final landform are indicated in Figure 3.5 and Figure 3.6.

The modelled 1 in 1,000 AEP velocities adjacent to the stable final landform adjacent to Z Pit are less than 0.5 m/s and are unlikely to cause erosion. There is no interaction between X Pit and the 1 in 1,000 AEP flood extent.

The southern toe of the rehabilitated overburden dump was adjusted through an iterative process to reduce modelled velocities. Flood depths immediately adjacent to the toe of the final landform are very shallow and velocities immediately adjacent to the final landform are approximately 0.3 to 0.4 m/s and therefore unlikely to cause erosion.

On the Isaac River floodplain there is a small zone of velocity increase, 40 to 60 meters away from the toe of the landform where velocities increase up to 0.35 m/s but only reach a peak velocity of 1.3 m/s.

The ACARP guideline (ACARP 9068: Bowen Basin River Diversions Design and Rehabilitation Centre) provides guideline values for average velocities for streams within the Bowen Basin. While there are no watercourse diversions proposed, these guidelines provide some hydraulic threshold values to compare against.

The ACARP guideline threshold value for velocity for the 2% AEP flood event is 2.5 m/s. The peak velocity in the small localised zone near the toe of the final landform for the 1 in 1,000 AEP event is only 1.3 m/s, well below the 2% AEP threshold value. The geomorphic impact of the proposed final landform on the Isaac River floodplain is therefore considered negligible.

While the 1 in 1000 AEP event has been provided for comparative purposes, it is an extreme event which would be expected to have catchment wide impacts on the hydraulic properties of the Isaac River. In this context, the final landform is considered to have negligible impacts on hydraulic properties, even under a 1 in 1,000 AEP event. Although the risk is low, it is recommended that rehabilitated floodplain surfaces adjacent to the toe of the final landform be established with vegetation cover to increase erosion resistance and stability as part of final landform preparation.

Finally, it is important to recognize that the final landform would have no impact on the frequency, intensity, or duration of flood events in the Isaac River. These flooding characteristics are determined by the hydrology of the upstream reaches of the Isaac River catchment and the climatic conditions.

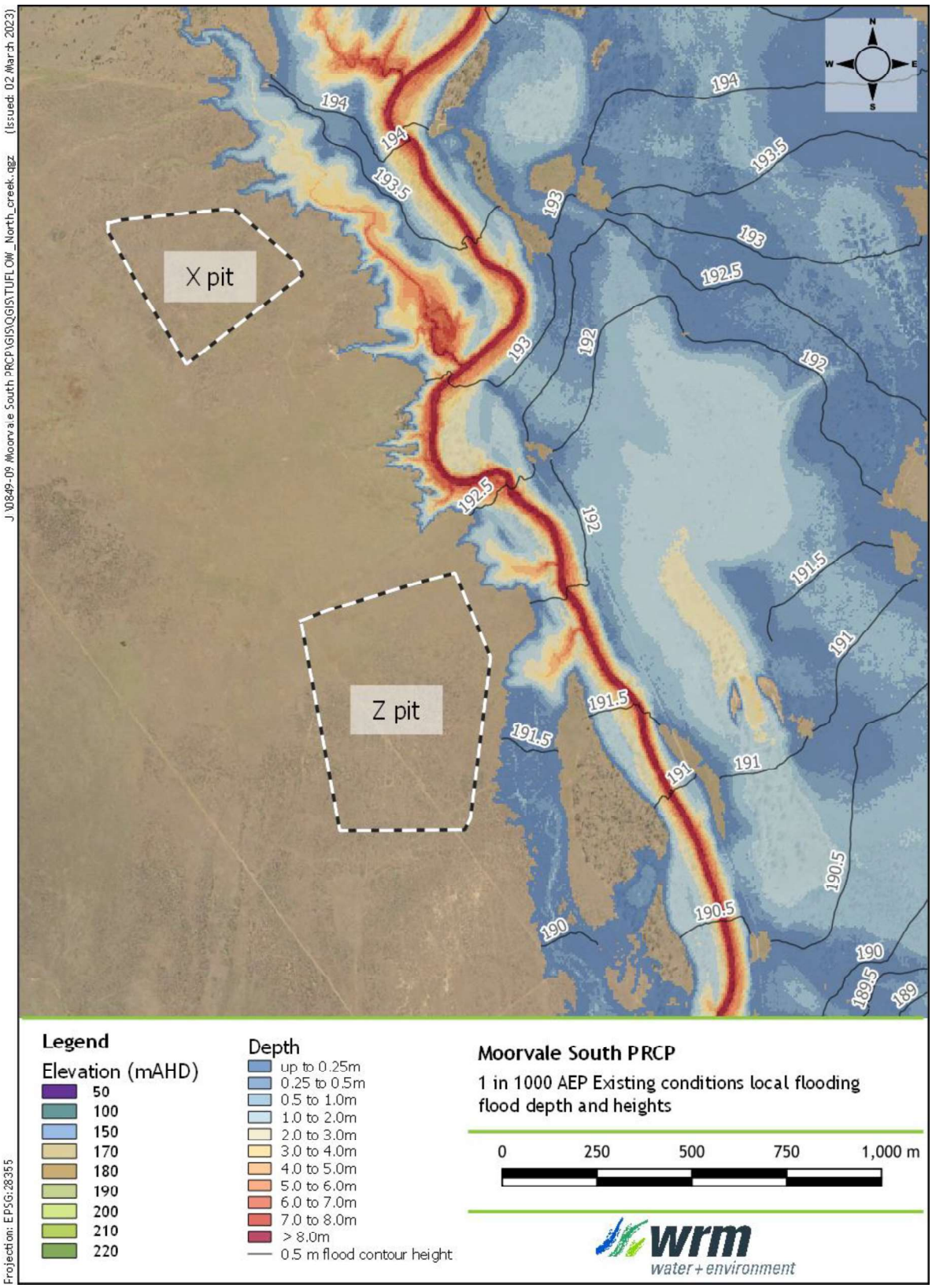


Figure 3.1 – 1 in 1,000 AEP flood depths and extents adjacent to voids - existing conditions

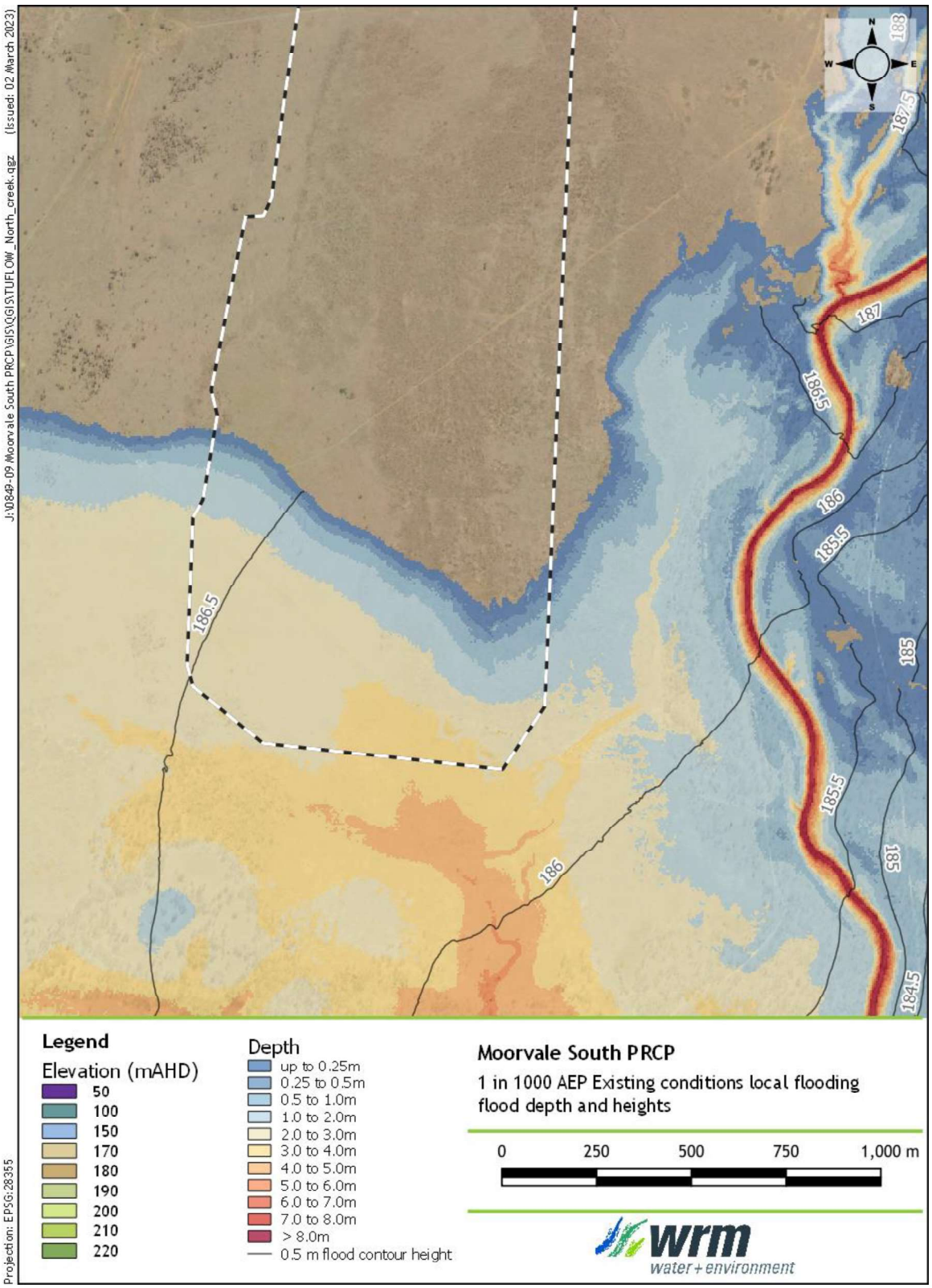


Figure 3.2 – 1 in 1,000 AEP flood depths and extents adjacent to southern final landform - existing conditions

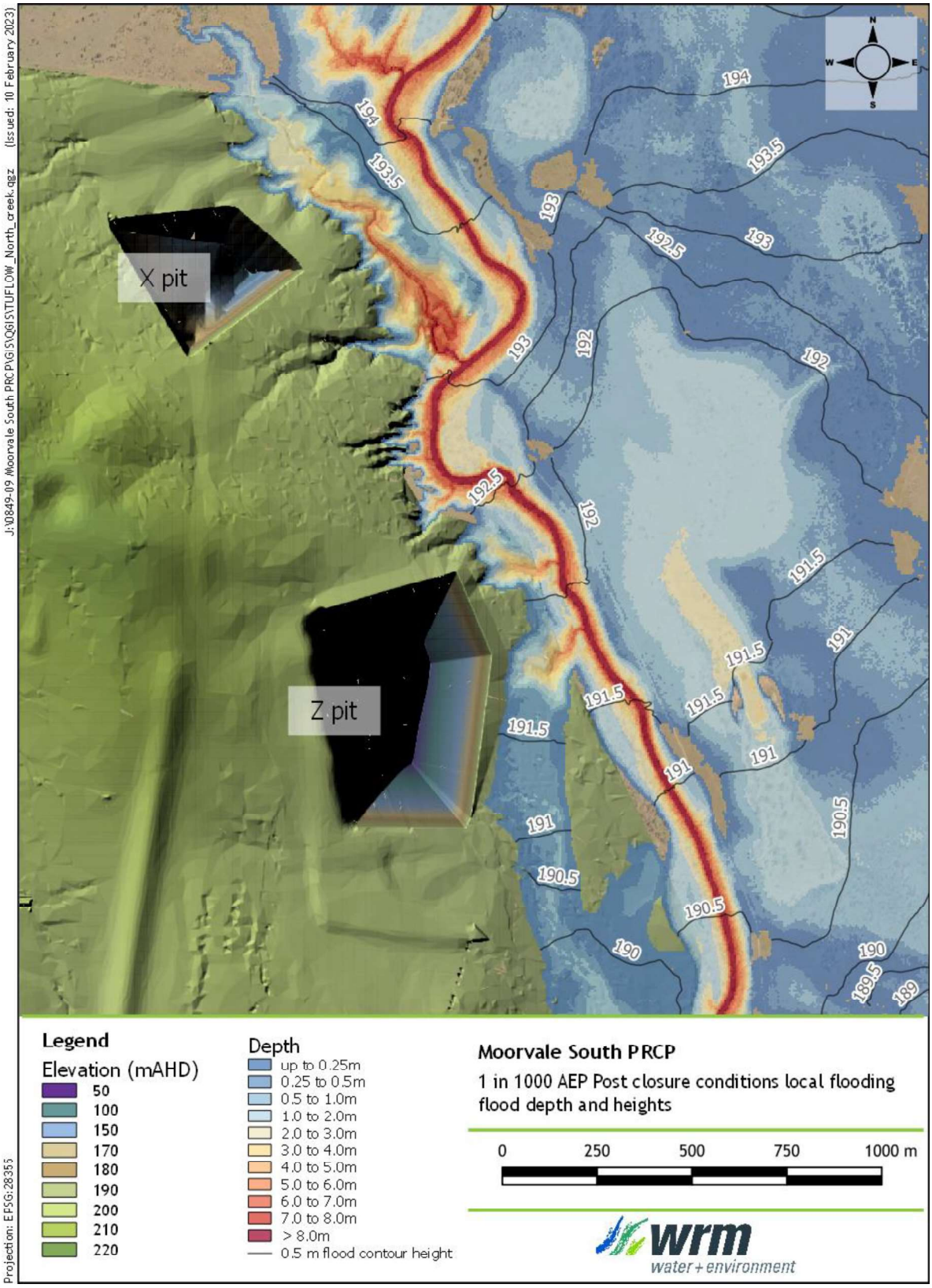


Figure 3.3 – 1 in 1,000 AEP flood depths and extents adjacent to voids - post closure conditions

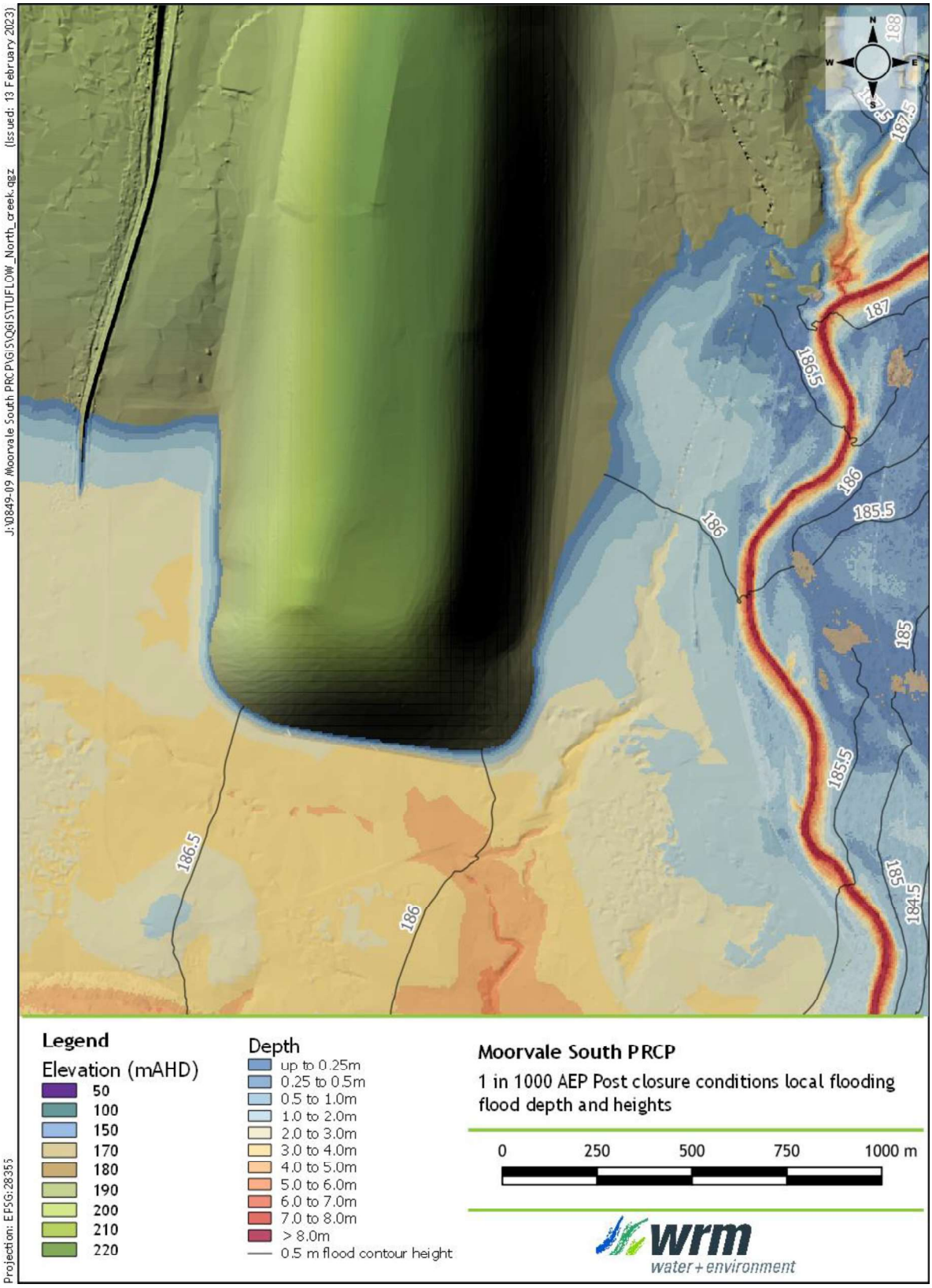


Figure 3.4 – 1 in 1,000 AEP flood depths and extents adjacent to southern final landform - post closure conditions

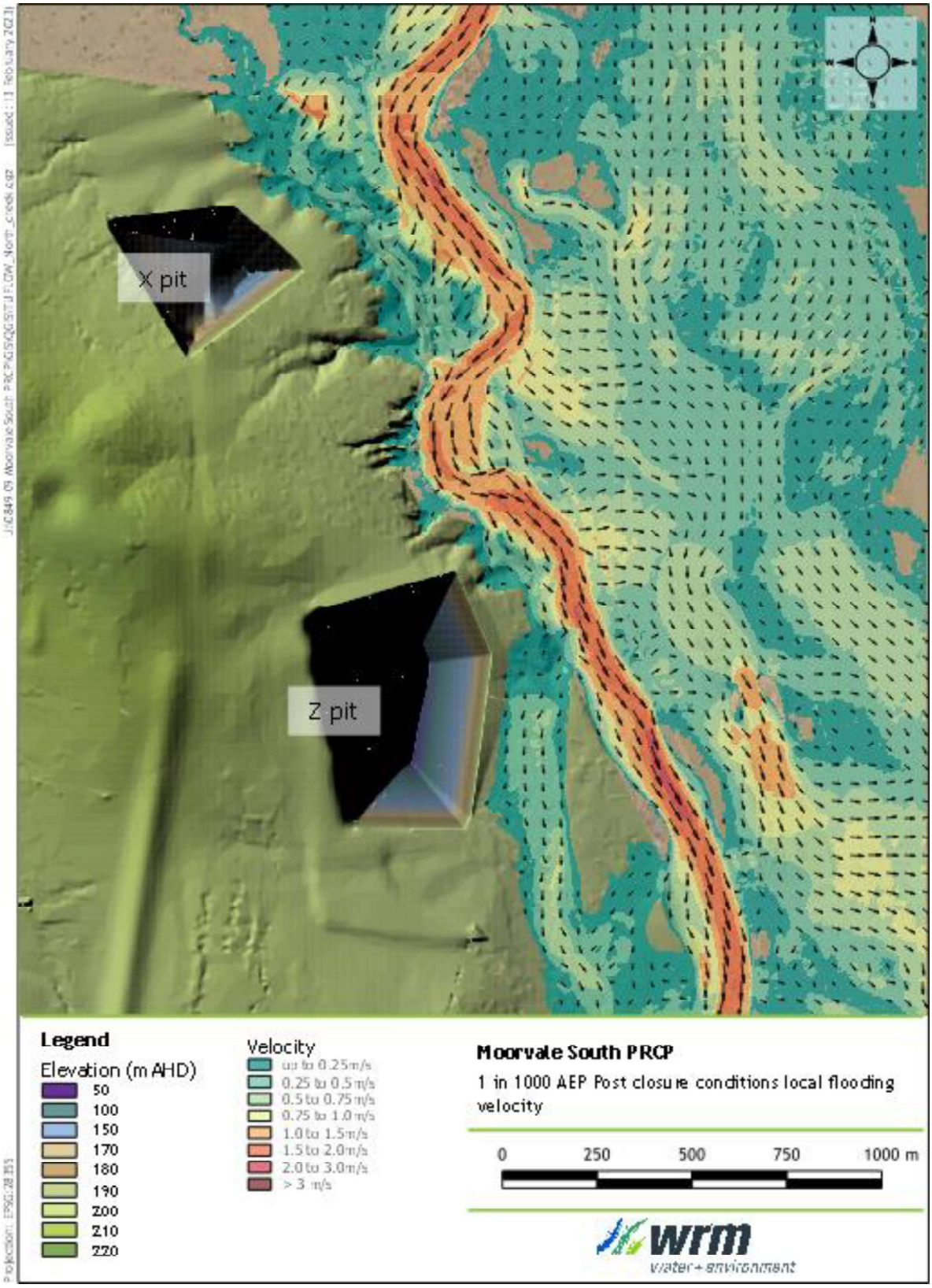


Figure 3.5 – 1 in 1,000 AEP flood velocity adjacent to voids - post closure conditions

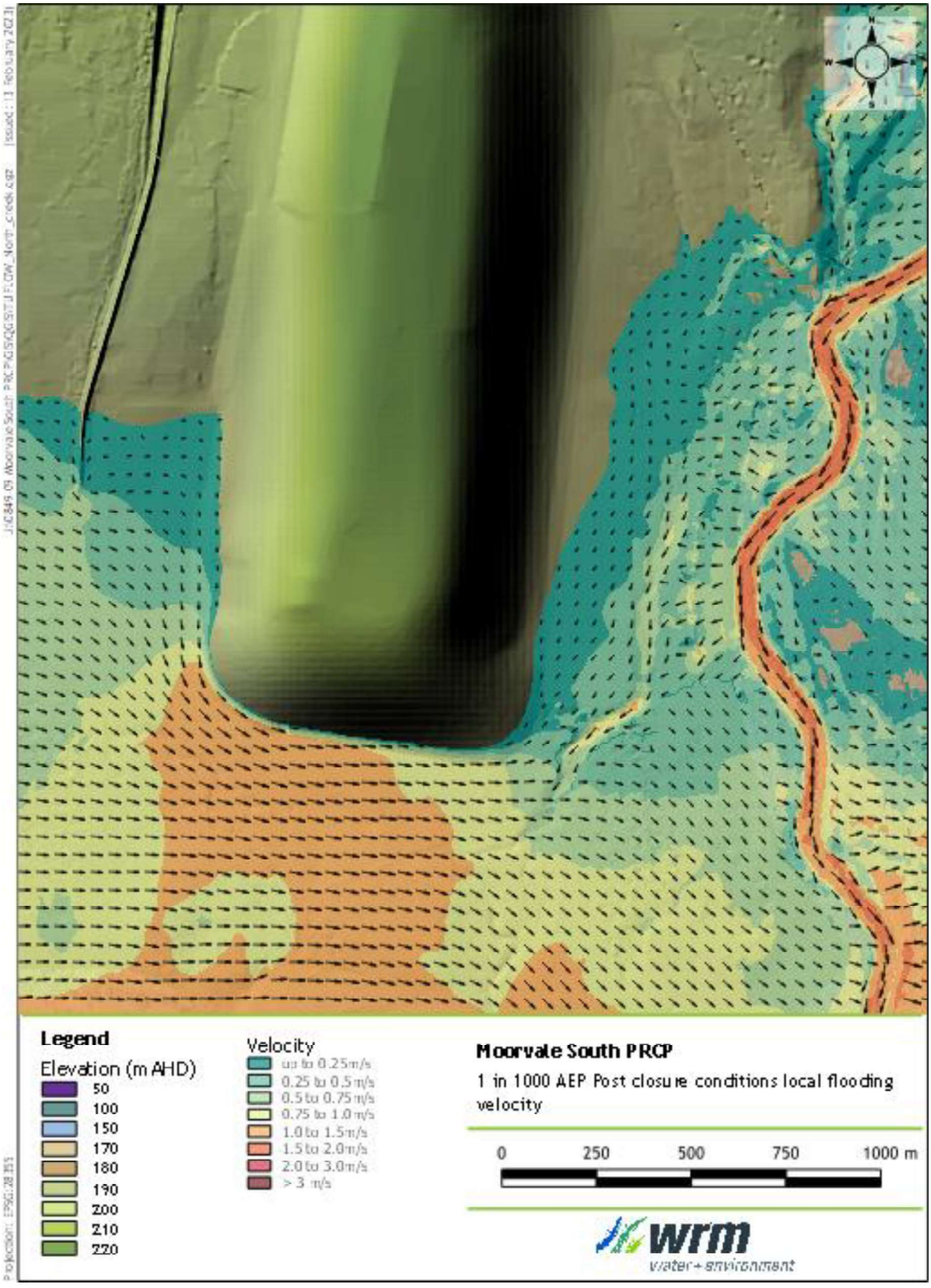


Figure 3.6 – 1 in 1,000 AEP flood velocity adjacent to southern final landform - post closure conditions

3.2 PROBABLE MAXIMUM FLOOD

Figure 3.7 overlays the estimated extent of the PMF in the North Creek floodplain under existing conditions. Figure 3.8 shows the estimated extent of flooding for the PMF event in the vicinity of the southern extent of the final landform. Figure 3.9 and Figure 3.10 show the modelled extent of PMF flooding under post closure conditions. The results show that the estimated PMF flood extents only marginally impinge upon the Z Pit and X Pit footprints.

The results show the proposed landform would protect both final voids from inundation under PMF conditions. Flow velocities adjacent to the voids and the southern extent of the final landform are shown in Figure 3.11 and Figure 3.12.

The modelled PMF velocities directly against the final landform adjacent to Z Pit are generally less than 1.1 m/s.

The modelled PMF velocities directly against the elevated southern final landform are generally less than 2.7 m/s. On the southwestern corner of the elevated landform the velocity would approach up to 3.3 m/s.

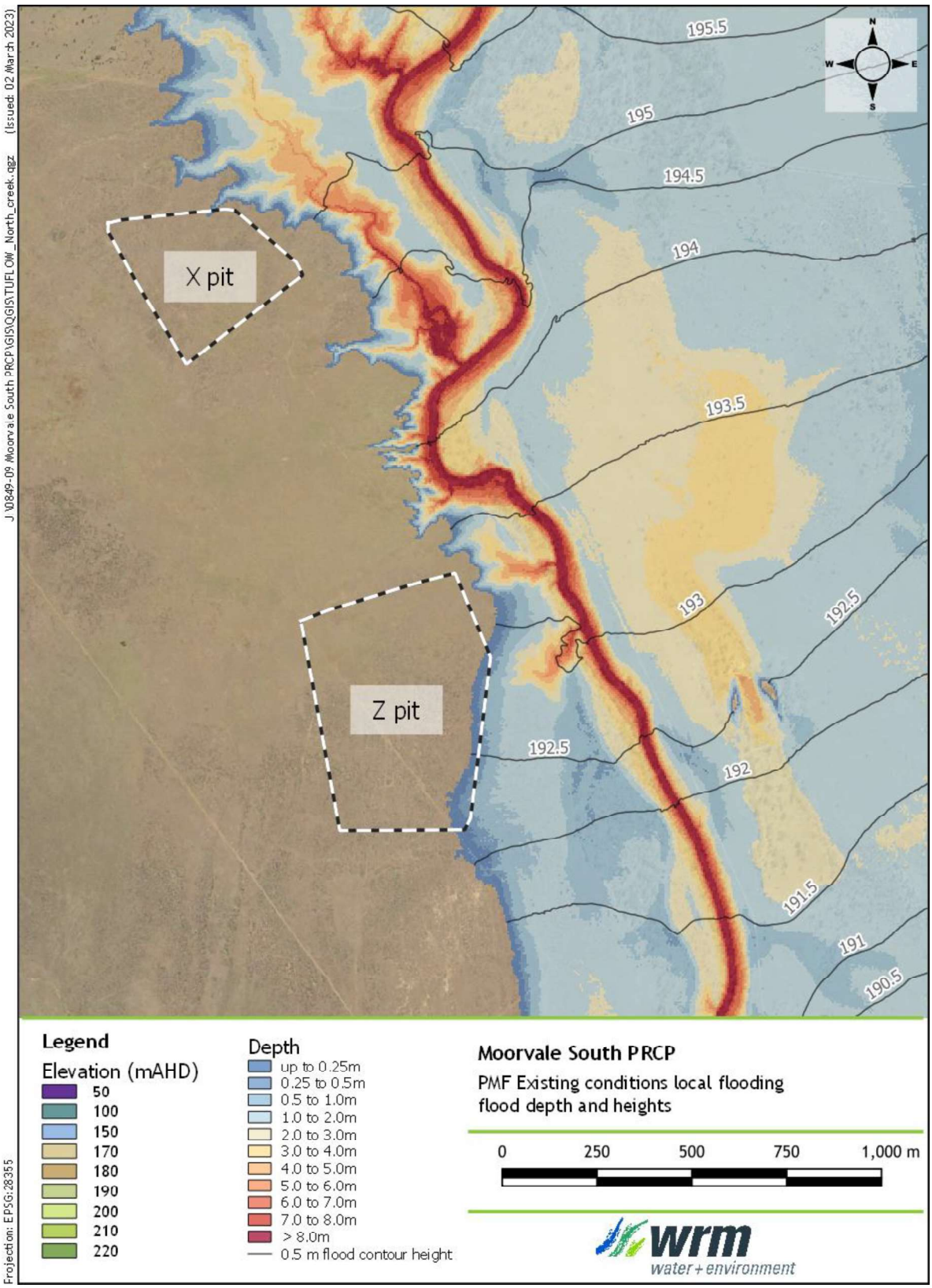


Figure 3.7 – PMF flood depths and extents adjacent to voids - existing conditions

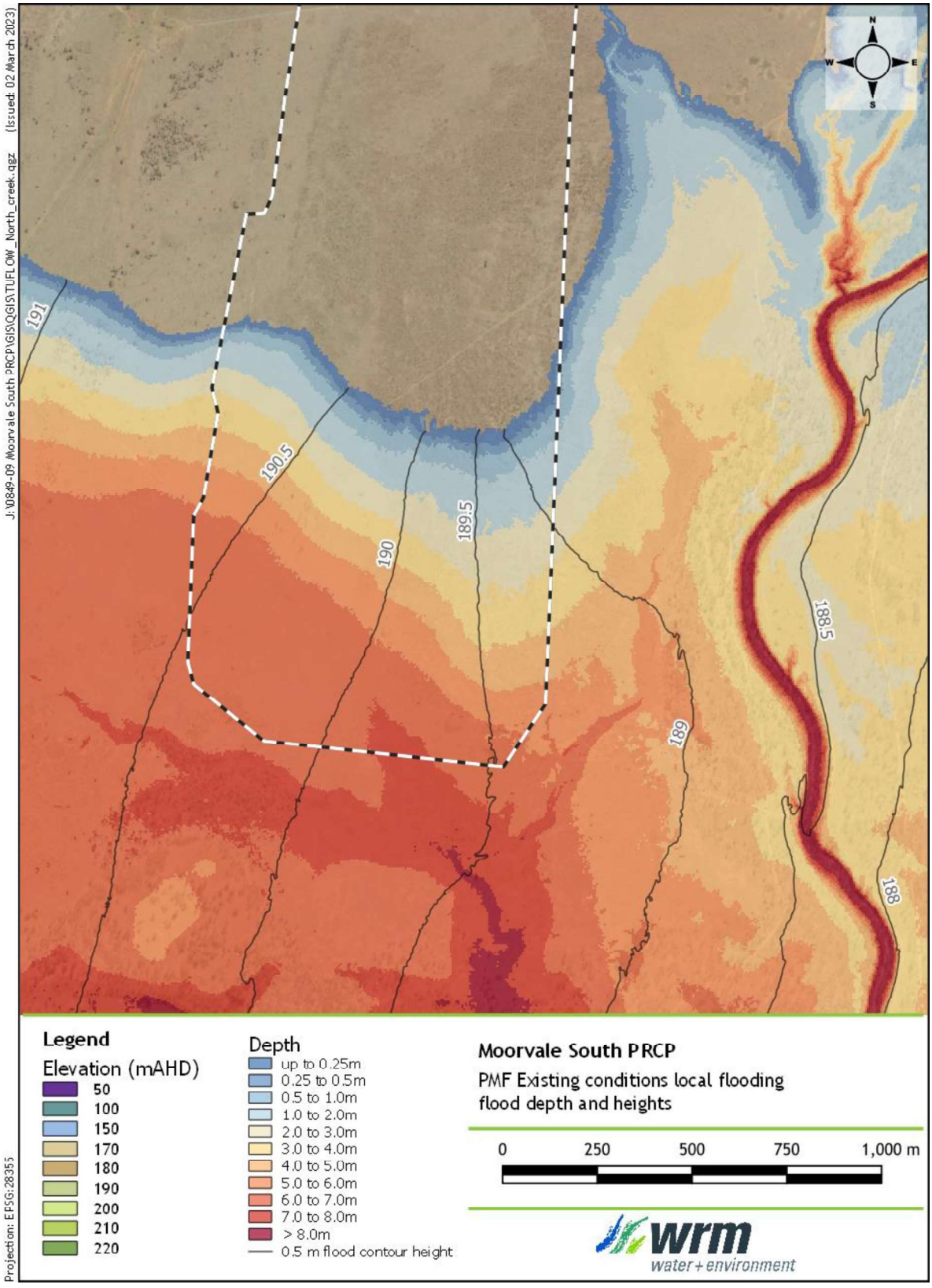


Figure 3.8 – PMF flood depths and extents adjacent to southern final landform - existing conditions

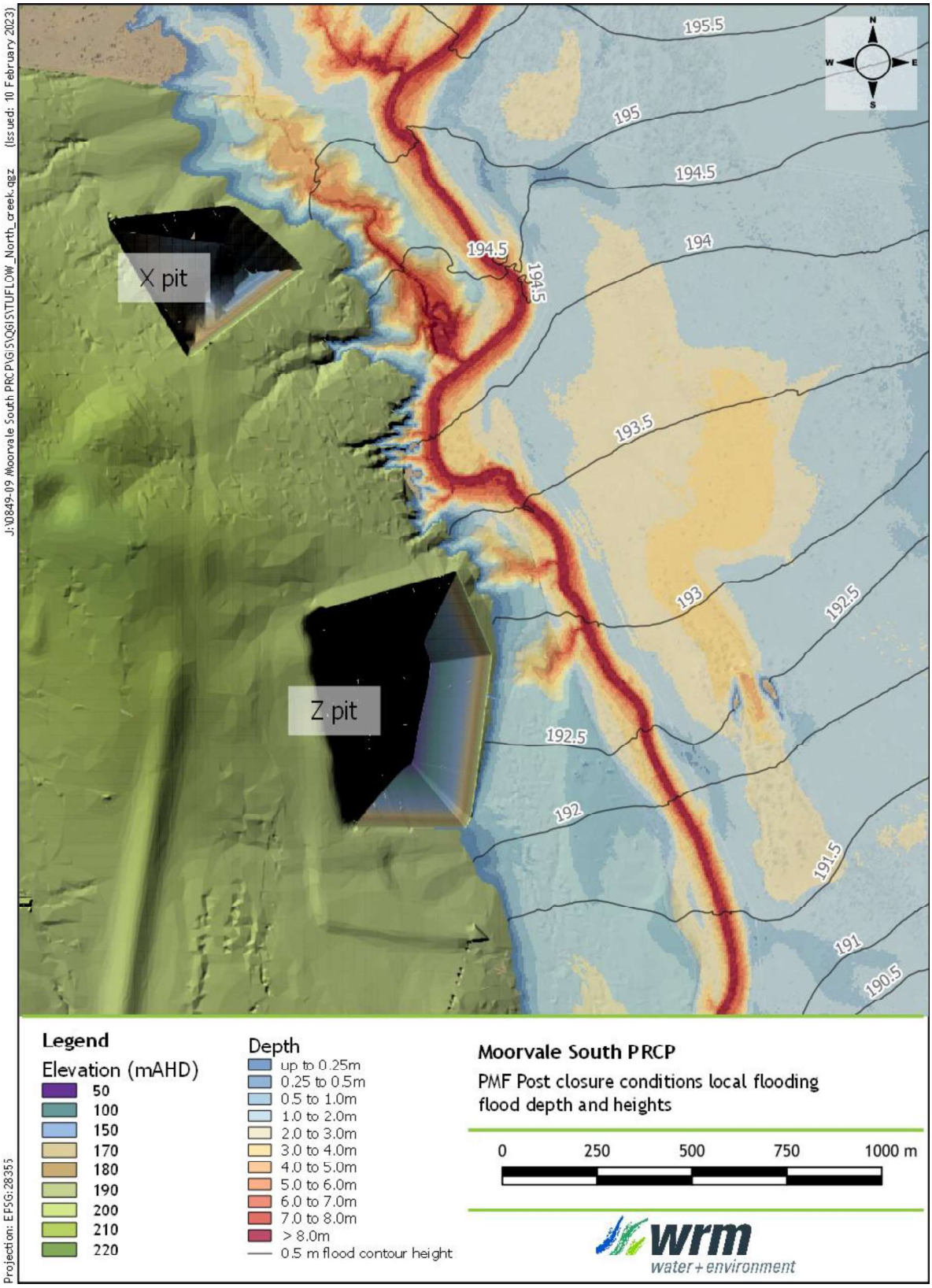


Figure 3.9 – PMF flood depths and extents adjacent to voids - post closure conditions

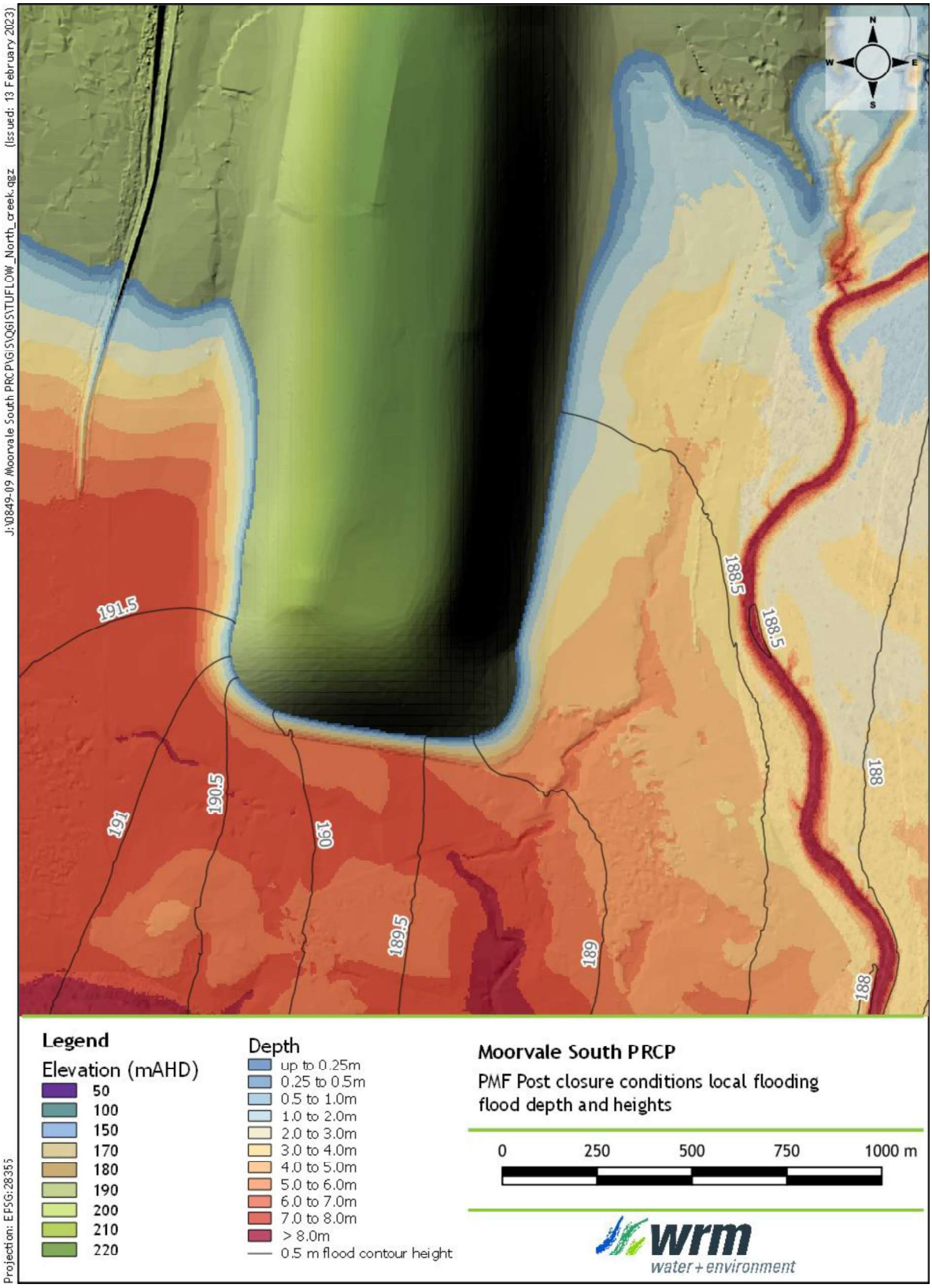


Figure 3.10 – PMF flood depths and extents adjacent to southern final landform - post closure conditions

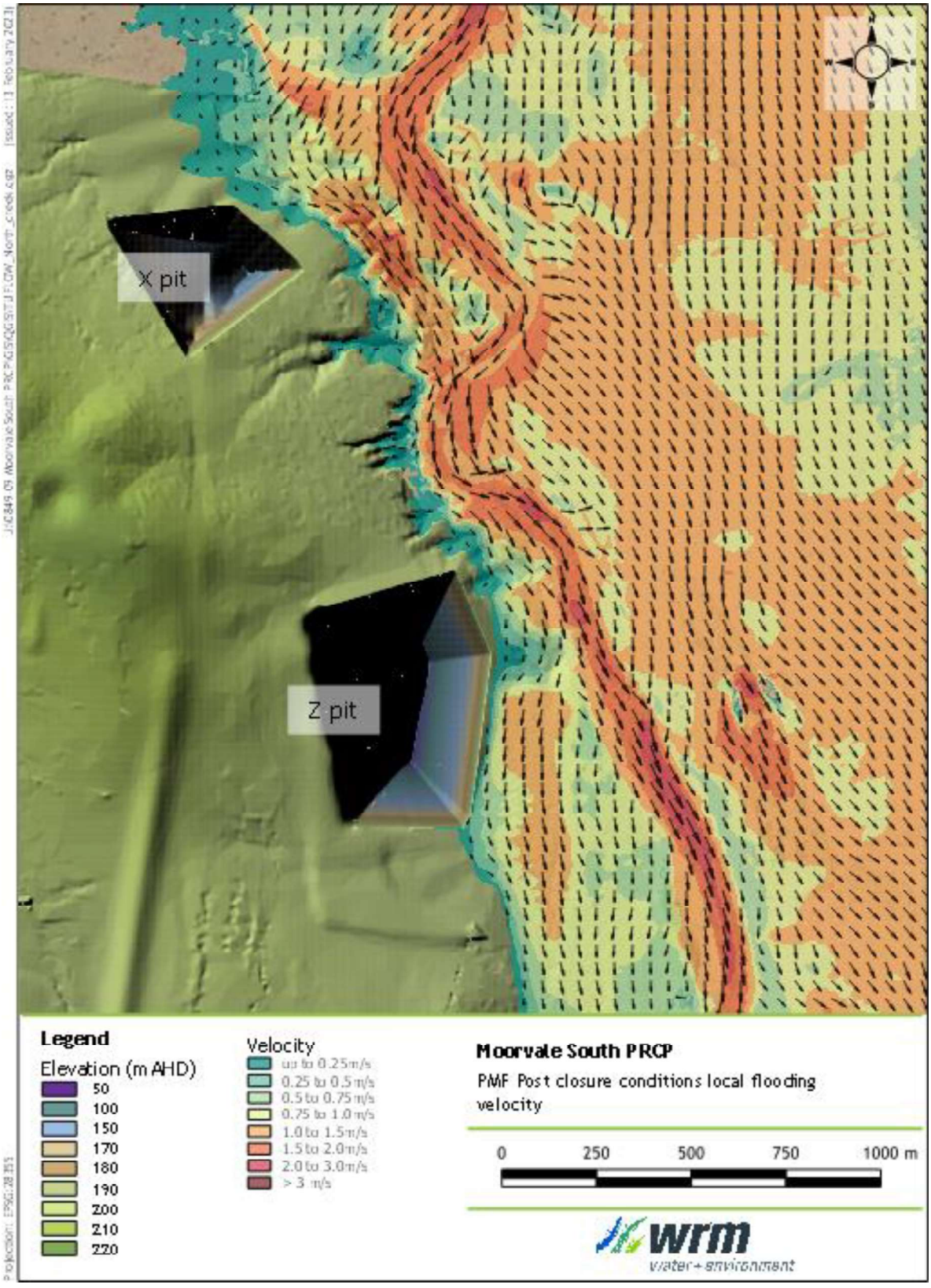


Figure 3.11 – PMF flood velocity adjacent to voids - post closure conditions

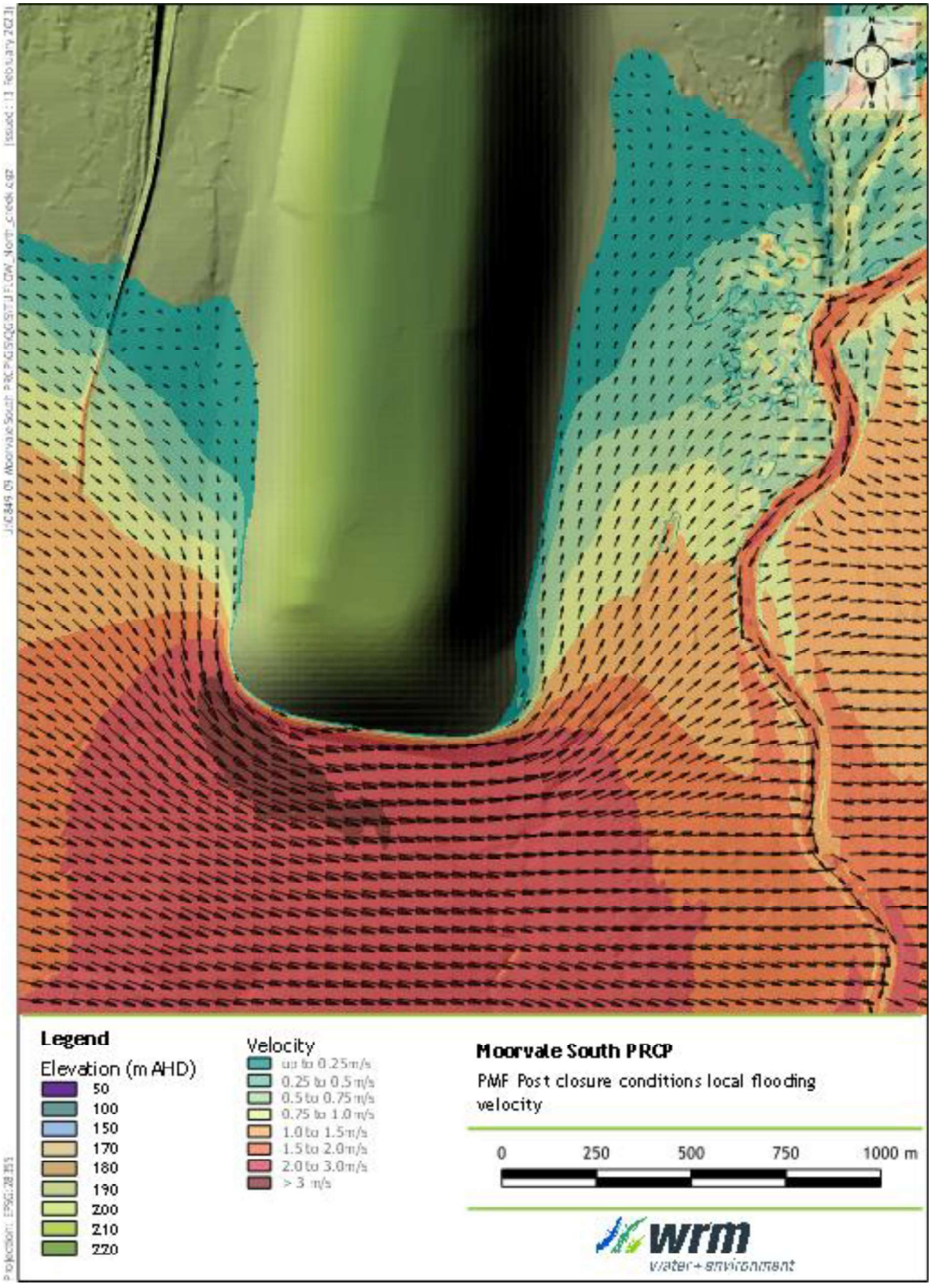


Figure 3.12 – PMF flood velocity adjacent to southern final landform - post closure conditions

4 Findings

The results of this flood assessment show:

- The proposed X Pit and Z Pit final void NUMAs are outside the extent of the 1 in 1,000 AEP flood event.
- The proposed final landforms are not susceptible to ingress of floodwater to the voids for all flood events up to and including the PMF.
- The modelled 1 in 1,000 AEP velocities adjacent to the elevated final landform in the vicinity of the voids are generally less than 0.5 m/s and is unlikely to cause erosion.
- Flood depths immediately adjacent to the toe of the final landform are very shallow and velocities immediately adjacent to the final landform are approximately 0.3 to 0.4 m/s, and therefore unlikely to cause erosion.
- The modelled 1 in 1,000 AEP velocities adjacent to the southern final landform are generally less than 1.3 m/s and are well below the ACARP guideline threshold value for velocity for the 2% AEP flood event (2.5 m/s). The geomorphic impact of the proposed final landform on the Isaac River floodplain is therefore considered negligible.
- As part of the final landform preparation, it is recommended that rehabilitated floodplain surfaces adjacent to the toe of the final landform be established with vegetation cover to increase erosion resistance and stability.
- The modelled PMF velocities adjacent to the elevated landform are generally less than 2.8 m/s. The velocity would approach to 3.3 m/s near the southwestern corner of the toe.

A full set of maps for the 1 in 100 AEP, 1 in 1,000 AEP and PMF are provided in Appendix A.

5 North Creek Hydrological Modelling

5.1 INTRODUCTION

The MVS final landform is located within the floodplain of North Creek, which is a tributary of the Isaac River. WRM has previously developed and validated an XP-RAFTS (Innovyze 2019) hydrological model of North Creek. This model was used for the MVS PRCP flood assessment. However, modelling for the 1 in 1,000 AEP and PMF design events in accordance with the ARR2019 guidelines has not previously been undertaken for local North Creek flood events.

The XP-RAFTS model was updated to include the estimation of design discharges for the 1 in 1,000 AEP and PMF design events. The discharges from the XP-RAFTS model were used as inflow boundary conditions in the TUFLOW hydraulic model to investigate the flood depths and velocities around the final landform design.

5.2 MODEL CONFIGURATION

The topographic data that forms the basis of the hydrological model consists of 1m LiDAR flown in October 2018 with a nominal vertical accuracy of 0.15m. This was supplemented with 1 m LiDAR that extends halfway up (approximately 25km) the North Creek catchment. The remainder of the upstream reaches of the North Creek catchment were based on SRTM data.

Figure 5.1 shows the XP-RAFTS model configuration for North Creek. The hydrologic model extends approximately eight kilometers downstream of the MVS final landform. The total catchment area of North Creek upstream of the final landform is approximately 295 km^2. The XP-RAFTS model consists of 32 subcatchments ranging in size from 0.9 km^2 to 43.6 km^2.

Model parameters for each sub-catchment were determined as follows:

- A percentage impervious of zero was adopted for all sub-catchments;
- An average vectored slope for each sub-catchment was derived from averaging the equal area slope of several flow paths in each sub-catchment using the underlying topographic data;
- A sub-catchment storage coefficient multiplication factor ‘Bx’ of 1.2 was adopted for all events; and
- Sub-catchment PERN ‘n’ values ranged from 0.05 to 0.065.

5.3 RAINFALL

The 1 in 1,000 AEP design rainfalls were derived from the ARR2019 Datahub with areal reduction factors for the catchment to the final landform applied. Due to the small variation in design rainfall estimates over the catchment a uniform spatial rainfall distribution was adopted.

PMP rainfall depths for design events up to six hours duration were estimated using the Generalised Short Duration Method (GSDM) (BoM, 2003). PMP rainfall depths for the 24 hour storm were estimated using the Generalised Tropical Storm Method Revised (GTSMR) (BoM, 2005). Rainfall depths for events between 6 and 24 hours were interpolated between the GSDM and GSTMR estimates.

The following parameters were adopted for the calculation of the GSDM PMP depths:

- Elevation Adjustment Factor of 1.0;
- Moisture Adjustment Factor of 0.90; and

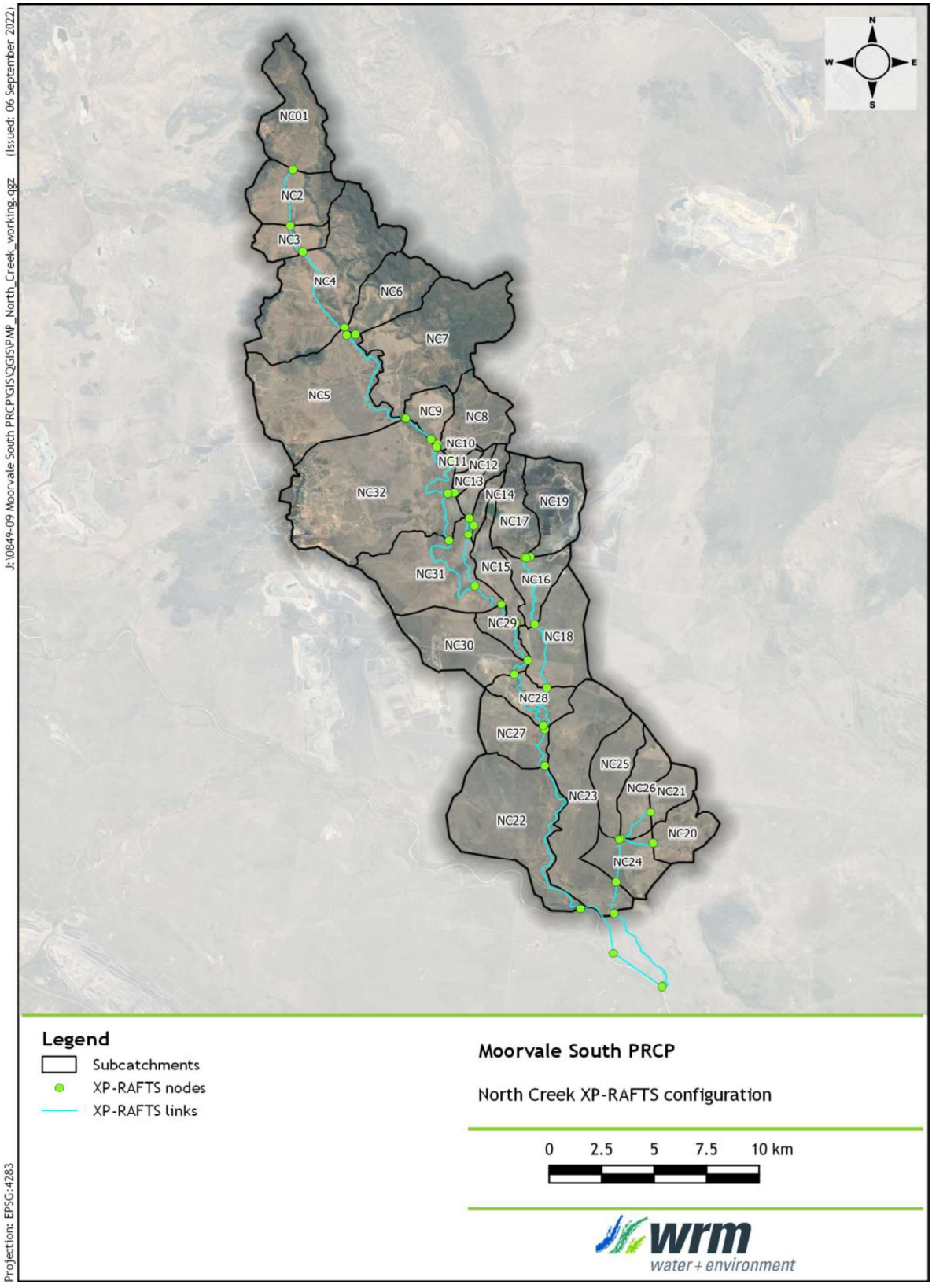


Figure 5.1 – XP-RAFTS configuration

- 100% of the catchment was considered rough due to the presence of rough terrain within a 20 km radius of a majority of the catchment.

The following parameters were adopted for the GTSMR PMP depths:

- Topographical Adjustment Factor (TAF) of 1.0;
- Decay Amplitude Factor (DAF) of 1.0; and
- Extreme Precipitable Water (EPW catchment) of 92.94.

The PMP rainfall for GSDM rainfall depths was spatially varied using the method of ellipses. The ellipses were centred over the entire catchment and the rainfall applied based on the ellipse that each sub-catchment centroid was located within. Because the TAF for the entire catchment was uniform the GTSMR design rainfall depths (24 h to 120 h) were not varied spatially.

Spatially distributed rainfall depths for durations between 6 and 24 hours were interpolated from the depths derived from the GTSMR method.

Figure 5.2 shows the spatial distribution of GSDM rainfalls within the North Creek catchment.

5.4 TEMPORAL PATTERNS

For the 1 in 100 AEP design event the East Coast North temporal patterns for rare events were applied.

For the 1 in 1,000 AEP design event, ARR recommends using the temporal patterns that are applied to the PMP. The ensemble of ten temporal patterns developed by Jordan et al. were used (Jordan, 2005) for storm durations up to 6 hours along with the GSDM average variable method (AVM) pattern. For storms of 24 hours duration or longer the appropriate ensemble of coastal storm patterns was used depending on the catchment size along with the AVM pattern. Durations between 6 hrs and 24 hrs were assessed by applying both sets of temporal patterns in accordance with the recommendation given in ARR 2019.

For the PMP rainfall the average variable method (AVM) temporal pattern for the GSDM and GTSMR were adopted for the short and long duration storms. For the storm durations between 6 and 24 hours both the short and long AVM temporal patterns were applied.

5.5 DESIGN RAINFALL LOSSES

For the 1 in 100 AEP event the losses were adopted from the ARR Datahub in the absence of any calibration data. The loss values supplied by Datahub were 38 mm initial loss and 2.1 mm/hr continuing loss. Median design preburst were applied to the losses.

The guidance from ARR2019 recommends a continuing loss of at least 1 mm/h for the PMF event in Northeastern Australia. It is suggested that a continuing loss value of 0 mm/h is generally too conservative. The adopted initial loss is 1 mm.

Losses for the 1 in 1,000 AEP design event are interpolated between the 1 in 100 AEP and PMF loss values in accordance with the recommendation of ARR2019. As the PMF loss values implicitly include preburst rainfall the interpolation of losses was based on 1 in 100 AEP loss values minus the preburst rainfall and the PMF loss values. As preburst values differ for each duration the interpolated 1 in 1,000 AEP initial loss values was varied for each duration. The interpolated continuing loss for each duration remained the same as it is not affected by preburst rainfall. The adopted losses for each duration assessed for the 1 in 1,000 AEP event are summarised in Table 5.1.

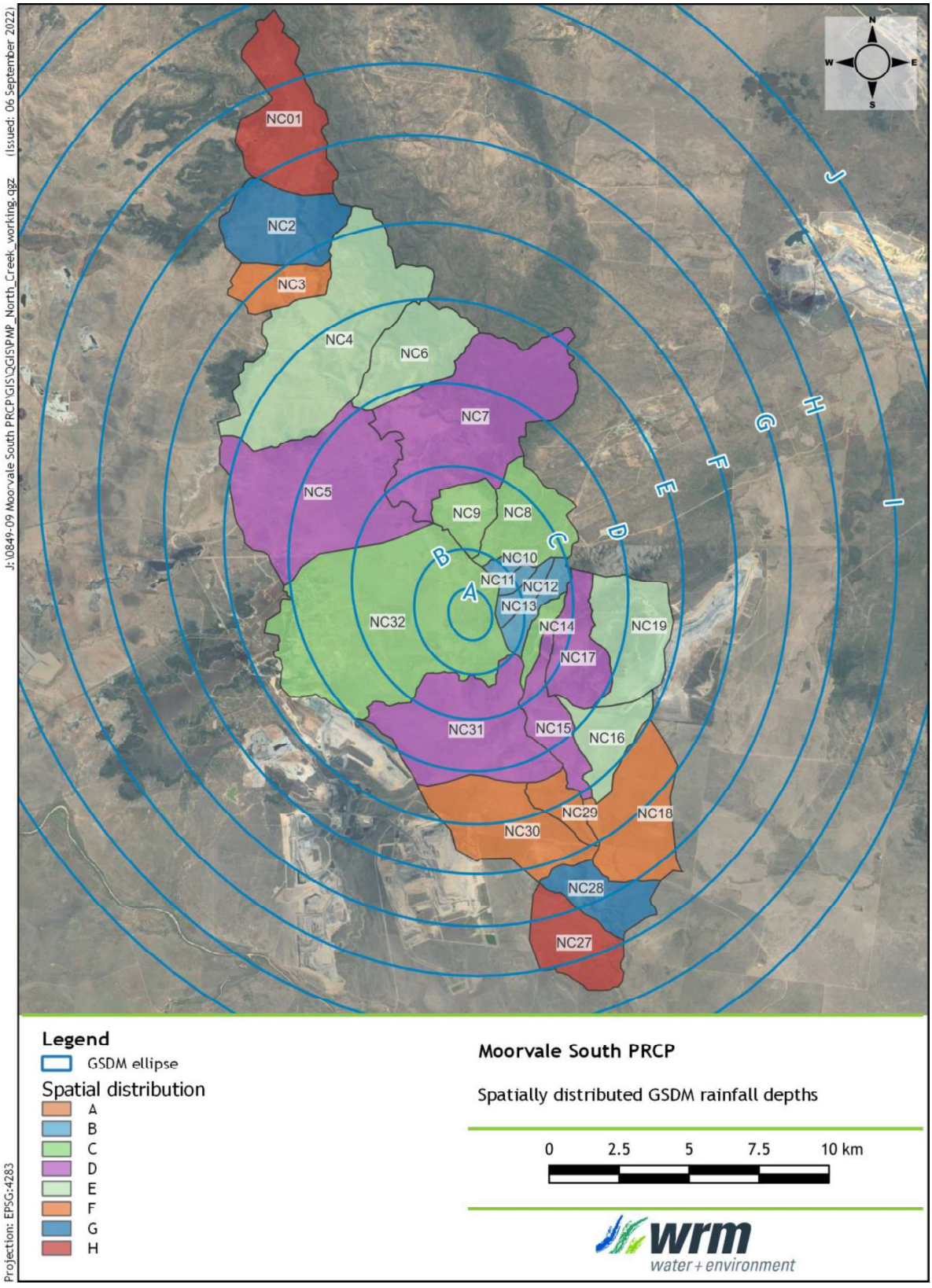


Figure 5.2 -North Creek GSDM rainfall variation

Table 5.1 - Adopted initial and continuing losses for the 1 in 1,000 AEP event

Duration	Initial loss (mm)	Continuing loss (mm/hr)
4.5 hours	3.7	1.8
6 hours	3.7	1.8
9 hours	4.2	1.8
12 hours	2.6	1.8
18 hours	5.9	1.8
24 hours	6.4	1.8
36 hours	7.4	1.8
48 hours	10	1.8

5.6 DESIGN DISCHARGES

The focal point for the selection of the critical storm and representative temporal pattern was chosen at the outlet of catchment NC27 which is located between the two final landforms.

The adopted design discharges at NC27 and critical storm duration and mean temporal pattern are shown in Table 5.2.

Table 5.2 – Adopted design discharges, critical storm duration and temporal pattern at NC27

Key location	Event	XPRafts adopted design peak discharge (m^3/s)	Critical storm duration (hours)	Temporal pattern
NC29	1 in 100 AEP	570	24	4
	1 in 1,000 AEP	1070	24	5
	PMF	4450	9	GTSMR AVM

WRM has developed a calibrated hydrological model of the upper Isaac River. This model has been used to extract flows for the Isaac River in the hydraulic model. As the two systems of North Creek and the Isaac River are not entirely independent of one another a conservative assumption was made to run a coincident event of the same AEP magnitude through the Isaac River as in North Creek. Testing of the hydraulic model indicated that at the location of the final landform the model is not affected by backwater from the Isaac River except in the PMF event although this is confined to the channel of North Creek. This approach will provide the most conservative estimate (within reason) of the extent of flooding in the vicinity of North Creek and the Isaac River.

6 Hydraulic model

6.1 METHODOLOGY

A TUFLOW (BMT, 2021) model of North Creek was developed to investigate floodplain extent in the vicinity of the final landform for Moorvale South for the 1 in 100 and 1 in 1,000 AEP events and PMF flooding. The model was also used to assess velocities in the vicinity of the final landforms.

The TUFLOW model was run for two scenarios:

- Existing conditions; and
- Developed conditions (with the final landform locations blocked out).

6.2 MODEL CONFIGURATION

The configuration of the TUFLOW model is shown in Figure 6.1.

6.2.1 Model topography and grid size

The model topography is based on available LiDAR survey data. A 5m grid size was adopted for the model.

6.2.2 Inflows

Total and local flow hydrographs were extracted from the RAFTS model for use in the TUFLOW model. Inflow boundaries are shown on Figure 6.1.

6.2.3 Downstream boundary conditions

An automatic rating curve boundary (HQ) was adopted as the downstream boundary of the model. A slope of 0.013% was adopted for the HQ boundary, which is consistent with ground slopes in the vicinity of the outflow boundary.

6.2.4 Hydraulic roughness

The roughness mapping adopted for the TUFLOW model is shown in Figure 6.2. The adopted Manning' 'n' values for each landuse are summarised in Table 6.1.

Table 6.1 – Adopted TUFLOW Manning's 'n'

Landuse	Manning's 'n'
Sandy bed	0.027
Dense vegetation	0.08
Light brush	0.06
Grass	0.055
Channel	0.045

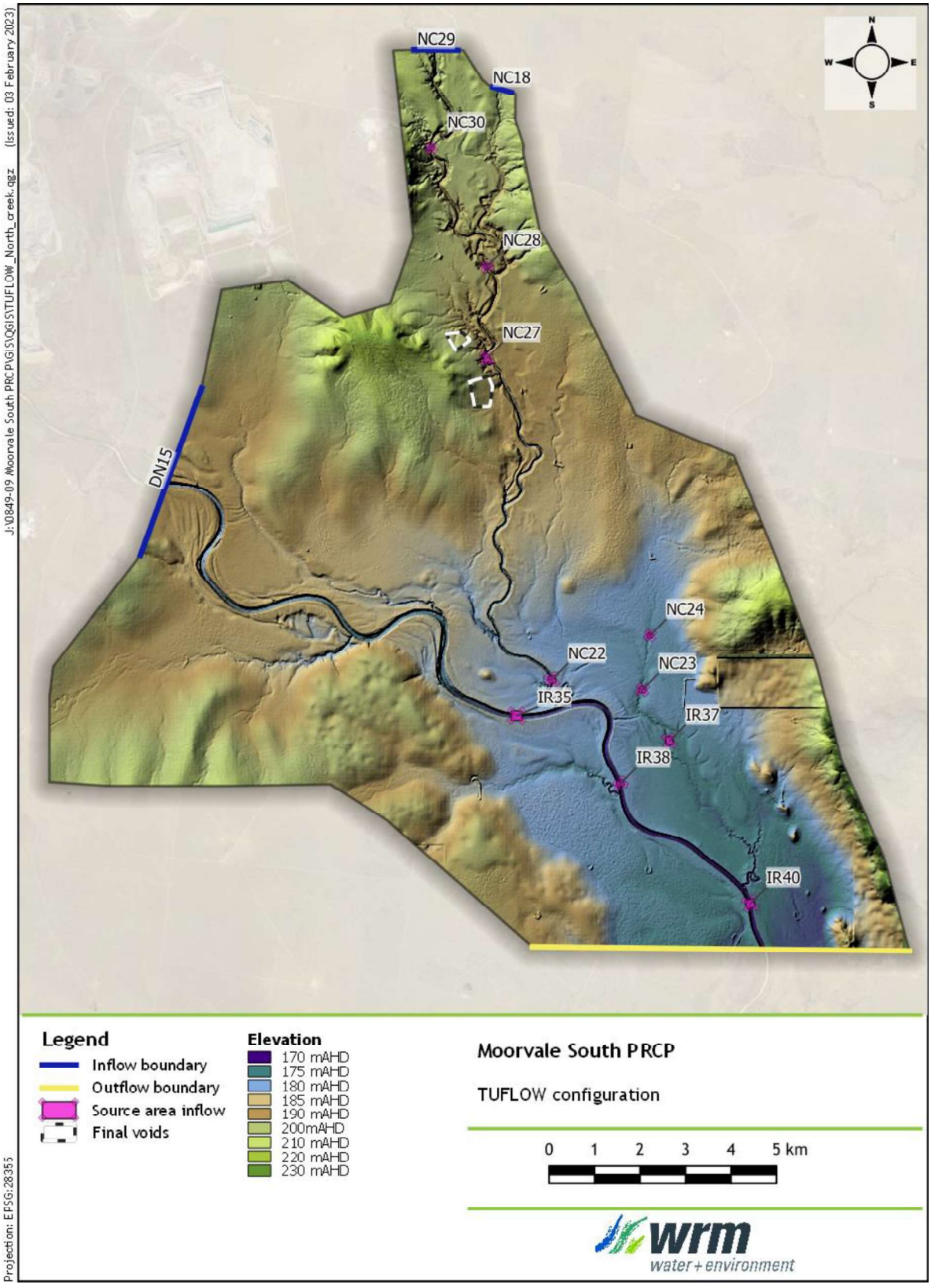


Figure 6.1 – TUFLOW configuration

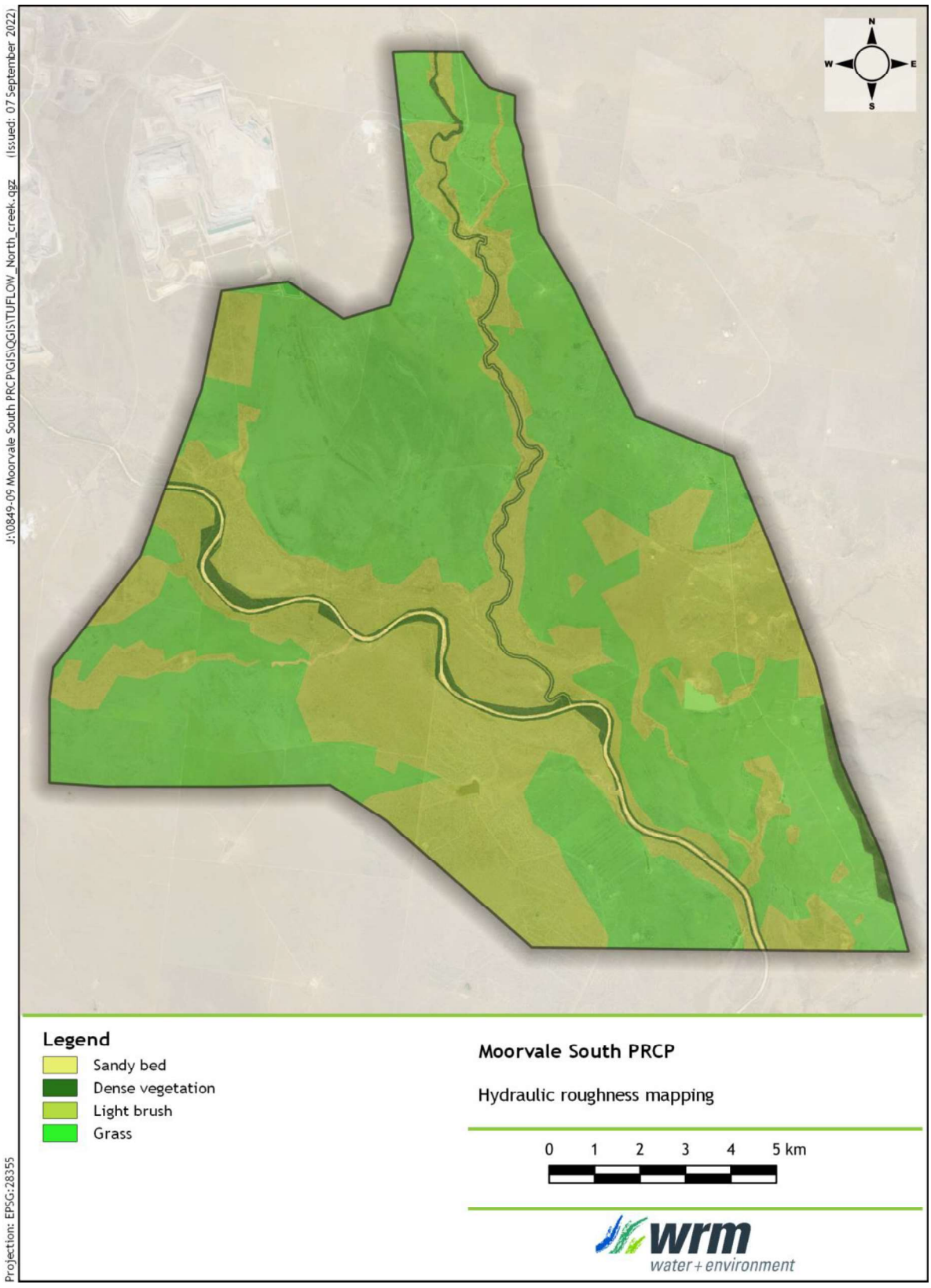


Figure 6.2 – TUFLOW hydraulic roughness mapping

7 References

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BMT, 2018	*'TUFLOW Classic/HPC User Manual - Build 2018-03-AD'*, BMT Pty Ltd, 2018.
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Innovyze, 2019	*XPRafts (software), Innoyvze, Version 2018.1.2, 2019.*
WRM, 2018	*'Moorvale South Project - Flood study for preliminary levee design and impact assessment', 0849-03-E, WRM Water & Environment, 12 November 2018*

Appendix A - Flood mapping



Legend

- Final voids
- Contour (0.5m)
- up to 0.25m
- 0.25 to 0.5m
- 0.5 to 1.0m
- 1.0 to 2.0m
- 2.0 to 3.0m
- 3.0 to 4.0m
- 4.0 to 5.0m
- 5.0 to 6.0m
- 6.0 to 7.0m
- 7.0 to 8.0m
- > 8.0m

0 250 500 m

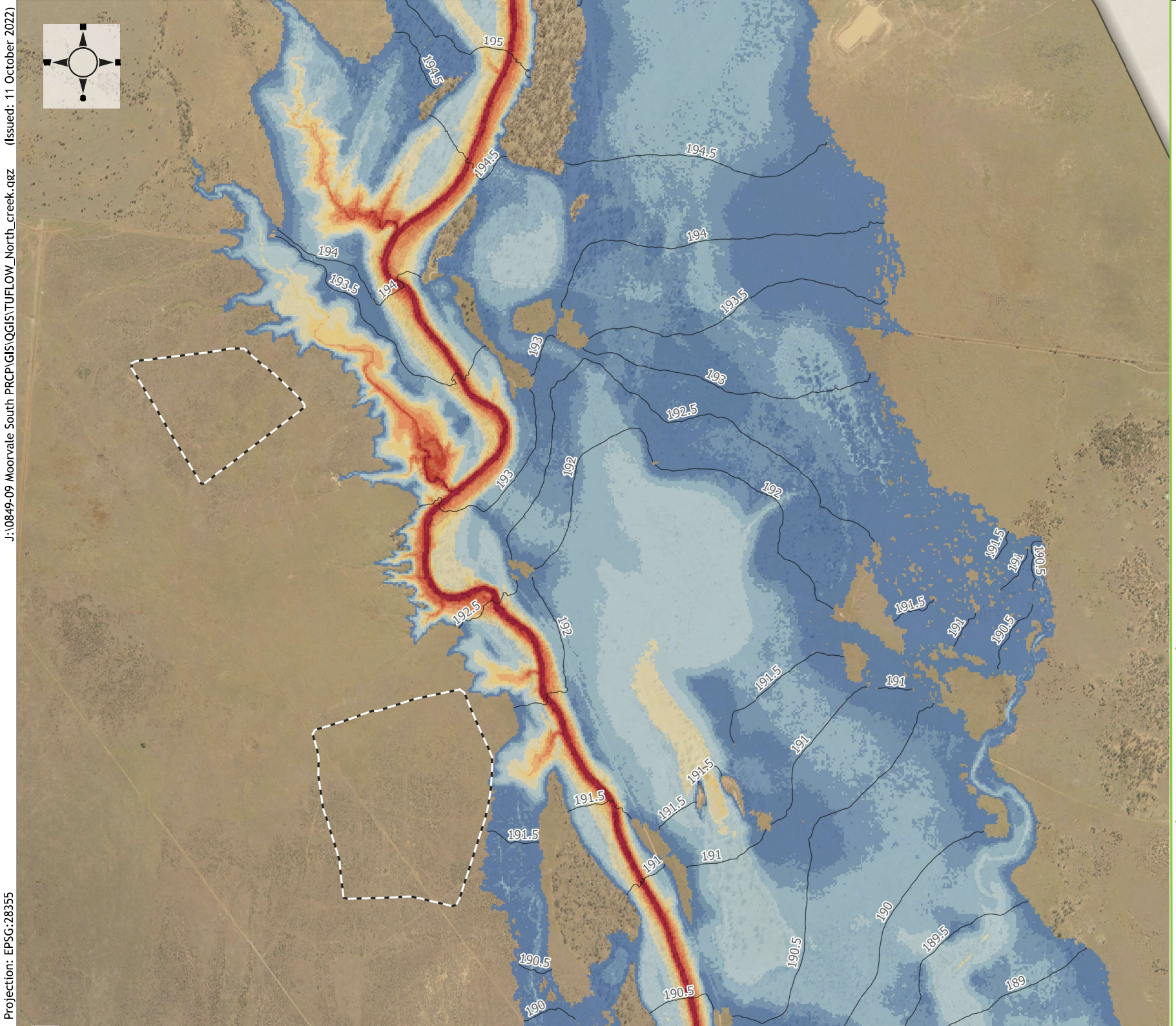
Moorvale South PRCP

North Creek 1% AEP event
Existing conditions

wrm water + environment

J:\0849-09 Moorvale South PRCP\GIS\QGIS\TUFLOW_North_creek.qgz (Issued: 11 October 2022)

Projection: EPSG:28355



Legend

- Final voids
- Contour (0.5m)
- up to 0.25m
- 0.25 to 0.5m
- 0.5 to 1.0m
- 1.0 to 2.0m
- 2.0 to 3.0m
- 3.0 to 4.0m
- 4.0 to 5.0m
- 5.0 to 6.0m
- 6.0 to 7.0m
- 7.0 to 8.0m
- > 8.0m

0 250 500 m

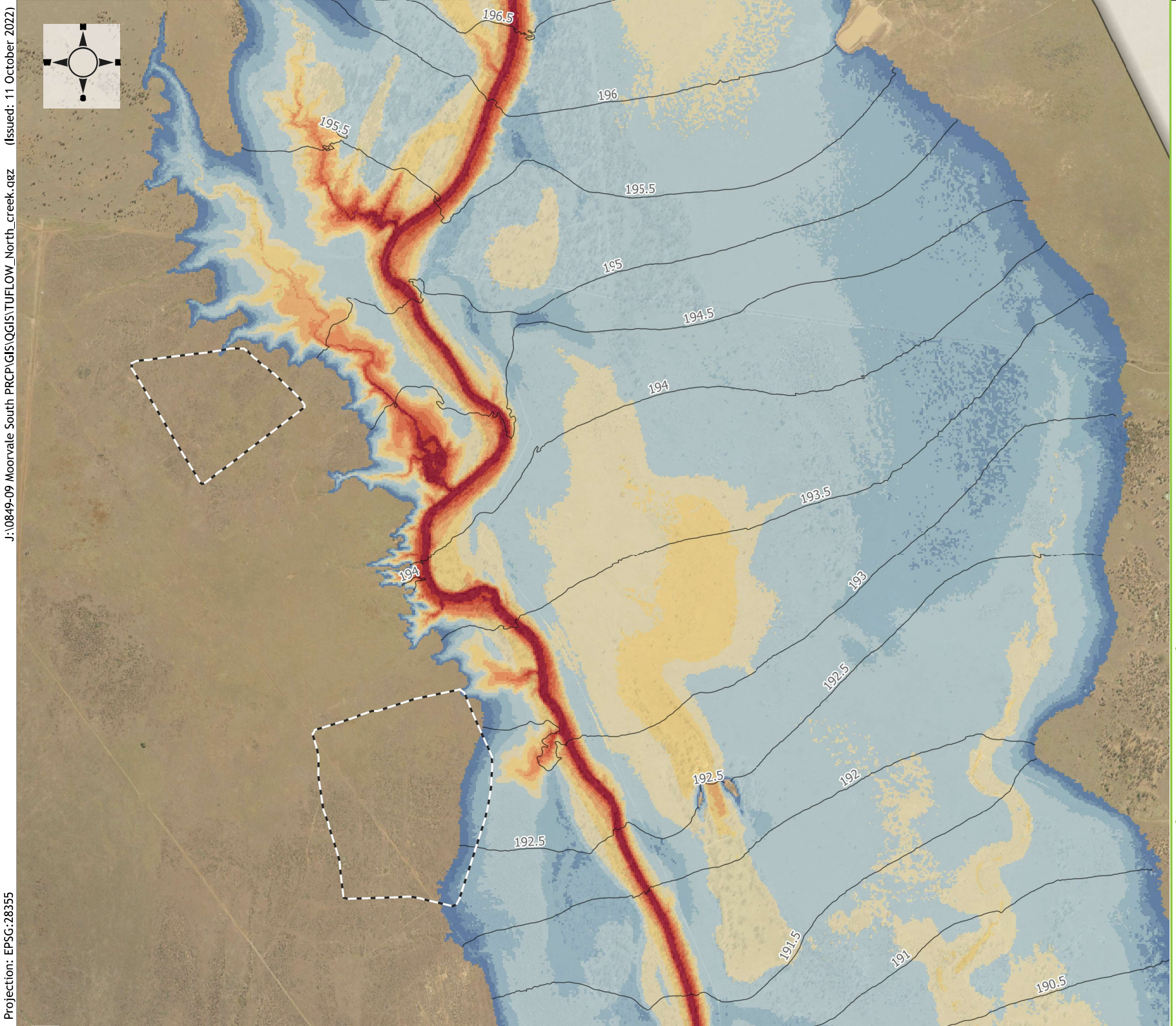
Moorvale South PRCP

North Creek 0.1% AEP event
Existing conditions

wrm water + environment

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Projection: EPSG:28355



Legend

- Final voids
- Contour (0.5m)
- up to 0.25m
- 0.25 to 0.5m
- 0.5 to 1.0m
- 1.0 to 2.0m
- 2.0 to 3.0m
- 3.0 to 4.0m
- 4.0 to 5.0m
- 5.0 to 6.0m
- 6.0 to 7.0m
- 7.0 to 8.0m
- > 8.0m

0 250 500 m

Moorvale South PRCP

North Creek PMF event
Existing conditions

wrm water + environment

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Projection: EPSG:28355

Final void hydrology report

Moorvale South PRCP

AARC Environmental Solutions Pty Ltd

0849-09-G4, 17 March 2023

For and on behalf of WRM Water & Environment Pty Ltd
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Principal Engineer

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1 Introduction

WRM Water & Environment Pty Ltd (WRM) was engaged by AARC Environmental Solutions (on behalf of Peabody Energy Australia [PEA]) to undertake a void hydrology assessment. This assessment is to support the Progressive Rehabilitation and Closure (PRC) Plan for the Moorvale South (MSV) coal mine in addition to an EA amendment application. The original mine plan included five residual voids. The EA amendment application is for a revised mine plan which has reduced the number of voids to two. The MVS coal mine is operated by PEA.

WRM has modelled the long-term final void hydrology and water quality behaviour of the proposed Z Pit and X Pit final voids over a 665-year post-closure period to assess whether the final voids would be safe and non-polluting. This report outlines the methodology and assessment of the expected final void pit lake behaviour, which has been modelled using the GoldSim water balance simulation software.

2 Final void geometry

The proposed final landscape of MVS incorporates two residual voids near the North Creek floodplain (Z Pit and X Pit) and an elevated rehabilitated overburden dump. This landform would form during mining, incorporating in-pit backfilled spoil sitting atop a mined pit shell. A digital elevation model (DEM) of the mined pit shell and the final landform (i.e. the final surface expected at the end of the mine life) was provided by AARC.

Figure 2.1 and Figure 2.2 show the stage-storage curve derived for the final voids for Z Pit and X Pit.

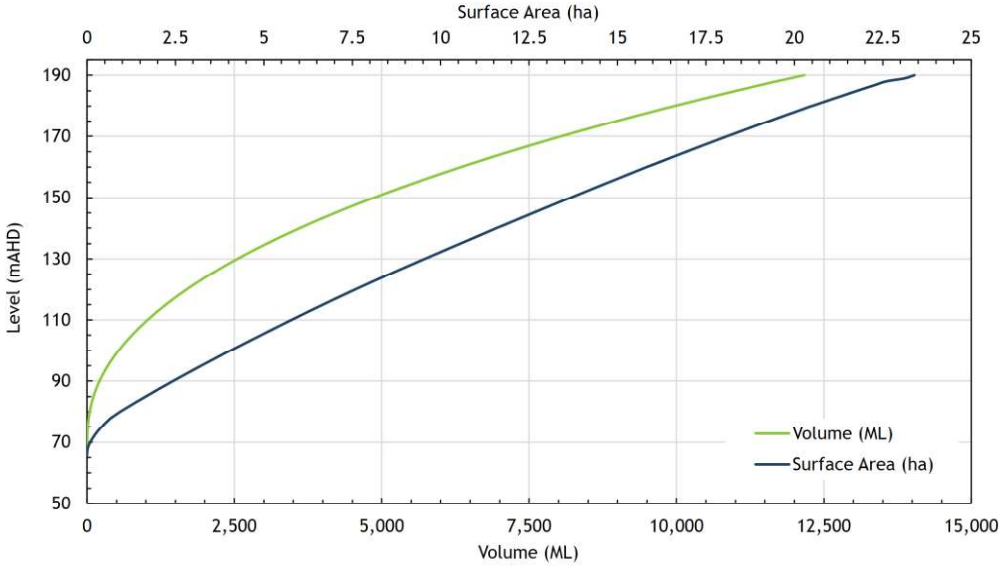


Figure 2.1 - Final void stage-storage and surface area curve - Z Pit

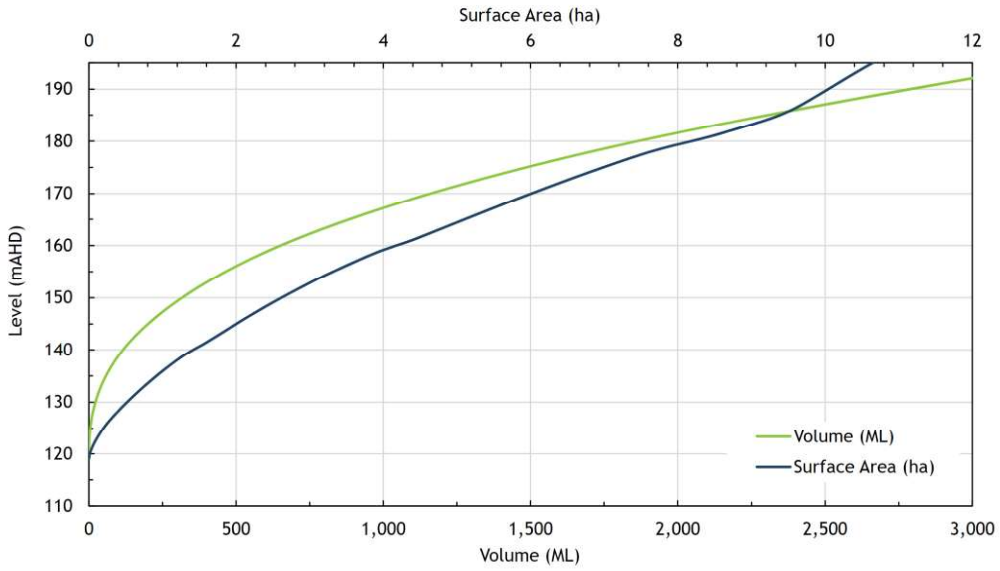


Figure 2.2 - Final void stage-storage and surface area curve - X Pit

3 Model configuration

3.1 MODELLING APPROACH

The GoldSim software platform was used to simulate the long-term water level behaviour, salinity, and the interaction of the pit lake water with the surrounding groundwater table for the two voids. Water levels in the residual voids would vary over time, depending on the prevailing climatic conditions, and the balance between evaporation losses and inflows from rainfall, surface runoff, and groundwater.

The GoldSim model was used to simulate the generation, movement, and loss of water on a daily time-step within the final void, over a 665-year period. The volume of water in the voids was calculated at each time step as the sum of direct rainfall to the void surface, catchment runoff, and groundwater inflows, less evaporation losses. The model also tracks the quantity of salt captured and stored within the system.

Key components of the model are summarised in the following sub-sections, including descriptions of key model inputs, assumptions, and sensitivity parameters.

3.2 CLIMATE DATA

3.2.1 Existing climate

Long-term daily rainfall and evaporation data for the area from January 1889 to December 2021 (133 years) obtained from the SILO database (which is hosted by the Department of Environment and Science [DES]) and forms the basis of the simulation (Jeffry, S.J et al, 2001).

Figure 3.1 shows the long-term monthly averages for the Morton Lake evaporation and rainfall data. Morton's Lake evaporation has been used to estimate evaporation losses from storages.

The 133 years of SILO rainfall and evaporation data was repeated five times to create an indicative long-term (665 year) climate sequence.

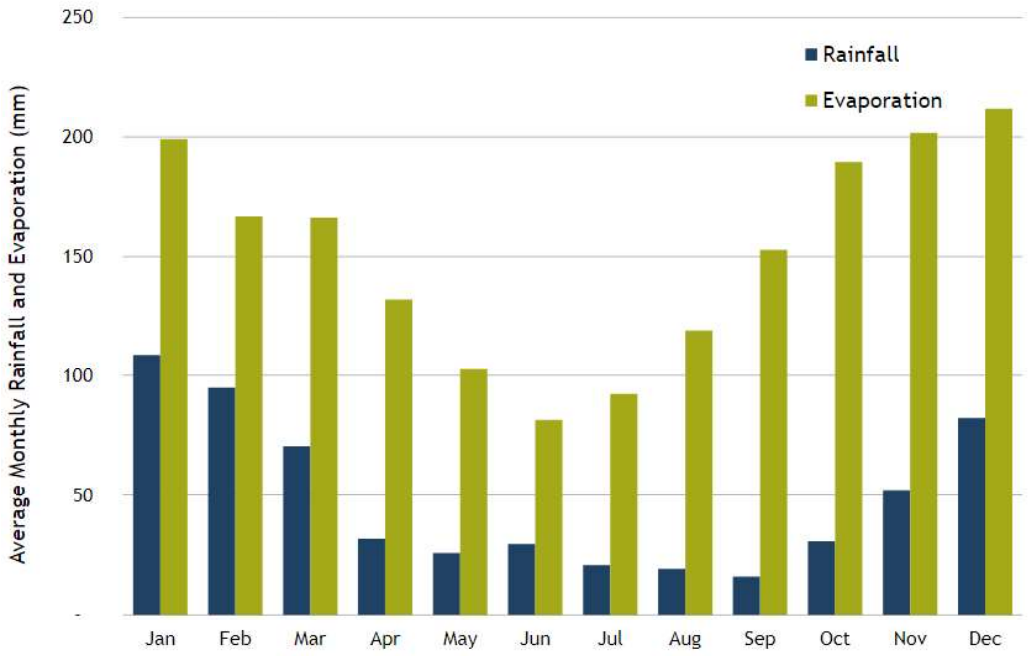


Figure 3.1 - Distribution of monthly rainfall and Morton Lake evaporation (SILO 1889 - 2021)

Evaporation from the final void pit lake is impacted by the final void geometry. The pit walls shade the pit lake which reduces the hours of direct sunlight on the pit lake and reduces evaporation. The depth of the pit lake below natural surface can reduce wind velocities, which increases humidity at the pit lake surface and reduces evaporation. A pit evaporation factor is applied to the daily evaporation to account for these factors.

The shape of the pit lakes at MVS change as the water level increases. Initially, the lake is contained within the 'pit' footprint. As the water level increases, the pit lake takes on a shape that is more like a conventional lake rather than a pit lake. However, due to the mine having a 'depressed' landform, the pit lake may still have some sheltering effects from wind.

To simulate this variation in the pit lake shape, the evaporation rate has been varied through the use of a pit evaporation factor. The pit evaporation factor has been applied to the pit lake in the following way for Z Pit:

- Pit evaporation factor of 0.7 when the water level is at the floor of the final landform (approximately 66 mAHD - 130 m below the pit crest);
- As the water level increases, the pit evaporation factor increases linearly to 0.9 at 184 mAHD (10 m below the pit crest) when the pit lake shape begins to reflect conventional lakes; and
- As the water level increases above 184 m AHD, the pit evaporation factor increases linearly to 1 at 194 mAHD (the pit overflow level).

The pit evaporation factor has been applied to the pit lake in the following way for X Pit:

- Pit evaporation factor of 0.7 when the water level is at the floor of the final landform (approximately 120 mAHD - 74 m below the pit crest);

- As the water level increases, the pit evaporation factor increases linearly to 0.8 at 180 mAHD (10 m below the pit crest) when the pit lake shape begins to reflect conventional lakes; and
- as the water level increases above 180 m AHD, the pit evaporation factor increases linearly to 1 at 190 mAHD (the pit overflow level).

Evaporation in the pit lakes was also adjusted to account for the effects of salinity in accordance with Morton's formula for reduced evaporation rate i.e. $1/(1+Sx10^{-6})$ (Morton et al, 1985).

3.2.2 Future climate

Climate-change adjusted SILO climate data are available from the Queensland Government Department of Environment and Science (DES) and were developed as part of the Consistent Climate Scenarios (CCS) project. The CCS project hosts data from 19 separate global climate models (GCMs), which explore four emissions scenarios, three timing horizons and three climate warming sensitivities. The nineteen separate models can be split into four Representative Future Climate (RFC) partitions, defined below:

- HI: a high level of global warming, where the Eastern Indian Ocean (EIO) warms faster than the Western Pacific Ocean (WPO);
- HP: a high level of global warming, where the WPO warms faster than the EIO;
- WI: a low level of global warming, where the EIO warms faster than the WPO; and
- WP: a low level of global warming, where the WPO warms faster than the EIO.

Figure 3.2 is an excerpt from the CCS project user guide (DSITIA, 2015) showing the four RFC quadrants, component models and indicative rainfall trends. The caption associated with the original version of this figure has been reproduced as a footnote[1].

Data based on the mean result of all models within each RFC quadrant is offered by the CCS for applications in which considering the output of all 19 models is not feasible/practical. This approach has been followed for the purposes of assessing climate change sensitivity as part of current investigations. Table 3.1 and Table 3.2 list the percentage change in evaporation and rainfall respectively, based on mean output for the four RFC quadrants. Data is based on the most conservative carbon emission rate (RCP8.5) available in the CCS dataset, and expected climate as at 2070. Data has been listed for the low, medium and high sensitivities. Information is for the MVS mine location.

The adjustments listed in Table 3.1 and Table 3.2 have been applied to the long-term SILO daily climate time-series and passed through the AWBM rainfall runoff sub-model to produce daily estimates of runoff (rehabilitated land use AWBM parameter set used). Annual average runoff depths have been plotted against average annual net evaporation depths (evaporation minus rainfall) in Figure 3.3 to illustrate the potential to impact on long-term water levels in the rehabilitated pit landform for the Project. Note the naming convention used in the figure, and henceforth in this document, is XX.Y where XX is the scenario (e.g. HI) and Y is the sensitivity (e.g. medium).

Figure 3.3 shows that all scenarios predict increases in net evaporation, and that all scenarios except the WP scenarios predict reductions in runoff. It is evident that all scenarios will result in lower final water levels than the base case scenario. The sensitivity of water levels to changes in the future climate have been assessed by modelling all the above scenarios.

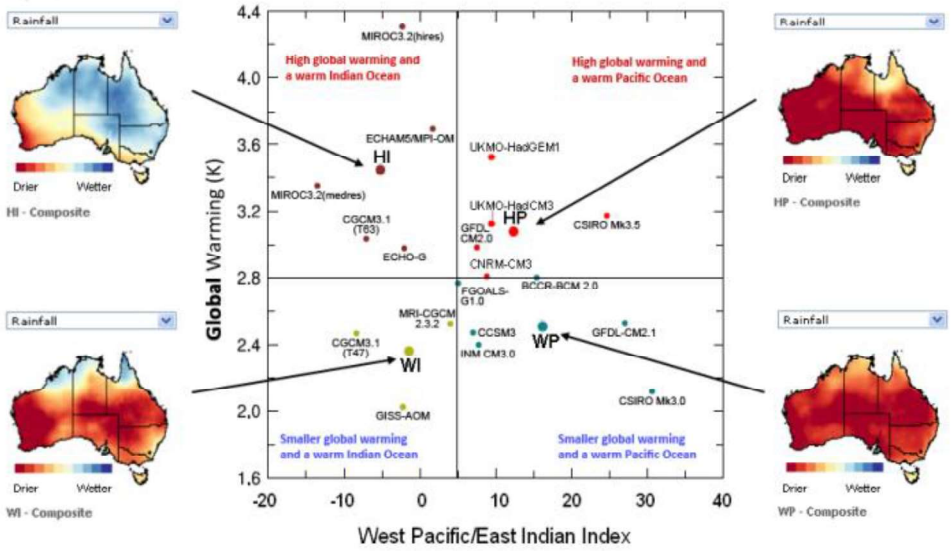


Figure 3.2 – A partition of Global Climate Models for future climate using global warming sensitivity and ocean warming indices (source: DSITIA, 2015)

[1] From DSITIA, 2015 – Figure 8.1 (verbatim): A partition of CMIP3 Global Climate Models (GCMs) for future climate using global warming sensitivity and ocean warming indices (adapted from Watterson, 2011). Values for nineteen individual GCMs (forced by the SRES A1B emissions scenario) are represented by the small dots and labelled by their GCM model code (Table 8.2). The central horizontal and vertical lines separate the four Representative Future Climate (RFC) partitions. The larger dots indicate the CCS composite means for GCMs within each of the four RFC responses: (HI) high global warming and a warmer Indian Ocean; (HP) high global warming and a warmer Pacific Ocean; (WI) lower global warming and a warmer Indian Ocean and (WP) lower global warming and a warmer Pacific Ocean. The maps show projected 21st Century changes in rainfall for the GCMs clustered in each of the four (HI, HP, WI and WP) RFC partitions.

Table 3.1 – Percentage change in evaporation by model and sensitivity

Model*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
HI (high)	18.3	18.5	20.2	12.4	11.5	9.0	6.9	4.9	10.3	10.0	15.7	12.5	12.9
HI (med)	11.3	11.5	12.4	7.7	7.0	5.2	4.1	2.8	6.4	6.3	9.8	7.8	7.8
HI (low)	6.1	6.2	6.7	4.1	3.7	2.7	2.1	1.4	3.5	3.5	5.4	4.2	4.1
HP (high)	19.8	19.3	19.6	16.3	16.0	15.9	11.8	12.3	13.8	14.5	14.1	14.9	15.5
HP (med)	12.5	12.1	12.3	10.2	10.0	9.9	7.3	7.8	8.7	9.2	9.0	9.5	9.7
HP (low)	6.9	6.6	6.7	5.6	5.5	5.4	4.0	4.3	4.8	5.1	5.0	5.3	5.2
WI (high)	17.6	16.2	12.2	8.6	7.0	8.5	8.8	5.9	9.0	6.9	8.8	12.0	10.2
WI (med)	11.1	10.1	7.5	5.2	4.1	5.1	5.3	3.6	5.6	4.2	5.5	7.5	6.2
WI (low)	6.1	5.5	4.0	2.8	2.1	2.6	2.8	1.9	3.1	2.2	3.0	4.1	3.2
WP (high)	30.3	17.5	22.3	19.8	23.7	16.7	12.7	9.3	9.1	13.0	18.7	13.7	17.1
WP (med)	19.1	10.8	14.0	12.5	14.8	10.1	7.7	5.6	5.6	8.2	11.8	8.5	10.5
WP (low)	10.5	5.8	7.6	6.9	8.1	5.4	4.1	3.0	3.0	4.5	6.5	4.6	5.6

Note: * model is RFC partition, text in brackets is the sensitivity

Table 3.2 – Percentage change in rainfall by model and sensitivity

Model*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
HI (high)	-26.9	7.1	-4.5	-41.6	39.7	-37.4	4.2	25.6	-4.6	-13.4	-42.3	-0.5	-9.9
HI (med)	-18.1	4.7	-3.0	-27.9	26.7	-25.1	2.8	17.2	-3.1	-9.0	-28.4	-0.3	-6.7
HI (low)	-10.5	2.7	-1.7	-16.2	15.5	-14.6	1.6	10.0	-1.8	-5.2	-16.4	-0.2	-3.9
HP (high)	-9.0	-13.6	3.5	-16.7	-36.5	-33.8	-19.7	-30.0	-41.7	-66.5	-47.7	-28.2	-23.3
HP (med)	-6.0	-9.1	2.3	-11.2	-24.5	-22.7	-13.2	-20.1	-28.0	-44.6	-32.0	-18.9	-15.6
HP (low)	-3.5	-5.3	1.4	-6.5	-14.2	-13.1	-7.6	-11.7	-16.2	-25.9	-18.6	-11.0	-9.1
WI (high)	-13.0	-5.3	4.4	-1.1	-2.2	-12.1	-2.3	3.2	-10.3	-9.6	-22.4	-21.1	-9.5
WI (med)	-8.7	-3.6	2.9	-0.7	-1.5	-8.1	-1.6	2.1	-6.9	-6.4	-15.0	-14.2	-6.4
WI (low)	-5.0	-2.1	1.7	-0.4	-0.8	-4.7	-0.9	1.2	-4.0	-3.7	-8.7	-8.2	-3.7
WP (high)	-19.4	20.3	-2.9	-10.4	-77.8	12.5	-8.4	54.2	19.0	-32.3	-40.2	18.0	-6.0
WP (med)	-13.0	13.6	-2.0	-7.0	-52.2	8.4	-5.6	36.3	12.8	-21.7	-27.0	12.0	-4.1
WP (low)	-7.5	7.9	-1.1	-4.0	-30.3	4.8	-3.3	21.1	7.4	-12.6	-15.7	7.0	-2.4

Note: * model is RFC partition, text in brackets is the sensitivity

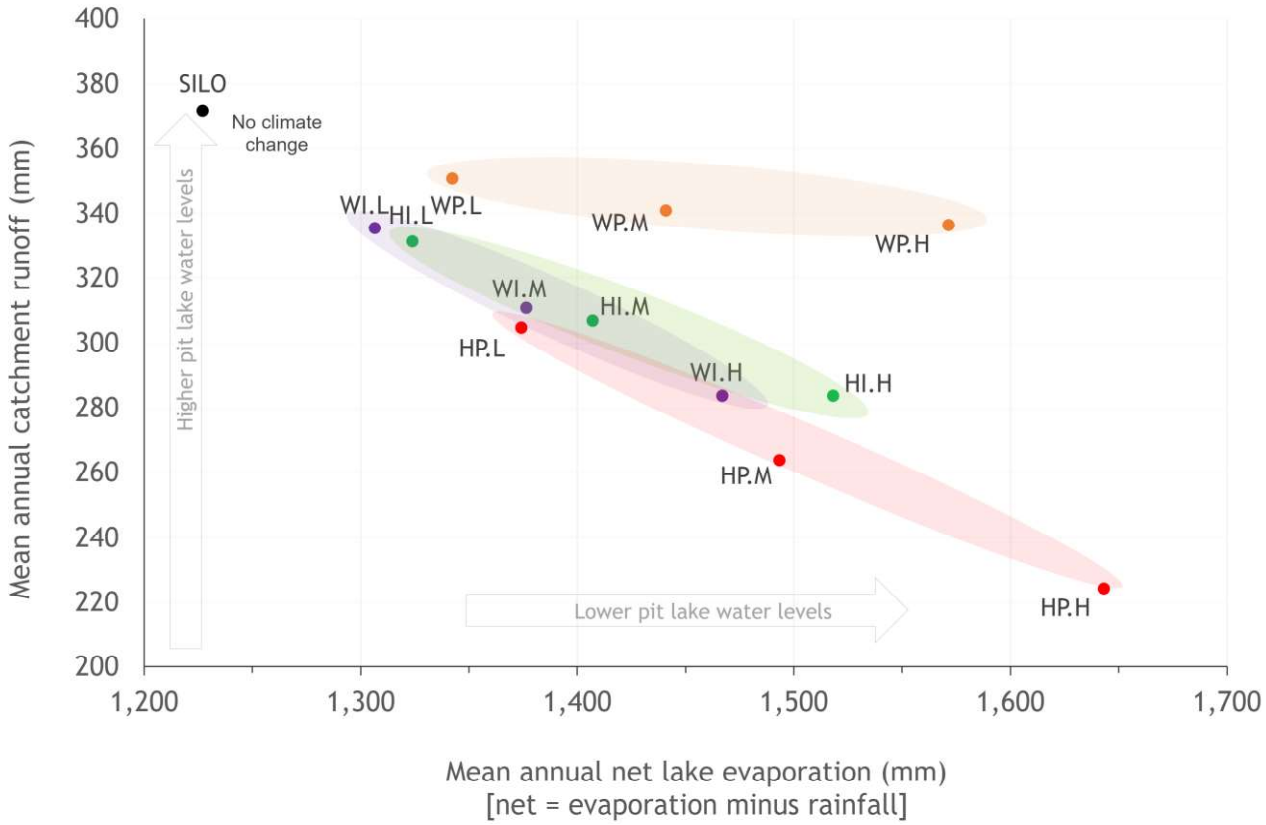


Figure 3.3 – Plot of net evaporation versus runoff for HI, HP, WI and WP GCM groupings

3.3 CATCHMENT RUNOFF

3.3.1 Catchment areas

The final landform catchment area was delineated from the final landform surface. It is proposed that the voids will be bunded to prevent inflow from an external catchment. The catchment area is therefore limited to the edges of the void. The landuse of the void has been characterise as spoil.

Figure 3.5 shows the catchment boundary and land uses adopted for the final void water balance. The catchment and land use values used in the GoldSim model are shown in Table 3.3.

Table 3.3: Final void catchment and land use areas (ha)

Catchment	Undisturbed	Rehabilitated spoil	Spoil	Total
Z Pit	0	0	26.79	26.79
X Pit	0	0	11.45	11.45

3.3.2 AWBM parameters

The GoldSim model incorporates the Australian Water Balance Model (AWBM) (Boughton and Chiew, 2003) to estimate daily runoff from daily rainfall. The AWBM is a saturated overland flow model which allows for variable source areas of surface runoff.

The AWBM uses a group of connected conceptual storages (three surface water storages and one ground water storage) to represent a catchment. Water in the conceptual storages is replenished by rainfall and is reduced by evapotranspiration. Simulated surface runoff occurs when the storages fill and overflow. Figure 3.4 shows the conceptual configuration of the AWBM model.

The model uses daily rainfalls and estimates of catchment evapotranspiration to calculate daily values of runoff using a daily balance of soil moisture. Runoff depth calculated by the AWBM model is converted into runoff volume by multiplying the contributing catchment area.

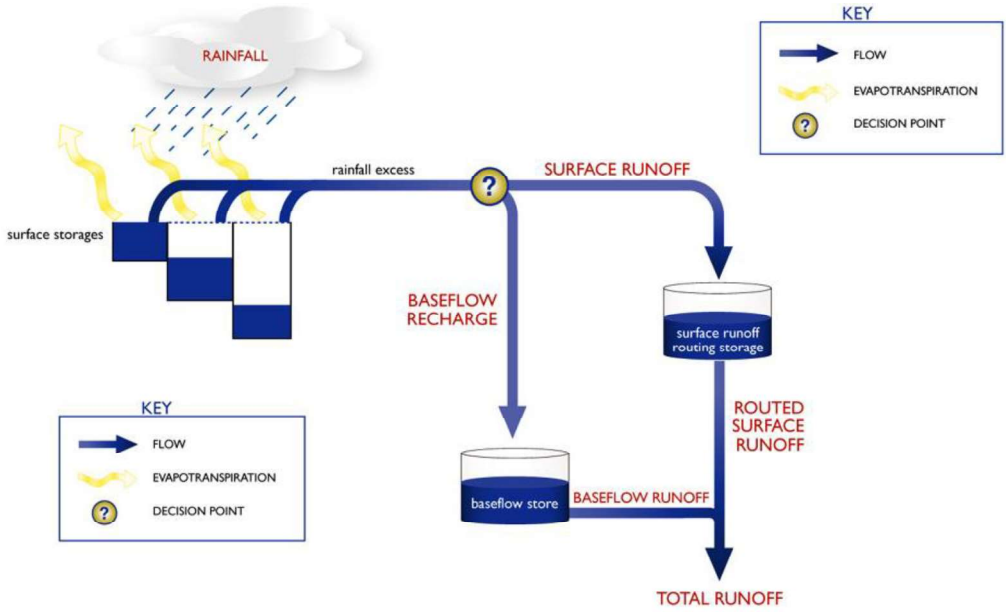


Figure 3.4 – Australian Water Balance Model configuration

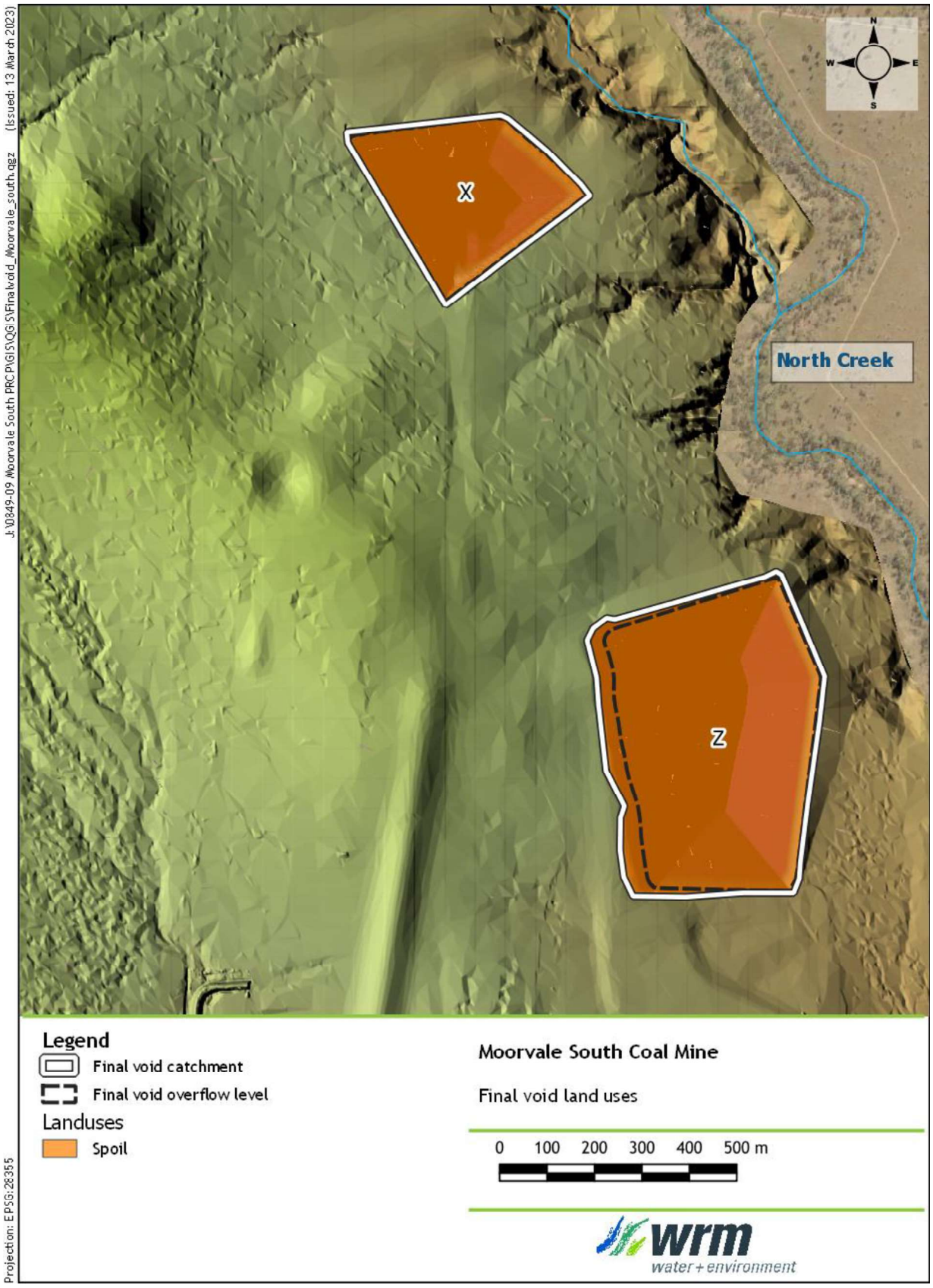


Figure 3.5 - Final void catchment/land uses

At each time step, the AWBM performs the following calculations:

Rainfall is added to each of the three surface moisture stores and evapotranspiration is subtracted from each store. The water balance equation is:

$$store_n = store_n + rain - evap \ (n = 1 \text{ to } 3).$$

If the value of moisture in the store becomes negative, it is reset to zero. If the value of moisture in the store exceeds the capacity of the store, the moisture in excess of capacity becomes runoff and the store is reset to the capacity.

When runoff occurs from any store, part of the runoff becomes recharge of the baseflow store. The fraction of the runoff used to recharge the baseflow store is BFI*runoff, where BFI is the baseflow index.

The remainder of the runoff, i.e. (1.0 - BFI)*runoff, is surface runoff.

The baseflow store is depleted at the rate of (1.0 - K)*BS where BS is the current moisture in the baseflow store and K is the baseflow recession constant of the time step being used (daily).

The surface runoff can be routed through a store if required to simulate the delay of surface runoff reaching the outlet of a medium to large catchment. The surface store acts in the same way as the baseflow store and is depleted at the rate of (1.0 - KS)*SS, where SS is the current moisture in the surface runoff store and KS is the surface runoff recession constant of the time step being used.

The model parameters define the storage depths, the proportion of the catchment represented by each of the storages, and the rate of flux between them (Boughton and Chiew, 2003).

The AWBM model parameters were selected for consistency with a model prepared for the existing operation (WRM, 2019).

The model divides the different land use types into separate model runoff sources. The adopted parameters and long-term runoff coefficients for each of the catchment land use types are presented in Table 3.4.

The surface runoff catchment area draining to the rehabilitated pit landform was determined based on the final landform design. The following land use assumptions were adopted:

- The final voids have been backfilled and therefore modelled as spoil.
- The final voids are protected by bunds that reduce the runoff catchment area to the voids; and
- Direct rainfall onto the pond surface was modelled with no losses and zero salinity.

Table 3.4: Adopted AWBM parameters

Parameter	Undisturbed	Spoil/Dump	Rehab spoil
A1	0.2	0.134	0.134
A2	0.4	0.433	0.433
A3	0.4	0.433	0.433
C1 (mm)	60	12	12
C2 (mm)	90	30	60
C3 (mm)	180	140	140
C_{avg} (mm)	120	75	88
BFI	0	1	0.3
K_{base}	0	0.9	0.9
K_{surf}	0	0.7	0.7

Parameter	Undisturbed	Spoil/Dump	Rehab spoil
Cv	8%	5%	4%

3.4 SALINITY OF THE PIT LAKE

Sources of salinity in the final void pit lake include:

- runoff and seepage from the final void catchments; and
- groundwater inflows.

The water balance model was configured to use electrical conductivity (EC) as an indicator of water quality. Salts are modelled as a conservative solute balance. This was achieved by assigning representative EC to runoff from catchments and other sources of water.

The adopted EC values for different land uses are based on the modelling for the MVS water balance undertaken by WRM (WRM, 2019) and shown in Table 3.5.

Table 3.5: Adopted salinity concentrations

Landuse	Electrical conductivity (µS/cm)
Spoil	750
Groundwater	2,985

3.5 GROUNDWATER INFLOWS

Groundwater inflow rates have been by provided the project groundwater consultants (SLR Consulting [2023]) with the inflow rate for Z Pit estimated at 1.7 L/s (i.e. approximately 147 kL/d) and the inflow rate for X Pit estimated at 0.30 L/s (i.e. approximately 26 kL/d). Groundwater inflow includes baseflow through the spoil and so a baseflow component has not been included in the AWBM model.

4 Final void results

4.1 OVERVIEW

The final void was modelled using the assumptions outlined in Section 3 and the results are outlined in Section 4.2. In addition, analysis of the final void behaviour for extreme rainfall events was undertaken as outlined in Section 4.3.

4.2 FINAL VOID MODEL RESULTS

4.2.1 Climate change analysis

The model was first run for the base case (looped historical SILO data) and the twelve climate change scenarios discussed in Section 3.2.2. The median water level result was selected from these scenarios for further modelling using a Monte Carlo approach.

The median scenario for Z Pit was HI.M. The peak water level for this scenario in Z Pit is 127.3 mAHD. The median scenario of X Pit is WP.M. The peak water level for this scenario is 147.5 mAHD. These peak water levels are 47 m and 63 m below the Z Pit and X Pit spill levels respectively. The results for all climate change scenarios for Z Pit and X Pit are shown in Figure 4.1 and Figure 4.2 respectively.

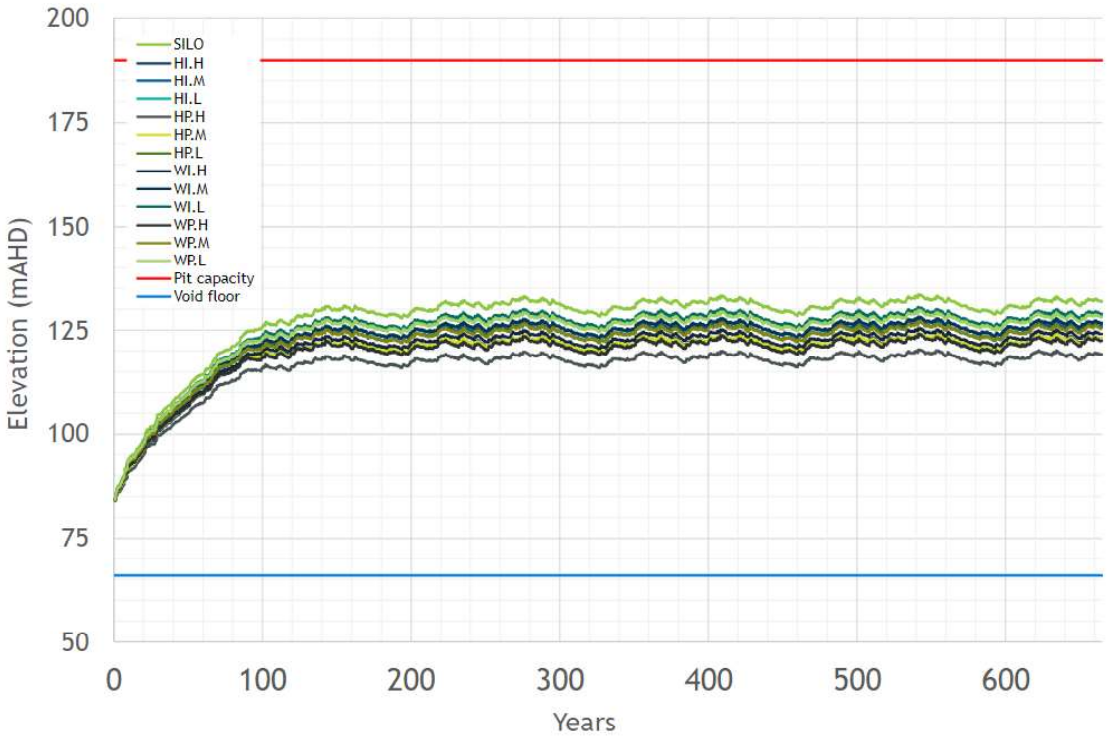


Figure 4.1 – Z Pit void - long-term predicted void water level for all scenarios

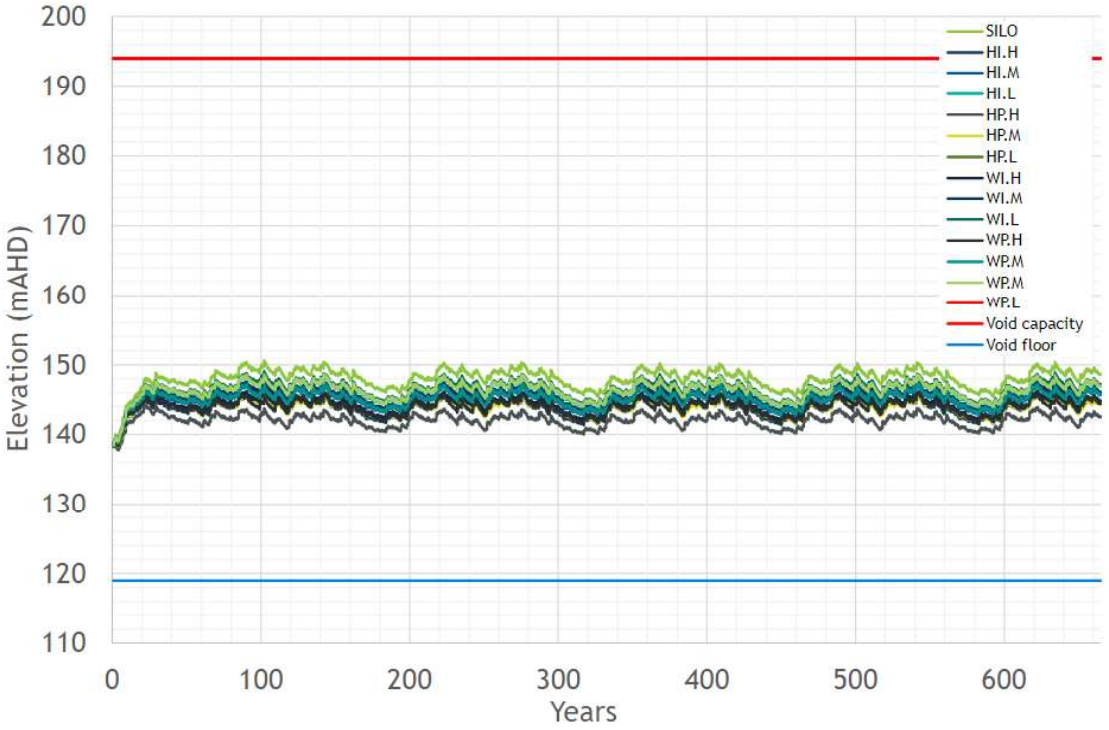


Figure 4.2 – X Pit void - long-term predicted void water level for all scenarios

4.2.2 Monte Carlo analysis

The HI.M and WP.M scenarios were analysed further using a Monte Carlo approach to account for parameter uncertainty. In this approach, the simulation is repeated many times, with each simulation using parameters sampled from predefined probability functions.

For the MVS final void assessment, uncertainties in catchment runoff characteristics were modelled by allowing the AWBM bucket capacities to vary randomly within ± 20% of their base case values with a triangular probability distribution. The model was run for 1,000 simulations to test the sensitivity of final void water levels to runoff behaviour. The 95th percentile result was selected as a reasonably conservative upper estimate final void water levels. This level is the water level that would be equalled or exceeded in only 5% of all the simulations that were run.

The 95th percentile water level time series are shown in Figure 4.3 and Figure 4.4 for Z Pit and X Pit respectively.

For Z Pit the model results show:

- The final void water level reaches equilibrium after about 140 years, with the void oscillating between approximately 122 and 127 mAHD thereafter (as shown on Figure 4.3).
- Groundwater table elevation in the vicinity of the Project site outside the immediate influence of the final voids approximates 170 mAHD (SLR, 2023) and therefore the final void forms a long-term groundwater sink.
- The maximum modelled 95th percentile water level is 127.5 mAHD.
- This water level is approximately 62 metres below the pit overflow level.

For X Pit the model results show:

- The final void water level reaches equilibrium after about 25 years, with the void oscillating between approximately 142 and 148 mAHD (as shown on Figure 4.4).
- Groundwater table elevation in the vicinity of the Project site outside the immediate influence of the final voids approximates 170 mAHD (SLR, 2023) and therefore the final void forms a long-term groundwater sink.
- The maximum modelled 95th percentile water level is 147.7 mAHD.
- This water level is approximately 46 metres below the pit overflow level.

Table 4.1 shows a summary of the storage details of the residual voids and the results of the water balance modelling.

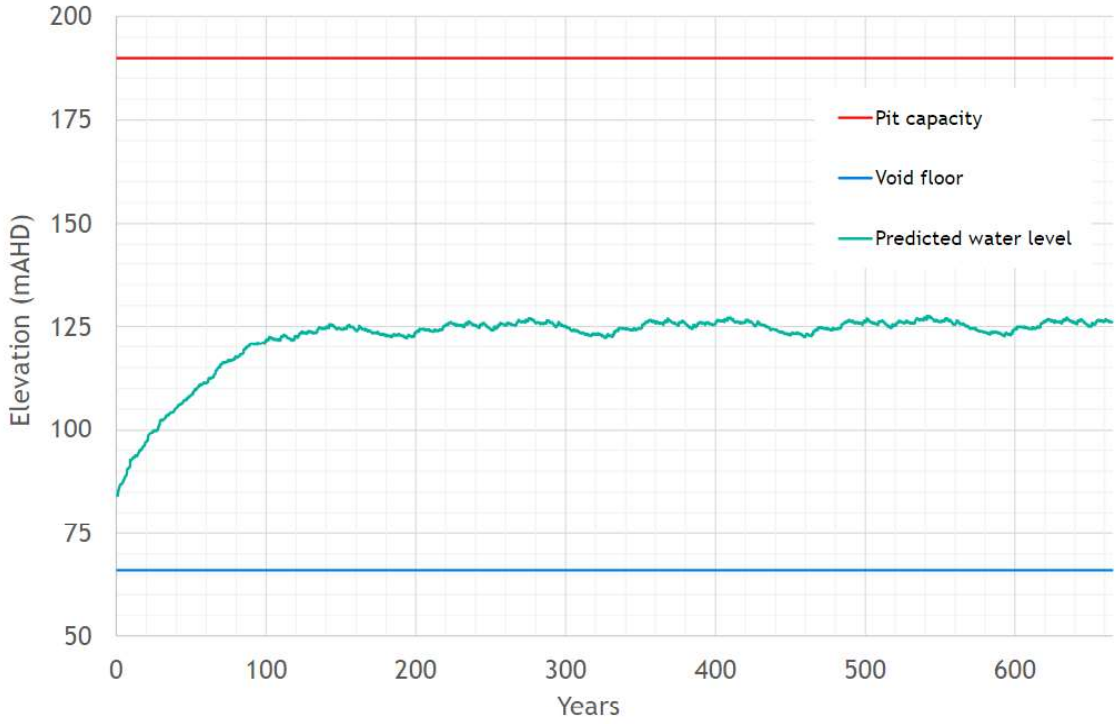


Figure 4.3 – Z Pit void long-term predicted void water level for 95th percentile Monte Carlo modelling

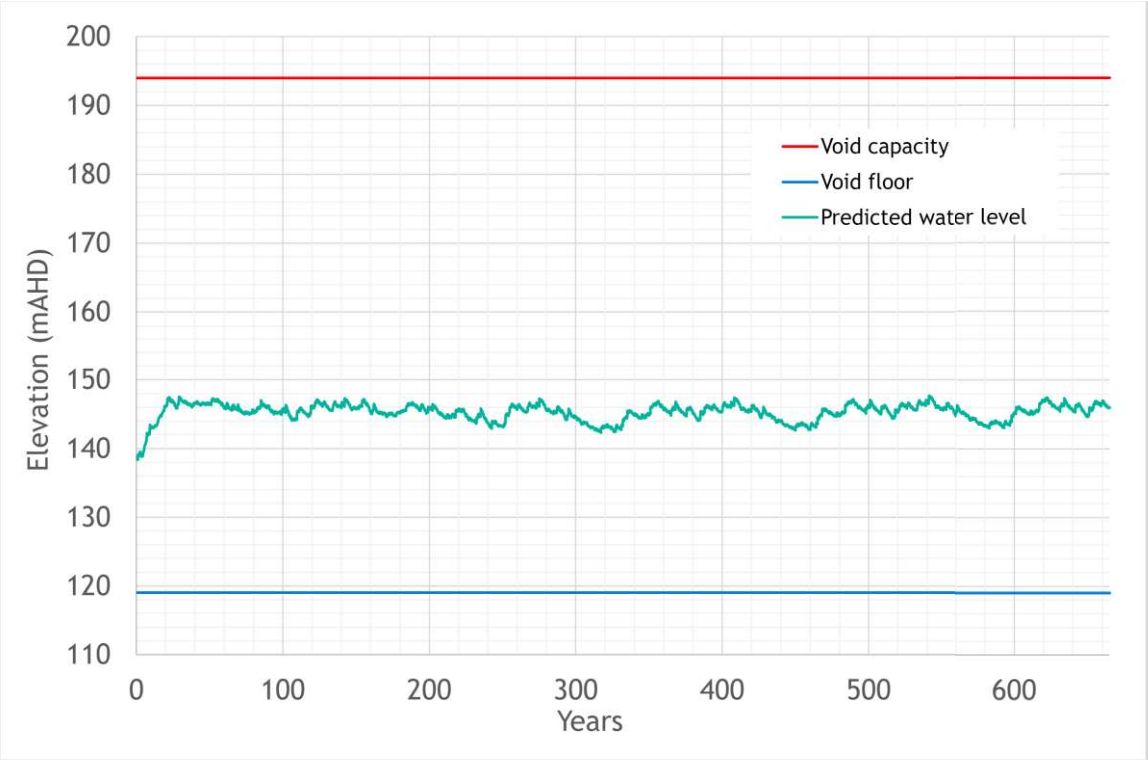


Figure 4.4 – X Pit void long-term predicted void water level for 95th percentile Monte Carlo modelling

Table 4.1 – Final void modelling results summary

Void	Elevation (mAHD)			
	Final landform floor level	Overflow level	Modelled average 95% long-term water level	Modelled peak 95% long-term water level
Z Pit	66	190	122.3	127.5
X Pit	119	194	145.3	147.7

4.2.3 Long-term salinity

The long-term salinity of the final voids progressively increases with time. This is expected for closed-loop systems with no mechanism for salt removal. The model results for salinity concentration and total salt load for Z Pit and X Pit are shown in Figure 4.5 and Figure 4.6 respectively.

The model results show the following:

- For Z Pit, the salinity of the pit lake progressively increases, rising to over 30,000 µS/cm after about 320 years and reaching a maximum salinity in the 665 year simulation of approximately 60,000 µS/cm. The salt load progressively increases, reaching about 83,000 tonnes after the 665-year modelled period.
- For X Pit, the salinity of the pit lake progressively increases, rising to over 85,000 µS/cm after about 320 years and reaching a maximum salinity of approximately 143,000 µS/cm. The salt load progressively increases, reaching about 16,500 tonnes after the 665-year modelled period.

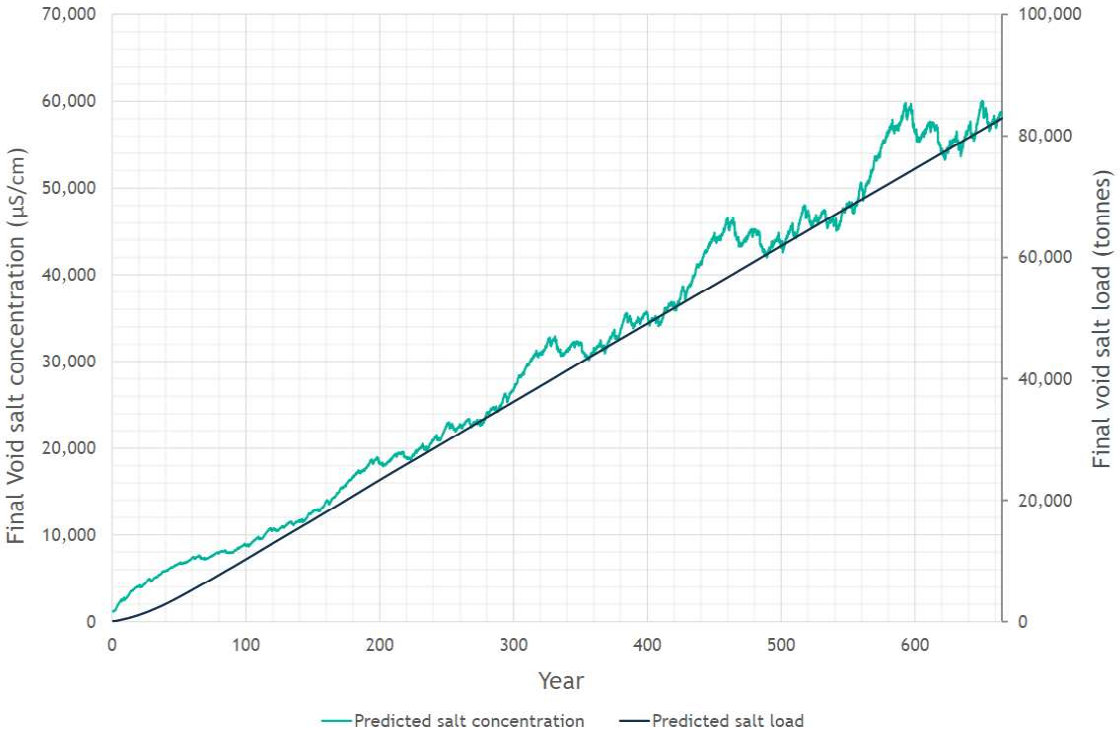


Figure 4.5 - Z Pit final void long-term predicted salinity concentration and load

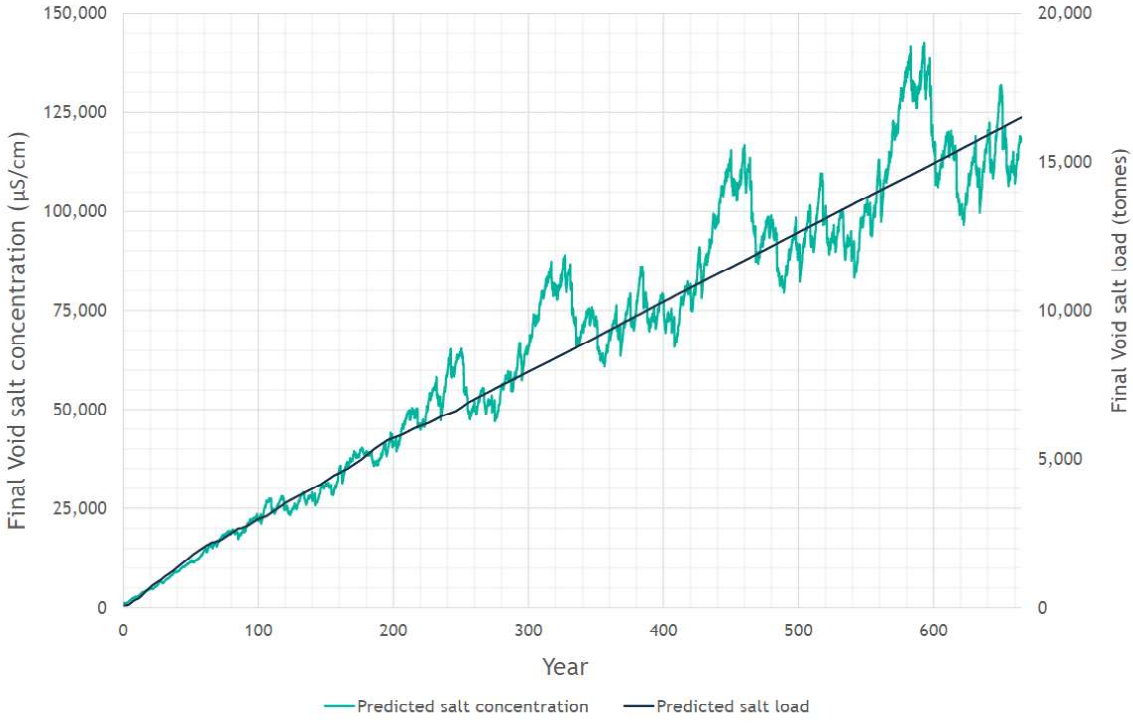


Figure 4.6 - X Pit final void long-term predicted salinity concentration and load

4.3 EXTREME STORM EVENT BEHAVIOUR

4.3.1 Methodology

An assessment of the impact of extreme storm events on the water levels in the final voids has been undertaken. The potential for discharge of void water during a large storm was assessed for the following 72-hour (3 day) design storms:

- 1 in 100 annual exceedance probability (AEP) (or 1% AEP);
- 1 in 1,000 AEP (or 0.1% AEP); and
- 1 in 2,000 AEP (or 0.05% AEP).

Design rainfall depths for the above events were estimated using standard procedures in Australian Rainfall and Runoff (ARR) (Ball *et al.*, 2019). The runoff generated from the storm events has been conservatively calculated assuming 100% of runoff reports to the voids (i.e. no losses) from the surface catchment reporting to the voids (26.8 ha for Z Pit and 11.5 ha for X pit).

4.3.2 Results

The results of the storm event analysis for Z Pit and X Pit are outlined in Table 4.2 and Table 4.3, respectively. The results show that even during a storm event with rainfall depths equivalent to the 1 in 2,000 AEP 72-hour storm, there would not be a significant impact on the level of water in the final voids.

If the storm occurred when the voids were at the maximum 95th percentile water level, the expected water level increases would be of the order of 1.9 m for Z Pit and 3.0 m for X Pit. The resultant 1 in 2,000 AEP design event peak water level is therefore 60 m below the void crest for Z Pit and 43 m below the void crest for X Pit.

Table 4.2 – Z Pit storm event modelling results summary

Storm Event (AEP)	Rainfall Depth (mm)	Runoff Volume (ML)	Final Volume (ML)	Final Level (mAHD)	Water Level Change (m)
1%	357	96	2,418	128.5	1.0
0.1%	570	153	2,475	129.2	1.7
0.05%	648	174	2,496	129.4	1.9

Table 4.3 – X Pit storm event modelling results summary

Storm Event (AEP)	Rainfall Depth (mm)	Runoff Volume (ML)	Final Volume (ML)	Final Level (mAHD)	Water Level Change (m)
1%	357	41	301	149.4	1.7
0.1%	570	65	325	150.3	2.6
0.05%	648	74	334	150.7	3.0

5 Summary and conclusions

A GoldSim water balance model was developed to assess the long-term water level and salinity behaviour at the proposed MVS final voids. The proposed final landscape of MVS incorporates two residual voids near the North Creek floodplain (Z Pit and X Pit) and an elevated rehabilitated overburden dump. The final voids are protected by a bund limiting the runoff catchment to the area of the voids. The final void was modelled for a 665-year period following mine closure.

The final void model results for Z Pit show the following:

- The final void reaches equilibrium after about 140 years, with the void oscillating between approximately 122 and 127 mAHD;
- Based on a groundwater table level of 170 mAHD (SLR, 2023), in the long-term, the void acts as a perpetual sink and does not contribute water or salinity to the surrounding groundwater system. Therefore forming a non-polluting landform.
- The maximum modelled water level is about 62 m below the void overflow level and therefore the risk of overtopping to the surrounding environment is low; and
- The salinity of the pit progressively increases over the simulation, reaching a maximum salinity of approximately 60,000 µS/cm.

The final void model results for X PZit showed the following:

- The final void reaches equilibrium after about 25 years, with the void oscillating between approximately 142 and 148 mAHD;
- Based on a groundwater table level of 170 mAHD (SLR, 2023), in the long-term, the void acts as a perpetual sink and does not contribute water or salinity to the surrounding groundwater system. Therefore, forming a non-polluting landform.
- The maximum modelled water level is about 46 m below the void overflow level and therefore the risk of overtopping to the surrounding environment is low; and
- The salinity of the pit progressively increases over the simulation, reaching a maximum salinity of approximately 143,000 µS/cm.

A storm event analysis was undertaken on the final voids, conservatively assuming 100% runoff. The storm analysis showed that runoff from a rare 72 hour event would not significantly impact on the final voids, with a 1 in 2,000 AEP 3-day storm increasing the Z Pit void water level by 1.9 m and the X Pit void water level by 3.0 m. If the storm occurred when water levels were at the simulated maximum, the increased water level would still be 60 m and 43 m below the void crests of Z Pit and X Pit respectively.

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MOORVALE SOUTH MINE

WATER MANAGEMENT PLAN

June 2022

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1 INTRODUCTION

1.1 BACKGROUND

Moorvale South Mine (MS) is a satellite pit of the Moorvale Mine (MM), with both sites extracting coal using open-cut coal mining operations. The MS site is within mine lease ML 70354, located 30 km southeast of Moranbah in Central Queensland, approximately 15 km south of MM. The haul road connecting MS and MM is situated within Mining Lease ML 70355. A location map of MS and MM sites is provided in Figure 1.1, also indicating proximity to nearby towns, regional transport networks, affected catchment watercourses, and rural property titles.

The Stage 1 (2020 to 2022) planned layout of MS is provided in Figure 1.2. The layout was revised during detailed planning and design of the MS operational areas and water management infrastructure (Figure 1.3). The site's water management infrastructure performance were designed to perform in accordance with the relevant regulatory requirements and statutory obligations of the Queensland Government's Environmental Protection Act (1994). All mining operations are obligated to receive an Environmental Authority (EA) permitting commencement of planned operations, and to ensure sustained compliance with the EAs specified approval conditions throughout the life of mine.

1.2 ENVIRONMENTAL AUTHORITY

The MS Environmental Authority EPML00380113 was executed 11th October 2021. The EA details legislated provisions that the mine lease holder is obliged to comply with, and the site-specific approval conditions for environmentally relevant activities undertaken within ML 70355 (the haul road) and ML 70354 (MS). The EA conditions relevant to Water management include general conditions for monitoring quality, maintaining monitoring measurements, reporting, and information required for the EA Amendment application due 30th June 2022.

Schedule G of the EA provides details of the approval conditions relating to the management of water onsite. In particular, the following conditions extracted from the MS EA define the requirements of the site's Water Management Plan.

Condition G28 – A Water Management Plan must be developed and implemented by 31 December 2011 that provides for the proper and effective management of the actual and potential environmental impacts resulting from the mining activity and to ensure compliance with the conditions of theenvironmental authority.

Condition G29 – The Water Management Plan must be developed in accordance with the DEHP Guideline for Preparing a Water Management Plan 2009 (to be developed by 1 October)or any updates that become available from time to time and must include at least the followingcomponents:

- Contaminant Source Study.
- Site Water Balance and Model.
- Water Management System.
- Saline Drainage Prevention and Management Measures.
- Acid Rock Drainage Prevention and Management Measures (if applicable).
- Emergency and Contingency Planning.
- Monitoring and Review.

Condition G30 – Each year the holder of this environmental authority must undertake a review of the Water Management Plan prior to the wet season (i.e., by 1 November) and a further review following the wet season (i.e., by 1 May the following year) to ensure that proper and effective measures, practices and procedures are in place so that the mine is operated in accordance with the conditions of this environmental authority and that environmental harm is prevented or minimise

Conditions A6 – A copy of the Water Management Plan and/or a review of the Water Management Plan must be provided to the administrating authority on request.

1.3 PURPOSE AND SCOPE

This purpose of this document is to report the plans for managing the range of water conditions reasonably expected on MS, to enable the project's objectives to be achieved. The actual and potential risks of environmental harm to receiving water flows posed by mining activities have been identified and management actions that will effectively minimise these risks are presented herein.

The MS Water Management Plan (WMP) aims to achieve this by balancing operational demands, storage capacities, storage volumes, transfer options, contingency measures, business objectives, option cost benefit, safety and risk, regulatory requirements, and system sensitivity to dynamic variables. Accrued operational experience is expected to allow for calibration of this WMP to continually improve its alignment with site conditions, therefore this document will be updated accordingly.

This WMP has been prepared to document MS compliance with the approval conditions specified within the Environmental Authority (EA) EPML00380113, effective 11 October 2021 under Chapter 5 of the Environmental Protection Act 1994. The WMP has been prepared in accordance with the following conditions of the MS EA:

1.4 RELATED DOCUMENTS

The WMP forms part of the MS Environmental Management System and should be read in conjunction with the following Moorvale documents:

- Erosion and Sediment Control Plan
- Operational Plans – Regulated Dams
- Consequence Category Assessment
- Water Balance Report
- Receiving Environment Management Plan
- Emergency Response Protocols

1.5 OUTLINE

This report is structured as follows:

- Section 2 describes the Environmental Values of the regional and local receiving waters.
- Section 3 presents the site operating activities including an assessment of the potential for generating contaminants onsite.
- Section 4 presents the surface WMS including the management objectives and principles.
- Section 5 provides a description of the site water balance and identifies the performance criteria for the WBM.
- Section 6 outlines the surface water monitoring strategy for the mine.
- Section 7 presents the Emergency Response Plan.
- Section 8 describes review of the WMP and proposed monitoring plan.
- Section 9 summarizes the WMP.
- Section 10 provides a list of references.

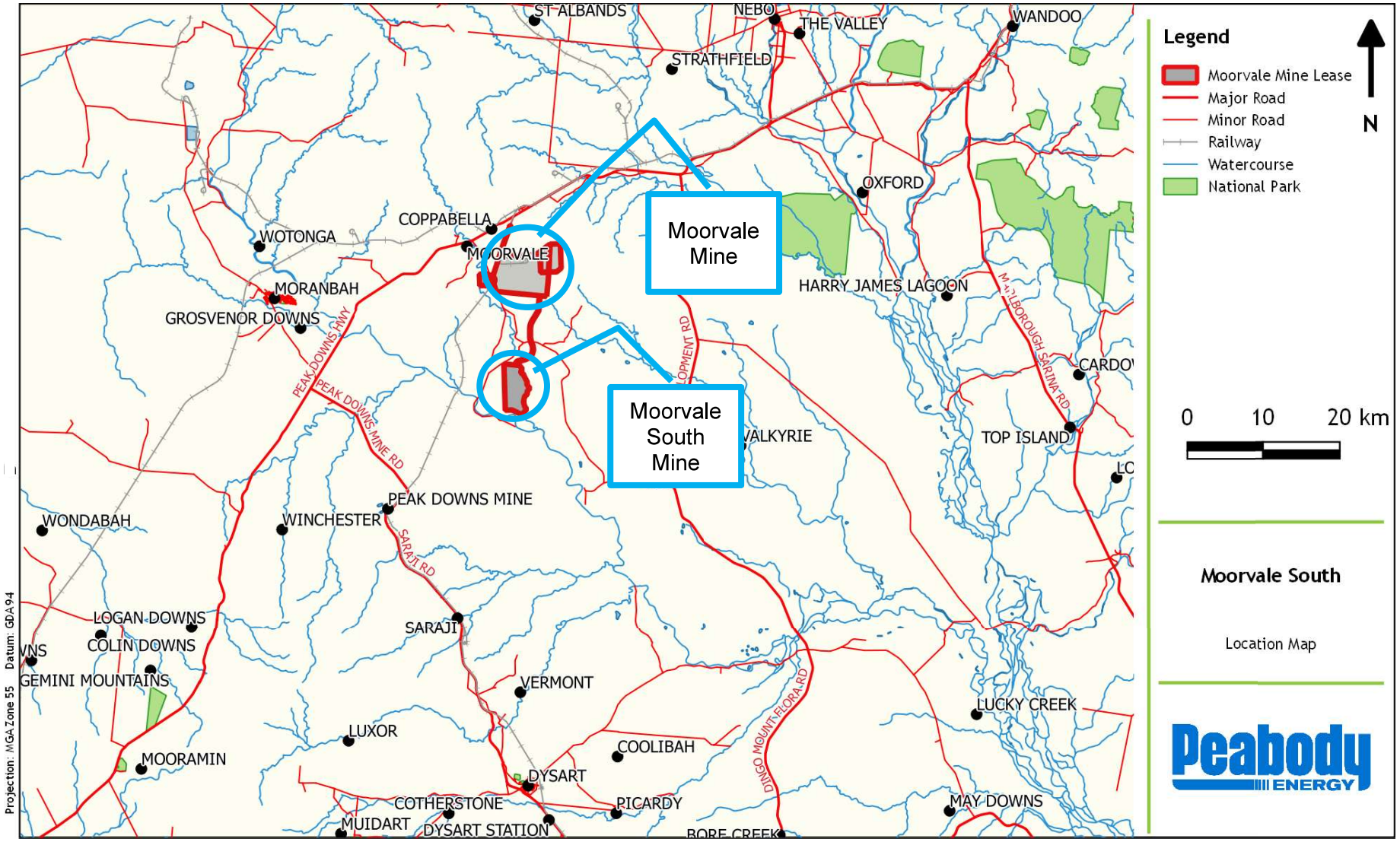


Figure 1: Moorvale South Mine Locality Map

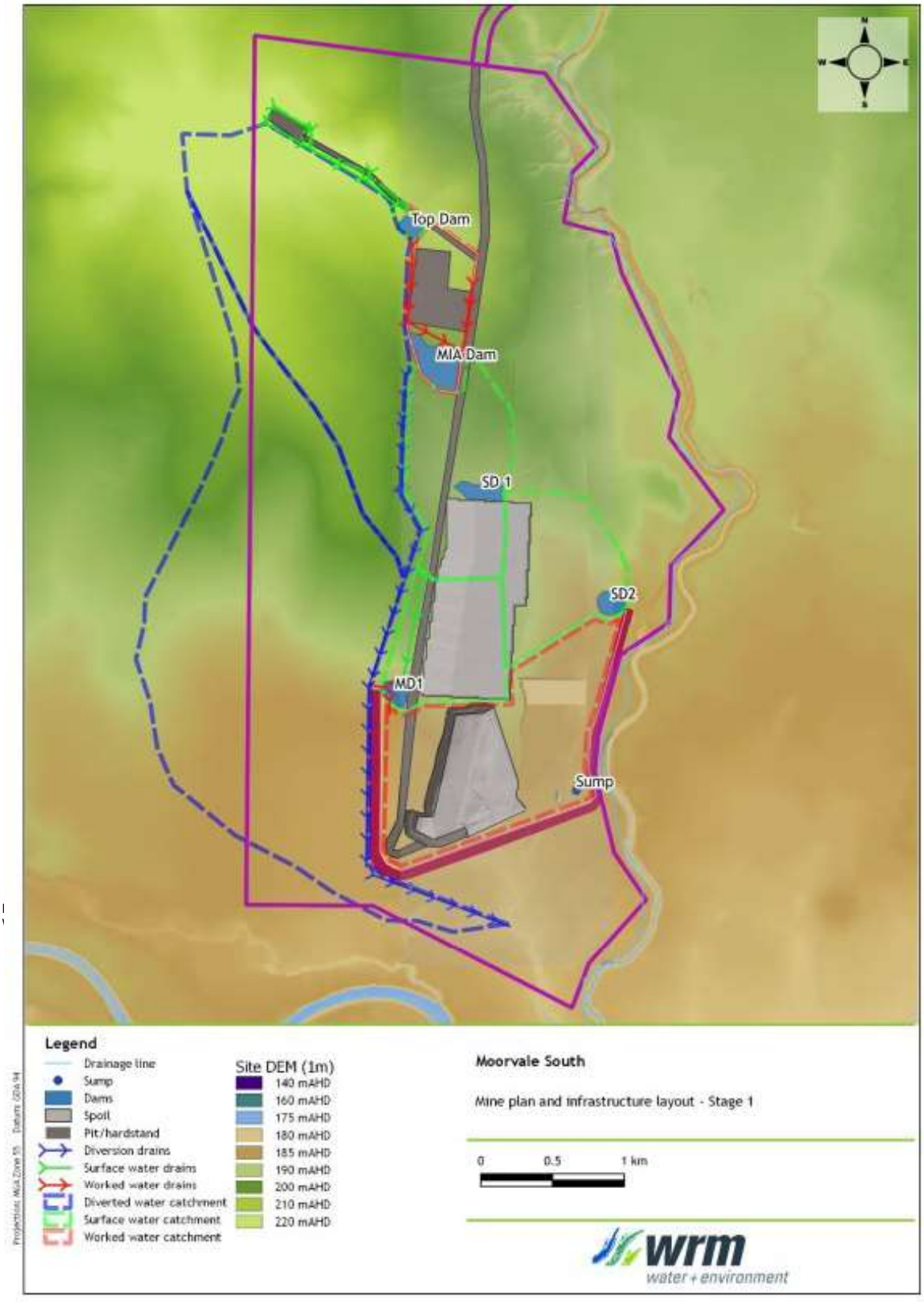


Figure 2: Key Features of Moorvale South Water Management System (Stage 1 2020 to 2022)

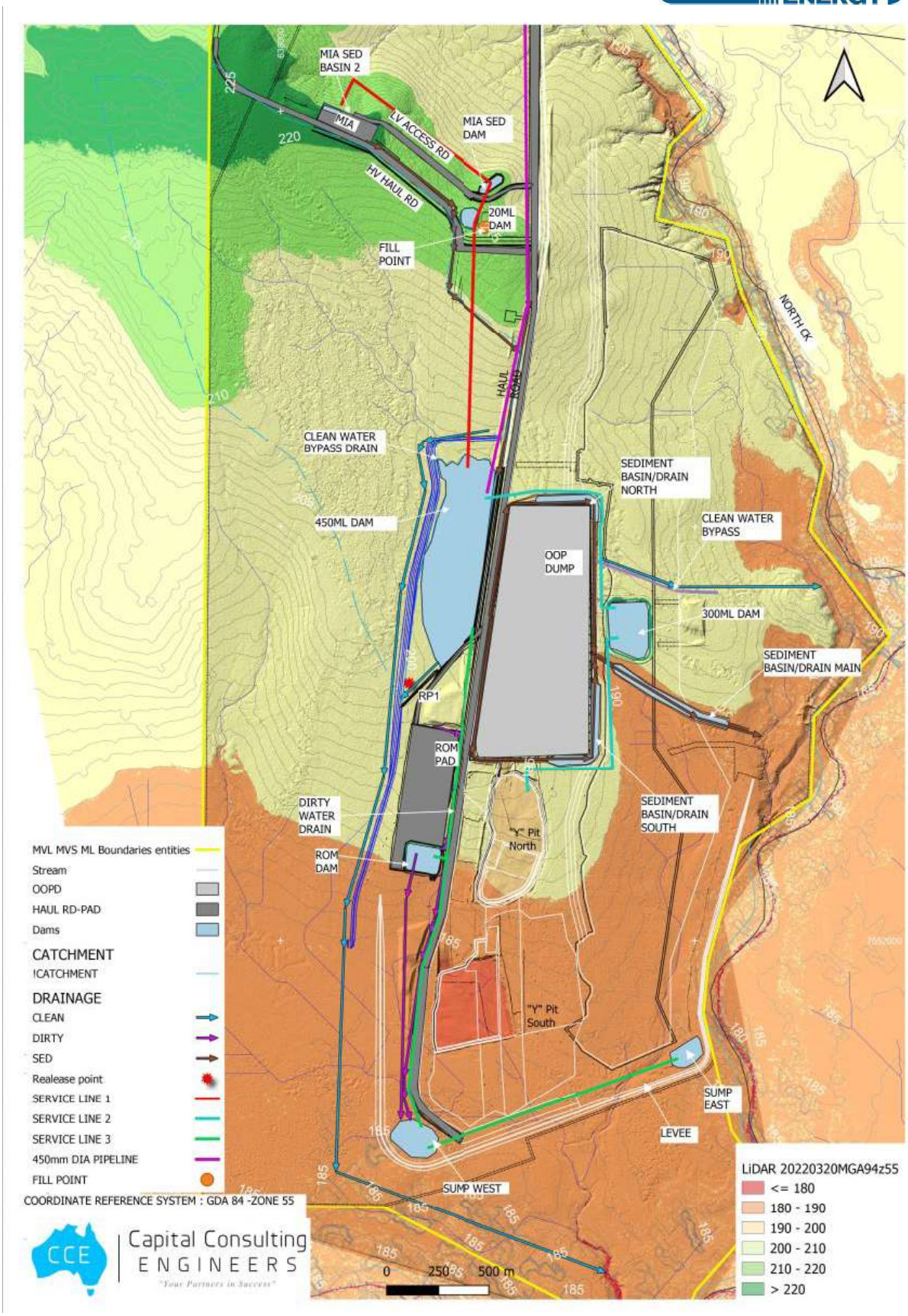


Figure 3: Moorvale South Mine Operational Areas and Water Management Infrastructure

2 ENVIRONMENTAL VALUES

This section of the WMP describes the regional drainage characteristics in the vicinity of MS. The environmental values as defined by the Environmental Protection Act 1994, Environmental Protection (Water) Policy 2009 (EPP Water) and the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2018) and regulations of these waterways are described.

2.1 REGIONAL AND LOCAL CATCHMENT HYDROLOGY

2.1.1 REGIONAL DRAINAGE NETWORK

As shown in Figure 4, MS is located within the headwaters of the Isaac River sub-catchment of the greater Fitzroy River Basin. MS is located along the northern side of the Isaac River and the western side of North Creek (see Figure 5). The confluence of the Isaac River and North Creek is located to the southeast of the MS southern ML boundary. The Isaac River and North Creek are ephemeral streams that only flow for short periods following rainfall. Upstream of the MS, the Isaac River flows past the township of Moranbah and the Millennium, Poitrel and Daunia coal mines. The Isaac River flows in a southeast direction downstream of the MS project area.

The Connors River, which has a catchment area similar to the Isaac River upstream of MS, flows into the Isaac River approximately 95 kilometres (km) downstream of MS. The Isaac River discharges into the Mackenzie River approximately 50 km further downstream.

Ultimately, the Mackenzie River joins the Fitzroy River, which flows initially north and then southeast towards the east coast of Queensland and discharges into the Coral Sea southeast of Rockhampton, near Port Alma.

At a regional scale, the greater Isaac-Connors sub-catchment area (at the confluence with the Mackenzie River) is approximately 22,364 square kilometres (km2) of the total Fitzroy River catchment of 142,665 km2, or if represented as a percentage, it accounts for 15 percent of the overall Fitzroy River catchment area. The MS ML covers an area of approximately 16.3 km², or 0.4% of the Isaac River catchment area of 4,092 km2 to the Isaac River and North Creek confluence and 0.07% of the overall Isaac-Connors catchment area.

The only significant water retaining structure in the catchment is the Burton Gorge Dam, which is located on the Isaac River, approximately 55 km to the northwest of the MS area.

2.1.2 ISAAC RIVER

The Isaac River is a perched watercourse in the vicinity of MS. The banks of the river are elevated above the flood plain. Therefore, overland flow from the local catchment accumulates in drainage lines before entering the Isaac River. The Isaac River is a seasonally flowing watercourse, typically with surface flows in the wetter months from November to April, reducing to shallow subsurface flows from about May to October. Stream flows are highly variable, with most channels drying out during winter to early spring when rainfall and runoff is historically low, although with some pools expected to hold water for extended periods. Therefore, physical attributes, water quality, and the composition of aquatic flora and fauna communities are also expected to be highly variable over time.

2.1.3 NORTH CREEK

The MS ML drains to North Creek via several drainage lines. North Creek discharges into the Isaac River approximately 3 km southeast of the ML boundary. North Creek has a catchment area of approximately 330 km2, with the predominant land use of the catchment being stock grazing and mining. The MS ML covers 16.3 km2 or 4.9% of the North Creek catchment. The North Creek catchment also contains other existing coal mine operations including Moorvale, Carborough Downs and Daunia.

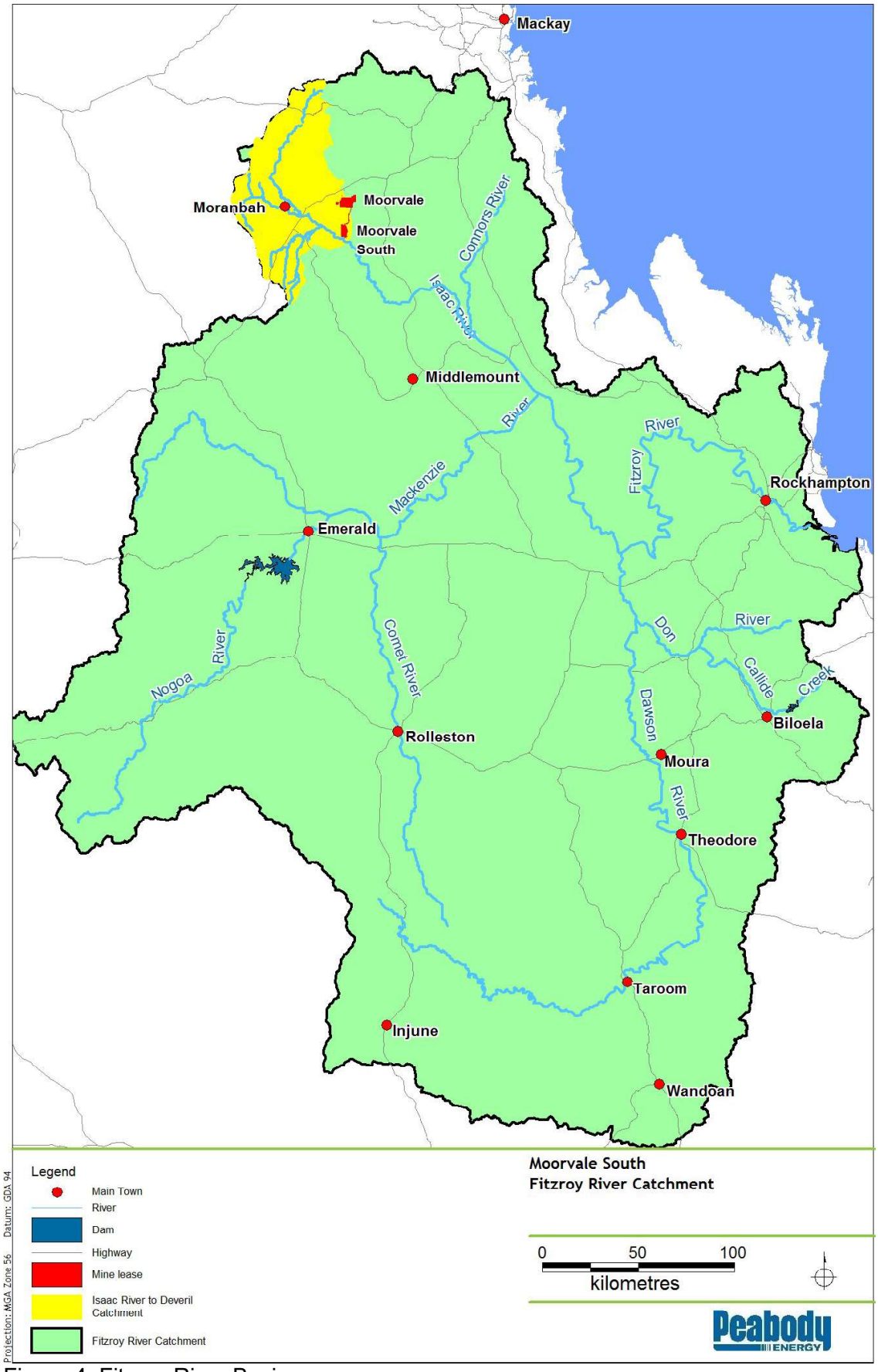


Figure 4: Fitzroy River Basin

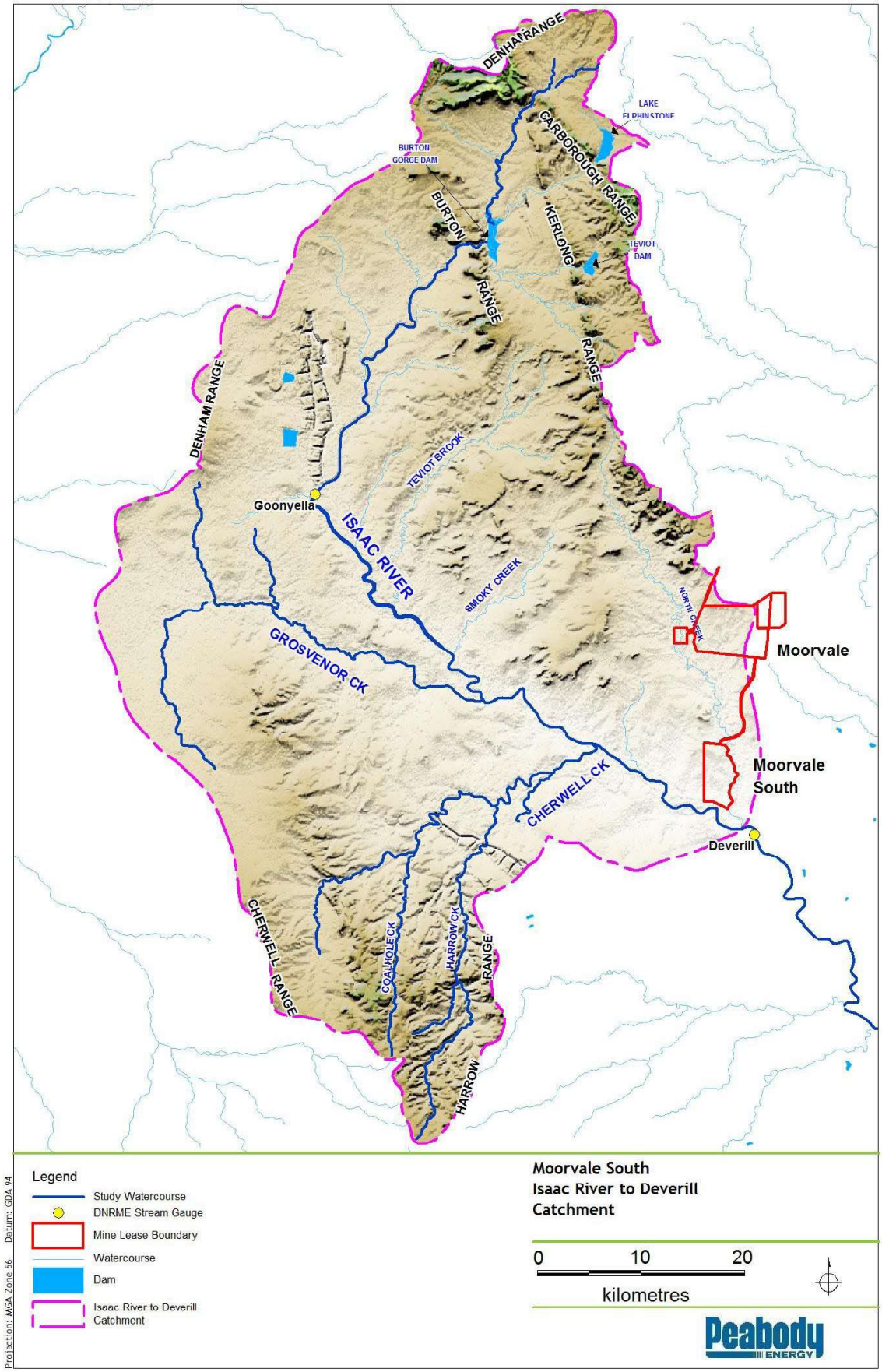


Figure 5: The Isaac River catchment to the Deverill gauging station.

2.2 STREAMFLOW

Table 1 shows the long-term streamflow for the Isaac River recorded at the Deverill and Goonyella gauging stations. The Deverill station is located 1 km downstream (southeast) ofthe confluence of the Isaac River and North Creek (see Figure 2.2). Peabody also records streamflow in North Creek, one upstream of the Moorvale ML boundary and another downstream.

Table 1: Isaac River gauging stations

Gauge No.	Gauge name	Catchment area (km^2)	Distance from Project (km)	Start year	End year
130414A	Goonyella	1,214	50	1983	-
130410A	Deverill	4,092	3	1968	-

2.3 RAINFALL AND EVAPORATION

In the absence of significant background water data for MS, this WMP utilises monitoring data from the Moorvale Mine due to its proximity and similar drainage characteristics.

Figure 6 shows the long-term daily rainfall and evaporation data for MS from January 1889 to May 2019 (130 years) based on data obtained from the Department of Environment and Science (DES) SILO Data (DES, 2018).The majority of annual rainfall occurs over the summer months (December to February) with winter rainfalls generally less than one third of summer rainfalls. Average monthly evaporation exceeds average monthly rainfall for all months of the year.

Figure 7 shows the annual rainfall totals obtained from SILO data over the years from 1889 to 2019. The average annual rainfall at MS is 582 mm.

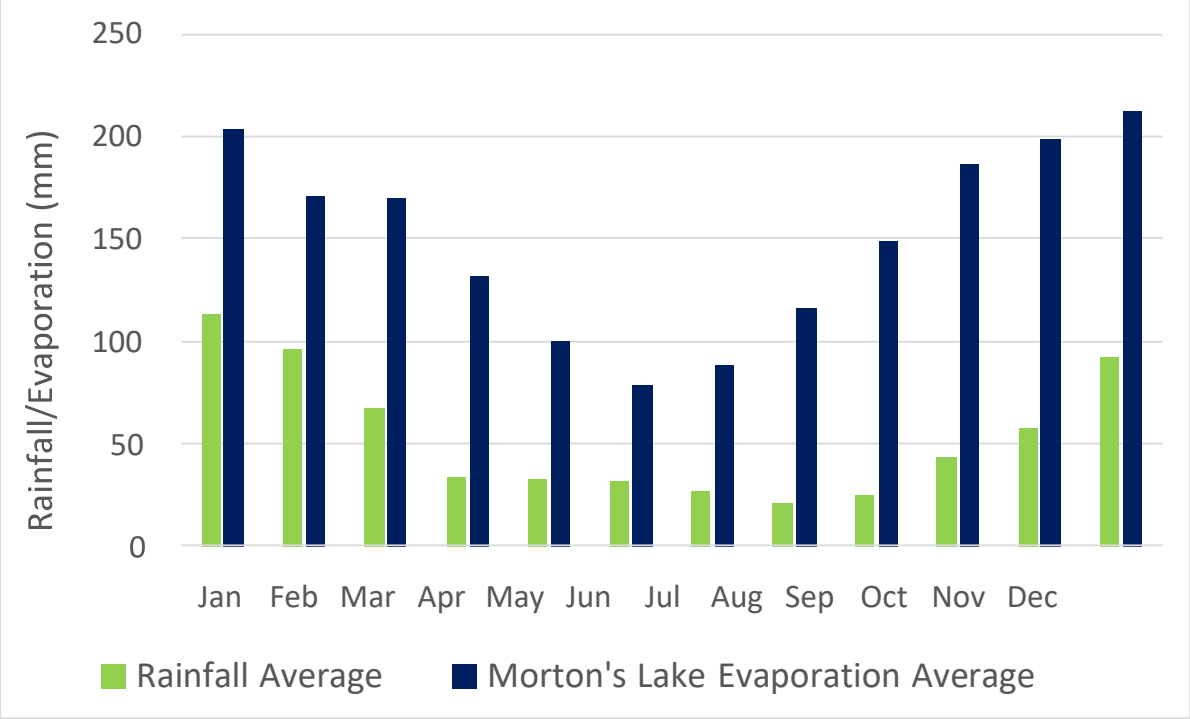


Figure 6: Distribution of Monthly Rainfall and Evaporation (SILO)

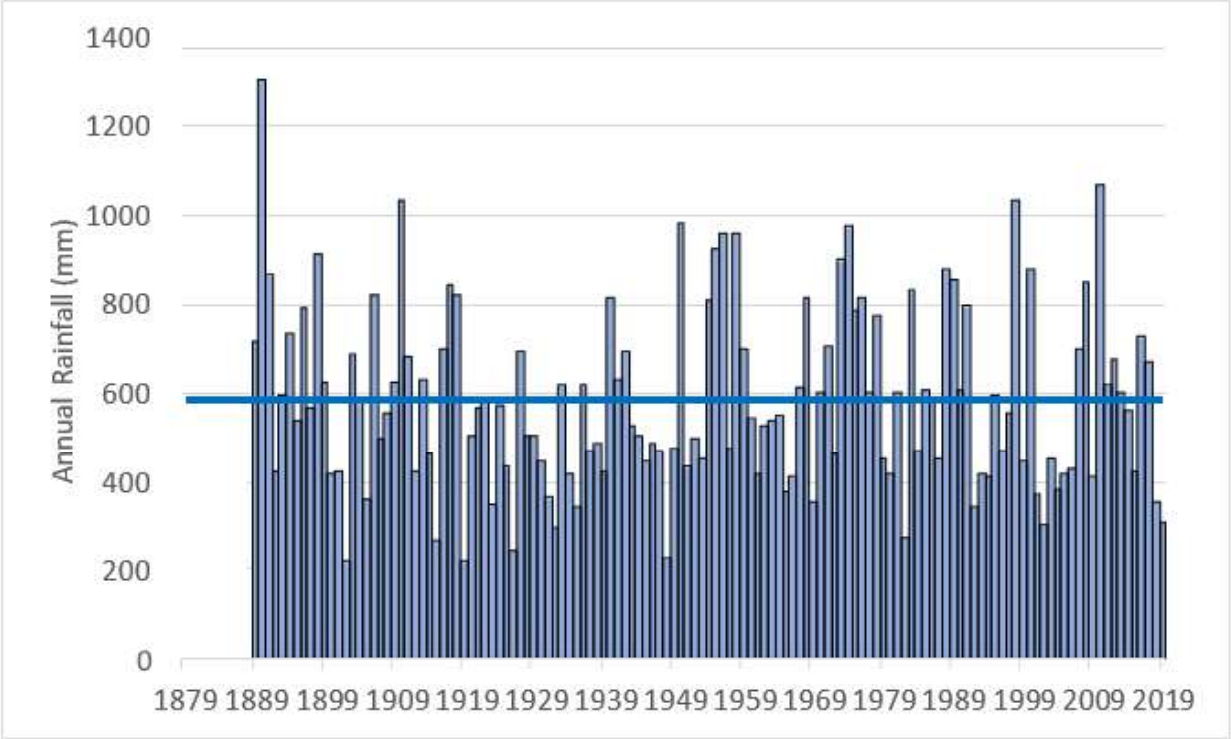


Figure 7: Annual Rainfall Totals – 1889 to 2019 (SILO)

There is a weather station currently installed at Moorvale and another planned for installation at Moorvale South.

2.4 GEOLOGY AND SOILS

Terrenus Earth Sciences (2018) undertook a geochemical assessment of the Olive Downs Project which is located approximately 3 km to the south of the MS. Given its proximity, Olive Downs is expected to have similar geological characteristics to MS.

Terrenus (2018) found that the lithology within the Olive Downs Project is typically characterised by basin-fill sediments, comprising mudstone, claystone, siltstone, sandstone (typically fine-grained), carbonaceous sediments and coal seams. The depth to base of weathering varied depending upon location, but generally sits approximately 45 m below natural surface. The principal coal bearing sequence at MS is the easterly dipping Permian- age Rangal Coal Measures.

2.5 GROUNDWATER

Figure 8 shows the 12 groundwater monitoring locations that were installed as part of the Associated Water License (AWL) application for MS. Table 2.2 shows the background standing water level (SWL) and quality monitoring at these locations provided by Golder. Thefollowing is of note:

Monitoring of alluvial groundwater indicates:

- SWL ranges from 161.2 to 180.7 m AHD.
- EC (field) is fresh to saline and ranges from 320 to 15,144 µS/cm; and
- pH (field) is slightly acidic to neutral and ranges from 6.2 to 7.1.

Monitoring of coal groundwater indicates:

- SWL range from 159.6 to 168.7 m AHD.
- EC (field) is brackish to saline and ranges from 1,514 to 27,979 µS/cm; and
- pH (field) is slightly acidic to neutral and ranges from 6.2 to 7.3.

Condition G51 of the MS EA requires groundwater in existing landholder bores to be monitored at the request of the Administrating Authority. This condition is not applicable tothe bores listed in Tale 2.

Table 2: Background groundwater monitoring

Bore ID	Geology	SWL (m AHD)	pH		EC (µS/cm)	
			Field	Lab	Field	Lab
ODN18MB1	Coal	162.0	6.6	7.3	1,514	1,420
ODN18MB2	Alluvium	172.1	6.2	7.0	501	474
ODN18MB3	Coal	161.6	6.2	7.0	27,086	25,300
ODN18MB4	Alluvium	161.2	6.4	7.2	15,144	13,500
ODN18MB5	Alluvium	Dry				
ODN18MB6	Coal	159.6	6.4	7.3	27,979	26,200
ODN18MB7	Alluvium	172.7	7.1	7.7	320	464
ODN18MB8	Alluvium	169.8	6.2	7.1	376	354
ODN18MB9	Alluvium	180.7	6.6	7.5	4,667	4,360
ODN18MB10	Coal	165.5	7.3	8.1	7,768	7,380
ODN18MB11	Coal	168.0	7.3	7.8	13,508	12,500
ODN18MB12	Coal	168.7	6.6	7.4	14,974	13,900
Alluvium Average		171.3	6.5	7.3	4,202	3,830
Coal Average		164.2	6.7	7.5	15,472	14,450

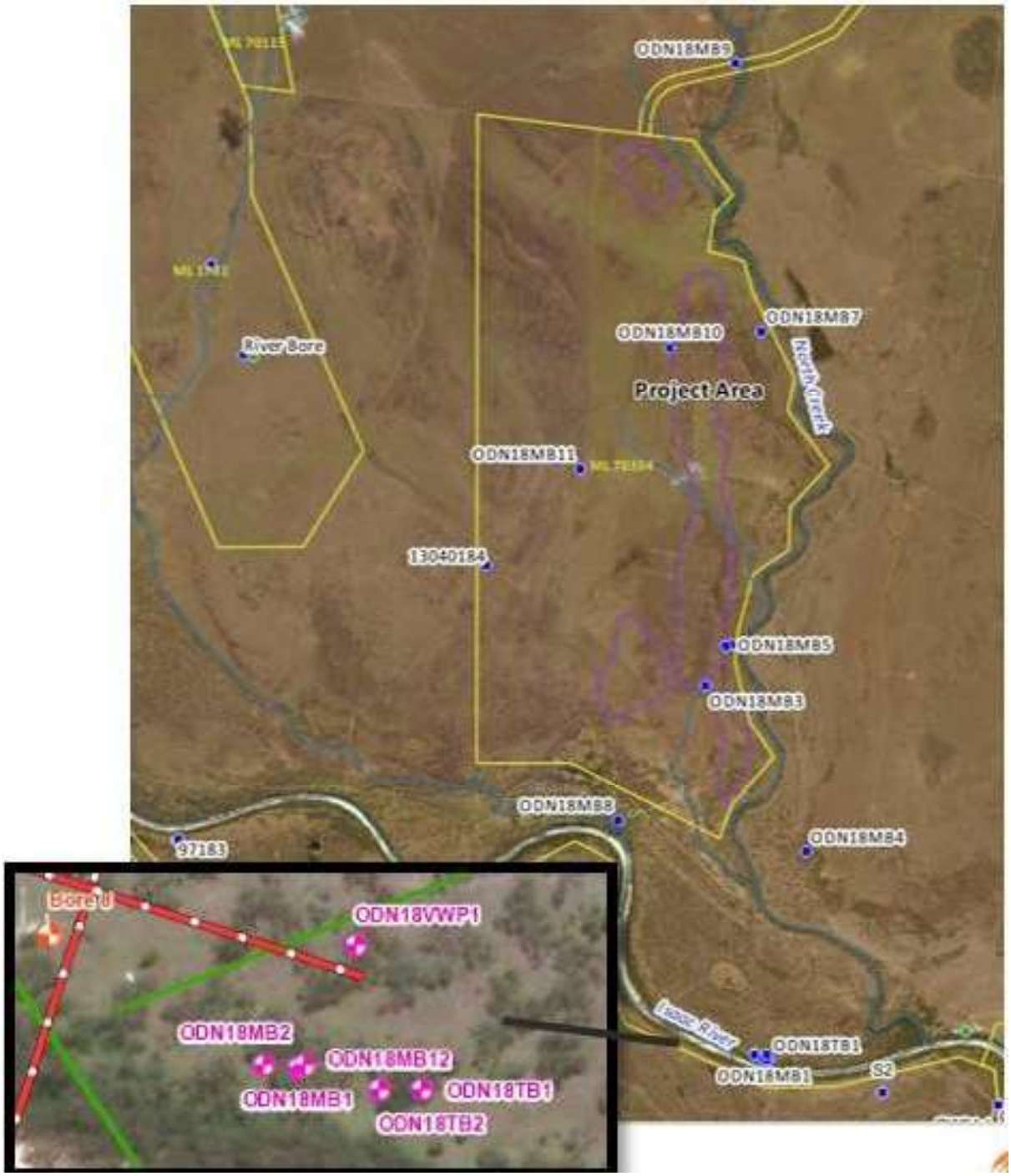


Figure 8: Groundwater Monitoring Locations

2.6 RECEIVING WATER ENVIRONMENTAL VALUES

The Environmental Protection Act 1994 seeks to protect Queensland's waters while allowing ecologically sustainable development under the guidance of the Queensland Government's Environment Protection (Water and Wetlands) Policy 2019 (EPP) framework. The initial requirements for implementing the EPP framework include:

- identifying environmental values (EVs) for aquatic ecosystems and for human uses; and
- determining water quality guidelines (WQG) and water quality objectives (WQO) to enhance and protect the environmental values.

Environmental Values are defined by waterway qualities, to be protected from activities within the catchment. The aim of EV protection is to ensure healthy aquatic ecosystems and waterways that are safe, stable, and suitable for community use. The EVs reflect the ecological, social, and economic values, and waterway uses such as stock water, swimming, fishing, and agriculture. The process for identifying EVs and determining WQGs and WQOs are based on the National Water Quality Management Strategy (Australian Government, 2018) and further outlined in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2019).

The waterways in the vicinity of MS are scheduled in the Isaac River Sub-basin Environmental Values and Water Quality Objectives (DEHP, 2011). This report shows that the downstream receiving waters do not include potable or irrigation water supply systems, or National Parks within 100 km of the site. The existing downstream water use is restricted to agricultural use for stock watering. The EVs and WQOs adopted for Queensland waters are included in Schedule 1 of the EPP Water. The EPP WQOs include a map of the sub-basin, which shows that the subject waterways are in the Isaac northern tributaries sub-catchments. The following EVs are identified in Schedule 1 of the EPP Water for these sub-catchments:

- Aquatic Ecosystems
- Irrigation
- Farm Supply
- Stock Water
- Human Consumption
- Primary Recreation
- Secondary Recreation
- Visual Recreation
- Drinking Water
- Industrial Use
- Cultural and Spiritual Values

The water quality monitoring indicators and WQGs relevant to Moorvale South EVs are listed in the ***Queensland Water Quality Guidelines*** (QWQG) (DEHP, 2009) and ANZECC/ARMCANZ (2019).

A study was undertaken by FRC Environmental in 2011 to assess the EVs of the Moorvale Mine's receiving environment. FRC Environmental (2011) described the receiving environment (including North Creek) as follows:

"*The aquatic ecological values of the waterways in the Coppabella or Moorvale mines receiving environments are defined primarily by the historical land use and the ephemeral nature of the waterways. Water quality is generally poor with low dissolvedoxygen, high conductivity, and variable turbidity. Biodiversity is low, with communities of macroinvertebrate and fish dominated by species that are tolerant of varying and often harsh conditions. No rare or threatened species of aquatic fauna have been recorded from the Coppabella or Moorvale mines receiving environments.*"

Based on the FRC Environment study, the conditions of waterways located in the vicinity of Moorvale ML are classified as Level 2 under the Queensland Water Quality Guidelines; slightly to moderately disturbed ecosystems. The same classification has been adopted for MS.

3 CONTAMINANT SOURCE STUDY

This section of the WMP describes the activities at MS that could potentially generate contaminants which may adversely impact the environmental value of the receiving waters. The source of the contaminants has been identified and evaluated based on water quality data collected onsite at Moorvale Mine since March 2004.

4.1 SITE OPERATING ACTIVITIES

The major components of Moorvale South Mine's operational activities are shown on Figure 3 and include:

- Open cut pits – Y Pit north, Y Pit south and Z Pit.
- One out-of-pit spoil dump north of the open cut pit.
- Access roads and haul roads.
- ROM coal stockpiles.
- Mine infrastructure areas including workshop, office buildings, and wash-down area

As shown in Figure 3, the existing and planned mine-affected water management storage structures on MS include:

- MIA Sediment Basins 1 & 2.
- 20 ML Dam.
- 300 ML Dam.
- 450 ML Dam.
- ROM Dam.
- Sump West and Sump East.

Many of the activities associated with the above structures have the potential to adversely impact MS EVs and WQOs. Mine infrastructure, including the ROM stockpiles and the workshop, are currently located in the northern part of the ML although plans have been developed to construct these facilities in MS. Medium-term planning is for MS coal to be stockpiled on its ROM and hauled by road train from MS to the Moorvale Mine CHPP for processing and rail load-out. Coal extracted from MS is hauled by heavy rigid mining trucks to a dedicated coal stockpile, then loaded into road trains and transported along the haul road to be processed as the MM Coal Handling and Preparation Plant (CHPP). The mine schedule is based on a forecast annual total coal production of 1.9 Mtpa.

4.2 SURFACE WATER TYPES

For water management purposes, all water generated onsite at MS is defined by the four water classifications detailed below.

4.2.1 EXTERNAL WATER

External water is water originating from outside the mine lease, that is used within mining operations. Water is currently piped from Daunia Mine to the MS 20 ML dam to support mining operations. The Daunia external water source is a temporary arrangement to enable site establishment and will be replaced by a new external water pipeline connecting the Moorvale Mine Dam (DSA Dam) and the 450 ML dam. Table 3 shows a summary of the water quality at the DSA Dam at Moorvale. The DSA Dam will be used to supply water to MS and is considered worked water.

4.2.2 DIVERTED WATER

Diverted water is rainfall runoff from surrounding catchments that is diverted around all operational areas. These flow paths avoid disturbed environments that may reduce its water quality so do not require monitoring under EA approval conditions. Sources of diverted water onsite at MS include

numerous culvert crossings along the haul road connecting Moorvale and Moorvale South Mine leases. There are two clean diversion drain systems planned for MS; immediately west of the 450 ML and north of the 300 ML dam.

4.2.3 *Surface Water*

Surface water is rainfall runoff from surrounding catchments that flows through environments disturbed by operations. Surface water flow typically collects and transports sediments but not environmental contaminants. Surface water flows may include runoff from rehabilitated and active spoil areas, pre-strip operations, and haul roads under normal conditions. The Environment Protection ACT 2019 approved the uncontrolled release of mine surface water, providing it is managed by an approved system of erosion and sediment controls. MS surface water management infrastructure includes numerous sediment basins adjoining the haul road; sediment drains north, main and south and the sediment dam surrounding the 300 ML dam (refer Figure 3). The Environment and Sediment Control Plan provides details for the management of surface water onsite, therefore it is not considered herein.

4.2.4 *Worked Water*

Worked water is water that is exposed to mining operations that are likely to contain transportable sediment and/or environmental contaminants that cannot be managed by erosion and sediment controls structures. Mine-affected or worked water is typically poor, requiring regulated approval for its monitoring, management and the conditions for approved release. Worked water is available for reuse onsite to support mining operations, providing all worked water returns to controlled storage available for reuse. Uncontrolled releases are a breach of EA approval conditions and must be reported to the governing regulatory bodies. Therefore, all worked water is retained onsite, reused under controlled operations, and released only in accordance with the relevant EA approval condition.

4.3 SURFACE WATER CHARACTERISTICS

Water quality at the Moorvale Mine has been monitored in several water storages, local creeks, and mining pits since March 2004. Moorvale Mine is located 10 km north of MS, within a similar environmental setting. It is therefore expected that MS will have similar water quality as Moorvale Mine.

Table 3: Moorvale Water Quality Summary

Parameter (mg/L)	DSA Dam			Environmental Dam		
	Count	Median	90th %ile	Count	Median	90th %ile
Conductivity (µS/cm)	18	11,295	13,977	33	4,140	6,094
pH	18	8.75	9.07	31	8.80	9.08
Turbidity (NTU)	1	5	5	2	22	30
TSS				15	16	45
Nitrate				15	20.0	36.0
Sulphate	4	447	551	23	186	401
Aluminium	4	145.0	195.0	38	290.0	743.0
Arsenic (total)	4	1.0	1.0	38	1.1	2.3
Cadmium	4	0.1	0.1	35	0.1	0.1
Chromium (CrVI)				30	1.0	1.1
Copper	4	1.0	1.0	38	2.0	5.0
Iron				30	250.0	663.0
Lead	4	1.0	1.1	38	1.1	1.3
Manganese				25	31.0	85.0
Mercury (inorganic)				30	0.1	0.1
Molybdenum				25	5.0	7.0
Nickel	4	1.0	1.7	38	1.0	2.3
Selenium				25	10.5	10.5
Silver				30	1.0	1.1
Uranium				25	2.0	2.0
Vanadium				25	10.5	10.5
Zinc	4	5.1	14.2	38	5.3	8.0

5 SURFACE WATER MANAGEMENT

This section of the WMP describes the objectives and principles of the MS WMS including a description of the infrastructure and systems that have been put in place to achieve the objectives and principles. A schematic diagram of the WMS is shown in Figure 9.

5.1 MANAGEMENT OBJECTIVES

The objective of the MS WMS is to manage all types of water onsite to meet operational, social and environmental objectives encapsulated by the site EA.

There are two WMS key objectives:

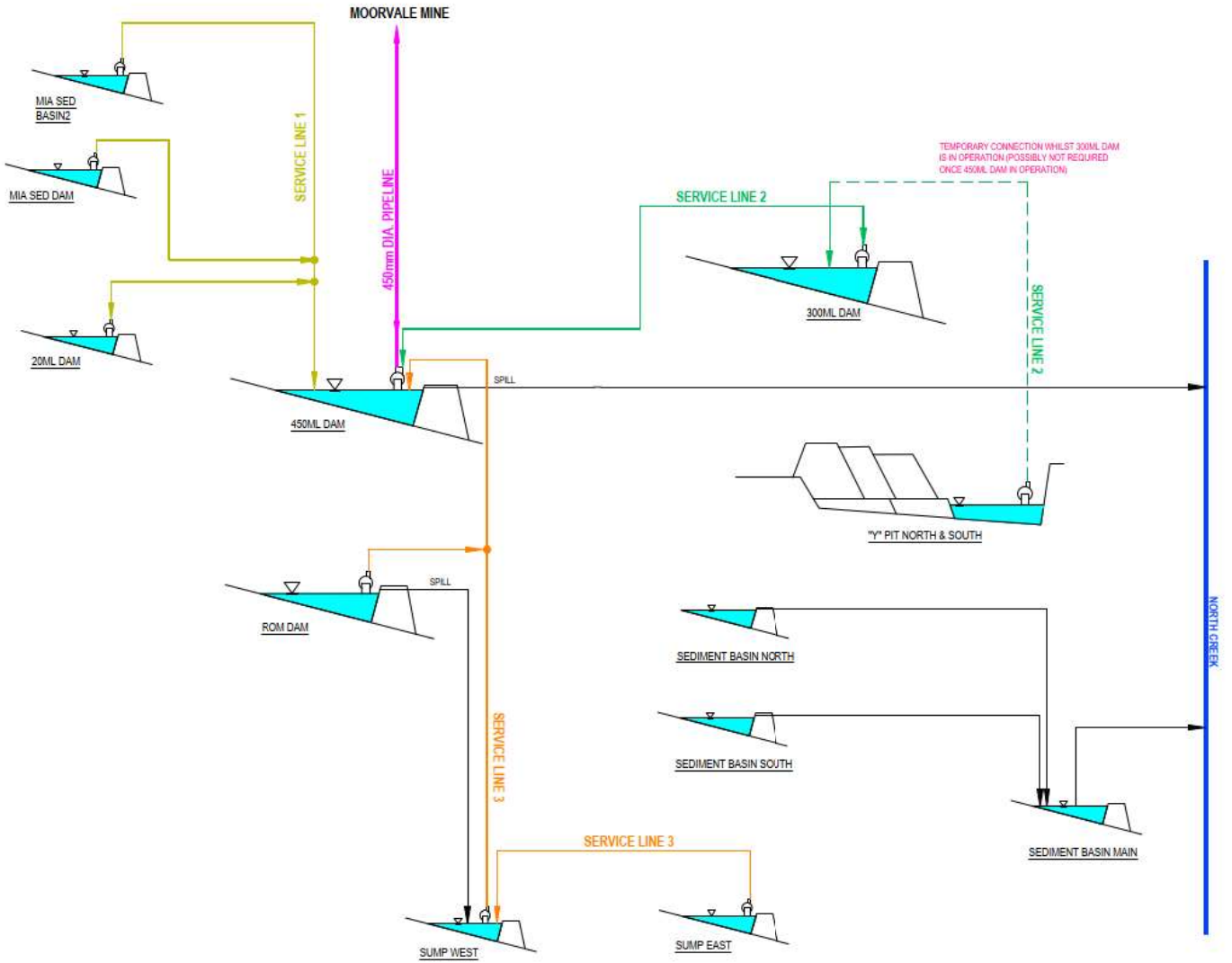
- Implementing an appropriate strategy which ensures Peabody reduces the risk of worked water spills and has sufficient worked and external water for operation in dry times; and
- being a good custodian of society's water resources. The priority areas are the site's impact on surface water and groundwater.
- Specific objectives for each water type are as follows:
- External water: Ensure that external water allocation and associated infrastructure is sufficient to meet site demands under low rainfall conditions.
- Worked water: Minimise uncontrolled discharges in wet periods and ensure adequate water supplies are maintained for site demand during dry periods.
- Surface water: Maintain water quality leaving the ESC structures to a quality as close to background levels as reasonably possible.
- Diverted water: Ensure that diverted water is separated from the worked water and surface water systems and allowed to pass uninterrupted to the receiving waters.

5.2 WATER MANAGEMENT PRINCIPLES

The general principles to manage surface water for the site are as follows:

- Separation of worked water, surface water and diverted runoff (as far as is possible).
- Reduce the area and exposure time of surface disturbance that has the potential to create poor quality surface runoff, thus reducing the volume of worked water runoff.
- Collect and contain onsite all potential worked water in dedicated worked water storages. The worked water storages will be used as the primary water source for mine demands, such as dust suppression.
- Collect and treat any surface water runoff in a controlled manner in accordance with the site ESCP.
- Minimise the potential for generation of "industrial" worked water. Examples include installing a roof over the bunded areas, using oil and water separators, or collecting and containing the potentially contaminated water within the bunds and transferring it to the worked water storages.
- Maximise the use of onsite water which will minimise the need for importing external water.

Figure 9: Moorvale WMS Schematic



5.3 WATER STORAGES

Figure 1.2 shows the locations of the water management storages at MS. Table 4 summarises details of the storage volumes and surface areas of the water storages at MS. Further details of the water storages including stage-storage characteristics, pump operating rules and release rules are outlined in the Water Balance Report.

Table 4: Worked Water Storage Details

Storage Name	Storage Type	Maximum Catchment Area (ha)	Storage capacity (ML)	FSL Surface Area (ha)	Overflows to	Design AEP
450 ML DAM	Worked Water	60	450	24.6	CWD/NORTH CREEK	10%
MIA SED DAM 2	Worked Water	13.3	25.6	1.4	SED BASIN MAIN	10%
MIA SED DAM	Worked Water	7.5	13	0.72	DIRTY WATE DRAIN	10%
20ML DAM	Worked Water	2.1	20	2.1	DIRTY WATER DRAIN	10%
ROM DAM	Worked Water	20	42.6	1.9	WEST SUMP	10%
300ML DAM	Worked Water	5.3	300	4.94	NORTH CREEK	10%

5.4 WORKED WATER MANAGEMENT

The general arrangement of the infrastructure planned for managing MS' worked water demands is presented in Figure 3. As shown, there is a 450 mm dia. pipeline connecting Moorvale Mines DSA Dam and the 450 ML with pumped two-way flow. There is a spillway on the 450 ML Dam in the south-western corner that releases into the clean water diversion drain and flows west of the levee and as overland flow, eventually reaching a tributary of North Creek. The levee shown in Figure 3 is a flood mitigation structure protecting the mine's pit operations. The water storages structures connected via the main 450 mm trunk pipeline, are the primary assets for managing MS worked water.

As shown in Figure 3, there are three service pipe networks (SPN) on MS that collect water stored in smaller assets and distribute it to the 450 ML dam. SPN1 is situated north-west of the 450 ML Dam; SPN2 is to the east; and SPN3 to the south. The service networks are expected to require much smaller diameter pipe than the 450 mm mains and generally flow one-way - toward the 450 ML dam - and are gravity-powered whenever possible. Service pipe network SPN1 connects the sediment dam (SD2) behind the MIA Maintenance pad to the 450 ML dam with a main pipeline. Sediment Basin SB2, which collects work area runoff near the wash down bay, is connected to this main line by a length of pipe and t-connection. The 20 ML dam collects the wash down bay worked water and is a water fill point for mining operations that may require replenishment during extended periods of hot dry weather. Therefore, SBN1 must allow for SD1&2 to replenish the 20 ML dam, and also allow for water to be pumped back up the main SPN1 line from the 450 ML dam to the 20 ML Dam connection pipe.

SPN2 comprises a main service line connecting the 300 ML dam with the 450 ML dam. Pit dewatering operations will pump into the 300 ML dam, and it is also considered an optional water fill point for mining operations. Due to this, it expected that only one-way flow to the 450 ML dam will be required although two-way flow is possible if warranted.

SPN3 is a main service line pumping stored water from the southern sumps between the levee and the pit to the 450 ML dam (see Figure 3). The ROM dam will connect into this SPN3 main line to distributed stored water to the 450 ML dam and water released from its spillway follows a flow path leading to the sump and SPN3 infrastructure.

The only worked water release point on MS is the spillway at the south-western corner of the 450 ML dam.

6 OPERATIONAL MANAGEMENT

The worked water release point for MS is the spillway at the south-western corner of the 450 ML dam. The spilled water flow path is south-western, merging with the clean water diversion drain alignment, then becoming overland flow west of the levee until flowing generally south and south-east until intercepting North creek. This release point is considered a critical component for managing water storage when ongoing inflow during severe weather events consumes site water storage capacity. The 450 ML pipeline is an additional contingency measure during these events with significant capacity to alleviate the storage demands by pumping to the Moorvale main dam and utilising the site's release points. This scenario indicates the importance of ensuring the water quality of the 450 ML dam consistently adheres to the EA approval conditions for release. It also indicates the critical importance of ensuring pump infrastructure is operational and ready to perform during such situations.

The water stored in SB1 & SB2 will supplement the fill point demands of the 20 ML dam, ideally without requiring replenishment by water pumped from the 450 ML dam. It is also important to ensure that SBN1 operational issues don't result in uncontrolled releases from overtopping events during severe weather, as this would breach the EA approval conditions.

SPN2 allows for mine pit water to pumped into the 300 ML dam if required; for the 300 ML dam to pump to the 450 ML dam if needed; and for the 300 ML dam to be used as a fill point if required, able to be replenished by the 450 ML dam via two-way pumped flow, if needed.

SPN3 allows for water that is captured north of the levee and the pit shell, to be pumped back to the 450 ML dam. This includes overflow from the ROM dam.

Asset management plans must be developed and implemented to ensure the structural integrity of the water management infrastructure components is well maintained, and that deterioration is identified early and remediated to prevent potential adverse environmental impacts from emerging. A water management safety plan will be implemented using the TARP system, to ensure that an appropriate response is actioned when adverse conditions begin to arise.

6.1 SURFACE WATER MANAGEMENT

The MS surface water management is detailed within the Erosion and Sediment Control Plan document.

Areas on the mine that are associated with this type of water are the Out of Pit Dump (OOPD) and water off the haul road north of the 20ML dam intersection.

6.2 DIVERTED WATER MANAGEMENT

The MS surface water management is detailed within the Erosion and Sediment Control Plan document.

Areas on the mine where this is applicable is the Clean Water Diversion Drain to the west of the 450ML dam and overland flow outside of the haul road bunds is directed to culverts to transfer diverted water.

6.3 SALINE DRAINAGE AND ACID MINE DRAINAGE MANAGEMENT

Terrenus (2018) did not find overall high levels of sodicity or acidity in interburden and overburden samples at the adjacent Olive Downs Mine. The out of pit spoil dump are built on sloping land which drains towards the pit. Therefore, any toe seepage from the dump would drain to the pit. In consideration of the Terrenus (2018) results, as well as the location of the out of pit spoil emplacement, saline drainage is considered low risk. MS will not have any tailings or rejects disposal on site, therefore the risk of acid mine drainage is low.

6.4 TAILINGS AND REJECTS CIRCUIT

ROM coal is hauled to Moorvale Mine and processed at the Moorvale Mine CHPP. Therefore, management of coal tailings and rejects material is not required at MS.

6.5 CHEMICAL AND FUEL STORAGE

Diesel and other hydrocarbon fuels are consumed by the haul trucks and other mobile equipment. Fuel storage facilities are located in designated areas. Reagents are used in the blasting process and are stored in bulk. Lubricants and solvents are also used within the ML. Waste lubricants and solvents are contained and transported offsite for recycling or reuse.

The potential for significant impacts from chemical waste in the post-mining landscape is considered low. Environmental Management Procedures are in place and implemented with waste disposal conducted by professional licensed contractors. The Contractor has a waste management system based on the waste hierarchy. Site awareness training seeks to maximise recycling and encourage proper disposal of the various waste streams including regulated waste.

Most chemicals are stored in the MIA. Fuels, including diesel for heavy vehicles, is stored in a bunded tank facility in the MIA.

6.6 WASTEWATER

All sewage effluent shall be monitored in accordance with Condition G37, G38 and G39, G40 and G51 and Table G09 and Table G10 of the MS EA.

6.7 CURRENT WATER MANAGEMENT RESPONSIBILITIES

6.7.1 Moorvale South Management

The Coppabella Moorvale Joint Venture (CMJV) is the owner of the Moorvale Mine and MS and the holder of the Environmental Authority (EPML00380113). Peabody Energy Australia Pty Ltd manage the mines on behalf of the CMJV and is responsible for ensuring the implementation of this WMP at MS.

6.7.2 Peabody Employees and Contractors

Mining and environmental activities at the MS are facilitated through Peabody mine employees. Environmental provisions are included in contract documents to ensure that mining operations at the MS are conducted in accordance with prevailing environmental regulations and associated instruments, including the EA, Plan of Operations and Management Plans.

Peabody has adopted a risk-based approach to the management of environmental aspects associated with water management. Water related aspects relevant to mine site activities have been identified and assessed using the risk assessment process. In addition to risk-based management of environmental aspects, mine employees are required to conduct mining and

related operations in accordance with the statutory requirements, as well as in accordance with site specific leases and licences.

6.8 DAM CONSEQUENCE CATEGORY ASSESSMENT

Consequence category assessments (CCA) have been undertaken for the 20 ML, 300ML and 450 ML dams to ensure that any proposed design concept did not present an unacceptable level of risk onsite. The findings of the CCAs for the 20ML, 300ML and the 450 ML dams indicated a Low consequence category.

6.9 DAM MAINTENANCE AND MONITORING

The construction and maintenance of all regulated dams will comply with the DES Guideline - *Structures which are dams or levees constructed as part of environmentally relevant activities* (DES, 2019), pursuant to the *Environmental Protection Act 1994*. Regulated structures require certified design plans to be submitted to the administering authority.

Certification of these dams must be undertaken by a suitably qualified and experiencedperson.

Regulated dams on the mine site will be inspected annually by a suitably qualified and experienced person and a report prepared outlining any recommendations to be taken toensure the integrity of each regulated dam.

All other dams on the mine site will require periodic inspection to assess their physicalcondition.

7 MINE SITE WATER BALANCE

7.1 OVERVIEW

This section of the WMP describes the water balance model (WBM) that has been used to assess the performance of the mine site WMS in meeting the prescribed objectives. The WBM was developed by WRM (2019) using the GoldSim simulation software.

7.2 WATER BALANCE MODEL

The MS GoldSim WBM is used to assess the dynamics of the water balance under historical conditions of varying rainfall and catchment conditions. The model works to dynamically simulate the operation of the WMS and in doing so keeps complete account of all site water volumes on a daily time step.

The model has been configured to simulate the operations of all major components of the MS WMS. The simulated inflows and outflows included in the model are given in Table 5.

Table 5: Simulated Inflows and Outflows to the MS WMS

Inflows	Outflows
Direct rainfall on water storage surfaces	Evaporation from water surface of storages
Catchment runoff	Dust suppression demand
Groundwater inflows	Vehicle wash down
External water supply	Offsite spill from storages

The model incorporates the Australian Water Balance Model (AWBM) rainfall runoff model (Boughton and Chiew 2009) to determine the runoff characteristics of the various catchment types on the mine site.

The WBM was used to determine the behaviour of the MS WMS over time. Full details of the water balance model are given in the Water Balance Report (WRM, 2019).

7.3 ASSESSMENT METHODOLOGY

To assess the effects of varying climatic conditions, the model is run for multiple 3-year rainfall cycles with each cycle corresponding to the subsequent three years of mine life. A different rainfall input sequence is applied to each cycle from the historical climatic data available from 1889. The first “block” of data, from 1889 to 1891 inclusive, is applied to the first cycle of the model. The second “block” of data, offset by one year, is then applied from 1890 to 1892 to the second cycle. Each subsequent cycle of the model has the rainfall data offset by one year, until the WMS has been tested against all rainfall cycles from the available rainfall dataset. A statistical analysis of all cycles can then be undertaken to predict the performance of the WMS over the first 3 years of operations (2020 to 2022) based on historical dry and wet conditions.

The model is used to predict: :

- The performance of site worked water inventory against the combined full supply capacity.
- The ability to dewater the open cut pit (i.e., if the out-of-pit storages have sufficient capacity to enable the pit to be dewatered).
- The frequency of utilising external water supply (i.e., frequency of pumping from the Moorvale Mine).
    - The frequency and volumes of uncontrolled discharge from dams.

7.4 PERFORMANCE CRITERIA ASSESSMENT

The adopted performance criteria for the MS WBM is as follows:

- Less than a 10% chance of an uncontrolled spill from the worked water system.
- Less than 10% chance of the pit being inundated for 7 or more consecutive days.
- External water will be demanded from Moorvale under all climate conditions.
- All uncontrolled releases from the sediment dams will go through release points.
- No significant accumulation of water within the onsite storages.

8 MONITORING PLAN

8.1 OVERVIEW

This section of the WMP describes the surface water monitoring locations and schedule at the MS to assess compliance with the EA conditions and the objectives of the WMP.

8.2 WATER STORAGE MONITORING

Quarterly water quality monitoring will be undertaken at all water storages at MS. Table 6 shows the parameters that shall be monitoring in accordance with Table G6 of the MS EA. The containment limits in Table 6 only apply to water storages which spill to the receiving environment. SD1 is the only dam that spills to the receiving environment via RP2. However, MIA Dam spills into SD1 and SD1 spills into SD2, therefore monitoring of all storages shall be undertaken.

Table 6: Onsite Water Storage Containment Limits (Table G6)

Parameter	Unit	Containment limit
pH		4 to 9
EC	us/cm	5,970
Sulphate	mg/L	1,000
Fluoride	mg/L	2
Aluminum	mg/L	5
Arsenic	mg/L	0.5
Cadmium	mg/L	0.01
Cobalt	mg/L	1
Copper	mg/L	1
Lead	mg/L	0.1
Nickel	mg/L	1
Zinc	mg/L	20

8.3 SURFACE WATER MONITORING LOCATIONS

Figure 10 shows the surface water monitoring locations listed in the MS EA. In addition, continuous remote sensors measuring water level and water quality (pH and EC) will be installed in North Creek.

8.4 WATER QUALITY MONITORING SCHEDULE

Table 7 and Table 8 define the water quality sampling frequency and locations during release, as specified in the MS EA. Background water quality sampling shall be conducted in accordance with the MS REMP.

Table 7: Contaminant Release Points

Release Point	Contaminant Source and Location	Easting (GDA94)	Northing (GDA94)	Monitoring Point	Receiving Waters	Monitoring Frequency
RP1	450 ML Dam	TBA	TBA	Dam Spillway	North Creek	

Table 8: Receiving Water Monitoring Points

Monitoring Point	Receiving Water Location Description	Easting (GDA94)	Northing (GDA94)	Monitoring Frequency
Upstream North Creek (UNC)	North Creek at road crossing	635,647	7,566,080	Daily during release
Upstream Isaac River (UIR)	Isaac River at the Aurizon rail bridge	631,783	7,553,749	
Downstream North Creek (DNC)	North Creek upstream of the confluence with the Isaac River	640,210	7,549,220	
Downstream Isaac River (DIR)	Isaac River, downstream of the confluence with North Creek	642,312	7,548,164	
Deverill (DNRM)_	The Deverill Gauging Station	642,713	7,547,619	

Full details of the surface water monitoring program are provided in the Receiving Environment Management Plan.

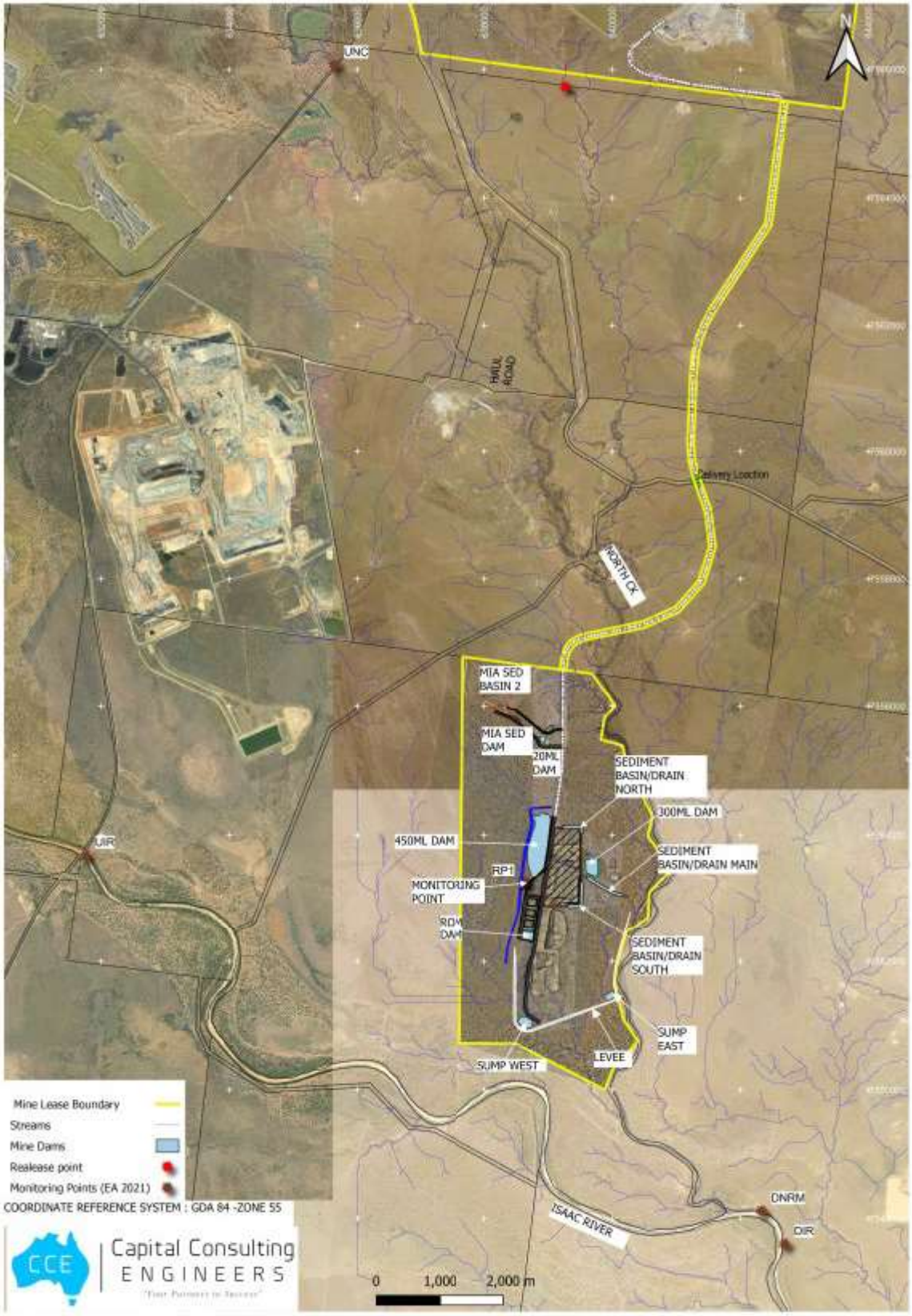


Figure 10: MS EA Surface Water Monitoring Locations

8.5 DAM AND LEVEE MONITORING

The embankments of all levees, drains and dams will be monitored during significant rainfall events to ensure they are operating satisfactorily and have not eroded and become damaged. Surface water dams shall be monitored in accordance with the MS ESC Plan.

Regulated structures shall be monitored in accordance with their operational plans.

Should a dam become damaged, the stored water will be pumped to the MIA Dam to minimise the risk of an uncontrolled flow to the downstream waterway. Levees and drains areto be repaired as soon as practicable after damage has been identified.

9 EMERGENCY RESPONSE PLAN

Emergency Response and contingency measures will be outlined in the MS Emergency Response Protocols, which are yet to be developed.

Specific operating procedures will be developed in Dam Operational Plans for all regulated structures.

10 MONITORING AND REVIEWING THE EFFECTIVENESS OF THE WMP

Numerous measures are employed at MS to both monitor and review the effectiveness ofthe WMP. These measures are summarised as follows:

- Every year, an appropriately qualified person will review the WMP (in accordance with Condition G34 of the EA) prior to the wet season (by November 1st) and a further review following the wet season (by May 1st). The review will provide recommendations for amendments to WMP if necessary.
- Surface and worked water quantity and quality is routinely monitored at MS. Monthly reports are prepared for site management and Peabody corporate with a summary of the site's water management system performance. The surface water monitoring plan (as described in Section 6) will be reviewed and updated as changes are made to the site configuration.
- The Operational Plan documents will be reviewed annually and updated to incorporate any changes to the WMS.

11 SUMMARY

This WMP has been prepared to satisfy Conditions G32, G33, G34 and G35 of the MS EA. It forms part of the MS Environmental Management System, which is used to manage the potential risks to the CVs of receiving waters. This WMP:

- Defines the EVs and WQOs of the receiving waters as defined by the Environmental Protection Act 1994, Environmental Protection (Water) Policy 2009.
- Describes the activities at MS that could potentially generate contaminants that may impact on the EVs of the receiving waters, if not managed and evaluates the risk based on available water quality data.
- Describes the objectives and principles of the WMS including a description of the infrastructure and systems that have been put in place to achieve the objectives and principles.
- Describes the water balance model that has been used to assess the performance of the MS WMS in meeting the WMS objectives.
- Details the water monitoring locations and schedule at MS to assess compliance with the EA conditions and the objectives of the WMP.
- Discusses the emergency response planning document and quality assurance measures for reviewing this Water Management Plan WMS.

12 REFERENCES

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ANZECC/ARMCANZ, 2019	*Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand, 2019.
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MEMORANDUM

Date	2 September 2024
Attention	Claudia Tang
Company	AARC Environmental Solutions Pty Ltd
WRM ref.	0849-09-Q3
Subject	Moorvale South PRCP response to RFI

Dear Claudia,

WRM has been asked to provide additional information to support a Request for Information (RFI) by the Department of Environment Science and Innovation (DESI) in relation to the Moorvale South Post Rehabilitation Closure Plan (PRCP). This memo is in response to that request.

DESI requires the following information:

- Receiving water quality background data for all the relevant water storages and local creeks;
- Details of potential Contaminants of Concern (CoC) from the activity and methodology used to determine the CoC; and
- An updated post-closure monitoring program to demonstrate that a stable condition has been achieved.

This memo is in response to that request.

1 ENVIRONMENTAL VALUES

The Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (EPP Water) which is subordinate legislation to the Queensland Environmental Protection Act 1994 (EP Act), provides a framework for identifying Environmental Values (EVs) for a waterway and deciding Water Quality Objectives (WQOs) to protect or enhance those EVs. EVs for water are the qualities of water that make it suitable for supporting aquatic ecosystems and human water uses. These EVs need to be protected from the effects of habitat alteration, contaminated runoff and releases and changed flow to ensure healthy aquatic ecosystems and waterways that are safe for community use.

The main waterway in the vicinity of the Project is the Isaac River. WQOs for the project area are specified in the Isaac River Sub-basin Environmental Values and Water Quality Objectives (DEHP, 2011). The Isaac River is located within the Isaac and lower Connors River main channel region of the Isaac River Sub-Basin (WQ1301). The other waterway in the general vicinity of the Project is North Creek (which is within the Isaac western upland tributaries region). The EVs for this region are the same as for the main channel region, except for the addition of the aquaculture EV.

The EVs selected for protection include:

- aquatic ecosystem protection (slightly to moderately disturbed ecosystems as described in the Water Quality Guidelines (WQGs);
- irrigation, farm use and stock watering;
- human consumption;
- primary, secondary and visual recreation;
- industrial use;
- cultural and spiritual values; and
- aquaculture (North Creek only)

In summary, the key EVs for water that are to be protected are:

- physical, chemical and biological integrity of the watercourses within the catchment and their amenity as potential water sources for human use and to support aquatic ecosystems and aquaculture (North Creek only);
- the qualitive and quantitative integrity of local groundwater as a potential water source for agriculture or other suitable uses; and
- the integrity of raw water supplies and associated infrastructure in the region.

The conditions of waterways located in the vicinity of the Project are classified as slightly to moderately disturbed ecosystems under the WQGs (DEHP, 2013). The indicators and water quality guidelines relevant to the above EVs are listed in the WQOs and can be drawn from the default guideline values (DGVs) (ANZG (2018)).

The WQOs relevant to the identified EVs are provided in Table 1.1. The WQOs were compared to regional and local water quality data to assess the background water quality. Where different EVs have different WQOs, the most conservative value has been adopted as the DGV. The WQOs of the EVs were also referred to derive interim values for post-closure water quality monitoring. The proposed post-closure monitoring interim values are outlined in Section 4. WQOs are displayed for physio-chemical parameters only.

Table 1.1 Water quality objectives, Isaac and Lower Connors River Main Channel

Parameter	WQO	Relevant EV
Ammonia N	< 0.02 mg/L	Aquatic ecosystem[b]
Oxidised N	< 0.06 mg/L	Aquatic ecosystem[b]
Organic N	< 0.42 mg/L	Aquatic ecosystem[b]
Total nitrogen	< 0.5 mg/L	Aquatic ecosystem[b]
Filterable Reactive Phosphorus (FRP)	< 0.02 mg/L	Aquatic ecosystem[b]
Total Phosphorus	< 0.05 mg/L	Aquatic ecosystem[b]
Chlorophyll a	< 0.005 mg/L	Aquatic ecosystem[b]

Parameter	WQO	Relevant EV
Dissolved oxygen	85-110% saturation	Aquatic ecosystem[b]
Turbidity	< 50 NTU	Aquatic ecosystem[b]
Suspended solids	< 55 mg/L	Aquatic ecosystem[b]
pH	pH 6.5-8.5	Aquatic ecosystem[b]
Conductivity (EC) baseflow	< 720 µS/cm	Aquatic ecosystem[b]
Conductivity (EC) high flow	< 250 µS/cm	Aquatic ecosystem[b]
Sulphate	< 25 mg/L	Aquatic ecosystem[b]
Total Dissolved Solids	< 2000 mg/L	Stock watering[d]
Aluminium	< 20 mg/L < 5 mg/L < 0.055 mg/L (pH > 6.5)	Irrigation[g,e] Stock watering[f] Aquatic ecosystem[a]
Arsenic	2.0 mg/L 0.5 mg/L up to 5 mg/L < 0.013 mg/L	Irrigation[g,e] Stock watering[f] Aquatic ecosystem[b]
Beryllium	< 0.5 mg/L	Irrigation[g,e]
Boron	< 5 mg/L < 0.94 mg/L	Stock watering[f] Aquatic ecosystem[k]
Cadmium	< 0.01 mg/L < 0.0002 mg/L	Stock watering[f] Aquatic ecosystem[a]
Chromium	< 1 mg/L < 1 mg/L < 0.001 mg/L	Irrigation[g,e] Stock watering[f] Aquatic ecosystem[a]
Cobalt	< 0.1 mg/L < 0.0014 mg/L	Irrigation[g,e] Aquatic ecosystem[h]
Copper	< 5 mg/L < 1 mg/L < 0.0014 mg/L	Irrigation[g,e] Stock watering (cattle)[f] Aquatic ecosystem[a]
Fluoride	< 2 mg/L	Irrigation[g,e]
Iron	< 10 mg/L < 0.18 mg/L	Irrigation[g,e] Aquatic ecosystem[l]
Lead	< 5 mg/L < 0.1 mg/L < 0.0034 mg/L	Irrigation[g,e] Stock watering[f] Aquatic ecosystem[a]

Parameter	WQO	Relevant EV
Lithium	< 2.5 mg/L	Irrigation[g]
Manganese	< 10 mg/L < 1.9 mg/L	Irrigation[g,e] Aquatic ecosystem[a]
Mercury	< 0.002 mg/L < 0.0002 mg/L	Irrigation[g] Aquatic ecosystem[i]
Molybdenum	< 0.05 mg/L < 0.034 mg/L	Irrigation[g,e] Aquatic ecosystem[h]
Nickel	< 2 mg/L < 1 mg/L < 0.011 mg/L	Irrigation[g,e] Stock watering[f] Aquatic ecosystem[a]
Selenium	< 0.05 mg/L < 0.02 mg/L < 0.005 mg/L	Irrigation[g,e] Stock watering[f] Aquatic ecosystem[a]
Silver	< 0.00005 mg/L	Aquatic ecosystem[a]
Uranium	< 0.1 mg/L < 0.001 mg/L	Irrigation[g,e] Aquatic ecosystem[i]
Vanadium	< 0.5 mg/L < 0.01 mg/L	Irrigation[g,e] Aquatic ecosystem[i]
Zinc	< 5 mg/L < 0.008 mg/L	Irrigation[g,e] Aquatic ecosystem[a]
Nitrate as N	< 1.1 mg/L	Stock watering[j]

a/ ANZG (2018): trigger values for slightly-moderately disturbed systems (95% level of protection)
b/ Table 2 of Isaac River Sub-Basin EVs and WQOs: Aquatic ecosystem – moderately disturbed
c/ Table 4 of Isaac River Sub-Basin EVs and WQOs: Drinking water EV
d/ Table 10 of Isaac River Sub-Basin EVs and WQOs: Stock watering EV: salinity
e/ short-term trigger value
f/ Table 11 of Isaac River Sub-Basin EVs and WQOs: Stock watering EV: heavy metals and metalloids
g/ Table 9 of Isaac River Sub-Basin EVs and WQOs: Irrigation EV: heavy metals and metalloids
h/ ANZG (2018): low reliability guideline
i/ Based on Limit of Reporting (LOR) for ICPMS/CV FIMS analytical methods
j/ Based on ambient WQGs (2006) for total nitrogen –standard trigger value for contemporary environmental authorities in Bowen Basin
k/ Based on 95% level of protection in Toxicant default guideline values for aquatic ecosystem protection: Boron in fresh water (ANZG, 2018)
l/ Based on 95% level of protection in Toxicant default guideline values for aquatic ecosystem protection: Total iron in fresh water (ANZG, 2018)
mg/L = milligrams per litre, NTU = Nephelometric Turbidity Units, µS/cm = microSiemens per centimetre.

2 BACKGROUND WATER QUALITY DATA

2.1 REGIONAL ISAAC RIVER WATER QUALITY

Publicly available regional water quality data for the Isaac River at the Burton Gorge, Goonyella and Deverill gauging stations have been analysed, and their water quality statistics are compared in Table 2.1. These sites were selected because complete datasets (i.e. individual sample analysis results) are publicly available (as opposed to only summary data).

The Isaac River (Burton Gorge) and Isaac River (Goonyella) stations are located downstream of the Goonyella, North Goonyella, Broadlea and Burton mines and therefore have measured water quality that may be affected by mine releases. The Isaac River (Burton Gorge) and Isaac River (Goonyella) stations are about 95 km and 60 km upstream of the Project, respectively. However, these stations provide an indication of water quality, including metal toxicants, in the Isaac River upstream of the Project.

Table 2.1 shows that some readings at the DoR monitoring locations along the Isaac River are at or above the regional DGVs, including the following:

- Dissolved aluminium at Goonyella and Deverill (80th percentile);
- Dissolved copper at Goonyella and Deverill (median and 20th/80th percentile);
- EC at Goonyella (80th percentile) exceeds the DGV based on the model water conditions;
- Dissolved iron at Burton Gorge (median and 80th percentile);
- Nitrate at all three gauges (median and 80th percentile values);
- Total suspended solids at all Burton Gorge and Goonyella (80th percentile values);
- Turbidity at Burton Gorge (median and 20th/80th percentile) and Goonyella/Deverill (median and 80th percentile); and
- Dissolved zinc at Goonyella/Deverill (median and 20th/80th percentile).

Table 2.1 Regional Isaac River water quality summary – DoR gauges

Parameter	Unit	Isaac River @ Burton Gorge				Isaac River @ Goonyella				Isaac River @ Deverill				Default Guideline Value (refer Table 1)
		No. of samples	20th %ile value	Median value	80th %ile value	No. of samples	20th %ile value	Median value	80th %ile value	No. of samples	20th %ile value	Median value	80th %ile value	
Aluminium (dissolved)	mg/L	-	-	-	-	13	0.004	0.050	0.056	14	0.03	0.05	0.15	< 0.055 (aquatic)
Boron (total)	mg/L	4	0.030	0.030	0.034	30	0.04	0.08	0.12	21	0.04	0.06	0.096	< 5 (stock)
Copper (dissolved)	mg/L	-	-	-	-	13	0.012	0.030	0.050	16	0.006	0.030	0.036	< 0.0014 (aquatic)
Electrical Conductivity	µS/cm	19	169	458	644	33	195	512	1,140	49	120	261	398	< 720 (baseflow) < 250 (high flow)
Fluoride (total)	mg/L	19	0.10	0.19	0.22	33	0.10	0.20	0.32	46	0.1	0.14	0.2	< 2 (irrigation)
Iron (dissolved)	mg/L	5	0.4	1.0	7.0	30	0.01	0.04	0.234	17	0.02	0.06	0.34	< 0.7 (aquatic)
Manganese (dissolved)	mg/L	-	-	-	-	13	0.012	0.030	0.050	16	0.006	0.030	0.036	< 1.9 (aquatic)
Nitrate (total)	mg/L	9	0.4	1.5	3.6	30	0.98	1.96	3.48	13	0.001	0.01	0.01	< 1.1 (aquatic)
pH	-	19	7.4	7.8	8.0	33	7.2	7.7	8.0	49	7.19	7.6	8	6.5–8.5 (aquatic)
Phosphorus (total)	mg/L	-	-	-	-	10	0.041	0.203	0.344	9	0.049	0.140	0.672	< 50 (aquatic)
Sodium (total)	mg/L	19	18	33	58	33	21	67	188	49	12	22	40	< 30 (drinking)
Sulphate (total)	mg/L	13	2.7	4.3	9.8	33	4.7	10.0	75.4	42	6.92	10	18.8	< 25 (aquatic)
Total Dissolved Solids	mg/L	19	122	255	353	33	114	280	622	47	81	155	224	< 2,000 (stock)
Total Suspended Solids	mg/L	15	10	230	2,002	33	14	74	2,752	41	10	135	1,340	< 55 (aquatic)
Turbidity	NTU	4	66	100	100	32	16	100	147	19	11	50	910	< 50 (aquatic)
Zinc (dissolved)	mg/L	-	-	-	-	12	0.01	0.015	0.02	14	0.01	0.01	0.06	< 0.008 (aquatic)

NOTE: values that were recorded as below the limit of reporting, have been assumed to be equal to the limit of reporting, for the purpose of this statistical analysis.

2.2 LOCAL WATER QUALITY

Baseline water quality sampling for the Project has been undertaken between 7 April 2016 and 16 May 2023 as part of the Receiving Environment Monitoring Program (REMP). A range of physio-chemical parameters were analysed at sites UNC and DNR. The locations of these sampling sites are shown in Figure 1. A summary of the water quality parameters compared to default guideline values for each sample location are shown in Table 2.2 and Table 2.3.

Table 2.2 Local water quality sampling data UNC

Parameter	Unit	UNC							Default Guideline Value
		7/04/2016	16/11/2016	27/04/2017	16/10/2017	16/04/2018	20/04/2022	16/05/2023	(refer Table 1)
pH	-	8.21	7.42	8.09	7.53	8.13	7.85	8.15	6.5–8.5 (aquatic)
Electrical Conductivity	µS/cm	387	131	340	248	340	324	346	< 720 (baseflow) < 250 (high flow)
Total Suspended Solids	mg/L	19	237	<5	510	182	102	77	< 55 (aquatic)
Sulphate as SO4	mg/L	5	6	3	6	3	<1	<1	<25 (aquatic)
Aluminium	mg/L	0.03	1.73	0.01	0.21	0.26	<0.01	0.04	< 0.055 (auqatic)
Arsenic	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001	< 0.0013
Boron	mg/L	0.06	<0.05	0.06	0.06	0.08	0.07		< 0.37 (aquatic)
Cadmium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	< 0.0002 (aquatic)
Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	< 0.001 (aquatic)
Cobalt	mg/L	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	< 0.09 (aquatic)
Copper	mg/L	<0.001	0.004	0.001	0.002	0.004	0.002	0.002	< 0.0014 (aquatic)
Lead	mg/L	<0.001	0.002	<0.001	0.001	<0.001	<0.001	<0.001	< 0.0034 (irrigation)
Manganese	mg/L	0.002	0.099	0.072	0.001	0.048	<0.001	0.148	< 1.9 (aquatic)
Molybdenum	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	< 0.034 (aquatic)
Nickel	mg/L	<0.001	0.002	<0.001	0.002	0.003	0.002	0.002	< 0.0011 (aquatic)
Selenium	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	< 0.005 (aquatic)
Silver	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	< 0.00005 (aquatic)
Uranium	mg/L						<0.001	<0.001	< 0.001 (aquatic)
Vanadium	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	< 0.01 (aquatic)
Zinc	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	< 0.008 (aquatic)
Iron	mg/L	<0.05	0.86	<0.05	0.24	0.26	<0.05	0.05	< 0.3 (aquatic)
Mercury	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	< 0.00006 (aquatic)
Aluminium (total)	mg/L	0.38	11.5	0.11	42.2	6.16	13.4	0.79	< 5 (stock)
Arsenic (total)	mg/L	<0.001	0.002	<0.001	0.005	0.002	0.004	0.002	< 2.0 (irrigation) < 0.5 (stock)

Parameter	Unit	UNC							Default Guideline Value
		7/04/2016	16/11/2016	27/04/2017	16/10/2017	16/04/2018	20/04/2022	16/05/2023	(refer Table 1)
Boron (total)	mg/L	0.08	<0.05	0.06	0.08	0.08	0.08		< 0.5 (stock)
Cadmium (total)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	< 0.01 (stock)
Chromium (total)	mg/L	<0.001	0.009	<0.001	0.04	0.006	0.009	<0.001	< 1 (stock)
Cobalt (total)	mg/L	<0.001	0.004	<0.001	0.026	0.004	0.003	0.002	< 0.1 (irrigation)
Copper (total)	mg/L	0.002	0.01	<0.001	0.05	0.01	0.007	0.004	<1 (stock)
Lead (total)	mg/L	<0.001	0.004	<0.001	0.034	0.004	0.004	0.002	< 0.1 (stock)
Manganese (total)	mg/L	0.029	0.167	0.086	1.48	0.352	0.555	0.475	< 10 (irrigation)
Molybdenum (total)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	< 0.05 (irrigation)
Nickel (total)	mg/L	0.002	0.01	<0.001	0.064	0.009	0.009	0.004	< 1 (stock)
Selenium (total)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	< 0.02 (stock)
Silver (total)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	< 1 (stock)
Uranium (total)	mg/L						<0.001	<0.001	< 0.1 (irrigation)
Vanadium (total)	mg/L	<0.01	0.02	<0.01	0.09	0.02	0.02	<0.01	< 0.5 (irrigation)
Zinc (total)	mg/L	<0.005	0.023	<0.005	0.085	0.012	0.011	<0.005	< 5 (irrigation)
Iron (total)	mg/L	0.32	10.5	0.16	45.8	6.32	7.26	1.17	< 1 (stock)
Mercury (total)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	< 0.002 (irrigation)
Fluoride	mg/L	0.2	0.2	0.2	0.2	0.3	0.4	0.2	< 2 (irrigation)
Ammonia	mg/L	0.08	0.04	0.03	0.25	0.21	0.17	0.22	< 0.02 (aquatic)
Nitrate as N	mg/L	<0.01	<0.01	<0.01	0.24	0.15	0.01	<0.01	< 1.1 (aquatic)
Total Nitrogen	mg/L								< 0.5 (aquatic)

Table 2.3 Local water quality sampling data DNR

Parameter	Unit	DNR			Default Guideline Value
		7/04/2016	16/11/2016	27/04/2017	(refer Table 1)
pH	-	8	8.03	8.15	6.5–8.5 (aquatic)
Electrical Conductivity	µS/cm	1060	366	347	< 720 (baseflow) < 250 (high flow)
Total Suspended Solids	mg/L	54	51	24	< 55 (aquatic)
Sulphate as SO4	mg/L	29	2	5	<25 (aquatic)
Aluminium	mg/L	0.06	1.23	0.17	< 0.055 (auqatic)
Arsenic	mg/L	0.001	<0.001	<0.001	< 0.0013
Boron	mg/L	0.06	0.1	0.06	< 0.37 (aquatic)
Cadmium	mg/L	<0.0001	<0.0001	<0.0001	< 0.0002 (aquatic)
Chromium	mg/L	<0.001	<0.001	<0.001	< 0.001 (aquatic)
Cobalt	mg/L	<0.001	<0.001	<0.001	< 0.09 (aquatic)
Copper	mg/L	<0.001	0.002	0.002	< 0.0014 (aquatic)
Lead	mg/L	<0.001	<0.001	<0.001	< 0.0034 (irrigation)
Manganese	mg/L	0.031	0.042	0.006	< 1.9 (aquatic)
Molybdenum	mg/L	0.001	<0.001	<0.001	< 0.034 (aquatic)
Nickel	mg/L	<0.001	0.002	0.001	< 0.0011 (aquatic)
Selenium	mg/L	<0.01	<0.01	<0.01	< 0.005 (aquatic)
Silver	mg/L	<0.001	<0.001	<0.001	< 0.00005 (aquatic)
Uranium	mg/L				< 0.001 (aquatic)
Vanadium	mg/L	<0.01	<0.01	<0.01	< 0.01 (aquatic)
Zinc	mg/L	<0.005	<0.005	<0.005	< 0.008 (aquatic)
Iron	mg/L	0.06	0.77	0.12	< 0.3 (aquatic)
Mercury	mg/L	<0.0001	<0.0001	<0.0001	< 0.00006 (aquatic)
Aluminium (total)	mg/L	1.62	1.91	3.89	< 5 (stock)
Arsenic (total)	mg/L	0.002	0.002	0.001	< 2.0 (irrigation) < 0.5 (stock)

Parameter	Unit	DNR			Default Guideline Value
		7/04/2016	16/11/2016	27/04/2017	(refer Table 1)
Boron (total)	mg/L	0.07	0.1	0.06	< 0.5 (stock)
Cadmium (total)	mg/L	<0.0001	0.0002	<0.0001	< 0.01 (stock)
Chromium (total)	mg/L	0.001	0.002	0.003	< 1 (stock)
Cobalt (total)	mg/L	0.001	0.002	0.001	< 0.1 (irrigation)
Copper (total)	mg/L	0.008	0.004	0.004	<1 (stock)
Lead (total)	mg/L	0.002	0.002	0.002	< 0.1 (stock)
Manganese (total)	mg/L	0.271	0.116	0.083	< 10 (irrigation)
Molybdenum (total)	mg/L	<0.001	<0.001	<0.001	< 0.05 (irrigation)
Nickel (total)	mg/L	0.003	0.004	0.004	< 1 (stock)
Selenium (total)	mg/L	<0.01	<0.01	<0.01	< 0.02 (stock)
Silver (total)	mg/L	<0.001	<0.001	<0.001	< 1 (stock)
Uranium (total)	mg/L				< 0.1 (irrigation)
Vanadium (total)	mg/L	<0.01	<0.01	<0.01	< 0.5 (irrigation)
Zinc (total)	mg/L	0.014	0.007	0.013	< 5 (irrigation)
Iron (total)	mg/L	1.63	1.71	3.87	< 1 (stock)
Mercury (total)	mg/L	<0.0001	<0.0001	<0.0001	< 0.002 (irrigation)
Fluoride	mg/L	0.3	0.4	0.3	< 2 (irrigation)
Ammonia	mg/L	0.05	<0.01	0.03	< 0.02 (aquatic)
Nitrate as N	mg/L	<0.01	<0.01	<0.01	< 1.1 (aquatic)
Total Nitrogen	mg/L				< 0.5 (aquatic)

3 CONTAMINANTS OF CONCERN

RGS's geochemical assessment of mine waste at Moorvale South (RGS, 2023) indicated that contaminants which could be at elevated concentrations, and therefore would require periodic monitoring included:

- Major ions (Ca, Mg, K, Na, SO_4 and Cl); and
- Dissolved metals (Al, Cd, Cu, Ni, Zn and Se).

After closure the landform will comprise consolidated mine spoil overlain by revegetated topsoil. At that time runoff will largely have come into contact only with the revegetated topsoil, so the likelihood of contamination with potential mine spoil contaminants would be low. However, the water monitoring program will test for exceedances above baseline levels.

RGS (RGS, 2023) noted that testing of mine waste rock indicated neutral to alkaline pH levels which would limit the potential of metals being liberated to a significant concentration.

The limit of reporting for several analytes (e.g. dissolved silver, selenium and mercury) was greater than the DGVs. It is recommended the sensitivity of reporting for these dissolved metals (particularly Selenium, which is potentially of concern) be increased to test for exceedance of the DGVs.

4 MONITORING

Monitoring of the post-mining landform through upstream and downstream locations will assist in demonstrating the implemented rehabilitation is successful.

Water quality monitoring will assist in:

- Demonstrating that the site is effective in meeting its objective of minimal impact on receiving water quality.
- Demonstrate that the landform does not release contaminants to the surface water environment and that a non-polluting landform has been achieved.
- Allow for early detection of any impacts and appropriate corrective action.

The proposed PRCP monitoring locations upstream and downstream of the MVS final landform are shown in Figure 2. The details of the proposed sites are summarised in Table 4.1.

Table 4.1 Proposed natural surface water quality monitoring locations

Station ID	Catchment Area	Easting*	Northing*	Description
US	North Creek	640010	7556760	450m downstream of the connecting haul road
DS	North Creek	640490	7549160	2.5km downstream of the final landform

*Projection MGA94 (Zone 55)

Monitoring triggers will be derived using site water quality data through methodologies outlined in the ANZG 2018 guideline. However, insufficient data is currently available to undertake statistical analysis. Therefore, interim monitoring values have been developed based on the default guideline values and appropriate levels of species protection. The interim values were derived by selecting the lowest WQO that is above the existing range of local water monitoring data available and presented in Table 2.2 and Table 2.3 The lowest WQO that is above the existing range of water quality data collected in North Creek has been selected as the interim value where possible.

Table 4.2 outlines proposed interim monitoring values for the identified CoCs in post-closure conditions. Once sufficient data is available in accordance with the minimum data requirements specified in the ANZG guideline, the interim values will be amended with site-specific values.

Post-closure monitoring will be implemented following completion of all required rehabilitation methodologies (e.g. final landform establishment and surface preparation) to demonstrate achievement of a non-polluting landform. Water quality sampling will be undertaken at the proposed monitoring locations monthly during flow, where practical following a rain event (e.g. an event greater than 50 mm in a 24-hour period) considering North Creek is an ephemeral watercourse. To demonstrate successful rehabilitation, downstream monitoring results must not exceed the proposed values for a minimum of five (5) consecutive years. If there is an exceedance, values will be compared between upstream and downstream locations to determine if the exceedance is the Project's influence. If downstream values are elevated with respect to upstream values, then monitoring will need to be continued for a further five years until the milestone of five years of non-exceedance is achieved.

Background water quality data at DoR monitoring locations along the Isaac River (see Section 2) indicates the existing water quality does not achieve the WQOs for the Isaac River sub-basin. It is noted that North Creek and the downstream Isaac River is heavily influenced by upstream mining and agricultural activities. There is a risk that the site may not achieve the WQOs due to the potential for external influences on impact water quality unrelated to the progressively rehabilitated areas. Monitoring of the surrounding upstream environment will provide evidence that any potential exceedances are not the result of the Project and that the proposed landform is non-polluting.

Therefore, where monitoring parameters have exceeded the proposed limits, a comparison with water quality of the upstream monitoring location is proposed to demonstrate that exceedances are not a result of mine disturbance. That is, water quality in the downstream monitoring location is statistically equivalent ($p<0.05$) to reference sites (upstream monitoring location).

Table 4.2 Proposed interim monitoring values for CoCs

Water parameter	Interim value	Justification
Ca	NA	Parameter not identified in any EV WQO
Mg	< 1.9 mg/L	95% level of species protection (ANZG, 2018)
K	NA	Parameter not identified in any EV WQO
Na	NA	Parameter not identified in any EV WQO
SO_4	25 mg/L	Isaac River subbasin EVs (DEHP, 2011)

Cl	NA	Parameter not identified in any EV WQO
Al	0.055 mg/L	95% level of species protection (ANZG, 2018)
Cd	0.0002 mg/L	95% level of species protection (ANZG, 2018)
Cu	0.0025 mg/L	80% level of species protection (ANZG, 2018), baseline levels currently elevated
Ni	0.017 mg/L	80% level of species protection (ANZG, 2018), baseline levels currently elevated
Zn	0.008 mg/L	95% level of species protection (ANZG, 2018)
Se	0.011 mg/L	95% level of species protection (ANZG, 2018), currently not analysed to detect 99th percentile value of 0.005 mg/L but recorded levels are below 95% level

Regards,

Matthew Buckley

Senior Engineer

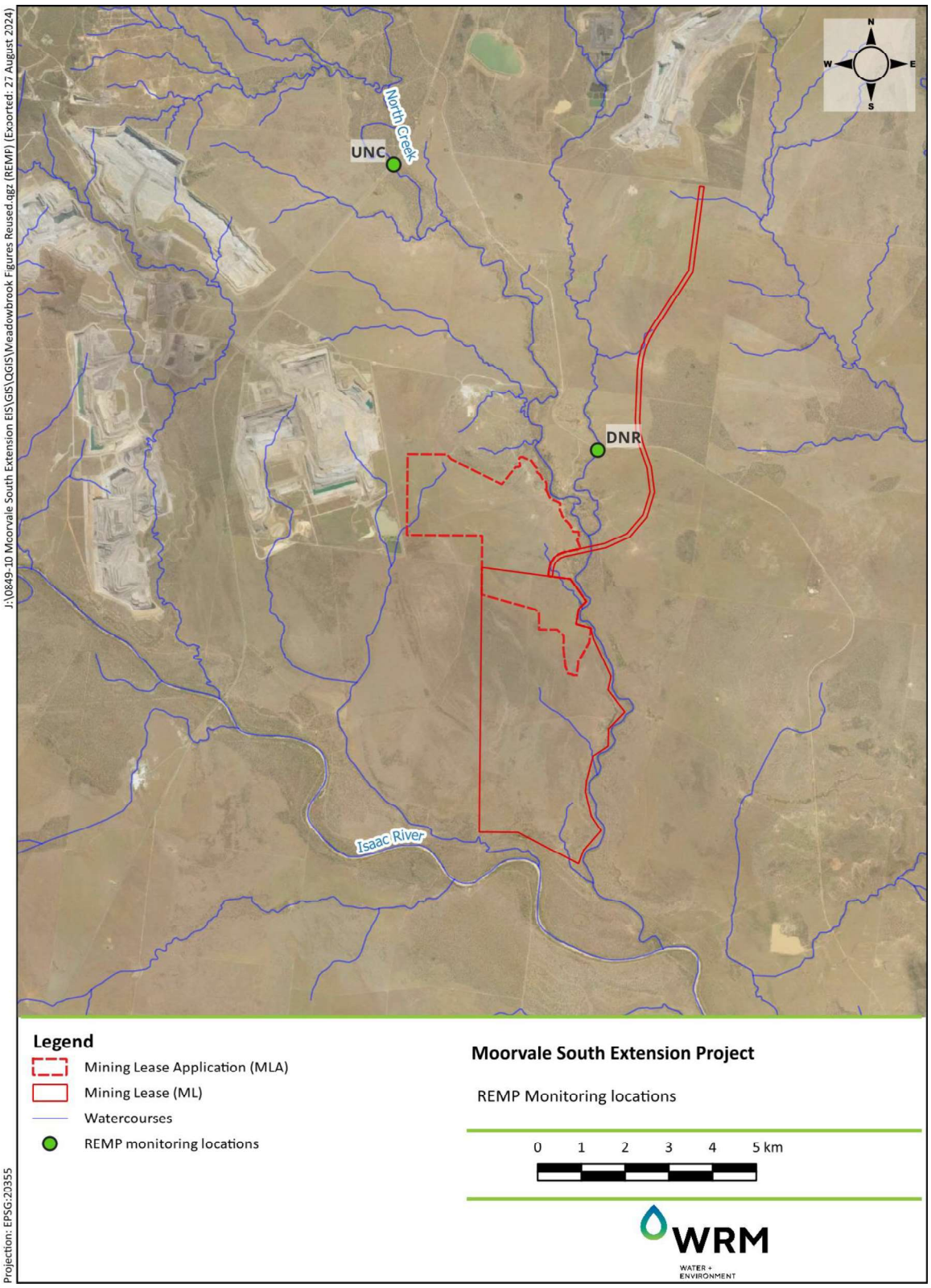


Figure 1 Locations of REMP sampling sites

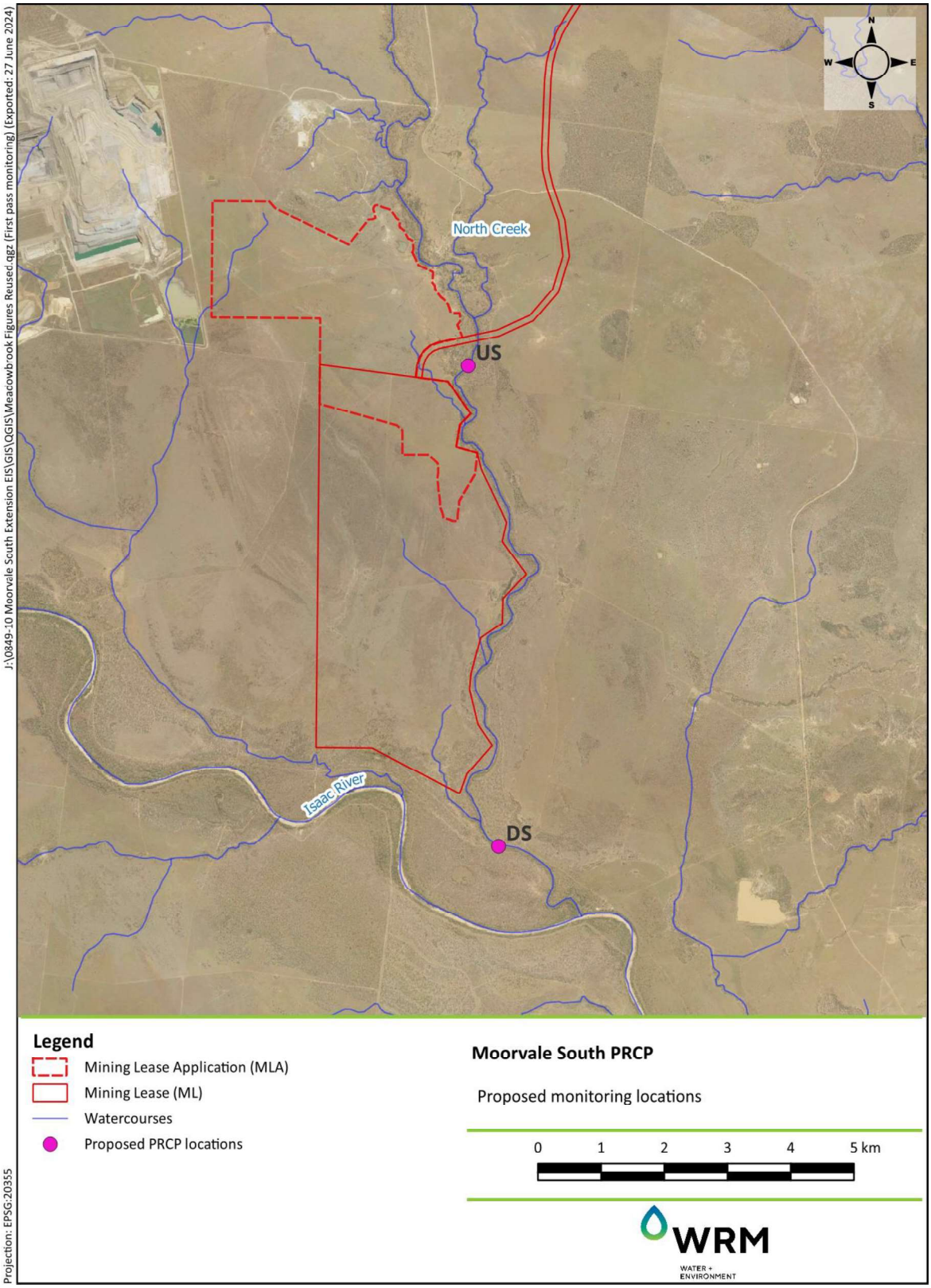


Figure 2 Proposed PRCP monitoring locations

5 REFERENCES

ANZG, 2018	'Australian and New Zealand Guidelines for Fresh and Marine Water Quality', Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia, Available at www.waterquality.gov.au/anz-guidelines.
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