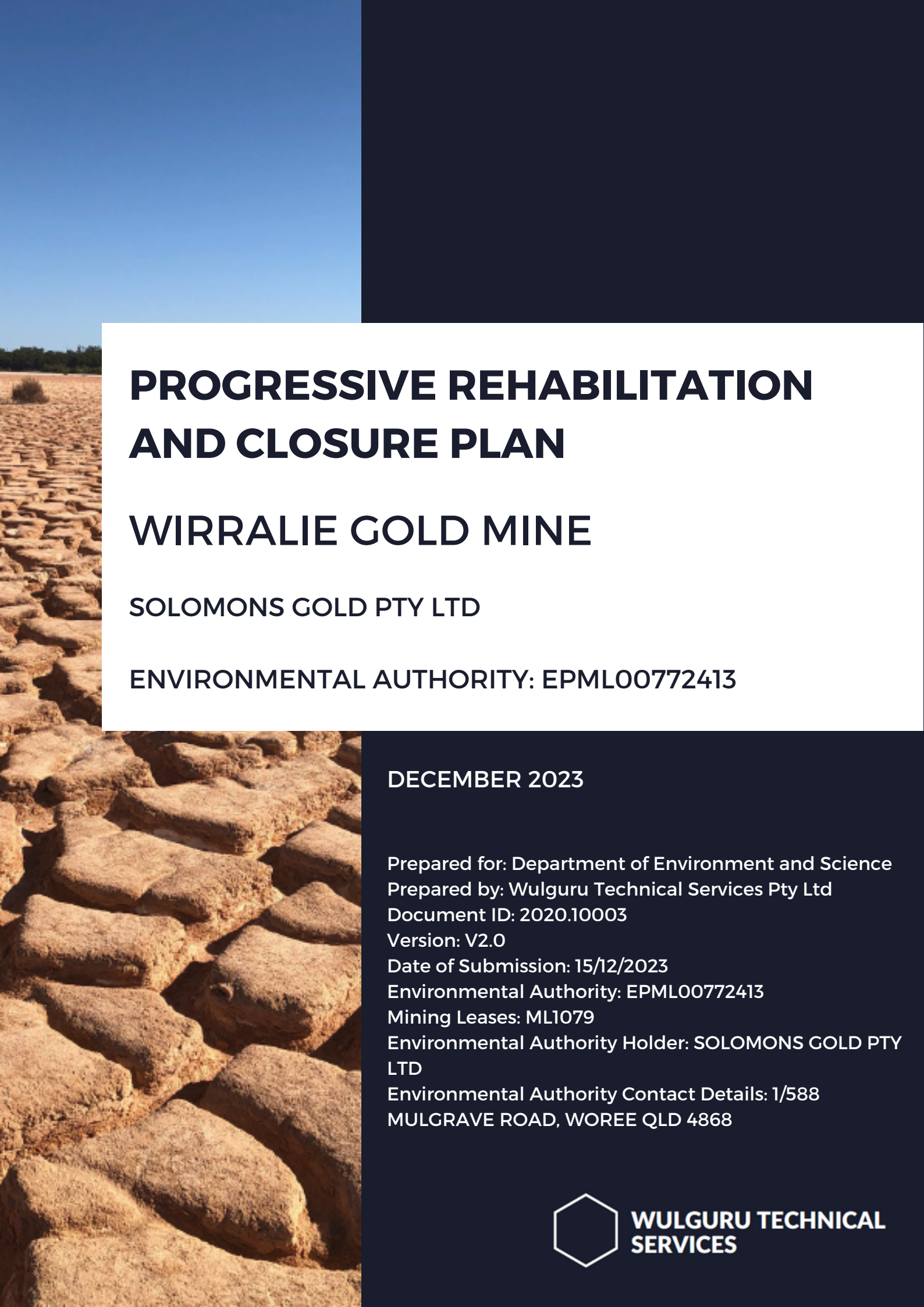




PROGRESSIVE REHABILITATION AND CLOSURE PLAN

WIRRALIE GOLD MINE

SOLOMONS GOLD PTY LTD

ENVIRONMENTAL AUTHORITY: EPML00772413

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1. Introduction

The Wirralie Gold Mine (the Project) is owned and operated by Solomons Gold Pty Ltd (Solomons Gold) under Environmental Authority EMPL00772413 (the EA). Wulguru Technical Services Pty Ltd (WTS) were engaged by Solomons Gold to prepare a Progressive Rehabilitation and Closure Plan (PRCP) in accordance with the following Department of Environment and Science (DES) guideline:

- Guideline ESR/2019/4964 – *Progressive rehabilitation and closure plans (PRC plans)*, Version 2.00 – 17 March 2021.

The PRCP outlines the Project planning and post-closure requirements, community consultation, post-mining land use, rehabilitation methods, risk assessment, monitoring and maintenance, and rehabilitation schedule.

2. Purpose of Plan

The purpose of this document is to assess the existing environmental values and provide for rehabilitation and closure planning based on current disturbances. This PRCP will:

- Outline how Solomons Gold will meet landholder expectations for final land use;
- Outline how Solomons Gold will achieve a decommissioned site that is safe, fit for purpose, and non-polluting;
- Outline how Solomons Gold will minimise residual impact or liability for community and future land holders following rehabilitation; and
- Outline how Solomons Gold will restore agreed areas of the mine footprint to agree post mine land uses.

3.Rehabilitation Planning

3.1. Project Planning

3.1.1.Project Description

The Project is located approximately 30 km north of the township of Mount Coolon, and approximately 200 km west of Mackay, North Queensland. The region is administered by the Whitsunday Regional Council and is located in a primarily rural zone. The main access route to the Project is via Rutherford Road and the Bowen or Suttor Developmental Roads.

The Project was discovered in 1986 during exploration activities to identify the source to a regional stream sediment sampling anomaly. Mining began at the Project in 1987 and continued until 1993, when the processing plant was relocated to the Yandan mine site, 30 km west. An upgraded 1.5 million tonne per annum treatment plant was reinstated at Wirralie in 1999. The plant treated low-grade oxide and Deep Lead mineralisation until early 2002, when the site was placed in care and maintenance.

Solomons Gold acquired the Project in December 2013 and since recommenced mining and processing operations.

3.1.2.Land Tenure

The Project is located on Wirralie Station, described as freehold land on Lot 3272 on Plan SP237696 (Table 1).

Table 1. Real Property Description

Company Name - ACN	Solomons Gold Pty Ltd – 82 601 398 841
Landholders	Wirralie Station
Lot on Plan	Lot 3272 on Plan SP237696
Property Size	20,100 ha
Local Government Area	Whitsunday Regional Council
Zoning Information	Freehold

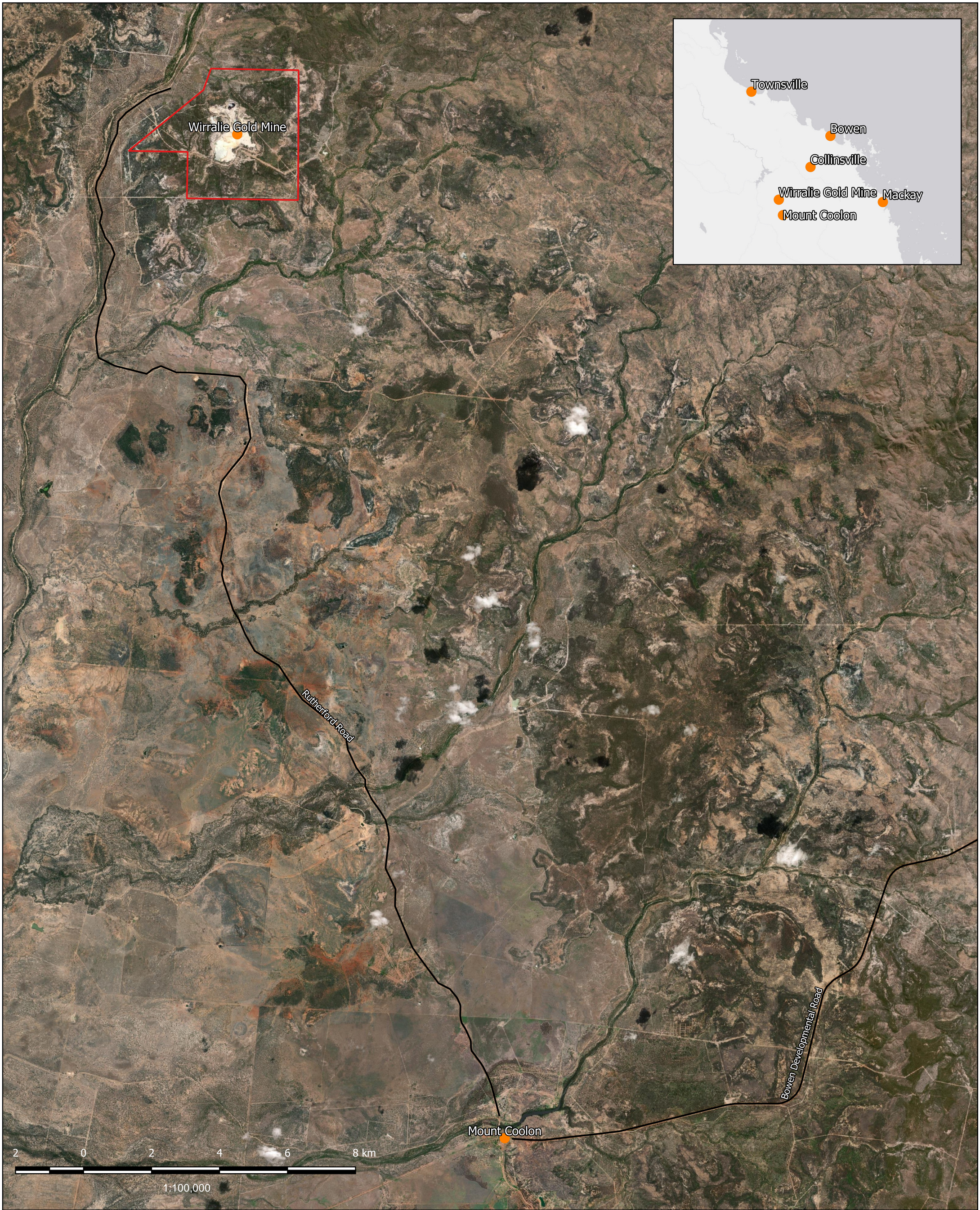
3.1.1.Mining Tenements

The Project is located on a single mining lease, ML1079, which covers an area of approximately 1,301 ha, as detailed in Table 2.

Table 2. Wirralie Mining Tenement

Mining Lease	ML 1079
Name	Wirralie
Property	Wirralie Station
Landholder	
EA Holder	Solomons Gold Pty Ltd

Minerals	BI, CO, CU, MN, NI, PB, SN, W, ZN, AG, AU
Purpose	Mining gold ore and other mining ancillary activities
Area:	1,301 ha



Client: Solomons Gold Pty Ltd
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Figure 1. Project Location

- Key Features
 - Major Roads
 - Mine Lease
- ESRI Satellite

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Figure 2. Mining Tenements

- Lot on Plan
- Mine Lease

ESRI Satellite

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3.1.2.Primary Mine Features and Infrastructure On-Site

The primary mine features and infrastructure is described in Table 3.

Table 3. Mine features

Relevant Activity	Area (ha)
Open Cut Pit Areas	
Pit A	8.32
Pit B	7.27
North Pit	0.67
Deep Lead Pit	1.83
Overburden Dumps and Piles	
ROM	2.46
ROM Stockpile	2.57
Topsoil stockpiles	3.66
WRD1	1.76
WRD2	3.18
WRD3	5.62
Rehabilitated former WRDs	20.90
Mine Infrastructure Area	
Access roads and tracks	7.65
Mine haul road	6.40
Laydown yards	1.01
Processing Plant	1.54
Camps/ administration/former camp	2.73
Storages	
Raw water pond	0.45
Run-off dam	8.54
Tailings Storage Facility/ Heap Leach Pad	
Tailings Storage Facility/ Heap Leach Pad	72.21
Exploration	
Exploration Tracks	10.66

3.1.1. Pre-mining Land Use

Prior to mining activities commencing, the land use within the ML was low-quality cattle grazing.

The two major land uses in the Suttor River Sub-basin are cattle grazing (more than 80 per cent) and dryland cropping, including sugarcane and wheat. Much of the native vegetation and riparian forests have been cleared in the past decades for this land use.

Regionally, the Project is located within the rural zone under the Whitsunday Regional Council (WRC) Planning Scheme. Within the WRC, agriculture is the biggest land use, however, mining is the biggest economic driver for the region, chiefly for coal and gold.

The Project ML area does not contain areas of regional interest (priority living areas, priority agricultural areas, strategic cropping land and strategic environmental areas) protected under the *Regional Planning Interests Act 2014* (QLD, 2021).

3.1.2.Type of Operations

The Project uses conventional haul truck and excavation operations in an open cut pit (Pit B), supported by traditional drill and blast activities. Mined ore is graded and stored as either low or high grade on the ROM. Ore is selected and blended prior to entering the crushing circuit. Following primary crushing, the material is screened and either placed on the heap leach or enters the Carbon In Leach (CIL) circuit, depending on the size fraction.

The Project utilises in-pit waste rock disposal to minimise the overall surface disturbance for the Project. Waste material extracted as part of the mining process is currently disposed into Deep Lead Pit. Existing waste rock dumps have previously been rehabilitated with varying success by previous mine operators.

3.1.3.Duration Of Operation

Mining is expected to continue until the oxide resource is depleted (currently anticipated as 2026). A production rate of up to 400,000 tonnes per annum (tpa) is expected whilst future development options are investigated.

3.1.4.Design for Closure

Solomons Gold acquired the Project in its current configuration and have not constructed any new mining features since acquisition. Any new disturbance will be designed and conducted in a way that supports future rehabilitation efforts. Ongoing ecological, soil and water monitoring activities will guide rehabilitation methods to maximise success.

In-pit waste rock disposal has been employed as a method to minimise land disturbance and allow progressive rehabilitation of the pits.

3.1.5.Existing Rehabilitation

Approximately 21.24 ha of the Wirralie Gold Mine has previously been rehabilitated by previous owners in 2002. The Project has implemented an annual rehabilitation monitoring program to evaluate the success of the rehabilitation and to inform future maintenance efforts. Rehabilitation monitoring conducted in 2022 and 2023 some erosion on longer and steeper slopes where water flow accumulates; these areas will require rework or maintenance. The rehabilitation areas are showing compatibility to existing analogue sites which will provide further guidance to other rehabilitation areas.

The findings from this monitoring have been incorporated into this PRCP, where relevant, to improve future rehabilitation outcomes.

3.1.6. Progressive Rehabilitation

Areas of mining disturbance will be progressively rehabilitated as they become available. A rehabilitation schedule has been developed (Appendix A), however rehabilitation will commence sooner if areas are no longer required for operations.

Where opportunistic progressive rehabilitation occurs, it is expected that at least one wet season will be needed to establish vegetation. As such each rehabilitation campaign is to be completed, at the latest, by October of each year to allow for vegetation establishment prior to the wet season and to minimise erosion potential.

Historic exploration disturbances, primarily being drill pads, have been rehabilitated in accordance with the *Environmental Authority and the Code of Environmental Compliance for Exploration and Mineral Development*.

Exploration activities will continue across the Project throughout the LOM. Land will be rehabilitated to a stable condition that achieves the relevant post mine land use designated for the location of disturbance. Over the course of operations, the location of exploration disturbance will vary however the rehabilitation strategy will remain the same. Exploration disturbance has been excluded from the PRCP as it is governed under the Code of Environmental Compliance for Exploration and Mineral Development.

3.2. Existing Environmental Context

3.2.1. Climate

3.2.1.1. Rainfall, Temperature and Evaporation

The nearest Bureau of Meteorology (BoM) weather station is at the Collinsville Post Office (Station ID: 033013), approximately 85 km north-east of the Project. Climate statistics are available from 1939 to 2022 (rainfall) and 1955 to 2022 (temperature) (Figure 3). The mean maximum temperature for the summer period (December to February) is 33.5°C, and the mean minimum monthly temperature for the same period is 21.7°C. The mean maximum monthly temperature for the winter period (June to August) is 25.7°C, and the mean minimum monthly temperature for the same period is 10.1°C. Mean annual rainfall for Collinsville is 701.9 mm with 83 days of rainfall ≤ 1 mm.

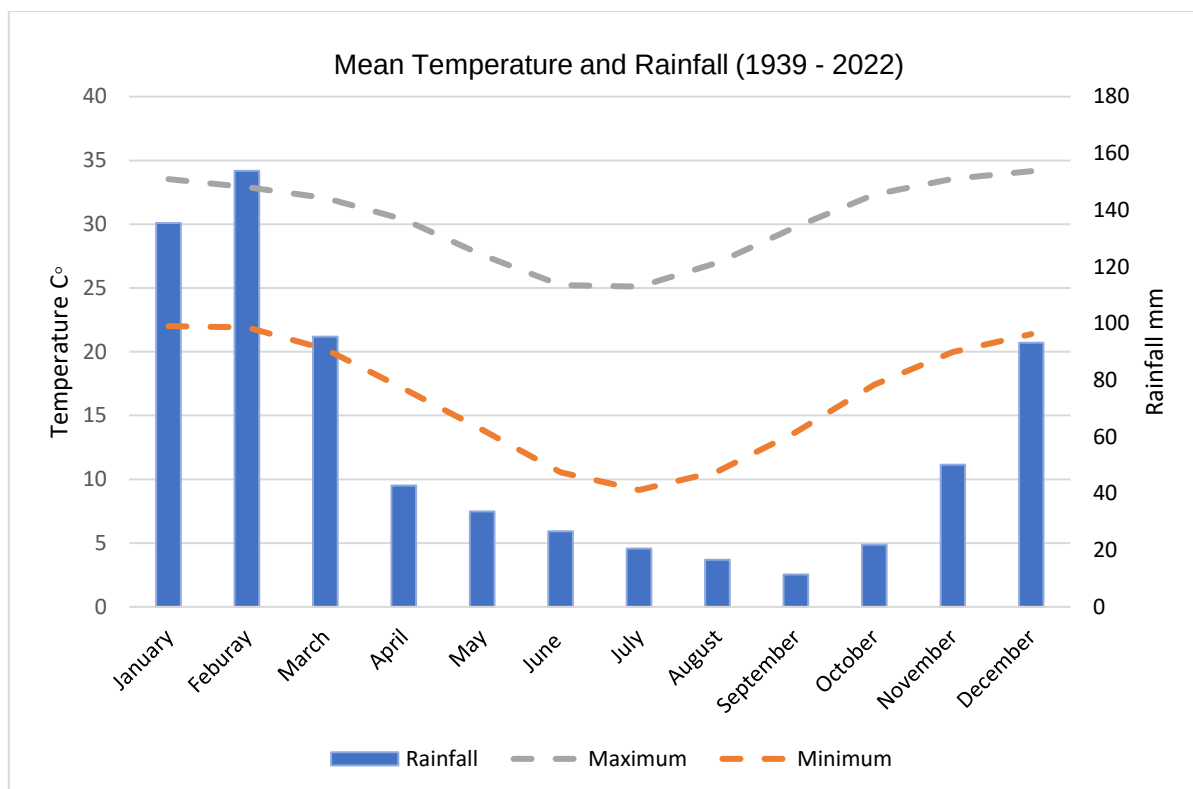


Figure 3. Mean temperature and rainfall at Collinsville Post Office (Bureau of Meteorology, 2023)

3.2.1.2. Wind

The region tends to have winds of low velocity (less than 10km/hr) with the prevailing wind direction predominantly from the east and southeast. Wind rose for the morning (9am) and afternoon period (3pm) are displayed in Figure 4 and Figure 5 respectively.

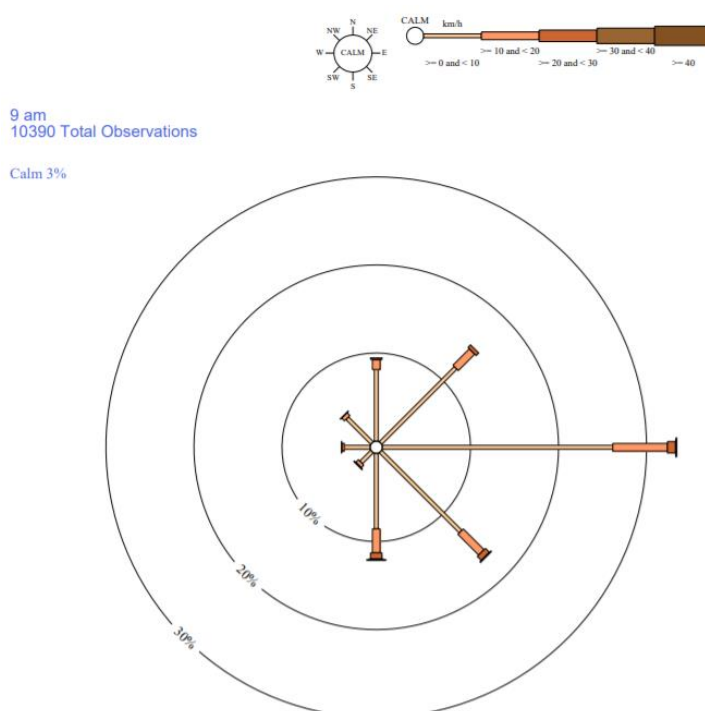


Figure 4. Rose of Wind direction versus Wind speed at 9am (034084) (Bureau of Meteorology, 2021)

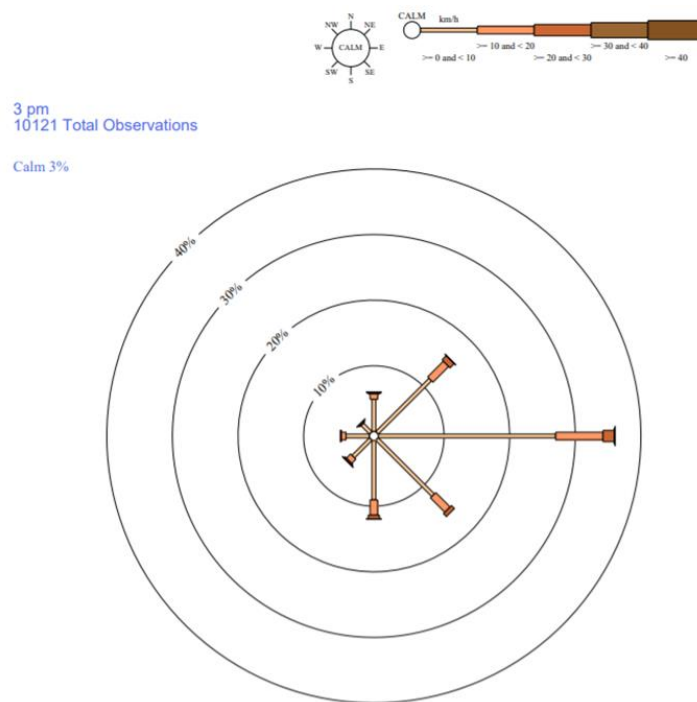


Figure 5. Rose of Wind direction versus Wind speed at 3pm (034084) (Bureau of Meteorology, 2021)

3.2.1.3. Long-term Climate Projections

The 2020 State of the Climate Report (Commonwealth Scientific and Industrial Research Organisation and Bureau of Meteorology, 2020) has predicted that air temperature will continue to rise with increased occurrence of extreme heat days. Dry season rainfall is predicted to decline however with an increased likelihood of more intense events across the year. Collectively, these two factors will continue to increase bushfire risk indicated by the change in dangerous fire weather days as illustrated in Figure 6.

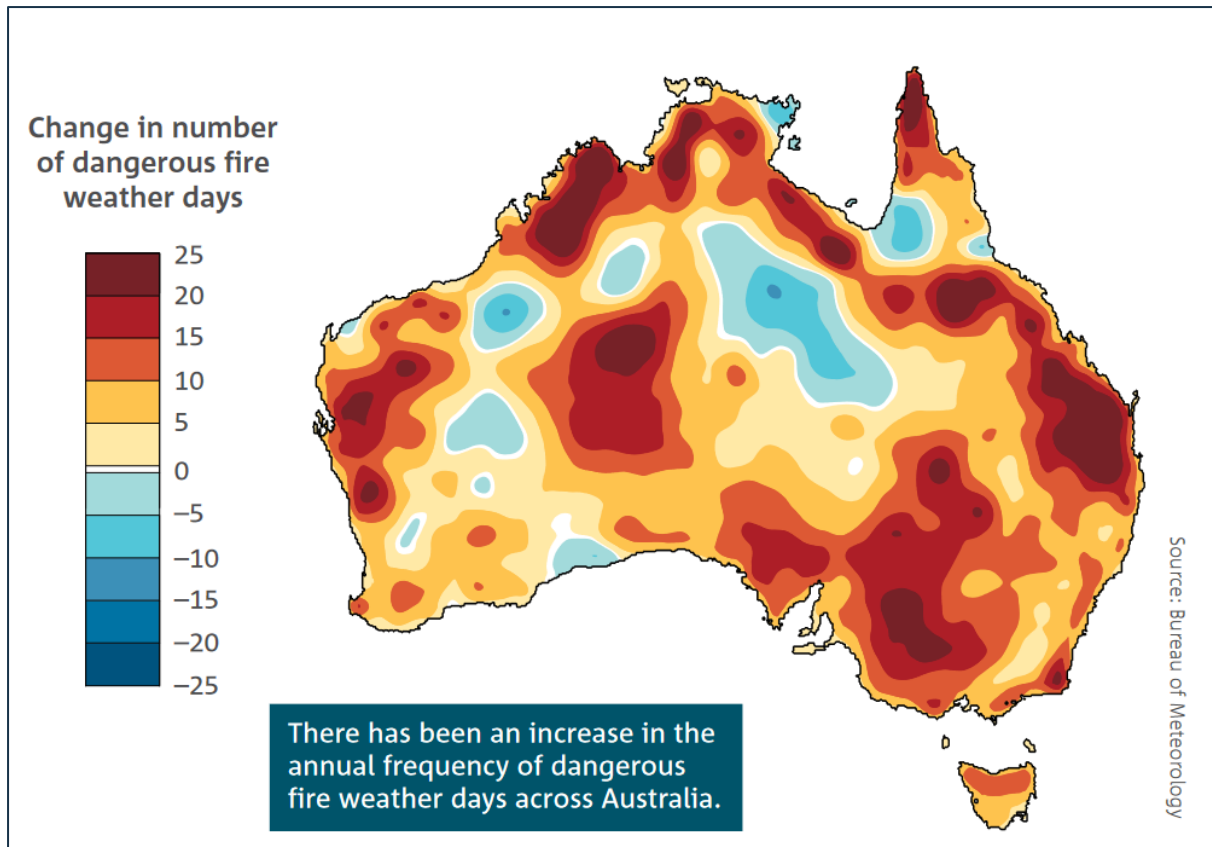


Figure 6. Excerpt from the 2020 State of the Climate Report illustrating change in dangerous fire weather days (CSIRO & BOM 2020).

3.2.1. Topography

Regionally, the Project lies to the east of the Great Dividing Range and is surrounded by low mountains ranging from 296 m AHD (Rodborough Hill) to 552 m AHD (Mount Landsborough).

At the Project, the topography is variable with rolling rises and hills dominating the site, transitioning to flats and plains (Figure 7). The highest local features are ~290 m AHD transitioning to ~260 m AHD north and south of the lease.



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Figure 7. Topography

- | | |
|----------------|--------------------|
| — 10m Contours | Hydro-enforced DEM |
| ▭ Mine Lease | 200m |
| ESRI Satellite | 250m |
| | 300m |
| | 350m |
| | 400m |

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Digital data for this report is available on the Queensland Government Spatial Portal at <http://www.information.qld.gov.au>.



3.2.2. Hydrology and Fluvial Networks

The Project is situated within the Suttor River sub-basin of the Burdekin River Basin with landscapes varying from the wet tropic rainforests of Eungella and the Paluma Range in the north to the drier areas of the upper catchments of the Belyando and Cape rivers (in the south and west) and the plains of the lower Burdekin River in the east (BOM, 2016).

Locally, the Project drains in a northerly direction via several minor drainage lines, including Sugarbag Creek, which in turn drains to Rosetta Creek. Rosetta Creek drains to the Suttor River approximately 44 km southwest of the Project. The Suttor River continues to flow in a northerly direction, discharging into the Burdekin Dam. A summary of Project watercourses and dams is provided in Table 4.

The local drainage features are predominately of the first stream order and ephemeral in nature, typically flowing for short durations immediately following rainfall and remaining dry for the rest of the year. Some pools do persist along Sugarbag Creek however none of these are permanent (Figure 8).

Table 4. Watercourses And Dams

ID	Watercourse	Perennially	Hierarchy	Stream order	Comment
Watercourses					
1	Unnamed	Ephemeral	Minor	1	Runs south – west through ML 1079 discharging into Rosetta Creek
2	Unnamed	Ephemeral	Minor	1	Runs south – west through ML 1079 discharging into Rosetta Creek
3	Unnamed	Ephemeral	Minor	1	Runs south – west through ML 1079 discharging into Rosetta Creek
4	Unnamed	Ephemeral	Minor	1	Runs south – west through ML 1079 discharging into Rosetta Creek
5	Unnamed	Ephemeral	Minor	1	Runs south – east through ML 1079 discharging into Bungosine Creek
6	Unnamed	Ephemeral	Minor	1	Runs south – east through ML 1079 discharging into Bungosine Creek
7	Unnamed	Ephemeral	Minor	1	Runs south – east through ML 1079 discharging into Bungosine Creek
8	Unnamed	Ephemeral	Minor	1	Runs west through ML 1079 discharging into Rosetta Creek
9	Unnamed	Ephemeral	Minor	1	Runs west through ML 1079 discharging into Rosetta Creek
10	Unnamed	Ephemeral	Minor	1	Runs west through ML 1079 discharging into Rosetta Creek
11	Unnamed	Ephemeral	Minor	1	Runs west through ML 1079 discharging into Rosetta Creek

ID	Watercourse	Perennially	Hierarchy	Stream order	Comment
12	Unnamed	Ephemeral	Minor	1	Runs west through ML 1079 discharging into Rosetta Creek
13	Sugarbag Creek	Ephemeral	Minor	2	Runs west through ML 1079 discharging into Rosetta Creek
14	Rosetta Creek	Ephemeral	Major	5	Runs southwest to north west direction and discharging into Suttor River.
15	Suttor River	Ephemeral	Major	8	Runs north and discharges into Burdekin Falls Dam
Dams					
16	TSF	-	-	-	Located west of the heap leach pads totalling approximately 58 ha.
17	Runoff Dam	-	-	-	Located directly downstream of the TSF totalling approximately 8 ha.
-	Burdekin Falls Dam	-	-	-	Located 60km north of the Project.



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Figure 8. Site Hydrology

- | | |
|----------------|--------------|
| Mine Lease | Stream Order |
| 10m Contours | 1 |
| Burdekin Basin | 2 |
| ESRI Satellite | 3 |
| | 4 |
| | 5 |

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Digital data for this report is available on the Queensland Government Spatial Portal at <http://www.information.qld.gov.au>.



3.2.2.1. Surface Water Environmental Values (EV) and Water Quality Objectives (WQO)

There are no specified EV or WQO's for the Suttor River sub-basin under *the Environmental Protection Policy (Water and Wetland Biodiversity) Policy 2019*. Draft EVs and WQOs for the Burdekin Basin were released for comment in 2017 and are still under review. The EVs and WQOs for the Burdekin Basin were based on the Burdekin Region Water Quality Improvement Plan 2016 (NQ Dry Tropics 2016). NQ Dry Tropics (2016) highlighted the following draft EVs for Rosetta Creek:

- Aquatic ecosystems;
- Human uses:
 - Irrigation;
 - Livestock;
 - Visual amenity;
 - Drinking water;
 - Industrial uses; and
 - Cultural and spiritual.

WQOs for cattle grazing and for slightly to moderately disturbed ecosystems have been adopted for the Project, due to the predominant land use and surrounding environment.

3.2.2.2. Surface Water Quality

Water quality monitoring is conducted at locations prescribed in Schedule C Table 1 of the EA, reproduced below in Table 5. Water quality is monitored against values defined in EA Schedule C – Table 2 (Receiving water contaminant limits), reproduced below in Table 6. A summary of water chemistry data collected from 2021 to 2023 is provided in Table 7.

Table 5. EA Schedule C Table 1 (Receiving water monitoring locations and frequency)

Monitoring Point	Easting	Northing	Monitoring Frequency
SW1 - Tailings Dam Spillway	526752	7663974	Monthly when flowing
SW2 - Tailing Dam Runoff Dam	526747	7664998	Monthly when flowing
Tailings Dam Ponded Water	527793	7664832	Six Monthly
SW4 - Rosetta Creek	524242	7665490	Monthly when flowing
SW5 - Sugar Bag Creek	526557	7665405	Monthly when flowing
Sugar Bag Creek (Release Point 1)	526350	7665700	Opportunistic rising stage sampler at 1.8m
Drainage to Pit (Release Point 2)	527800	7665094	Monthly when flowing

Table 6. EA Schedule C – Table 2 Receiving water contaminant limits

Parameter	Units	Limit Type	Contaminant Limits (Unfiltered)
pH		Range	6 to 9
Total Dissolved Solids	mg/L	Maximum	4000
Sulphate	mg/L	Maximum	1000
Arsenic	mg/L	Maximum	0.5
Cadmium	mg/L	Maximum	0.01
Copper	mg/L	Maximum	0.5
Lead	mg/L	Maximum	0.1
Mercury	mg/L	Maximum	0.002
Molybdenum	mg/L	Maximum	0.05
Selenium	mg/L	Maximum	0.02
Zinc	mg/L	Maximum	20
WAD Cyanide	mg/L	Maximum	0.2

Table 7. Surface Water Chemistry

Monitoring Point	pH (field)	TDS	Sulfate (SO4)	Arsenic Total	Cadmium Total	Copper Total	Lead Total	Mercury Total	Molybdenum Total	Selenium Total	Zinc Total	WAD Cyanide
Sampling Date	pH units	mg/L										
North Pit												
23/03/2023	2.47	4960	4040	5.62	0.0414	1.56	<0.001	<0.0001	0.008	0.04	5.52	<0.004
17/11/2021	3.18	10600	8760	13.7	0.0813	3.24	<0.001	<0.0001	0.021	0.05	11.2	<0.004
29/05/2023	2.42	7340	4520	6.75	0.0503	1.9	<0.001	<0.0001	0.01	0.03	6.93	<0.004
2/08/2023	n/d	7020	5200	7.06	0.052	1.99	0.001	<0.0001	0.01	0.03	7.53	<0.004
12/10/2023	2.40	7780	5670	8	0.0581	2.17	<0.001	<0.0001	0.01	0.04	8.56	<0.004
Runoff Dam												
22/03/2023	8.21	137	38	0.033	<0.0001	<0.001	<0.001	<0.0001	<0.001	<0.01	<0.005	<0.004
29/05/2023	5.81	159	47	0.014	<0.0001	0.001	<0.001	<0.0001	<0.001	<0.01	<0.005	<0.004
2/08/2023	n/d	271	69	0.048	<0.0001	0.002	0.001	<0.0001	<0.001	<0.01	0.007	<0.004
2/08/2023	n/d	239	60	0.02	<0.0001	0.001	<0.001	<0.0001	0.001	<0.01	<0.005	<0.004
Sugar Bag Creek (Release Point 1)												
01/02/2022	6.90	251	<1	0.014	<0.0001	<0.001	0.003	<0.0001	<0.001	<0.01	0.006	<0.004
SW1												
23/07/2021	n/d	n/d	1490	0.084	<0.0001	0.014	<0.001	<0.0001	0.043	<0.01	<0.005	0.007
SW2												
01/02/2022	3.93	296	123	0.006	0.0002	0.002	<0.001	<0.0001	<0.001	<0.01	0.053	<0.004
23/07/2021	n/d	n/d	308	0.004	0.0009	0.003	<0.001	<0.0001	<0.001	<0.01	0.202	<0.004
SW4												
20/09/2021	7.31	254	<1	0.008	<0.0001	0.001	0.003	<0.0001	0.001	<0.01	<0.005	<0.004
01/02/2022	7.54	127	2	0.003	<0.0001	<0.001	<0.001	<0.0001	<0.001	<0.01	<0.005	<0.004
09/11/2022	7.15	161	2	0.005	<0.0001	<0.001	<0.001	<0.0001	<0.001	n/d	<0.005	<0.004
04/05/2023	n/d	134	2	0.004	<0.0001	<0.001	<0.001	<0.0001	<0.001	n/d	<0.005	<0.004
SW5												
29/05/2023	4.44	258	65	0.013	0.0002	0.005	<0.001	<0.0001	<0.001	<0.01	0.04	<0.004

11/10/2023	4.57	303	74	0.006	0.0002	0.003	<0.001	<0.0001	<0.001	<0.01	0.043	<0.004
02/02/2022	n/d	<10	<1	<0.001	<0.0001	<0.001	<0.001	<0.0001	<0.001	<0.01	<0.005	<0.004
TSF												
17/11/2021	8.45	8230	3050	0.080	0.0002	0.027	<0.001	<0.0001	0.078	0.01	<0.005	0.012
31/05/2022	7.86	265	38	0.019	<0.0001	0.002	0.001	n/d	<0.001	<0.01	0.007	<0.004
11/08/2022	8.17	1610	586	0.069	<0.0001	0.007	<0.001	n/d	0.037	<0.01	<0.005	0.006
08/11/2022	7.15	2700	59	0.155	<0.0001	0.006	0.001	<0.0001	0.04	<0.01	0.009	<0.004
22/03/2023	8.50	1460	570	0.242	<0.0001	0.002	<0.001	<0.0001	0.030	<0.01	<0.005	<0.004
30/05/2023	6.04	1920	748	0.217	<0.0001	0.004	<0.001	<0.0001	0.04	<0.01	0.019	<0.004
2/08/2023	n/d	2780	866	0.225	<0.0001	0.007	<0.001	<0.0001	0.05	<0.01	<0.005	<0.004
12/10/2023	7.05	4180	1470	0.285	<0.0001	0.005	<0.001	<0.0001	0.046	<0.01	<0.005	<0.004
Turkey's Nest												
2/08/2023	n/d	2680	926	0.385	0.0001	0.002	<0.001	0.0002	0.259	0.04	<0.005	2.61
12/10/2023	7.55	1180	78	0.015	<0.0001	0.003	<0.001	<0.0001	0.002	<0.01	<0.005	<0.004
29/05/2023	6.28	198	48	0.024	<0.0001	0.002	<0.001	<0.0001	<0.001	<0.01	<0.005	<0.004

3.2.3. Groundwaters

AGE (2023) completed a Hydrogeology Report (provided in Appendix H); findings are provided herein.

3.2.3.1. Hydrostratigraphic Units

The target ore is located within the Mount Wyatt Formation, locally composed of volcanics and considered a fractured rock aquifer. Overlying is the sedimentary lithologies of Rosetta Creek and Suttor Formations. The formations are further discussed by AGE (2023).

3.2.3.2. Groundwater Levels

Frequent monitoring has been occurring at the Project to help inform the PRCP. AGE (2023) utilised this information to characterise background groundwater flow and quality.

Groundwater is generally more than 20 m below ground level, rising to the surface around bore WTB05. There are no seasonal or overall trends observed in the apparent groundwater levels. The groundwater levels are relatively flat which is typical of areas with limited and slow recharge; such observations are consistent with the Projects climate and low hydraulic conductivity.

Groundwater levels at the Project from 2021 to 2023, are characterised temporally in hydrographs (Figure 9 and Figure 10) and spatially in a potentiometric map (Appendix H (Figure 9.3)).

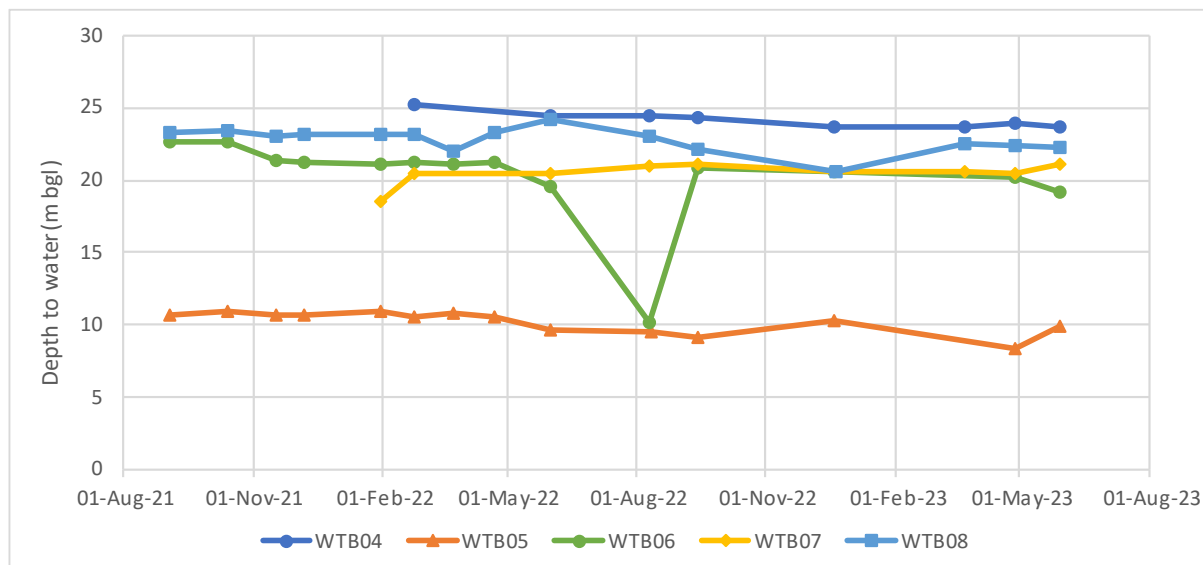


Figure 9. Hydrograph of Depth to Water (mbgl) at Wirralie (AGE, 2023).

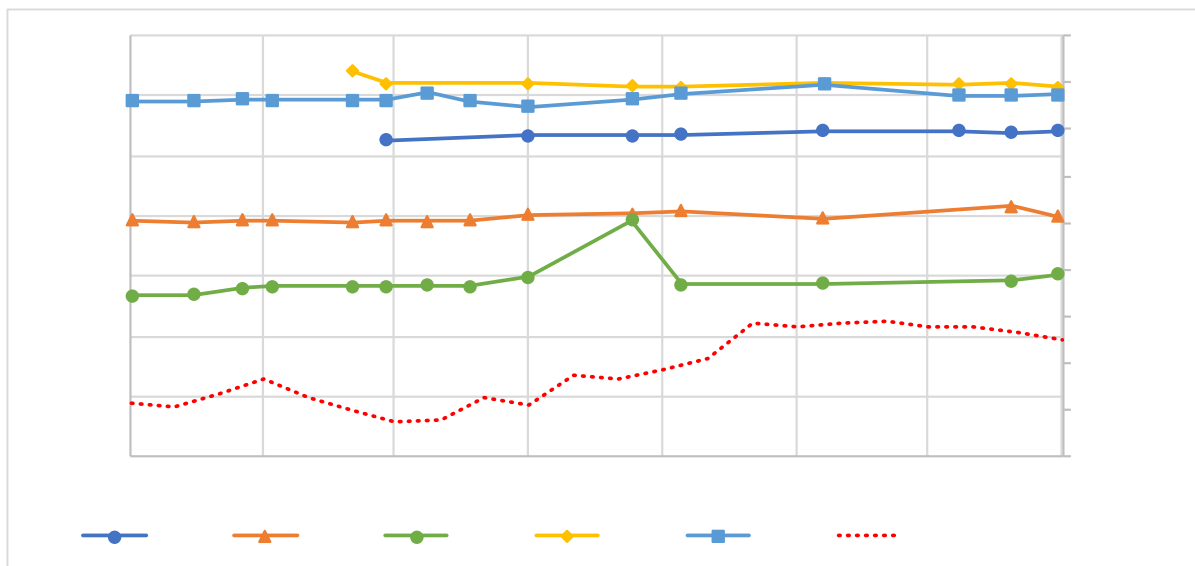


Figure 10. Hydrograph of groundwater elevation (mAHD) at Wirralie

3.2.3.3. Recharge and Discharge

AGE (2023) estimates that the quaternary sediments and Suttor Formation are recharged directly by heavy rainfall. The Mount Wyatt Formation, Rosetta Creek Formation, and Suttor Formation aquifers are likely recharged by downward seepage from overlying and adjacent geology, infiltration from outcrops or open cut pits, and leakage through faults or other structures (AGE, 2023).

Evaporation and through flow is likely the discharge method for the quaternary alluvium and colluvium. The Suttor Formation likely discharges via seepage to underlying formations and evaporation. The Rosetta Creek is thought to enter underlying bedrock through seepage and faults and some through flow. Mount Wyatt is thought to discharge via fault structures (AGE, 2023).

The creeks in the Project area are ephemeral. The base of Rosetta Creek is approximately 1.7 m higher than the groundwater level recorded at WTB05. AGE (2023) notes that it is inferred that no groundwater discharge is occurring to the natural surface waters features.

3.2.3.4. Groundwater EVs and WQOs

NQ Dry Tropics (2016) suggest the following groundwater EVs for the Rosetta Creek sub-catchment:

- Farm supply;
- Livestock;
- Drinking water; and
- Industrial uses.

WQOs for livestock drinking water have been adopted for the project, due to the predominant land use and surrounding environment.

3.2.3.5. Groundwater Quality

Groundwater monitoring is conducted at five groundwater bores, established in 2021 (Table 8). Prior to this, groundwater monitoring was sporadic due to the intermittent nature of mining at Wirralie.

Table 8: Monitoring Bores Details

Proposed ID	Easting	Northing	Target lithology	Total Depth (mBGL)	Screen depth (mBGL)
WTB04	527407	7664918	Weathered Rosetta Creek/Sutton Formation	28	22-28
WTB05	526748	7665239	Weathered Rosetta Creek/Sutton Formation	28	22-28
WTB06	527319	7665825	Weathered Rosetta Creek Formation	50	29-50
WTB07	526809	7663693	Weathered Rosetta Creek/Sutton Formation	25	19-25
WTB08	526845	7663693	Rosetta Creek Formation	76	55-76

Table 9. Baseline Groundwater Data 2021 - 2022

Site ID	pH (field) pH units	TDS	Sulfate (SO4)	Arsenic Total	Cadmium Total	Copper Total	Lead Total	Mercury Total	Molybdenum Total	Selenium Total	Zinc Total	WAD Cyanide
mg/L												
WTB-04 - 10 samples												
Minimum	3.58	370	62.0	0.0520	0.00010	0.0620	0.0250	0.00005	0.0005	0.005	0.1000	0.002
Maximum	5.47	720	79.0	0.1580	0.00020	0.1810	0.1440	0.00130	0.0080	0.005	0.2170	0.002
Mean	4.58	522	71.0	0.1030	0.00017	0.1247	0.0768	0.00052	0.0040	0.005	0.1628	0.002
80th Percentile	5.12	604	75.4	0.1346	0.00020	0.1732	0.1128	0.00050	0.0056	0.005	0.2056	0.002
95th Percentile	5.33	691	78.1	0.1522	0.00020	0.1791	0.1362	0.00110	0.0074	0.005	0.2142	0.002
WTB-05 - 18 samples												
Minimum	3.15	4810	1460.0	0.0080	0.00470	0.0210	0.0080	0.00005	0.0005	0.005	2.8500	0.002
Maximum	7.47	12400	1670.0	0.0730	0.00570	0.6710	0.0620	0.00490	0.0030	0.020	4.9600	0.002
Mean	4.22	10015	1596.7	0.0343	0.00518	0.2017	0.0286	0.00217	0.0012	0.013	3.8650	0.002
80th Percentile	4.50	12000	1658.0	0.0534	0.00550	0.1480	0.0380	0.00450	0.0020	0.020	4.2800	0.002
95th Percentile	6.62	12300	1667.0	0.0688	0.00564	0.5189	0.0560	0.00476	0.0027	0.020	4.7900	0.002
WTB-06 - 18 samples												
Minimum	6.32	10400	1360.0	0.0020	0.00005	0.0010	0.0005	0.00005	0.0005	0.005	0.0180	0.002
Maximum	7.90	15100	1990.0	0.1350	0.00600	0.3930	0.1370	0.00005	0.0060	0.010	0.9120	0.002
Mean	6.83	13025	1758.9	0.0508	0.00159	0.1198	0.0474	0.00005	0.0032	0.006	0.3774	0.002
80th Percentile	6.96	14700	1968.0	0.0792	0.00084	0.1254	0.0616	0.00005	0.0046	0.005	0.5668	0.002
95th Percentile	7.56	15050	1987.0	0.1299	0.00450	0.3264	0.1187	0.00005	0.0057	0.006	0.8368	0.002
WTB-06 - 18 samples												
Minimum	6.32	10400	1360.0	0.0020	0.00005	0.0010	0.0005	0.00005	0.0005	0.005	0.0180	0.002
Maximum	7.90	15100	1990.0	0.1350	0.00600	0.3930	0.1370	0.00005	0.0060	0.010	0.9120	0.002
Mean	6.83	13025	1758.9	0.0508	0.00159	0.1198	0.0474	0.00005	0.0032	0.006	0.3774	0.002
80th Percentile	6.96	14700	1968.0	0.0792	0.00084	0.1254	0.0616	0.00005	0.0046	0.005	0.5668	0.002
95th Percentile	7.56	15050	1987.0	0.1299	0.00450	0.3264	0.1187	0.00005	0.0057	0.006	0.8368	0.002
WTB-07 - 11 samples												
Minimum	6.37	2330	273.0	0.0020	0.00005	0.0130	0.0010	0.00005	0.0020	0.005	0.0380	0.002
Maximum	7.46	2480	297.0	0.0080	0.00040	0.0360	0.0310	0.00005	0.0100	0.005	0.1200	0.002
Mean	6.86	2408	286.7	0.0055	0.00017	0.0238	0.0160	0.00005	0.0053	0.005	0.0833	0.002
80th Percentile	7.11	2456	295.2	0.0080	0.00024	0.0312	0.0226	0.00005	0.0070	0.005	0.1152	0.002
95th Percentile	7.30	2474	296.6	0.0080	0.00036	0.0348	0.0289	0.00005	0.0093	0.005	0.1188	0.002

WTB-08 - 17 samples												
Minimum	5.79	378	40.0	0.0005	0.00005	0.0005	0.0005	0.00005	0.0005	0.005	0.0025	0.002
Maximum	17.00	6	7.0	12.0000	15.00000	9.0000	8.0000	18.00000	9.0000	18.000	7.0000	18.000
Mean	7.30	470	41.0	0.9240	0.93755	0.9132	0.8912	0.94742	0.9008	0.952	0.9023	0.949
80th Percentile	6.98	655	50.0	0.0020	0.00005	0.0054	0.0058	0.00005	0.0010	0.005	0.0290	0.002
95th Percentile	7.36	671	53.0	0.0030	0.00005	0.0778	0.0067	0.00008	0.0017	0.005	0.1123	0.002

3.2.4. Geology

The Project is regionally situated in the Drummond Basin, a 26,000 km² area of central Queensland. The Drummond Basin is from the Upper Devonian to Lower Carboniferous periods that underwent 3 cycles (Olgers 1969). The Project has been historically described as a low-grade, low-sulfidation epithermal system, which lies within cycle one rocks in the central part of the eastern Drummond Basin, and close to the basal unconformity with basement rocks of the Anakie Inlier (NRC 2026).

Water bore establishment and publicly available information confirmed that ML1079 surface geology predominately consists of the Suttor Formation, underlain by both the Rosetta Creek and Mt Rankin Formation (Queensland Government, 2021). The Project geology is described below:

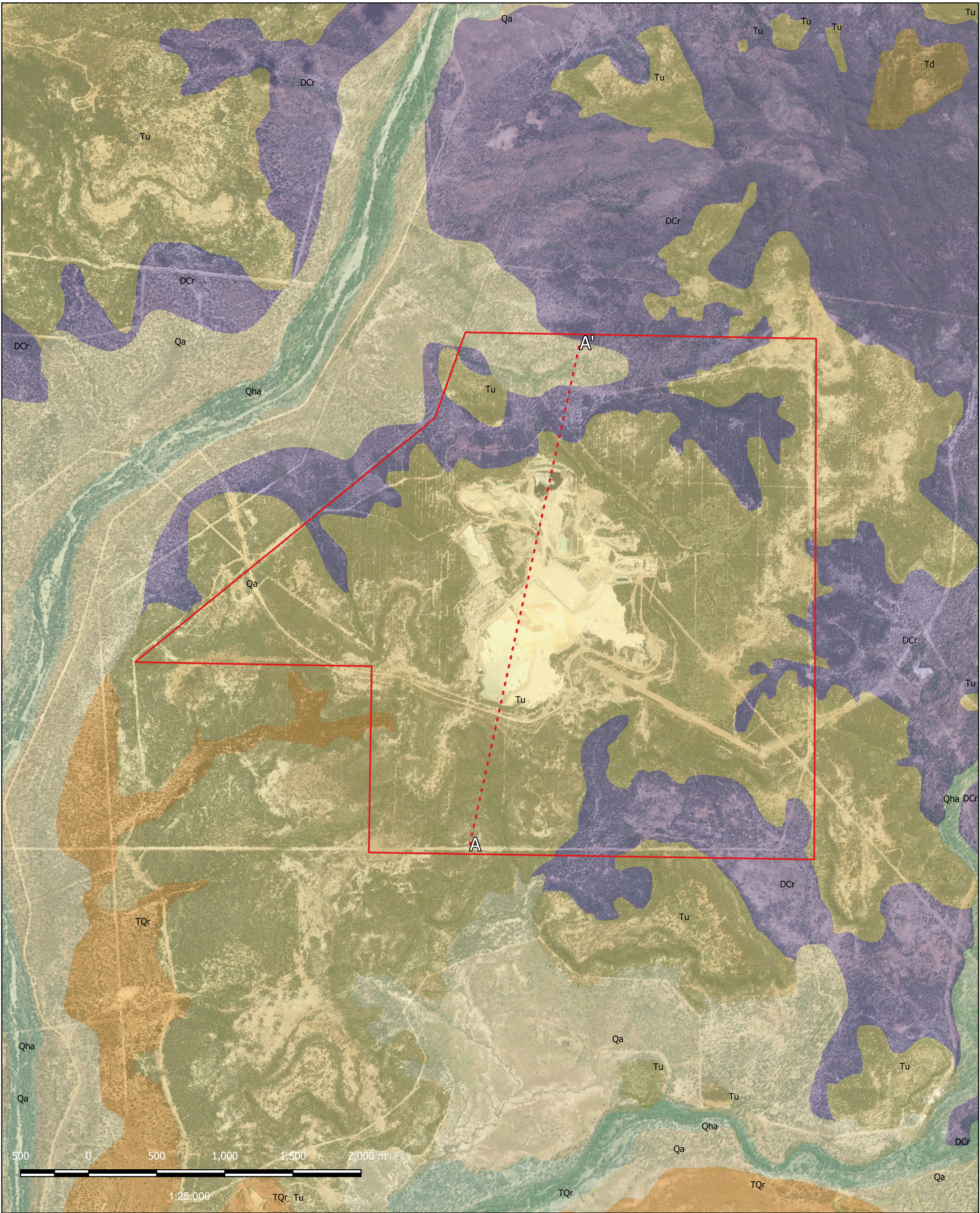
- **Alluvium (Cz)** – Alluvium, soil, sand, lateritic soils and gravels.
- **Suttor Formation (Ta)** – Quartz Sandstone, conglomerate, sandy claystone, silicified claystone.
- **Rosetta Formation** - Late Devonian interbedded siltstone to pebbly sandstone and relatively thin rhyolitic ignimbrite sheets.

Underlying the three formations exists bedrock which can be loosely grouped as a combination of the following formations:

- Bimurra Volcanics;
- Foyle Volcanics;
- Mount Wyatt Formation;
- Saint Anns Formation;
- Silver Hills Volcanics; and
- Stones Creek Volcanics.

The Wirralie epithermal gold deposit is hosted by the late Devonian Mount Wyatt Formation, a formation consisted of labile siltstone and sandstone, epiclastic sediments, tuff, algal limestone pods, minor rhyolite and oligomictic quartz-pebble conglomerate (Geoscience Australia 2016). Lithological data (Section 5.1.2) suggests that the Mount Wyatt Formation is directly overlain by the Suttor Formation around the ore body (northern portion of the ML). The Rosetta Creek Formation underlies the Suttor Formation south of the open cut pits.

Project geology is detailed in Figure 11 and Figure 12.



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Figure 12. Geological Setting

- Mine Lease

Cross Section

Surface Geology

Qa-QLD

Qha-QLD

Rosetta Creek Formation
- Suttor Formation

Td-QLD

TQr-QLD

ESRI Satellite

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3.2.5. Soil Types, Properties and Suitability

3.2.5.1. Soil types and Properties

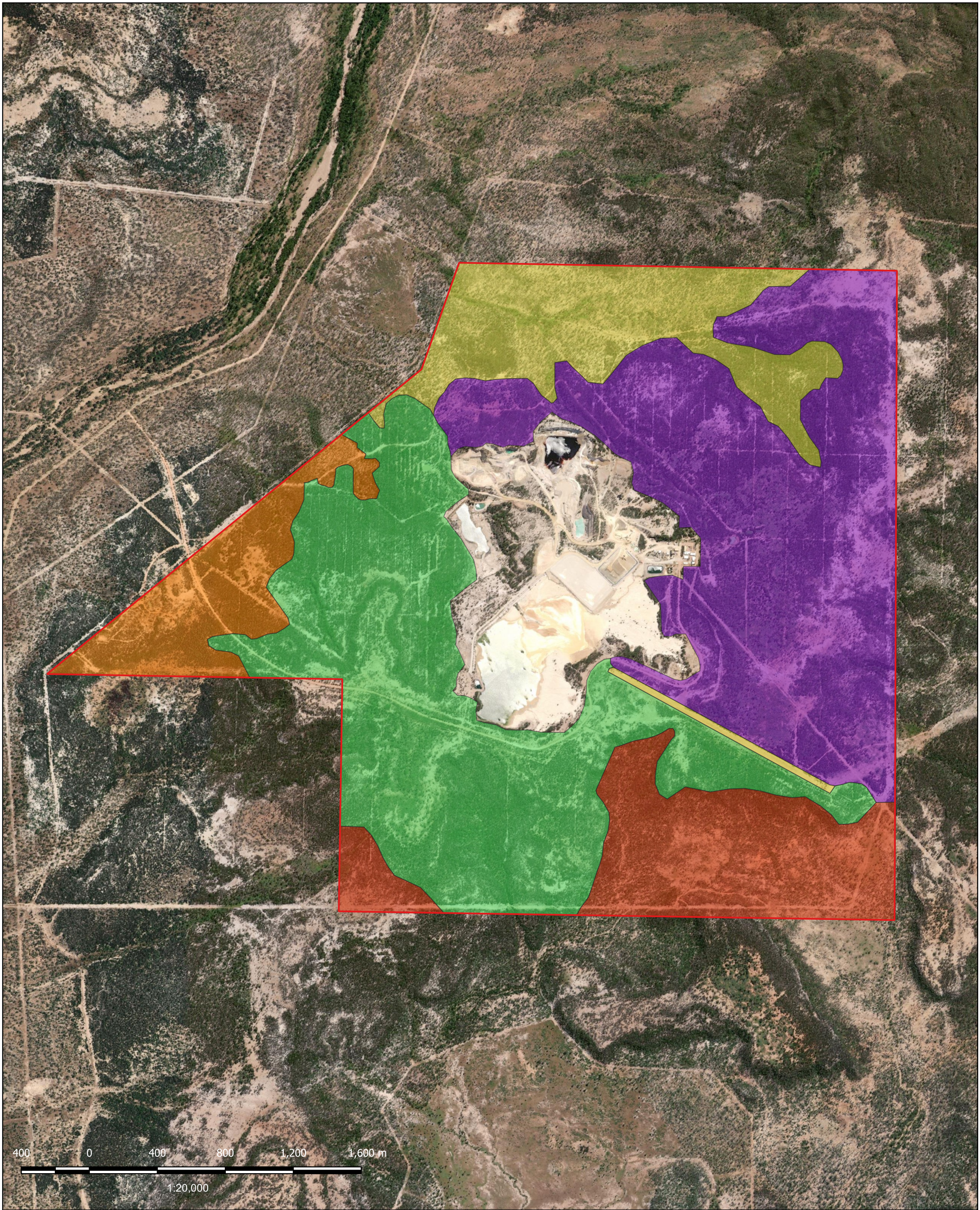
Five soil map units have been identified across the Project (Wulguru Technical Services Pty Ltd, 2021). Representative soil profiles are described in Table 10 and the distribution of soils is mapped in Figure 13. The Soils and Land Suitability Assessment is provided in full in Appendix B.

Table 10. Representative Soil Profiles

Australian Soil Classification	Area (ha)	Area (percentage)
Eutrophic Brown Dermosol, Deep	137.78	12.18
Leptic Brown Rudosol	365.22	32.30
Leptic Brown-Orthic Tenosol, Shallow	394.86	34.93
Sodic Brown Dermosol, Deep	148.40	13.12
Self-Mulching Brown Vertosol, Moderate	84.15	7.44

Table 11. Rehabilitation-Related Chemical Properties

Soil Type	pH (pH Unit)	EC (µS/cm)	Organic Carbon (%w/w)	CEC (meq/100mg)	ESP (%)
Eutrophic Brown Dermosol, Deep	5.3 – 6.0	12 - 15	0.63 – 0.83	3.3 – 3.5	<0.1
Leptic Brown Rudosol	4.4	234 – 142	1.46 – 1.96	2.9 – 3.6	<0.1 – 16.2
Leptic Brown-Orthic Tenosol, Shallow	4.7 – 4.9	19 - 20	0.29 – 0.46	1.3 – 1.5	<0.1
Sodic Brown Dermosol, Deep	6.0 – 6.4	13 - 108	0.14 – 0.43	5.6 – 9.2	2.9 – 32.4
Self-Mulching Brown Vertosol, Moderate	6.4 – 6.6	60 - 265	0.11 – 0.83	5.9 – 5.9	8.8 – 31.7



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Figure 13. Soil Mapping

- Mine Lease

ESRI Satellite
- Eutrophic Brown Dermosol

Leptic Brown-Orthic Tenosol

Leptic Brown Rudosol

Sodic Brown Dermosol

Self-Mulching Brown Vertosol

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3.2.5.2. Land Suitability Assessment

Land Suitability has been assessed using the methods and criteria provided in the Guideline for Agricultural Land Evaluation (Department of Science Information Technology and Innovation and Department of Natural Resources and Mines, 2015) and Guideline for Land Suitability Assessment Techniques (Department of Mines and Energy, 1995). This assesses how suitable an area of land is for two major rural agricultural enterprises: rainfed broadacre cropping and beef cattle grazing.

The Land Suitability assessment cross-references each soil unit's characteristics with suitability criteria from Department of Mines and Energy (1995). The Land Suitability assessment uses a five-class system, where Class 1 indicates that the land is most suitable for the enterprise and Class 5 the least suitable. The overall land suitability ranking for each specific soil unit is determined by the most severe limitation, or a combination of the varying limitations. Land is considered less suitable as the severity of limitations for a land use increases. The increasing limitations may reflect any combination of:

- Reduced potential for production;
- Increased inputs to achieve an acceptable level of production; and/or
- Increased inputs required to prevent land degradation.

The Land Suitability Classes are described in Table 12 and Figure 14.

Table 12. Land Suitability Classes

Class	Suitability	Limitations	Description
1	Suitable	Negligible	Highly productive land requiring only simple management practices to maintain economic production.
2	Suitable	Minor	Land with limitations that either constrain production, or require more than the simple management practices of class 1 land to maintain economic production.
3	Suitable	Moderate	Land with limitations that either further constrain production, or require more than those management practices of class 2 land to maintain economic production.
4	Unsuitable	Severe	Currently unsuitable land. The limitations are so severe that the sustainable use of the land in the proposed manner is precluded. In some circumstances, the limitations may be surmountable with changes to knowledge, economics or technology.
5	Unsuitable	Extreme	Land with extreme limitations that preclude any possibility of successful sustained use of the land in the proposed manner.

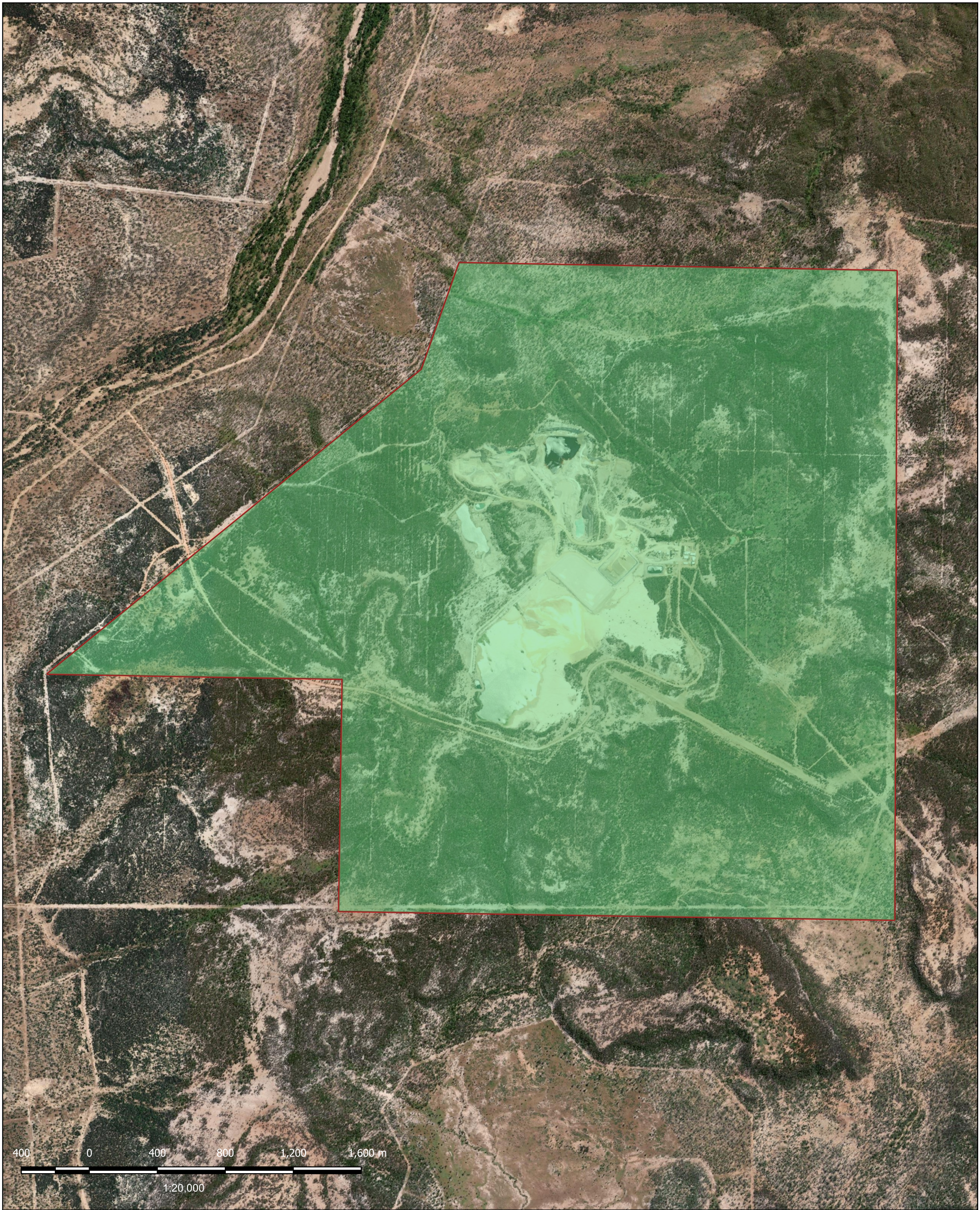
WTS' analysis provides a considered approach to land suitability assessments whereby each soil management unit's characteristics have been cross-referenced against Department of Mines and Energy (1995) and Guidelines for Agricultural Land Evaluation in Queensland (Department of Science Information Technology and Innovation and Department of Natural Resources and Mines, 2015). The overall land suitability class for each SMU is determined by the most severe limitation, or a combination of varying limiting components under both the rainfed broadacre cropping and beef cattle grazing. The results are summarised in Table 13 and Table 14 and presented in full in Appendix B.

Table 13. Summary of Land Suitability Classes for Beef Cattle Grazing

Limitation	Eutrophic Brown Dermosol, Deep	Leptic Brown Rudosol	Leptic Brown-Orthic Tenosol, Shallow	Sodic Brown Dermosol, Deep	Self-Mulching Brown Vertosol, Moderate
Water Availability	4	5	5	5	5
Nutrient Deficiency	1	5	4	1	1
Soil Physical Factors	1	1	2	1	1
Salinity	1	1	1	1	2
Rockiness	1	1	1	1	1
Microrelief	1	1	1	1	1
pH	1	3	3	1	1
ESP (10cm)	1	4	1	3	4
Wetness	1	1	1	2	2
Topography	5	5	5	5	5
Water Erosion	1	1	1	1	1
Flooding	1	1	1	1	1
Vegetation	4	4	4	4	4
Land Suitability Class	5	5	5	5	5

Table 14. Summary of Land Suitability Classes for Rainfed Broadacre Cropping

Limitation	Eutrophic Brown Dermosol, Deep	Leptic Brown Rudosol	Eutrophic Brown Dermosol, Deep	Eutrophic Brown Dermosol, Deep	Eutrophic Brown Dermosol, Deep
Water Availability	5	5	5	5	5
Nutrient Deficiency	1	4	1	1	1
Soil Physical Factors	1	1	3	1	1
Soil Workability	1	1	2	1	1
Salinity	1	1	1	1	2
Rockiness	1	1	1	1	1
Microrelief	1	1	1	1	1
Wetness	1	1	1	2	2
Topography	1	5	2	1	1
Water Erosion	1	1	1	1	1
Flooding	1	1	1	1	1
Land Suitability Class	5	5	5	5	5



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Figure 14. Land Suitability

-  Mine Lease
-  Class 5
- ESRI Satellite

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3.2.5.3. Land Stability

3.2.5.3.1. Soil Erosion Hazard

An assessment of soil erosion susceptibility is given in Table 15, which lists influencing factors for each soil type that has been identified at the Project.

Table 15. Soil Erosion Susceptibility

Soil Type	Sodicity	Texture	Landform	Groundcover	Erosion Susceptibility
Eutrophic Brown Dermosol, Deep	Non- Sodic	Clay Loam	Flat to gently undulated	20-50%	Low susceptibility
Leptic Brown Rudosol	Highly Sodic	Clay Loam	Flat to gently undulated	10-20%	Moderate susceptibility
Leptic Brown-Orthic Tenosol, Shallow	Non- Sodic	Loamy Silt	Flat to gently undulated	<2%	High susceptibility due to sparse erosion protection
Sodic Brown Dermosol, Deep	Non sodic topsoil. Moderately sodic subsoil	Silty Loam	Flat to gently undulated	<2%	High susceptibility due to sparse erosion protection
Self-Mulching Brown Vertosol, Moderate	Sodic to highly sodic	Clay Loam to light/medium clay	Flat to gently undulated	20-50%	Moderate susceptibility

3.2.5.3.2. Erosion Hazard (Average Rainfall)

The International Erosion Control Association's (IECA) Best Practice Erosion and Sediment Control Guidelines (IECA 2008) sets erosion hazard based on average rainfalls for regions around Australia. IECA erosion hazard for the Charters Towers region is detailed in Table 16.

Table 16. Erosion Hazard (IECA, 2008)

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
H	H	H	L	VL	VL	VL	VL	VL	VL	L	H

3.2.5.3.3. Erosion Hazard (Calculated)

Soil erosion presents a significant hazard on downstream receptors, particularly where ground cover is disturbed, and the soil is subject to erosive agents of wind and water. Soil erosion occurs when soil particles detach and are transported off site. This detachment and subsequent entrainment of sediment

is affected by a range of factors, predominantly soil erodibility and steepness of terrain. Soil Erosion Hazard has been assessed for each soil type using the RUSLE equation to determine soil loss (t/ha/yr) and assess erosion risk. The RUSLE equation is outlined below:

$$A = R \times K \times LS \times C \times P$$

Where:

A = estimated average soil loss in tons per hectare per year

R = rainfall-runoff erosivity factor

K = soil erodibility factor

L = slope length factor

S = slope steepness factor

C = cover-management factor

P = support practice factor

RULSE calculations for each soil type are detailed in Table 17.

Table 17. RUSLE Calculations

Soil Type	R	K	LS	C	P	A
Eutrophic Brown Dermosol, Deep	1804	0.030	3.5	0.1	0.8	15.5
Leptic Brown Rudosol	1804	0.055	1.0	0.19	0.8	15.0
Leptic Brown-Orthic Tenosol, Shallow	1804	0.055	1.0	0.40	0.8	31.75
Sodic Brown Dermosol, Deep	1804	0.055	1.2	0.40	0.8	38.1
Self-Mulching Brown Vertosol, Moderate	1804	0.030	2.4	0.10	0.8	10.39

Regarding erosion risk, it is considered that:

- the average Australian rate of erosion is 6.3 t/ha/yr;
- a low rate of erosion is defined as less than (<) 0.5 t/ha/yr;
- a medium rate of erosion is defined as 0.5-10 t/ha/yr ; and
- a high rate of erosion is defined as greater than (>) 10 t/ha/yr (Lu et al. 2001).

All soil types identified at the Project, with the exception of Self-Mulching Brown Vertosol, express a high erosion risk. It is noted that high erosion rates reflect seasonal variance in climate, vegetation cover and seasonal rainfall. With a vegetation cover sparse with coverage dominantly between <2 – 20 %, and seasonal heavy rainfall (November – April) soil may readily be lost naturally due to naturally low

erosion protection. Self-Mulching Brown Vertosols have significantly higher vegetation cover and intern good erosion protection resulting in a lower erosion rate. However, erosion is still considered moderate for Self-Mulching Brown Vertosols due to soil Sodicity and the risk of dispersion where groundcover is disturbed.

3.2.6. Vegetation Communities and Ecological Data

3.2.6.1. Vegetation Communities

The Project is located within the Brigalow Belt Bioregion (Bordering the Wyarra Hills and Beylando Downs Sub Bioregion). Regional ecosystem (RE) mapping shows the Project is located within a mosaic of remnant and non-remnant vegetation under the *Vegetation Management Act 1999* (VM Act) (Table 18). The mapped remnant vegetation areas are comprised of mixed polygons with varying proportions of the REs detailed in Table 18 (QLD, 2021). There were three REs identified that are classed as endangered under the VM Act, generally south of the Project. For a RE to be classified as endangered under the VM Act, the remnant vegetation will be less than 10 per cent (in the bioregion) or 10-30 per cent (and less than 10,000ha) of its pre-clearing extent remains.

Table 18. Regional Ecosystems

Regional Ecosystem	Vegetation Management Act Class	Biodiversity Status	Description	Presence relative to Project location
11.4.9	Endangered	Endangered	<i>Acacia harpophylla</i> shrubby woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains	South
11.3.1	Endangered	Endangered	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	South-west
11.4.8	Endangered	Endangered	<i>Eucalyptus cambageana</i> woodland to open forest with <i>Acacia harpophylla</i> or <i>Acacia argyrodendron</i> on Cainozoic clay plains	South-west
11.3.2	Of concern	Of concern	<i>Eucalyptus populnea</i> woodland on alluvial plains	Surrounding
11.3.4	Of concern	Of concern	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. woodland on alluvial plains	East
11.5.10	Of concern	Of concern	<i>Melaleuca tamariscina</i> tall open shrubland to low woodland on Cainozoic sand plains and/or remnant surfaces	North-west
11.3.25	Least concern	Of concern	<i>Eucalyptus tereticornis</i> or <i>Eucalyptus camaldulensis</i> woodland fringing drainage lines	South-west to north-east
11.7.3	Least concern	No concern at present	<i>Eucalyptus persistens</i> , <i>Triodia mitchellii</i> open woodland on stripped margins of Cainozoic lateritic duricrust	Surrounding
11.7.2	Least concern	No concern at present	<i>Acacia</i> spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone	Surrounding
11.5.9	Least concern	No concern at present	<i>Eucalyptus crebra</i> and other <i>Eucalyptus</i> spp. and <i>Corymbia</i> spp. woodland on Cainozoic sand plains and/or remnant surfaces	Surrounding
11.12.1	Least concern	No concern at present	<i>Eucalyptus crebra</i> woodland on igneous rocks	East to north-east
11.12.2	Least concern	No concern at present	<i>Eucalyptus melanophloia</i> woodland on igneous rocks	North
11.3.37	Least concern	No concern at present	<i>Eucalyptus coolabah</i> fringing woodland on alluvial plains	South-west to north-east

3.2.6.2. Threatened Flora

A search of the State mapping was conducted and determined that the following threatened flora species may exist at the Project.

- *Dichanthium setosum* (Bluegrass) – Possible occurrence however, no records within 50km, suitable habitat mapped in region.
- *Samadera bidwillii* (Quassia) - Possible occurrence however, no records within 50km, suitable habitat mapped in region.

3.2.6.3. Threatened Fauna

The Project is located in the Brigalow Belt Bioregion. Site habitat consists primarily of Acacia, eucalypt and melaleuca woodland and open forest on alluvial plains.

Desktop surveys were undertaken to determine that abundance and assemblage of fauna recorded within. A wide range of common, and non-threatened species were identified to potentially occur within the Project, including 7 amphibians, 137 birds, 32 mammals, and 25 reptiles. Threatened species that may occur within the Project have been summarised below (Table 19).

Table 19: Threatened fauna within a 10km radius of the Project

Listed Threatened Species			
	Name	Status	Type of Presence
Birds	<i>Calidris ferruginea</i> (Curlew Sandpiper)	Critically Endangered	Species or species habitat may occur within area.
	<i>Erythrotriochis radiatus</i> (Red Goshawk)	Vulnerable	Species or species habitat likely to occur within area.
	<i>Falco hypoleucos</i> (Grey Falcon)	Vulnerable	Species or species habitat may occur within area.
	<i>Geophaps scripta scripta</i> (Squatter Pigeon)	Vulnerable	Species or species habitat likely to occur within area.
	<i>Neochmia ruficauda ruficauda</i> (Star Finch)	Endangered	Species or species habitat likely to occur within area.
	<i>Poephila cincta cincta</i> (Southern Black-throated Finch)	Endangered	Species or species habitat may occur within area.
	<i>Tyto novaehollandiae kimberli</i> (Masked Owl)	Vulnerable	Species or species habitat may occur within area.
Migratory Marine Birds	<i>Apus pacificus</i> (Fork-tailed Swift)	Threatened	Species or species habitat likely to occur within area.
	<i>Cuculus optatus</i> (Oriental Cuckoo)	Threatened	Species or species habitat may occur within area.

Listed Threatened Species			
	Name	Status	Type of Presence
Migratory Terrestrial Species	<i>Motacilla flava</i> (Western Yellow Wagtail)	Threatened	Species or species habitat may occur within area.
Migratory Wetland Species	<i>Actitis hypoleucos</i> (Common Sandpiper)	Threatened	Species or species habitat may occur within area.
	<i>Calidris acuminata</i> (Sharp-tailed Sandpiper)	Threatened	Species or species habitat may occur within area.
	<i>Calidris melanotos</i> (Pectoral Sandpiper)	Threatened	Species or species habitat may occur within area.
	<i>Gallinago hardwickii</i> (Latham's Snipe)	Threatened	Species or species habitat may occur within area.
	<i>Pandion haliaetus</i> (Osprey)	Threatened	Species or species habitat may occur within area.
Mammals	<i>Dasyurus hallucatus</i> (Northern Quoll)	Endangered	Species or species habitat may occur within area.
	<i>Macroderma gigas</i> (Ghost Bat)	Vulnerable	Species or species habitat likely to occur within area.
	<i>Phascolarctos cinereus</i> (Koala)	Vulnerable	Species or species habitat likely to occur within area.
Reptiles	<i>Denisonia maculata</i> (Ornamental Snake)	Vulnerable	Species or species habitat likely to occur within area.
	<i>Egernia rugosa</i> (Yakka Skink)	Vulnerable	Species or species habitat may occur within area.
	<i>Lerista vittata</i> (Mount Cooper striped lerista)	Vulnerable	Species or species habitat may occur within area.

3.2.6.4. Matters of National Environmental Significance

Using the Protected Matters Search Tool with a 10km buffer, two listed threatened ecological communities were identified to have a likelihood of being in the region as detailed in Table 20. Table 21 details the significant flora that may occur within 10km of the Project.

Table 20. Matters of National Environmental Significance - Ecological Communities within 10km of the Project (Department of Agriculture, Water and the Environment, 2020).

Listed Threatened Ecological Communities			
Name	Status	Description	Type of Presence
Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered (as of 2001)	Ranges from open woodland to open forest, characterised by the presence of Brigalow (<i>Acacia harpophylla</i>) as one of the three most dominant trees usually along with other <i>Acacia</i> , <i>Eucalyptus</i> , or <i>Casuarina cristata</i> .	Community known to occur within area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered (as of 2019)	Typically, grassy woodland with a canopy dominated by <i>Eucalyptus populnea</i> .	Community likely to occur within area

Table 21. Matters of National Environmental Significance that may occur within 10km of the Project. (Department of Agriculture, Water and the Environment, 2020).

Listed Threatened Species – Plants		
Name	Status	Type of Presence
<i>Dichanthium setosum</i> Bluegrass	Vulnerable	Species or species habitat likely to occur within area.
<i>Eucalyptus raveretiana</i> Black Ironbox	Vulnerable	Species or species habitat likely to occur within area.
<i>Samadera bidwillii</i> Quassia	Vulnerable	Species or species habitat likely to occur within area.

3.2.6.5. Matters of State Environmental Significance

Using State mapping, Matters of State Environmental Significance (MSES) were identified at/surrounding the Project. Project MSES include:

- MSES Regulated Vegetation (Essential Habitat)
- MSES Regulated Vegetation (GBR Riverine)
- MSES Regulated Vegetation (Category C)
- MSES Regulated Vegetation (Category B Endangered or of Concern)
- MSES Wildlife Habitat (Endangered or Vulnerable)

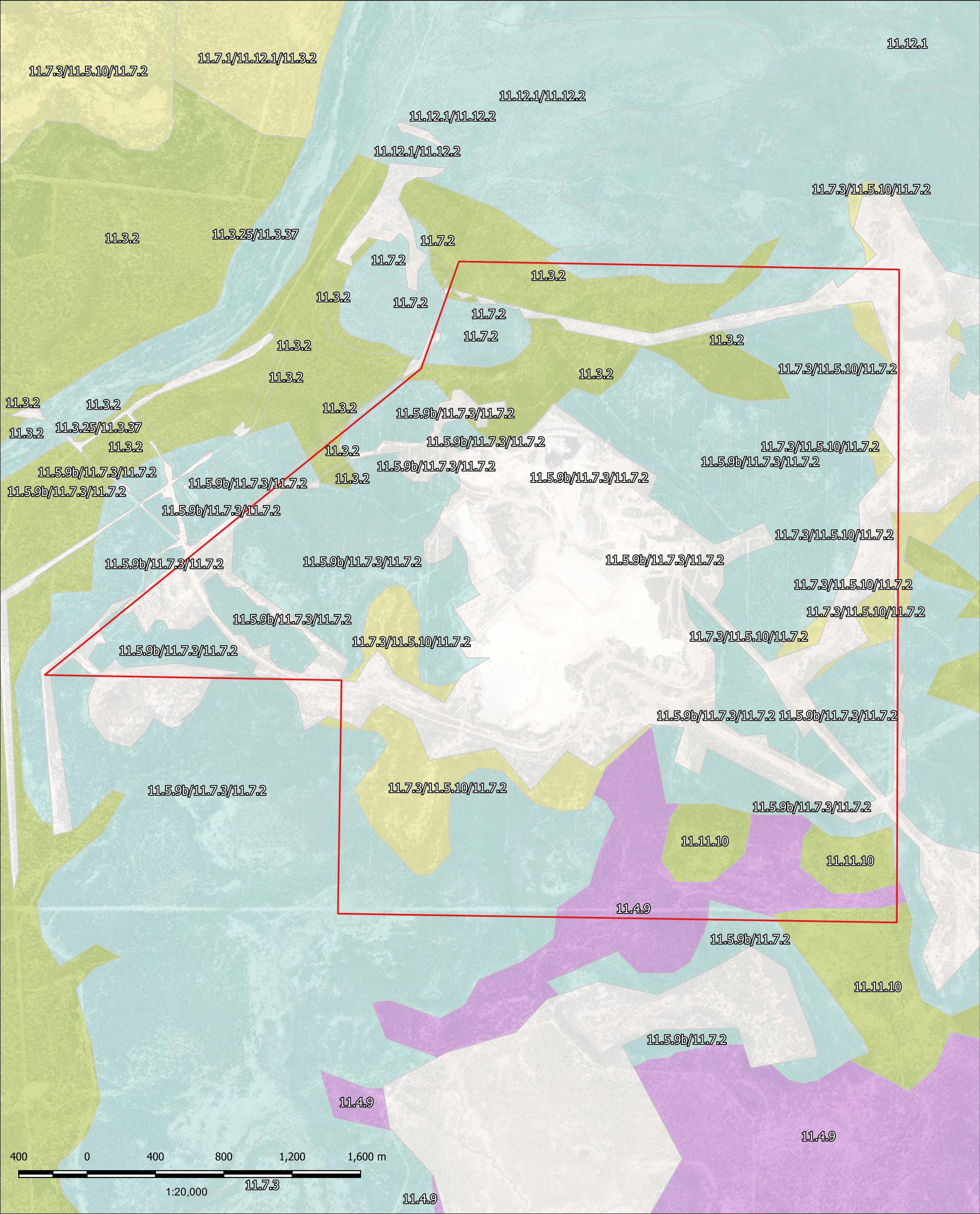
- MSES Regulated Vegetation (Defined Watercourse)

MSES at the Project are displayed in Figure 16.

3.2.6.6. Environmentally Sensitive Areas

State mapping identified the presence of one Environmentally Sensitive Area (ESA) within/ surrounding the Project. ESAs of the Project are displayed in Figure 17.

Data for a desktop analysis of ESAs within the vicinity of the mining lease (ML1079) was requested from DES online. This analysis showed an environmentally sensitive area within the mining lease, and nearby. These ESAs were classified as “Endangered Regional Ecosystems – regrowth and remnant” (Figure 15).



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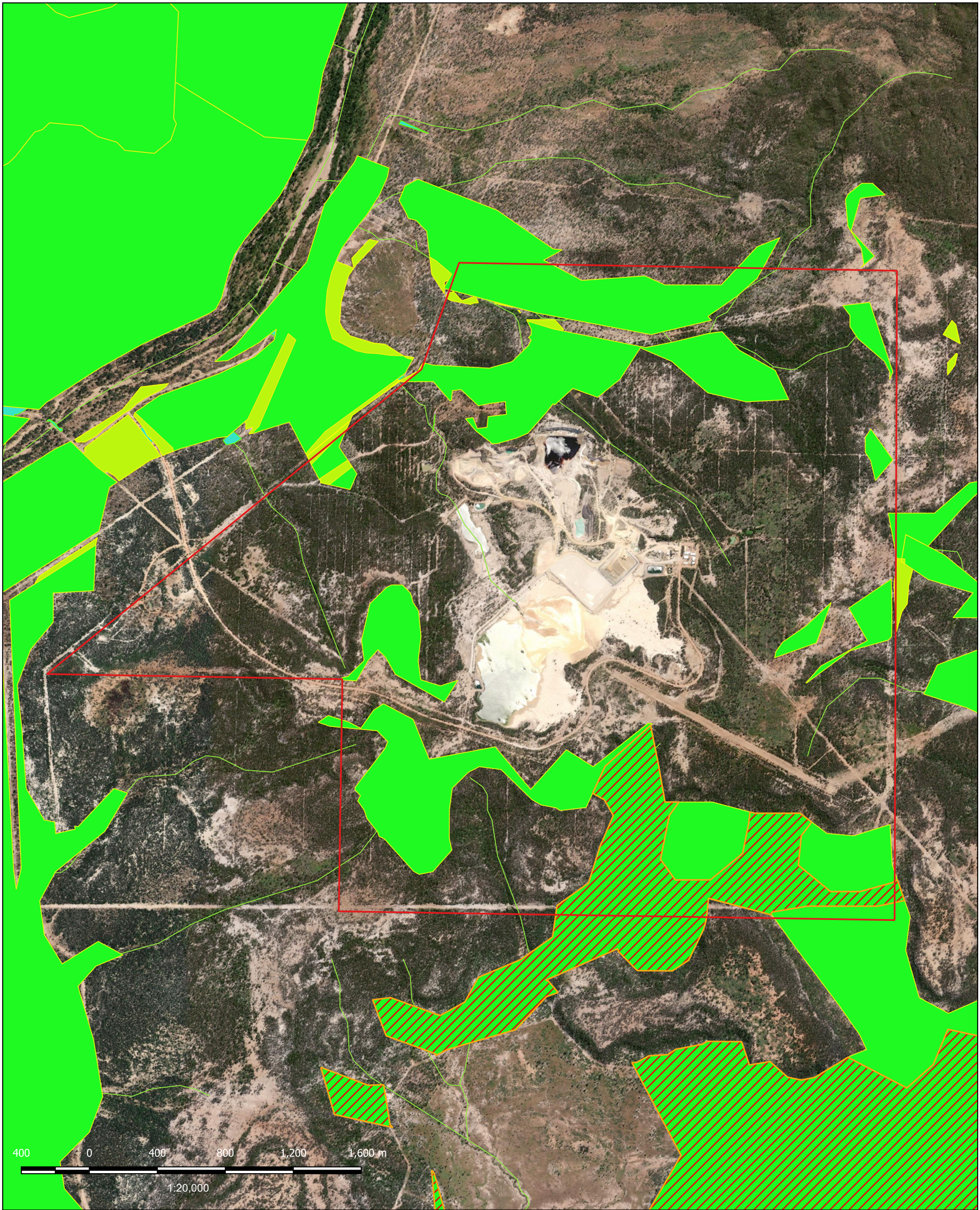


Figure 15. Project Regional Ecosystems

- | | |
|--------------------------|----------------|
| Mine Lease | Least Concern |
| Regional Ecosystems | |
| Endangered - dominant | Non-Remnant |
| Of Concern - dominant | ESRI Satellite |
| Of Concern - subdominant | |

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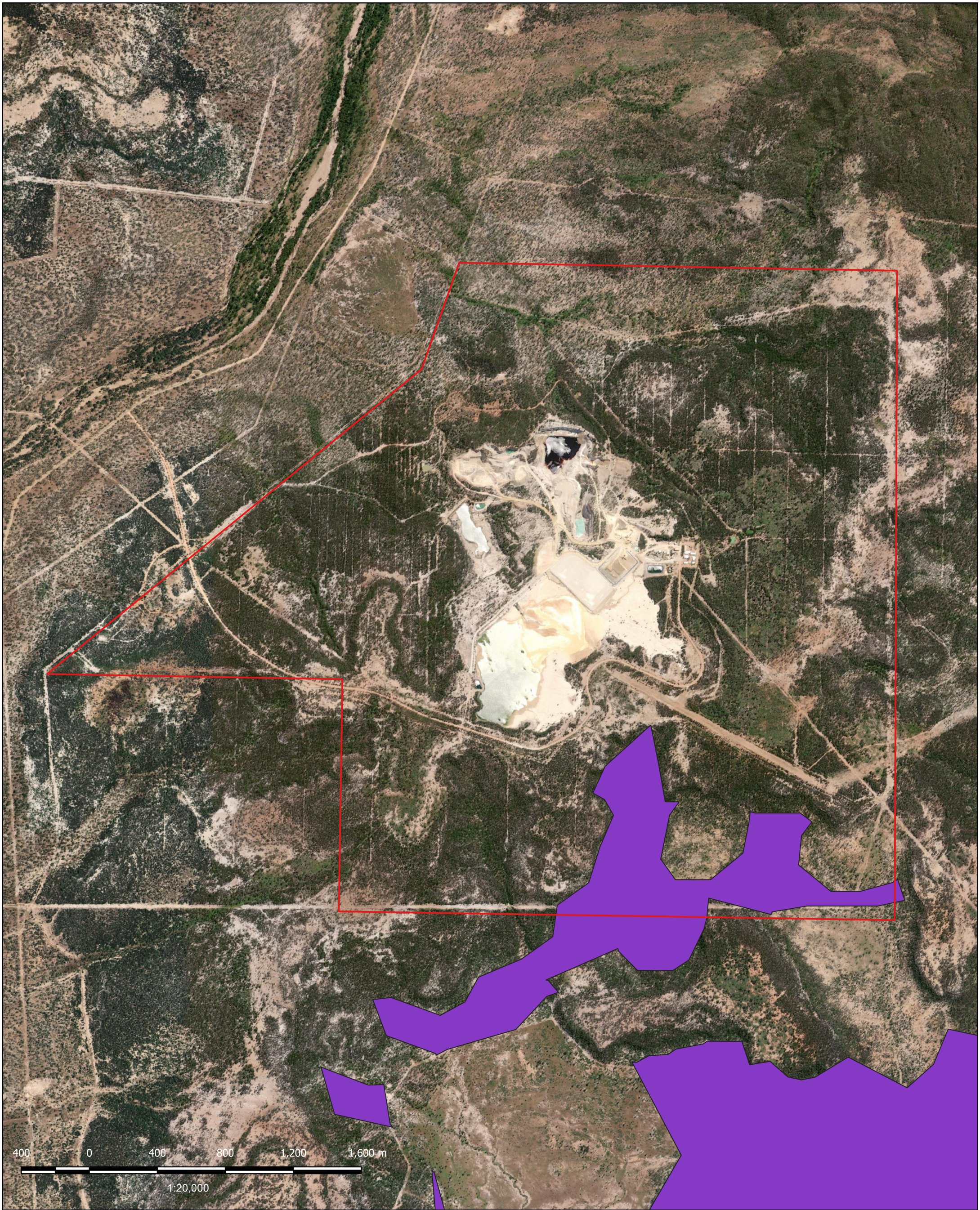


Figure 16. Matters of State Environmental Significance

- | | |
|--------------------------------|----------------------------|
| Mine Lease | RV- Essential Habitat |
| RV - Category B - END/OC | RV - Defined Watercourse |
| RV - Category C - END/OC | Wildlife Habitat - END/VUL |
| RV - Category R - GBR riverine | ESRI Satellite |

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Figure 17. Environmentally Sensitive Areas

-  Mine Lease
- Environmentally Sensitive Areas**
-  Endangered Regional Ecosystems - regrowth and remnant (biodiversity status)
- ESRI Satellite

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3.3. Community

3.3.1. Community Profile

Mount Coolon is the nearest town, located 40 km to the south of the Project. As of the 2021 Census, the population was 172, with 80.1% male, and 19.9% female. The largest employment industry is Construction followed by Agriculture, Forestry, and Fishing.

The Project is an owner-operated mine, with approximately 10 staff, the majority of which work a 15:6 Drive in Drive Out (DIDO) roster from Townsville, Cairns, or Mackay. The Project presents an employment opportunity for locals, as well as potentially boosting local economy through increased demand for basic amenities (food supply, fuel supply etc.), and increased traffic through the region by DIDO workers.

Mackay is the nearest regional centre, located approximately 200 km east of the Project with a population of 121,691, and an unemployment rate of 4% (Census 2021). Due to the small work force and Mackay being a reasonably sized city, it can be expected that the Project has little to no impact on employment demographics for the region.

3.3.2. Community Consultation Register

Potentially affected community stakeholders are detailed in Table 22. Solomons Gold maintain a community consultation register (Table 23) which records community interaction, including:

- Details of each community member;
- When the consultation occurred;
- Records of all previous engagements with the community;
- Type of consultation;
- Information provided;
- Issues raised;
- How issues consideration where considered in decision-making; and
- Commitments.

The register will continue to be updated during operations, to ensure all relevant communication is captured.

Table 22. Community Stakeholders

Community Stakeholder	Details	Potential Issues
Relevant Community Stakeholders		
Wirralie Station	Wirralie Gold Mine is on Wirralie Station. Land within the ML is used for grazing. Compensation Agreements are in place between Solomons Gold and Wirralie Station.	• Access to agistment land under Wirralie MLs not required for mining • Future access to land covered by the ML • Rehabilitation outcomes • Environmental issues and management • Water access
Traditional owners	The Jangga people are the traditional owners of the land on which Wirralie is situated. During 2012 a Native Title claim for the region was implemented (Fed Court NoQUD6230/1998).	• Cultural heritage impacts • Environmental impact and management • PMLU • Impacts on Native Title
Utility owners • Department of Transport and Main Roads • Ergon Energy	Department of Transport and Main Roads, and Ergon Energy own assets within or adjacent to Wirralie (Rutherford Road). Solomons Gold engage with utility owners on an as needs basis. The PRCP will not require an update to any agreements.	• Rehabilitation and impacts to assets • Disruption of access to assets • Impacts to asset value
Local Government	Whitsunday Regional Council is the local government for the LGA Wirralie is situated within.	• Local opportunities • Economic and community sustainability • Environmental impact and management • Effects on Council assets • Mine rehabilitation • PMLU • Compliance with the Whitsunday Regional Council Planning Scheme
Other stakeholders		
Nearby Landowners	There are four other properties surrounding Wirralie including Pyramid, Bungobine, Olderfleet and Ill L Ra Stations. Solomons	• Future access to land covered by the ML • Rehabilitation outcomes

Community Stakeholder	Details	Potential Issues
	Gold has means to provide correspondence with the surrounding landholders on a as needs basis.	• Environmental issues and management • Potential water access
Solomons Gold Employees	All Solomons Gold personnel are expected to be interested in closure planning where it may be thought to impact employment security.	• Job retention • Loss of jobs with closure • Living conditions
Community members and group	Affiliated communities' members and organisations of the Mt Coolon region.	• Job opportunities • Job retention • Loss of jobs with closure • Environmental impact and management • PMLU • Rehabilitation
Queensland Government	Government organisations with invested interest in Wirralie including: • Department of Resources • Department of Environment and Science • Whitsunday Regional Council • Mayors and Councillors of Whitsunday Regional Council • Electorate member for Burdekin • Minister for Natural Resources, Mines and Energy • Minister for the Environment and the Great Barrier Reef and Minister for Science and Youth Affairs	• Resource development • Job opportunities • Job retention • Environmental impacts and management • Rehabilitation cost • Environmental risk • PMLU
Federal Government	Department of Agriculture Water and Environment (DAWE)	• Resource development • Job opportunities • Job retention • Environmental impacts and management • Rehabilitation cost • Environmental risk • PMLU

Table 23. Community Consultation Register

Consultation Date	Community member	Consultation type	Information provided	Issues raised by community	How issues were considered	Decisions/ Outcomes	Commitments
01/09/2020	Department of Environment and Science	Email	Transition to PRCP kick off discussion	None	N/A	Future teleconference to be had to discuss timeframes	None
30/10/2020	Department of Environment and Science	Teleconference	Initial discussions regarding PRCP transition timeframes	None	N/A	Proposed transition timeframes to be provided	None
16/11/2020	Department of Environment and Science	Letter	Proposed PRCP transition timeframes	None	N/A	Proposed PRCP transition timeframes provided	Draft PRCP – 30/09/2021 Final 31 December 2021
05/01/2022	Department of Environment and Science	Letter	Submission of PRCP to Department of Environment and Science	None	N/A	PRCP Submitted	N/A
20/01/2022	Department of Environment and Science	Letter	PRCP not properly made Notice issued	None	None	Response to Not Properly Made Notice due by 14 July 2022	Response to Not Properly Made Notice date set.

3.3.3.Ongoing Consultation

Ongoing communication between the community and Solomons gold is to continue under the Wirralie Community Consultation Plan. The plan details the communication processes followed to ensure ongoing positive communication between stakeholders and Solomons Gold. The Community Consultation Plan is detailed in Appendix C.

3.3.1. Native Title

The Project predates Native Title claims and thus is not applicable to the site. The Native Title claimants of the land surrounding the Project is the Jangga People (QCD2012/009).

3.4. Post Mining Land Use

Land must be rehabilitated to a stable condition as defined in section 11A of the EP Act. Land is considered in a stable condition if:

- the land is safe and structurally stable, and
- there is no environmental harm being caused by anything on or in the land, and
- the land can sustain a Post Mining Land Use (PMLU).

A PMLU is defined under the EP Act as the purpose for which the land will be used after all relevant activities have ceased. The PMLU must be consistent with the outcome of consultation with the community and any strategies for the land of a local government, the State or Commonwealth.

3.4.1. Rehabilitation Areas and Improvement Areas

Project activities are grouped in this PRCP by Rehabilitation Areas (RAs), defined under the Progressive Rehabilitation and Closure Plans guideline as “an area of land in the PMLU to which a rehabilitation milestone for the post-mining use relates”. An Improvement Area (IA) is defined in the EP Regulation as, for a Non-Use Management Area (NUMA), an area of land in the NUMA to which a management milestone for the NUMA relates (Department of Environment and Science, 2021).

The RAs for the Wirralie Gold Mine are detailed in Table 24; the IAs are detailed in Table 25.

Table 24. Rehabilitation Areas

Rehabilitation Area	
RA1	Deep Lead Pit
RA2	Waste rock dumps (WRD1, WRD2 and WRD3, rehabilitated former waste dumps)
RA3	ROM pad
RA4	Mine Infrastructure Area (processing plant, camp/administration)
RA5	Raw Water Pond
RA6	Runoff Dam
RA7	Tailings Storage Facility / Heap Leach

Table 25. Improvement Areas

Improvement Area	
IA1	Pit A, Pit B and North Pit

3.4.2. Assessment of PMLU Options

As part of the assessment of PMLUs it is acknowledged that the EP Regulation requires that each PMLU:

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

b) satisfies at least one of the following:

- a. the use is consistent with how the land was used before a mining activity was carried out on the land
- b. the use is consistent with a development approval relating to the land –
- c. the use is consistent with a use of the land, other than a use that is mining, permitted under a State or Commonwealth Act, including, for example, a planning instrument under the Planning Act 2016
- d. the use will deliver, or is aimed at delivering, a beneficial environmental outcome.

The post mine land descriptions for Wirralie are currently prescribed in Schedule F Table F1 (Final Land Use and Rehabilitation Approval Schedule) of the EA. These are presented below in Table 26 along with the proposed PMLUs. These post mine land descriptions and PMLUs were assessed to determine if they are appropriate to Wirralie. The assessment considered the environmental, economic, and social benefits as well as the requirements of the EP Regulation, the planning scheme and community consultation. The assessment is presented below.

Table 26 Post Mine Land Uses

RA	Mine Domain	Post-mine land description	Post mine land use
RA1	Deep Lead Pit	Open void	Low intensity grazing on native pasture
RA2	Waste Rock Dump 1	Low hill	Low intensity grazing on native pasture
	Waste Rock Dump 2	Low hill	Low intensity grazing on native pasture
	Waste Rock Dump 3	Low hill	Low intensity grazing on native pasture
	Rehabilitated Waste Rock Dumps	Low hill	Low intensity grazing on native pasture
RA3	ROM	Low hill	Low intensity grazing on native pasture
RA4	Processing Plant	Open pasture	Low intensity grazing on native pasture
	Camps/ administration	Open pasture	Low intensity grazing on native pasture
	Laydown yards	Open pasture	Low intensity grazing on native pasture
RA5	Raw water pond	N/A	Low intensity grazing on native pasture
RA6	Run-off dam	Water storage	Water storage
RA7	Tailings Storage Facility/ Heap Leach Pad	Open pasture	Native pasture
RA8	Access roads and tracks	Open pasture	Low intensity grazing on native pasture
RA9	Topsoil stockpiles	Open pasture	Low intensity grazing on native pasture
RA10	Former Camp	Open pasture	Low intensity grazing on native pasture

3.4.2.1. EP Regulation Requirements

Table 27 describes how the PMLU's meet the requirements of the EP Regulation.

Table 27. Requirements of a PMLU

Requirement of the PMLU	Justification
The land is safe and structurally stable	Where required, final landforms will be shaped to ensure long term stability. After initial rehabilitation, structures will continue to be monitored by suitably qualified persons to assess stability over time. The remaining areas will have minor reshaping to establish drainage and prevent erosion. Fencing will be constructed to prevent cattle ingress to the TSF whilst vegetation establishes.
There is no environmental harm being caused by anything on or in the land	All contaminants will be removed from domains and either encapsulated within the TSF or removed from site. A contaminated land assessment will be conducted at specified domains following rehabilitation activities to verify the removal of contaminants. All infrastructure and waste will be removed from site during the demolition phase of rehabilitation. The site will be revegetated to reduce the possibility of erosion. Ongoing surface and groundwater monitoring will be conducted to assess the potential for environmental harm.
The land can sustain a Post Mining Land Use (PMLU)	The proposed PMLUs of grazing and native ecosystem are consistent with surrounding land uses.
The PMLU is viable having regard to the use of land in the surrounding region	The WRC is a significant beef producing region. The proposed PMLU of grazing on native pasture is consistent with previous and current land uses in the area. The Run-off Dam will remain as a water source for stock, consistent with the surrounding proposed PMLU.
The PMLU satisfies at least one of the following: - the use is consistent with how the land was used before a mining activity was carried out on the land - the use is consistent with a development approval relating to the land – - the use is consistent with a use of the land, other than a use that is mining, permitted under a State or	The proposed PMLUs of low intensity grazing on native pasture and native pasture are consistent with how the land was used before a mining activity was carried out on the land.

Requirement of the PMLU	Justification
Commonwealth Act, including, for example, a planning instrument under the Planning Act 2016 d. the use will deliver, or is aimed at delivering, a beneficial environmental outcome	

3.4.2.2. Community Consultation

The proposed PMLUs of grazing on native pasture and water storage are:

- Consistent with the land use prior to the commencement of mining activities;
- Consistent with the surrounding land use; and
- Compatible with, and beneficial to, the current underlying landholder activities.

3.4.2.3. Planning Scheme

Under the Whitsunday Planning Scheme 2017, the Project is located in a 'rural' zone, which includes cropping, intensive horticulture, intensive animal industries, animal husbandry, animal keeping and other primary production activities (Whitsunday Regional Council, 2017). The outcomes for the rural zone include:

- development provides for a broad range of Rural activities, including animal husbandry, cropping, roadside stalls and wholesale nurseries, animal keeping, aquaculture, intensive animal industry, intensive horticulture and rural industry, provided that adverse environmental and amenity impacts are avoided or appropriately managed;
- permanent Accommodation activities are limited to dwelling houses and caretaker's accommodation on existing lots. Home based businesses, nature-based tourism, rural workers accommodation and tourist parks may also be established where the scale, intensity and nature of the use complements Rural activities and promotes the sustainable use of rural land;
- Business, Industry and Community activities that are compatible with a rural setting and support rural enterprise and community wellbeing are facilitated where they do not compromise the use of the land for Rural activities. Such uses include agricultural supply stores, veterinary services, bulk landscaping supplies, community uses and emergency services;
- non-rural activities are located, designed and operated to minimise conflicts with existing and future Rural activities on the surrounding rural lands;
- intensive Rural activities are not located adjacent to sensitive uses and are designed and operated to maintain the rural character and amenity of the zone;

- development encourages the continued operation of existing agri-business and continued development of new agri-business opportunities;
- development for extractive industry is appropriately designed, operated and managed to minimise significant nuisance and environmental impacts on surrounding premises;
- development does not alienate or fragment agricultural land unless:
 - there is an overriding need for the development in terms of public benefit; and
 - no other site is suitable for the particular purpose;
- the built form of development in the zone integrates with and complements the predominant rural character and scale of the zone and sensitively responds to the environmental and topographical features of the landscape;
- development avoids or mitigates any adverse impacts on areas of cultural heritage significance or environmental significance (including creeks, gullies, waterways, wetlands, coastal areas, habitats and vegetation) through sensitive location, design, operation and management;
- development is provided with an appropriate level of services and infrastructure that maintains public health, avoids negative impacts on the natural environment and ensures the safety of buildings and works;
- development is located and designed to maximise the efficient extension and safe operation of infrastructure; and
- the safety and efficiency of existing and future infrastructure (including road, rail, telecommunications and electrical infrastructure) is protected and the amenity and safety of development is not adversely affected by proximity to such infrastructure (Whitsunday Regional Council, 2017).

The proposed PMLUs are consistent with the outcomes defined in the Whitsunday Planning Scheme 2017.

3.4.2.4. Environmental Benefit

Maintaining a coverage of pasture species on final landforms will reduce erosion and promote long term stability. Pasture species will bind soil on the batters together and prevent erosion of topsoil. Additionally, pasture species have a shallow root system when compared to native shrubs and trees. Targeting growth of these species will minimise the presence of large trees that potentially uproot, further establishing stability on landforms.

The pasture covered PMLUs may also provide a food source for native fauna. The pasture cover will produce seed and flowers throughout the seasons, which may be utilised by native fauna, therefore helping support local ecosystems.

Retaining the Runoff Dam has a water storage will provide an additional water source for native fauna, as well as grazing livestock. This will reduce pressure on groundwater sources for local graziers.

3.4.2.5. Economic Benefit

Establishing grazing pastures will result in a lower cost of direct seeding and a quicker establishment of adequate vegetation cover, potentially leading to an earlier relinquishment of Mine Leases.

Additionally, the future landowners of the Project area will likely be pastoralists as per the surrounding land uses. Rehabilitating Project areas to low-intensity grazing will provide an additional feed source leading to a direct increase in the economic benefit to the future landholder.

Retaining the Runoff Dam has a water storage will provide an additional water source for grazing livestock leading to a direct increase in the economic benefit to the future landholder.

3.4.2.5.1. Social Benefit

Future landholders will likely be pastoral holdings. Returning the land to grazing pastures will be preferential as this would result in a PMLU that is consistent with surrounding land uses.

3.4.2.6. Summary of PMLUs

This PRCP proposes to retain the PMLUs described in Schedule F – Table 1 (Final Land Use and Rehabilitation Approval Schedule) of the EA. These PMLUs have been assessed as meeting the requirements of the EP Regulation and providing the best environmental, social, and economic benefit. A PMLU of low intensity grazing on native vegetation has been assigned to all undisturbed MLs.

The following sections describe how the PMLUs will be achieved.

3.4.2.7. Rehabilitation activities

3.4.3.RA1 – Deep Lead Pit

3.4.3.1. Outcome

The post mine land description defined in the EA is an open residual void. However, Solomons Gold are actively backfilling Deep Lead Pit with waste rock to reduce surface disturbance and allow for progressive rehabilitation of the pit. For this reason, a revised PMLU of low intensity grazing on native pasture has been adopted. This will provide a beneficial environmental outcome and is consistent with the surrounding land uses.

3.4.3.2. Rehabilitation strategy

Waste material extracted from Pit B is disposed into Deep Lead Pit. Deep Lead Pit will be backfilled to surface and capped in the same manner as the WRDs, as described below in Section 3.4.4. In summary, the pit will be backfilled to surface level and contoured to promote drainage. Topsoil will be applied, and the area will be seeded to support grazing on native pasture.

3.4.3.3. Environmental Benefit

Backfilling Deep Lead Pit will reduce residual surface disturbance and allow for a sustainable land use, post mining.

A waste rock characterisation (C&R, 2022) was completed with samples collected from waste rock dumps across the Project. All waste rock had similar physical and geochemical properties and it is presumed to be comparable to the material currently being extracted from Pit B. The results demonstrate that most of the waste rock is barren (<0.1% total sulphur) with very low sulphur (0.55% total sulphur) detected at WRD3. The WRDs are considered either barren or of low acid generating capacity.

Waste rock samples were enriched with arsenic, likely due to volcanoclastic geology. The kinetic leach tested indicate that arsenic contained within the waste rock is relatively immobile. Arsenic was below the contaminant release limits defined in the EA for all leaches at all sample locations.

The results of the kinetic testing indicated that backfilled material present a low risk of contaminants leaching to groundwaters. Therefore, backfilling Deep Lead Pit is a beneficial outcome, compared to retaining it as a residual void.

The results of the waste rock characterisation are discussed in more detail in Section 5.1.3. and Appendix G.

3.4.4.RA2 – Waste Rock Dump (WRD)

RA2 of the Project includes WRD1, WRD2, WRD3 and the rehabilitated former waste rock dumps.

3.4.4.1. Outcome

The proposed PMLU for the RA2 is low intensity grazing on native pasture.

3.4.4.2. Waste rock characterisation

Waste rock characterisation completed by C&R Consulting (2022) noted the *“overwhelming majority (98%) of waste rock samples at Wirralie are considered NAF. These samples represent material with a very low to low risk of acid generation and a high safety factor with respect to potential acid mine drainage (AMD).”* Specifically, it was noted that there were slightly elevated measures for total sulphur (very low to low concentrations).

A copy of the waste rock characterisation assessment is provided in Appendix G and summarised below.

3.4.4.2.1. Acid Mine Drainage

The acid base account results were slightly acidic, however this is due to the nature of the testwork. It is not expected that surface runoff would be as acidic as results indicate.

Total sulphur concentrations in waste rock were mostly <0.1% and are considered barren. Samples collected from WRD3 were slightly elevated however were still very low to low concentrations of sulphur. When assessing the sulphur concentrations with the NAG_{ph} , most of the waste rock (98%) is considered non-acid forming (NAF).

3.4.4.2.2. Salinity

The majority of electrical conductivity (EC) measurements were generally low (<300us/cm). Therefore, it is considered that there is a very low risk of salinity impact from waste rock.

3.4.4.2.3. Elements

Waste rock samples were enriched with arsenic, likely due to volcanoclastic geology. The kinetic leach tested indicate that arsenic contained within the waste rock is relatively immobile. Arsenic was below the contaminant release limits defined in the EA for all leaches at all sample locations.

3.4.4.3. Rehabilitation strategy

3.4.4.3.1. Landform Design

The waste rock dumps will be shaped as a low-profile structure as described conceptually in Figure 18.

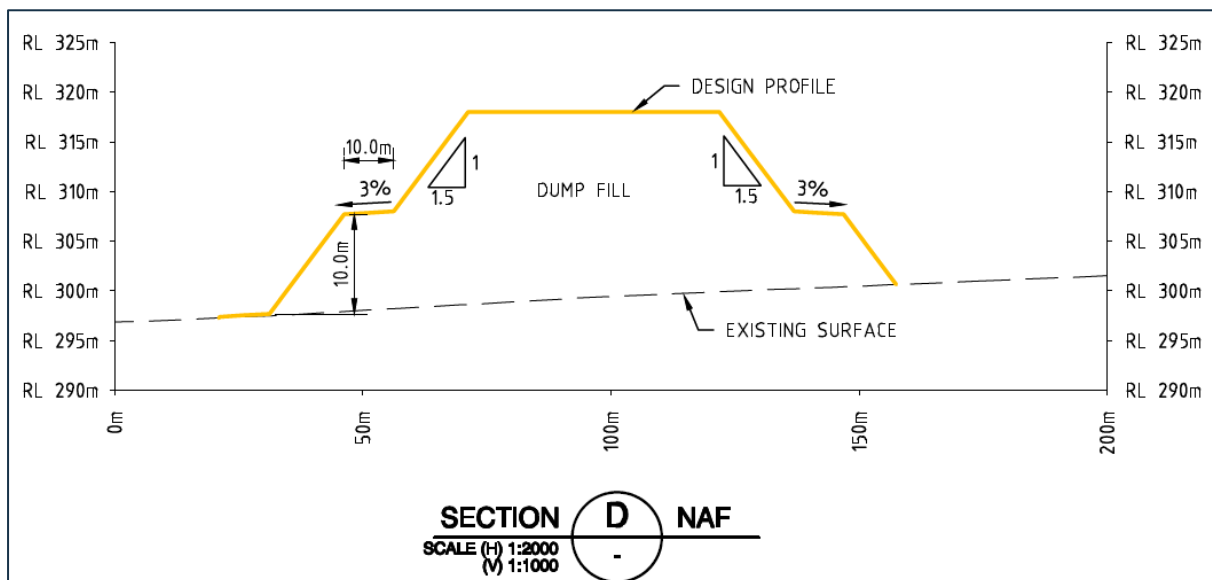


Figure 18 Conceptual NAF WRD Design

Generally, once the WRD landform is complete and reshaped, the structure will be topsoiled and revegetated. An impermeable layer is not proposed due to the low-risk nature of the waste rock.

3.4.4.4. Low Intensity Grazing

3.4.4.4.1. Economic Benefit

Establishing grazing pastures will result in a lower cost of direct seeding and a quicker establishment of adequate vegetation cover, potentially leading to an earlier relinquishment of Mine Leases.

Additionally, the future landowners of the Project area will likely be pastoralists as per the surrounding land uses. Rehabilitating the WRDs to low-intensity grazing will result in an increase in the weight of stock, leading to a direct increase in the economic benefit to the future landholder.

3.4.4.2. Social Benefit

Future landholders will likely be pastoral holdings. Returning the land to grazing pastures will be preferential as this would result in a PMLU that is consistent with surrounding land uses.

3.4.4.3. Environmental Benefit

Maintaining a coverage of pasture species on the final landform will help stabilise the landform. Pasture species will bind soil on the batters together and prevent erosion of topsoil. Additionally, pasture species have a shallow root system when compare to native shrubs and trees.

The pasture covered PMLU may also provide a food source for native fauna. The pasture cover will produce seed and flowers throughout the seasons, which may be utilised by native fauna, therefore helping support local ecosystems.

3.4.5. RA3 – Run of Mine (ROM)

3.4.5.1. Outcome

The proposed PMLU for the RA3 is low intensity grazing on native vegetation.

3.4.5.2. Rehabilitation strategy

The ROM pad will be excavated and utilised as working layers for rehabilitation of the TSF. The footprint of the ROM pad will be ripped and recontoured for drainage. Topsoil will be applied, and the area will be seeded with pasture species.

3.4.5.3. Economic Benefit

Establishing grazing pastures will result in a lower cost of direct seeding and a quicker establishment of adequate vegetation cover, potentially leading to an earlier relinquishment of Mine Leases.

Additionally, the future landowners of the Project area will likely be pastoralists as per the surrounding land uses. Rehabilitating the WRDs to low-intensity grazing will result in an increase in the weight of stock, leading to a direct increase in the economic benefit to the future landholder.

3.4.5.4. Social Benefit

Future landholders will likely be pastoral holdings. Returning the land to grazing pastures will be preferential as this would result in a PMLU that is consistent with surrounding land uses.

3.4.5.5. Environmental Benefit

The ROM pad will be excavated, removing any residual contaminants from ore storage during operations. Material will be disposed of within the TSF, which will be appropriately capped to prevent migration of contaminants.

Maintaining a coverage of pasture species on the final landform will help stabilise the landform. Pasture species will bind soil on the batters together and prevent erosion of topsoil. Additionally, pasture species have a shallow root system when compare to native shrubs and trees.

The pasture covered PMLU may also provide a food source for native fauna. The pasture cover will produce seed and flowers throughout the seasons, which may be utilised by native fauna, therefore helping support local ecosystems.

3.4.6.RA4 - Mine Infrastructure Areas

RA3 of the Project include access roads and tracks, mine haul road, laydown yards, processing plant, camps/administration, and landfills.

3.4.6.1. Outcome

The proposed PMLU for the RA3 is low intensity grazing.

3.4.6.2. Rehabilitation Strategy

To achieve the nominated PMLU (Section 5.1.7.1), RA3 domain infrastructure such as concrete hardstands, buildings, telecommunications, electrical supply etc., will be decommissioned and removed. With infrastructure removed, the landform is to be shaped to be a stable, free draining landform. RA3 domains will then be spread with topsoil which is to be ripped parallel to landform contours and revegetated.

3.4.6.3. Low-Intensity Grazing

3.4.6.3.1. Environmental Benefit

The establishment of low intensity grazing will provide a good coverage of vegetation, which will minimise the chance of erosion as a result of runoff. The establishment of pasture on the domains will also limit the amount of fuel load, reducing the impact of potential bushfires.

The pasture covered PMLU may also provide a food source for native fauna. The pasture cover will produce seed and flowers throughout the seasons, which may be utilised by native fauna, therefore helping support local ecosystems

Additionally, Other than occasional watering during closure, no further activities would be required to form a stable landform consistent with grazing.

3.4.6.3.2. Economic Benefit

Establishing grazing pastures will result in a lower cost of direct seeding and a quicker establishment of adequate vegetation cover, potentially leading to an earlier relinquishment of Mine Leases.

Future landowners of the Project area will likely be pastoralists as per the surrounding land uses. Rehabilitating the WRDs to low-intensity grazing will result in an increase in the weight of stock, leading to a direct increase in the economic benefit to the future landholder.

Additionally, Other than occasional watering during closure, no further activities would be required to form a stable landform consistent with grazing.

3.4.6.3.3. Social Benefit

Future landholders will likely be pastoral holdings. Returning the land to grazing pastures will be preferential as this would result in a PMLU that is consistent with surrounding land uses.

3.4.7.RA5 – Raw Water Dam

RA5 of the Project includes the Raw Water Dam which has a PMLU of low intensity grazing.

3.4.7.1. Outcome

The proposed post mine land use for RA5 areas is pasture covered area suitable for low intensity grazing.

3.4.7.2. Design

The final landform for RA5 is to be reflective of the pre-mining landform characterised by slightly undulating hills, and relatively flat land draining towards the northwest.

To achieve the final landform for the RAW Water Dam:

- Infrastructure will be decommissioned and removed from the Project;
- Sediment dams and the water storage dam will be desilted, with material removed to the WRD or TSF;
- Domains will be shaped by plant to drain similarly to the pre-mining landform;
- Subsoil will be spread where required to assist in achieving a free draining, low gradient landform;
- Topsoil will be spread to a thickness of ~0.20 – 0.40cm for vegetation establishment.

3.4.7.3. Environmental Benefit

The establishment of low intensity grazing will provide a good coverage of vegetation, which will minimise the chance of erosion as a result of runoff. The establishment of pasture on the domains will also limit the amount of fuel load, reducing the impact of potential bushfires.

The pasture covered PMLU may also provide a food source for native fauna. The pasture cover will produce seed and flowers throughout the seasons, which may be utilised by native fauna, therefore helping support local ecosystems

Additionally, Other than occasional watering during closure, no further activities would be required to form a stable landform consistent with grazing.

3.4.7.4. Economic Benefit

Establishing grazing pastures will result in a lower cost of direct seeding and a quicker establishment of adequate vegetation cover, potentially leading to an earlier relinquishment of Mine Leases.

Future landowners of the Project area will likely be pastoralists as per the surrounding land uses. Rehabilitating the WRDs to low-intensity grazing will result in an increase in the weight of stock, leading to a direct increase in the economic benefit to the future landholder.

Additionally, Other than occasional watering during closure, no further activities would be required to form a stable landform consistent with grazing.

3.4.7.5. Social Benefit

Future landholders will likely be pastoral holdings. Returning the land to grazing pastures will be preferential as this would result in a PMLU that is consistent with surrounding land uses.

3.4.8. RA6 Runoff Dam

The Runoff Dam is to be utilised as a sedimentation basin until the catchment has appropriately stabilised/rehabilitation. Once complete, it will be desilted, lined, and retained on site for PMLU as a stock water supply for future landholders.

3.4.8.1. Environmental Benefits

Creating a stock water source for the PMLU of the Runoff dam, will provide native fauna utilising surrounding areas and the rehabilitated project landform with a source of water which otherwise would not be available. The water storage will also provide breeding habitat for fauna such as amphibians and birds.

3.4.8.2. Economic Benefits

Retaining the Runoff Dam as a water storage for PMLU provides a benefit to future landholders. The additional water supply will provide cattle with a suitable water source, relieving draw downs on other water sources. The reduced pressure on other water sources also would reduce the requirement to purchase water during dry periods.

3.4.8.3. Social Benefit

Future landholders will likely be pastoral holdings. Converting the domain to a water supply will be preferential as this would result in a PMLU that is consistent with surrounding land uses.

3.4.9. RA7 - Tailings Storage Facility and Heap Leach

3.4.9.1. Outcome

The proposed PMLU for the Tailings Storage Facility / Heap Leach is open pasture. The TSF will be fenced from cattle, capped, and revegetated with a mix of shallow rooting native species so as not to

compromise the integrity of the sealing layer. Species will be targeted to the surrounding regional ecosystems (REs 11.3.2, 11.7.3, 11.7.2 and 11.5.9). The downstream embankment will be reshaped to create a safe, stable, and non-polluting landform.

3.4.9.2. Overview

The Tailings Storage Facility (TSF) covers 72 ha of the southern section of the Project; 94.4 ha including the catchment of the process areas (Northern Resources Consultants Pty Limited, 2016) (Figure 19). The TSF is an unlined single cell structure comprising of the following components:

- An earthfill embankment dam acting as the tailings retaining structure (Tailings Storage);
- Waste rock is placed on the downstream of the northern section of embankment (approx. 22 ha) acting as the buttress;
- Heap Leach Pads with an approximate area of 7 ha are located within the northern corner of the TSF impoundment;
- Tailings delivery system;
- Internal decant embankment and return water system located in the western edge of the TSF;
- Clean water diversion drain located around the southern boundary of the TSF diverting surface runoff from the upstream catchment area; and
- An emergency spillway (RL277.300) located in the western end of embankment, immediately north of the decant embankment. Any overflow from the spillway flows into the Water Management Runoff Dam.

There are no leak detection systems or seepage collection systems for the TSF.

The TSF has a total available storage capacity of 1,747 ML (Northern Resources Consultants Pty Limited, 2016). As the Solomon's activities are to a smaller scale and processing volumes than previous operators, the capacity is more than current operational requirements. An emergency spillway is located on the western side of the TSF (Figure 19). The Design Storage Allowance (DSA) has been calculated and is presented in Table 28 (STC, 2022).

Table 28 DSA Containment Requirements

DSA Requirements	TSF
Hazard Category	High
Critical Wet Season Duration	3 months
Wet Season Containment Criteria	1:100 AEP
Rainfall Total	922 mm
Catchment Area	103.8 ha
Runoff Coefficient	1.0
Calculated Runoff	956.8 ML

Process inputs over critical wet period	41.5 ML
DSA	988 ML

The characteristics of the tailings are expected to result in fast consolidation of the deposited tailings such that rehabilitation earthworks can commence very soon after deposition ceases. Decant waters currently drain to the southern portion of the TSF, referred to as the TSF wetland. Current rehabilitation practices will require removal and treatment of the wetland waters either via mechanical processes or evaporation.

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Client: Wirralie Gold Mine
Project number: 2020.10003
CRS: GDA2020 / MGA zone 55 EPSG:7855
Date: 7 December 2023

Print as A3



Legend Title

-  Mine Lease
-  TSF spillway
-  Tailings storage facility

Google Satellite

Figure 19. Tailings Storage Facility

Disclaimer:
Whilst every effort and care has been taken to ensure the accuracy of this report, Wulguru Technical Services Pty Ltd makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incur as a result of the product being inaccurate or incomplete in any way and for any reason.
Digital data for this report is available on the Queensland Government Spatial Portal at <https://qldspatial.information.qld.gov.au>.



3.4.9.3. TSF Characterisation

As an element of the Waste Rock Characterisation, geochemical analysis of the tailings was also undertaken; the full report and supporting information is provided in Appendix G, Appendix K, and Appendix J. The results are referred to herein.

TSF samples were found to have an EC range of 195 $\mu\text{S}/\text{cm}$ to 4,860 $\mu\text{S}/\text{cm}$, with a median value of 1,175 $\mu\text{S}/\text{cm}$.

TSF samples were found to have arsenic enrichment, which was also accompanied by mercury. The enrichment is not considered to be of concern as the values remain below limit for NEPM HIL 'Recreational C' (public open space scenario), and mercury was found to be well below the NEPM HIL 'Residential A' threshold of 10 mg/ kg. These standards are considered surpass the PMLU of low intensity grazing.

Kinetic leach tests determined that both arsenic and mercury in the TSF were relatively immobile.

Historically, Wirralie tailings had been characterised as having low acid forming potential as:

- the net acid producing potential (NAPP) for surface salts ranged from 17 to 95 kg $\text{H}_2\text{SO}_4/\text{t}$, with NAGpH values ranging 7.2 to 8.4, although most of the sulfur in the samples occurred as nonreactive salts and are therefore non-acid forming (NAF).
- the NAPP for depth profiled tailings samples ranged from 0 to 8 kg $\text{H}_2\text{SO}_4/\text{t}$, with NAGpH values ranging 6.1 to 6.7. This material is expected to be relatively barren of acid generation and therefore have a low acid forming potential.
- multi-elemental scans performed on the tails indicate elevated arsenic concentrations above ANZECC guidelines. Mercury, antimony and selenium were enriched however in most samples were below ANZECC guidelines. Silver was enriched in some of the samples tested (NRC, 2016).

Appendix G, Appendix J, and Appendix K discuss the characteristics of the tailings material in detail. The findings of the Tailings Dam Characterisation conclude that the TSF is low risk.

3.4.9.4. TSF Water Quality

Limited water quality data is available for the TSF due to regularly low volumes of supernatant pooling. Recent site inspections completed by Wulguru Technical Services included the monitoring and sampling of the TSF (SW1) and indicated a volume of approximately 0.5 ML and standing water level of approximately 50 mm depth. Comparison of water quality data for the site inspection is presented below (Table 29).

Table 29. TSF (SW1) water quality data (dated 23 July 2021)

Parameter	Livestock Drinking Water Limit (EA)	Result 23 July 2021	12 October 2023
pH	6 – 9	7.88	7.05
Total Dissolved Solids	4000 mg/l	4,121 ¹	4180

Sulfate	1000 mg/l	1490	1470
Arsenic	0.5 mg/l	0.084	0.285
Cadmium	0.01 mg/l	<0.0001	<0.0001
Copper	0.5 mg/l	0.014	0.005
Lead	0.1 mg/l	<0.001	<0.001
Mercury	0.002 mg/l	<0.0001	<0.0001
Molybdenum	0.05 mg/l	0.043	0.046
Selenium	0.02 mg/l	<0.01	<0.01
Zinc	20 mg/l	<0.005	<0.005
Weak Acid Dissociable Cyanide	0.2 mg/l	0.007	<0.004

¹Calculated from Electrical Conductivity results i.e. [EC value x 0.65] = TDS mg/l.

3.4.9.5. Rehabilitation Strategy

The Tailings Dam (or TSF) including the heap leach pad, covers an area of approximately 72 ha and is to be rehabilitated to a PMLU of, Low Intensity Grazing (ATC Williams Pty Ltd, 2021). Current fall on the TSF allows water to pond at the western end of the TSF, covering approximately 25 ha of area. The heap leach pad area covers an area of approximately 5 ha. As mentioned in Section 3.4.9.3, (also Appendix G, Appendix J, and Appendix K) the tailings material is considered to have a low risk of acid forming potential. The results of kinetic leach testing indicated that most elements, with the exception of cadmium and selenium, were well below the respective receiving water contaminant limits. As discussed in Appendix K, the potential mobility of cadmium and selenium is high, however its absorption by other characteristics of the tailings limits the mobility and bioavailability of both elements. The elevated levels of arsenic and mercury, as detected in the static test work, are relatively immobile, as indicated by the kinetic test work. The tailings material is considered low risk.

As the TSF is considered low risk, the rehabilitation strategy for the TSF is 1.0 m of waste rock and 0.15 m of topsoil and seeded with the selected pasture species.

As discussed in Section 5.1.3., Appendix G, Appendix J, and Appendix K, the waste rock material is considered low risk and NAF which is suitable to act as a working layer for the TSF cap. The tailings has a different risk profile to the waste rock, The waste rock material will not be required to stabilise the structure of the TSF (i.e., embankments). The waste rock material will support the growth media by restricting the uptake of salts and assists with moisture cycling zone allowing efficient evapotranspiration. The waste rock layer will also provide further solid barrier between the potential contaminants and receiving environment as well as reducing percolation, oxygen ingress, and erosion.

The soil layer will be spread across the waste rock material and seeded with the selected seed mix of shallow rooting pasture species providing a landform supporting the PMLU of low intensity grazing whilst isolating the risks associated with the tailings material.

The TSF surface will be capped and graded to achieve free-draining fall to the downstream environment. Rehabilitation works will be carried out progressively, splitting up the TSF into eastern and western catchment areas. The eastern catchment (Stage 1) will be rehabilitated first, with the western catchment (Stage 2) being used as a water and sediment storage area to capture runoff from the disturbed areas. Following Stage 1 achieving suitable vegetation cover, Stage 2 can be rehabilitated, and a temporary High Efficiency Sediment (HES) basin would likely be required to temporarily capture Stage 2 dirty water runoff during the rehabilitation works.

This strategy reflects the environmental objectives for rehabilitation of Wirralie. Ensuring water leaving the rehabilitated TSF is of an acceptable standard is a priority for the design through implementation and post lease relinquishment.

The strategy is also designed to handle the climate variability; the water control systems to be implemented will convey water as needed especially during initial rehabilitation stages. Conveying runoff is an important mechanism for minimising erosion and ensuring success (INAP, 2017). Orchestrated through the stages, the water controls and catchments allow for effective runoff particularly during the summer months when the region experiences the wet season. The final landform is to be free draining avoiding ponding and areas of significant weathering. The vegetation cover is to include species found in the region as their long-term success and tolerance to the region's climate is known.

3.4.9.6. Materials Balance and Suitability

Table 30 details materials requirements for rehabilitation of the active TSF.

As discussed in Section 3.4.4.2, the waste rock has been classified as low risk and is suitable for use as a working layer on the surface of the tailings dam. Topsoil assessment and management is discussed further in Section 5.1.4. Due to the low-risk nature of the tailings, no additional layers, such as an impermeable layer, are proposed.

Table 30. Materials balance requirements for a low risk TSF.

Material	Layer thickness (m)	Volume required (m ³)	Volume available (m ³)	Source
Rock cover	1.0	720,000	1,590,000	WRD
Growth media	0.15	108,000	115,500	Site topsoil stockpiles

3.4.9.7. Environmental Benefit

The purpose of the cover system is to provide a stable, reliable, and sustainable engineered barrier isolating the potential contaminants from the receiving environment while supporting an agreed upon land use (INAP, 2017). The chosen rehabilitation strategy will ensure the TSF is rehabilitated to a safe, non-polluting, and free-draining state. The vegetation will further strengthen the capping material and

maintain its integrity preventing potential contamination from tailings and allowing for use within the native ecosystem. Vegetation will also reduce weathering and erosion of the capping material.

3.4.9.8. Economic Benefit

The PMLU of native vegetation does not have a direct economic benefit.

3.4.9.9. Social Benefit

The social benefit of re-establishing native vegetation is the aesthetic appearance and cohesion with the surrounding environment.

3.4.10. Rehabilitation Milestones

Rehabilitation milestones have been identified for each significant event necessary to rehabilitate the land to a stable condition. Completion criteria is used to determine if rehabilitation milestones have been achieved and ultimately shows if the mining domain has been rehabilitated to a point that the Final Landform PMLU has been achieved at surrender.

The Rehabilitation Milestones (RM) are defined in Table 31 and the completion criteria for each milestone are defined in Table 32.

Table 31 Rehabilitation Milestones

Rehabilitation Milestone	
RM1	Infrastructure decommissioning and removal
RM2	Remediation of contaminated land/sediment
RM3	Backfill of Deep Lead Pit
RM4	Landform development and reshaping (RA2)
RM5	Landform development and reshaping (RA3, RA4)
RM6	Landform development and reshaping (RA6)
RM7	Landform development and reshaping (RA7)
RM8	Surface preparation
RM9	Revegetation
RM10	Achievement of surface requirements
RM11	Achievement of PMLU to a stable condition
RM12	Achievement of PMLU to a stable condition (water storage)

Table 32 PMLU completion criteria

Rehabilitation milestone	Requirement	Justification of completion criteria	Verification of milestone achievement	Applicable RA
RM1 Infrastructure decommissioning and removal	- All services disconnected - All buildings and associated infrastructure dismantled and removed offsite - All hardstand and concrete areas demolished and removed - Pipelines removed - Waste removed and disposed of within the WRDs or offsite at a licenced waste facility - All road materials removed - All stockpiled material not a part of the PMLU removed - Machinery / equipment not required for rehabilitation removed from site	Infrastructure is required to be removed from site to enable surface treatment of areas.	Documented inspection following infrastructure decommissioning and removal.	RA1 RA2 RA3 RA4 RA5 RA6 RA7
RM2 Remediation of contaminated land/sediment	- Contaminated land assessment is completed by a suitably qualified person - Identified contaminated material removed from the mine domain and disposed of either within the TSF or offsite at a licenced facility. - Validation sampling determines that contaminant removal has been successful.	- Contaminated material is required to be removed to minimise potential for environmental harm. - A validation report will provide verification that contaminants have been removed and landform shaping can commence.	Validation sampling report accepted by a suitably qualified Contaminated Land Auditor.	RA3 RA4 RA5
RM3 Backfill of Deep Lead Pit	- Deep Lead Pit is backfilled with waste rock material to surface level - Landform is shaped to pre-mining landform - Domain is certified by geotechnical engineer to be a safe and stable landform	- Landform is made safe to wildlife and humans. - The final landform must be profiled to limit erosion. - The final landform must be profiled to be free draining	- Survey of landform slope. - QAQC report detailing that works were completed in accordance with design and management plans.	RA1
RM4 Landform development and reshaping (RA2)	- Landform is shaped to encourage natural drainage and limit erosion. - Target slopes of <70 % are achieved - Maximum of 10 m high lifts - Benches at every 10 m and 10 m wide <3 % slope on benches. - Domain is certified by geotechnical engineer to be a safe and stable landform	- Landform is made safe to wildlife and humans. - The final landform must be profiled to limit erosion.	- Survey of landform slope. - QAQC report detailing that works were completed in accordance with design and management plans.	RA2
RM5 Landform development and reshaping (RA3, RA4)	- Landform is shaped to pre-mining landform - Re-establish natural drainage pathways - Landform ripped parallel to landform - Ensure land is free draining Land is free draining	- Landform is made safe to wildlife and humans. - The final landform must be consistent profiled allow drainage and to limit erosion	QAQC report detailing that works were completed in accordance with design plans.	RA3 RA4
RM6 Landform development and reshaping (RA6)	- Water removed from dam through evaporation or use on site - Dam walls pushed in and reprofiled to be gently sloping - Landform is shaped to encourage natural drainage and limit erosion - Domain is certified by geotechnical engineer to be a safe and stable landform	- Landform is made safe to wildlife and humans. - The final landform must be consistent with the surrounding land and profiled to limit erosion	- Survey of landform slope. - QAQC report detailing that works were completed in accordance with design and management plans.	Ra5

Rehabilitation milestone	Requirement	Justification of completion criteria	Verification of milestone achievement	Applicable RA
RM7 Landform development and reshaping (RA7)	- Water is removed from TSF through evaporation or other mechanical methods - Waste rock is layered over TSF to 1.0 m thickness - Landform is graded to be free draining, directing water to existing spillway - Topsoil is applied to 0.15 m thickness - Domain is certified by geotechnical engineer to be a safe and stable landform	- Landform is made safe to wildlife and humans. - Landform is free draining utilising existing spillway. - The final landform must be consistent with the surrounding land and profiled to limit erosion.	- Survey of landform slope. - QAQC report detailing that works were completed in accordance with design and management plans.	RA7
RM8 Surface preparation	- Existing soil erosion, rills and gullies repaired prior to seeding - No active gullies >1.0 m depth - Any gullies <1.0 m >0.3m have shown progressive stabilisation (i.e., have become partly stabilised or stabilised) over successive annual monitoring events - A soil health and suitability assessment completed by a SQP and confirms that the soil is suitable for target vegetation establishment or whether there are any requirements for amelioration. - Topsoil placement of a minimum 15 cm - Application of ameliorant where required in the soil health and suitability assessment. - Compacted soil ripped to at least 300 mm	Ripping and application of growth media will encourage establishment of vegetation.	QAQC report detailing that works were completed in accordance with design plans.	RA1 RA2 RA3 RA4 RA5 RA7
RM9 Revegetation	- Revegetation strikes creates a groundcover >30% of analogue sites - Seeding rate of 6 – 8 kg/ha achieved (if natural revegetation unsuccessful).	- Monitoring will assess success of natural revegetation and determine if intervention measures are required e.g. further application of seed is required. - Vegetation species have been selected based on PMLU of grazing.	Report summarising regular rehabilitation monitoring, utilising techniques such as the BioCondition Assessment Manual (or similar). The report will include data over a suitable period, considering seasonality.	RA1 RA2 RA3 RA4 RA5 RA7
RM10 Achievement of surface requirements	- Weed species in densities less than 10 % total coverage - Vegetation percentage cover is 50 % of the ground surface area or >70 % of the rehabilitation reference sites for 3 consecutive years. - Groundcover biomass and tree density is equal to, or greater than, 50 % of reference sites for three consecutive years - Species richness is equal to, or greater than, 50% of reference sites for three consecutive years - No active gullies >1.0 m depth - Any gullies <1.0 m >0.3m have shown progressive stabilisation (i.e., have become partly stabilised or stabilised) over successive annual monitoring events - Surface water sites complies with ANZECC/ARMCANZ (2000) livestock drinking water - Stream sediment sites complies with ANZECC/ARMCANZ (2000) Interim Sediment Quality Guidelines – low - Groundwater monitoring complies with ANZECC/ARMCANZ (2000) livestock drinking water	- Livestock drinking water values have been selected based on surrounding land use of grazing - Monitoring sites have been selected to capture all areas of disturbance - RA will be compared to reference sites to account for seasonal fluctuations.	- Report summarising regular rehabilitation monitoring, utilising techniques such as the BioCondition Assessment Manual (or similar). The report will include data over a suitable period, considering seasonality. - Report summarising water and sediment quality monitoring. The report will include data over a suitable period, considering seasonality.	RA1 RA2 RA3 RA4 RA5 RA7

Rehabilitation milestone	Requirement	Justification of completion criteria	Verification of milestone achievement	Applicable RA
RM11 Achievement of PMLU to a stable condition	- RA has maintained a stable, safe condition. - Vegetation percentage cover is 50 % of the ground surface area or >70 % of the rehabilitation reference sites. - Surface water quality measured at Environmental Authority EPML00557513 surface water sites (Schedule C - Table 1) complies with ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality for a consecutive two years - Stream sediment at Environmental Authority EPML00557513 sites complies with ANZECC/ARMCANZ (2000) Interim Sediment Quality Guidelines – low for a consecutive two years - Groundwater monitoring complies with ANZECC/ARMCANZ (2000) Livestock Drinking Water Quality for a consecutive two years	- Site specific vegetation completion criteria will be determined based on reference site monitoring. - Excessive rilling is unlikely to occur at erosion rates of <5t/ha/y. - Livestock drinking water values have been selected based on surrounding land use of grazing - Monitoring sites have been selected to capture all areas of disturbance	- Report summarising regular rehabilitation monitoring, utilising techniques such as the BioCondition Assessment Manual (or similar). The report will include data over a suitable period, considering seasonality. - Report summarises water and sediment quality monitoring. The report will include data over a suitable period, considering seasonality. - Inspection and report by a suitably qualified geotechnical engineer.	RA1 RA2 RA3 RA4 RA5 RA7
RM12 Achievement of PMLU to a stable condition (water storage)	Dam meets ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality during biannual sampling events for a consecutive two years.	Retained water storage required to meet the livestock values to align with the PMLU.	NATA Lab Results Certificate of Analysis (COA) indicate water quality is within the ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality values for a consecutive two years.	RA1 RA2 RA3 RA4 RA5 RA7

4. Non-use management areas

4.1. Description of NUMAs

Pit A, Pit B and North Pit are designated NUMAs with the final outcome being residual voids. The three final voids are described in the land outcome documents and have been transitioned into this PRC Plan and PRCP Schedule. Consistent with the process outlined in the PRCP Guideline, the Project is not required to comply with the requirements under section 126C(1)(g) or (h), or section 126D(2) or (3) of the EP Act and is not required to complete the information requirements under section 126C(1)(j) of the EP Act for the approved NUMAs.

There have been no changes to the final voids compared to the approved layout in the EA. The final outcome for the improvement areas is listed in Table 33.

Table 33 Mine Domains nominated as NUMAs

IA	Mine Domain	NUMAs
IA1	Pit A	Residual void
	Pit B	
	North Pit	

4.1.1. Voids in Floodplains

The Project does not reside within a floodplain. The final landforms are to drain away from residual voids. The Project site will be left in a stable, non-polluting condition as to achieve best practice management and minimise environmental harm.

Flooding was investigated by ATC Williams (2022); the report is provided in Appendix I.

AGE (2023) modelled the capacity of the voids during a 1% AEP and 5 % AEP event and found the voids would have significant capacity in the event(s) including with other influences (i.e., groundwater ingress).

4.1.2. Achieving Sufficient Improvement

A NUMA is to be managed in accordance with best practice management strategies whilst minimising risks to the environment, in doing so, 'sufficient improvement' to the void can be achieved prior to relinquishment of the lease. Sufficient improvement may be achieved when:

- The risk of the area collapsing, eroding, or subsiding is minimised;
- The need to actively manage the area is minimised; and
- Measures are implemented to minimise fauna and persons access to the area (i.e., fencing).

Management milestones have been developed to demonstrate sufficient improvement (Table 33).

Table 33. NUMA Management Milestone

Management Milestones	Milestone Criteria	Justification of completion criteria	Verification of milestone achievement	Applicable IA
MM1 Highwall Treatment	IA is certified as safe and stable by a suitably qualified person.	Voids must be made safe for humans and wildlife.	Inspection and report by a suitably qualified person to verify that the voids are stable.	IA1
MM2 Achievement of Surface Requirements	- All services disconnected - Water management infrastructure removed (i.e., pumps) - Safety bund constructed at 1m high - Fencing of 2m high is erected around the perimeter of the residual void - Warning signage posted every 10m of the perimeter	Voids must be made safe for humans and wildlife.	- Inspection and report verifying infrastructure has been removed. - Inspection and report verifying fencing and signage has been erected.	IA1
MM3 Achievement of Sufficient Improvement	- IA is certified as safe and stable by a suitably qualified person. - Pit water quality sampling complies with ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality - Groundwater water quality measured at EA sites complies with ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality	Residual void must not cause environmental harm outside of the tenure boundary.	- Inspection and report by a suitably qualified person to verify that the area has maintained a stable condition. - Report summarising water quality monitoring. The report will include data over a suitable period, considering seasonality.	IA1

5. General rehabilitation principles

The following sections contain information required for the development and management of rehabilitation methodologies.

5.1.1. Flooding

Queensland Government's FloodCheck mapping service was used to estimate the regional flood extents adjacent to the Project. The flood mapping overlay includes regional flood data for the 1% AEP and Probable Maximum Flood (PMF) events. The flood mapping (Figure 20 and Figure 21) demonstrate that the flood extents are well clear of the proposed site voids (ATCW, 2022). Further detail is provided in Appendix D.

Bunding along the eastern extent of the voids will be maintained after closure, to divert the natural flow to the east away from the pits.

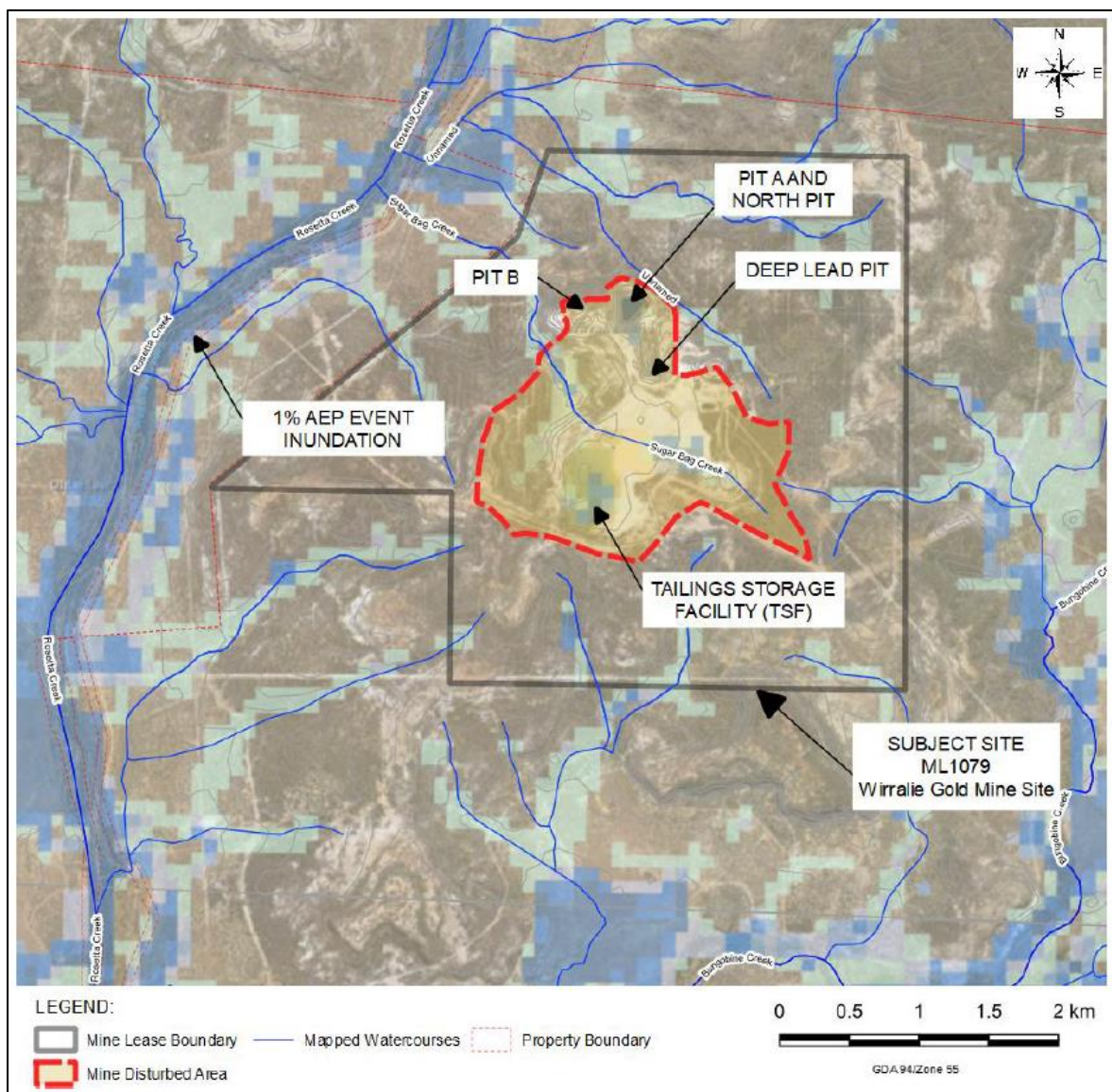


Figure 20 1% AEP Event Inundation (ATCW, 2022)

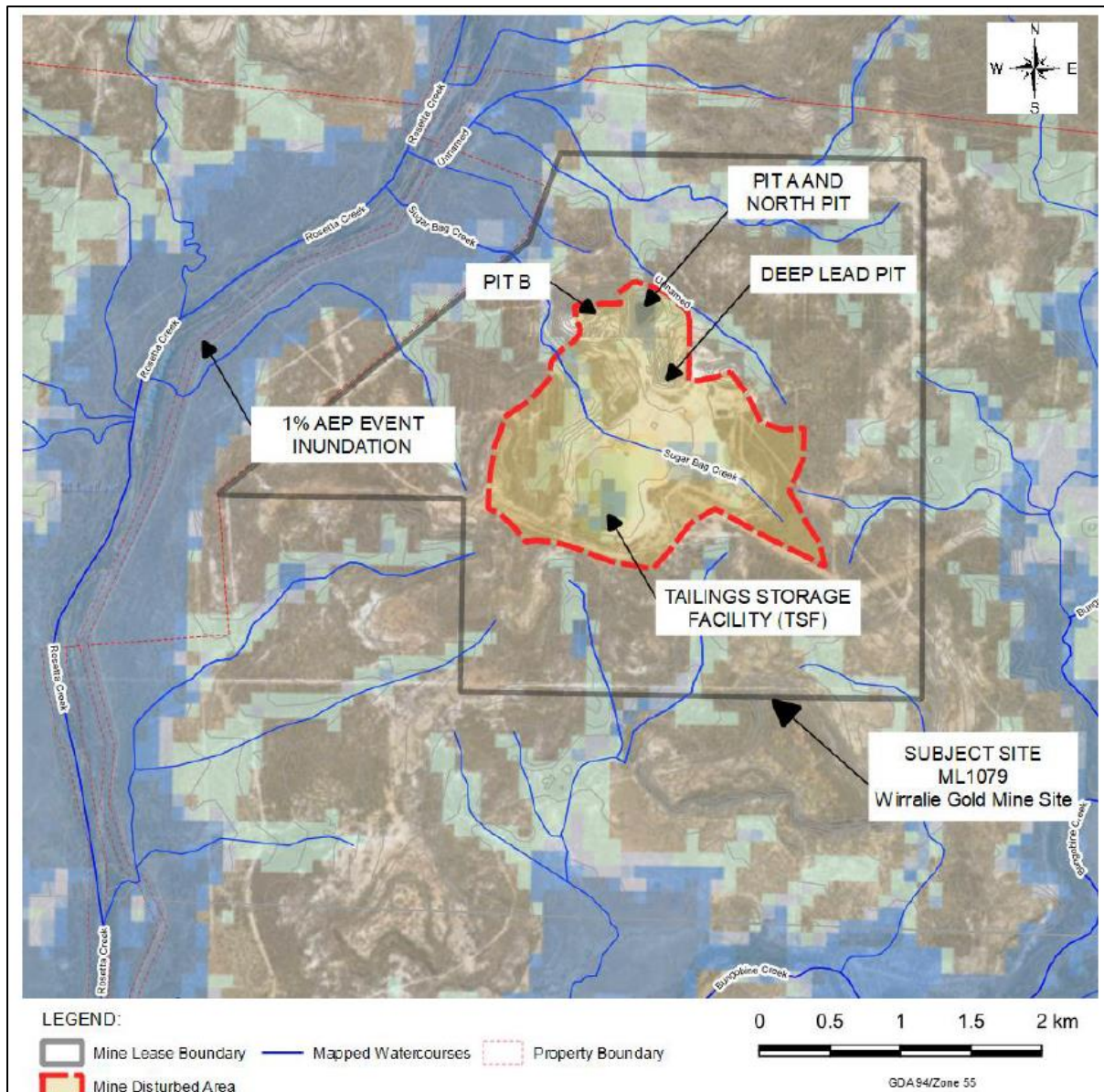


Figure 21 PMF Event Inundation

5.1.2. Hydrogeology

As per Section 3.2.3, historic groundwater data is limited due to intermittent sampling events since the commencement of mining in 1989. In response to this, Solomons Gold established 5 groundwater monitoring bores at Wirralie to characterise the background groundwater quality and flow.

5.1.2.1. Groundwater Monitoring Network

Five groundwater bores were established at Wirralie during August 2021. These bores were established via rotary air drill methods and supervised by a suitably qualified environmental professional with experience establishing groundwater bores. Groundwater construction details are included in Table 34.

Table 34. Groundwater Bore Construction Details

ID	Easting	Northing	Geology Intersected	Total Depth	Screened Interval	Water Intersected (mbgl)
WTB-04	527407	7664918	Waste Rock, Suttor Formation	28	22 - 28	N/A*
WTB-05	526748	7665239	Suttor Formation, Mt Wyatt Formation	28	22 - 28	20
WTB-06	527319	7665825	Suttor Formation, Mt Wyatt Formation	50	29 - 50	37**
WTB-07	526809	7663693	Suttor Formation	25	24 - 19	N/A*
WTB-08	526845	7663693	Suttor Formation, Rosetta Creek Formation	76	55 - 76	54

*No standing Water during post construction

**Poor permeability. No standing water at time of construction.

5.1.2.2. Groundwater Quality

Groundwater monitoring of the 5 newly established groundwater bores commenced in August 2021. Groundwater quality is summarised in Table 9.

5.1.2.3. Groundwater Recharge and Discharge

As identified in Section 3.2.1, Wirralie is underlain by the Suttor Creek Formation, Rosetta Creek Formation and Mt Wyatt Formation, with minor amounts of quaternary sediments near Rosetta creek. (Figure 12).

Bore construction initially intersected water within the Rosetta Creek Formation and Mt Wyatt Formation only. However, background groundwater monitoring conducted from August 2021 indicates that groundwater is present in the Suttor formation, which is thought to be recharged directly by heavy rainfall. Predominant recharge of the Mt Wyatt Formation or Suttor Formation aquifers is thought to cause by downward seepage from overlying/adjacent geology, infiltration from outcrops or the Wirralie open cut pits; and leakage through faults or other structures. The main recharge of quaternary

sediments is be recharged directly by heavy rainfall given the unconsolidated nature of sediments and the proximity of Rosetta Creek.

Groundwater discharge in the quaternary alluvium is thought to be via through flow of the aquifer. historically quaternary the alluvial aquifer had been used as a water supply for Wirralie. Groundwater discharge in the Suttor Formation is thought to be through flow of the aquifer, evaporation or seepage to the underlying Rosetta Creek/Mount Wyatt Formations. Given the lack of registered bores in the vicinity of Wirralie, it is not expected that groundwater is extracted. Groundwater discharge in the Rosetta Creek Formation is thought to be through flow of the aquifer and seepage to underlying bedrock predominantly, with other discharges via fault structures. Discharge of the Mount Wyatt Formation is thought to be dominated by fault structures.

5.1.2.4. Potentiometric Surface and Flow Direction

The general flow direction in the Project area is from the south to north. Groundwater flow broadly follows topography, with groundwater level becoming closer to the ground surface downgradient (WTB – 05).

A Potentiometric Map is provided in Appendix H.

5.1.2.5. Current and Potential Future Uses

Wirralie currently operate bores in the Rosetta Creek Borefield. When natural rainfall is not sufficient, small volumes of water are pumped from the borefield, to the RAW water dam situated directly east of the runoff dam for use in gold processing or as a potable water supply for the accommodation camp. Where the runoff dam stores water, this may be used as a water source to supplement groundwater use.

Post mining groundwater use is to be used predominantly for stock watering.

5.1.3. Waste characterisation

A waste rock characterisation study (C&R, 2021) has been completed including desktop review of all waste rock areas and the sampling of waste rock. The study was guided by the *Australian technical guidelines for the geochemical assessment of mining wastes* (DME, 1995). The study is presented in full in Appendix G and summarised below.

5.1.3.1. Methodology

A total of 155 rock/sediment samples were collected from 82 sampling locations across the Project, providing a good overall representation of the Project waste. The drillhole cuttings were obtained from the WRD, HLP, former ROM and haul road, whereas the crustal scoops and push-tube sediments were taken from the TSF. Sampling locations are summarised in Table 35.

Table 35. Sampling Summary

Sample Type	Area	Number of Samples a
Drillhole cuttings	WRD01	11 (from 5 holes)
	WRD02	13 (from 8 holes)
	WRD03	29 (from 12 holes)
	Rehabilitated WRD	31 (from 16 holes)
	Former run-of-mine (ROM) pad	12 (from 5 holes)
	Heap leach pad (HLP)	7 (from 7 holes)
	Haul road	2 (from 2 holes)
Trowel scoops	Tailings surface facility (TSF)	23
Push-tube sediments	TSF	27

The geochemical test work was based on industry-recognised procedures for the geochemical characterisation and assessment on mine waste (AMIRA, 2002; The International Network for Acid Prevention [INAP], 2014; COA, 2016) (C&R Consulting, 2021).

Static geochemical tests were conducted to provide information on the bulk geochemical characteristics of samples at a single point in time. All 155 samples underwent static geochemical testing to evaluate the risk associated with the potential oxidation of sulphides, acid generation, and the presence of metals/metalloids and salts. Static analysis included the following analytes:

- pH;
- Electrical conductivity;
- Moisture;
- Total sulphur;
- Acid neutralising capacity;
- Net acid generation capacity;

- Net acid producing potential; and
- Total metals/metalloids (Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Se, V, Zn)

Kinetic leach column (KLC) tests were also conducted on 11 samples to evaluate the risk associated with dissolution and mobility of metals/metalloids and salts, over a period of time.

5.1.3.2. Geochemical Analysis Results

The majority of samples analysed were deemed to be in the slightly acidic range which is indicative of the Project's volcanoclastic/intermediate volcanic geology. The exception to this was identified within the tailings sediment samples, which recorded minor amounts of strongly acidic samples. pH analysis results are displayed in Figure 23.

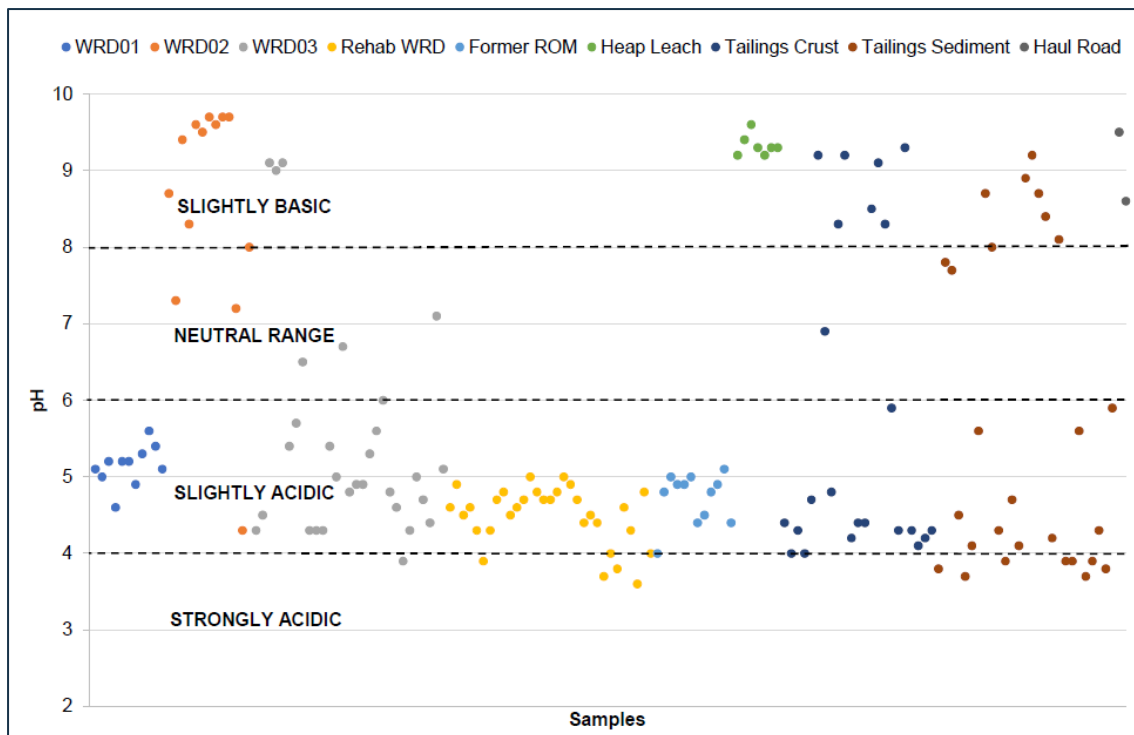


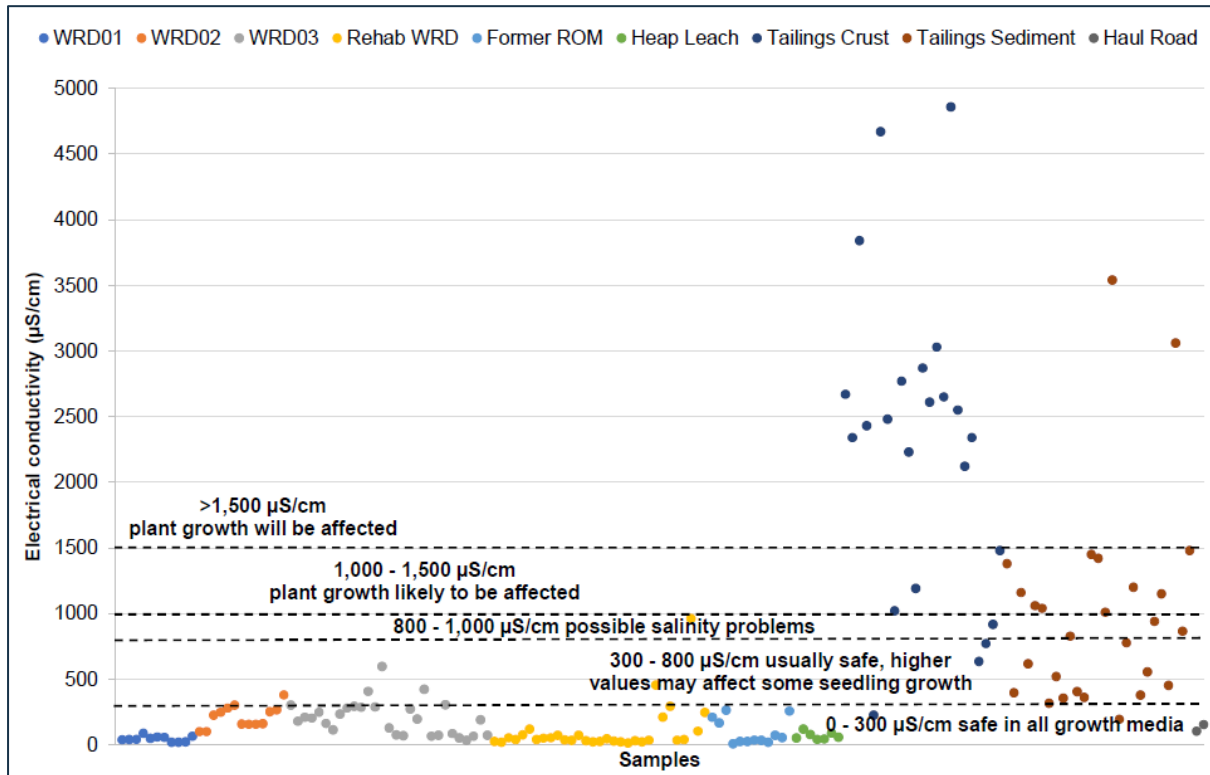
Figure 23. pH Vales for Wirralie Waste Rock Samples (C&R Consulting,2021)

Because of the method of analysis (i.e. fluid extract from crushed samples, with a very high surface area to solution ratio), low and high pH results of samples are considered a worst-case scenario. It is envisaged that the pH of runoff from the Wirralie operations will not be as low or high as that reflected in analysis results. Additionally, for significant runoff to occur at Wirralie, the rainfall dilution factor should be greater than the 1:5 (soil:water ratio) used in analysis. This, in turn, would counteract the resulting acidity or alkalinity.

It is noted that the KLC results indicate that there is minor (developing or residual) acidity associated with the TSF. The TSF samples either decrease in pH or sustain a relatively low pH (<4.5). Waste rock samples were also below the lower pH limit, however increased over time.

5.1.3.3. Electrical Conductivity

The Electrical Conductivity (EC) of samples ranged from 8 $\mu\text{S}/\text{cm}$ to 4,860 $\mu\text{S}/\text{cm}$ and had a low median value of 204 $\mu\text{S}/\text{cm}$. Most Wirralie waste rock samples had low EC values (<300 $\mu\text{S}/\text{cm}$) and, apart from the tailings dam samples, all waste rock had ECs below 1000 $\mu\text{S}/\text{cm}$. TSF samples overall had higher ECs than the rest of the waste rock samples. In particular, the salinity of the surface crust of the tailings dam is much higher than the rest of the waste rock, including the tailings sediment contained below the crust (C&R Consulting,2021). EC analysis results are displayed in



. The TSF KLC results demonstrate that the weathering of the TSF material has the potential to form moderately/highly saline waters up to around 20,000 $\mu\text{S}/\text{cm}$.

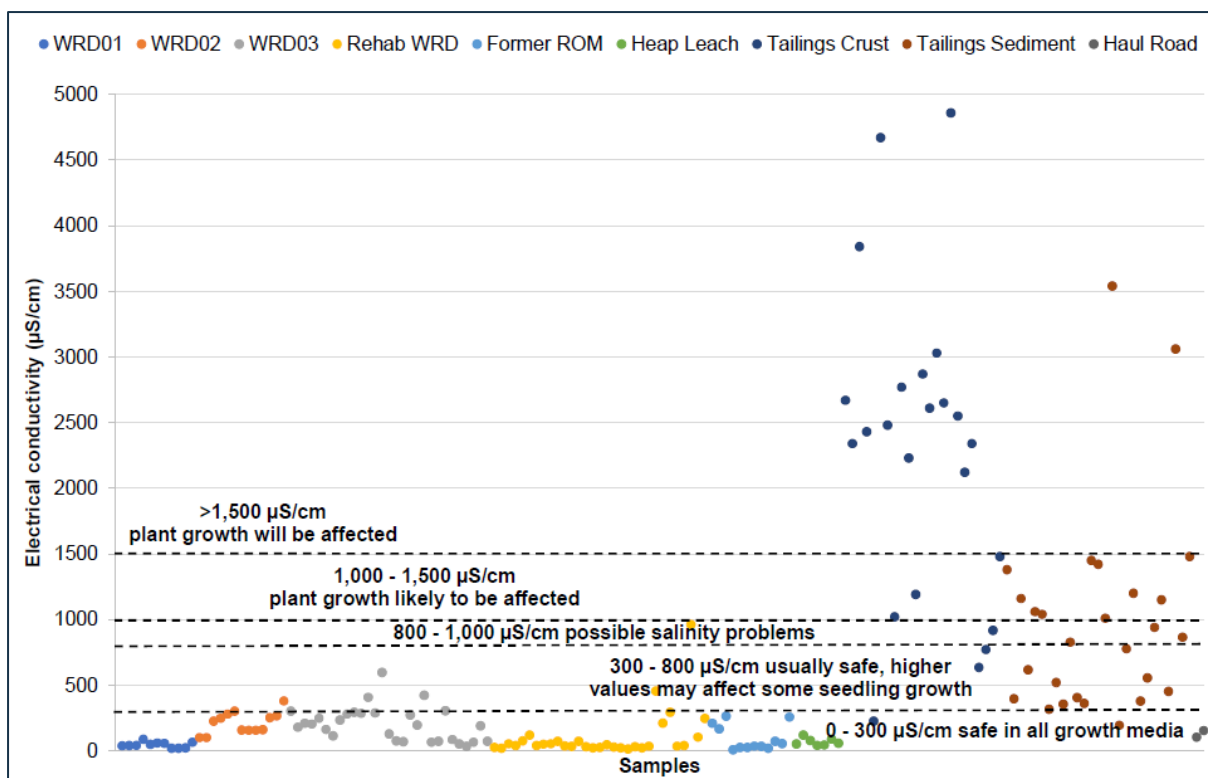


Figure 24. Electrical conductivity for Wirralie waste rock samples (C&R Consulting,2021)

5.1.3.4. Total Sulphur

The total sulphur concentrations ranged from 0.01% to 0.60% and have an extremely low median of 0.07%. Most of the waste rock is barren of sulphur (<0.1%). Both WRD03 and the TSF have higher sulphur levels than the rest of the waste rock. However, these elevated sulphur concentrations are still classified as very low (<0.55%) (C&R Consulting,2021).

Results of total sulphur analysis is displayed in Figure 25.

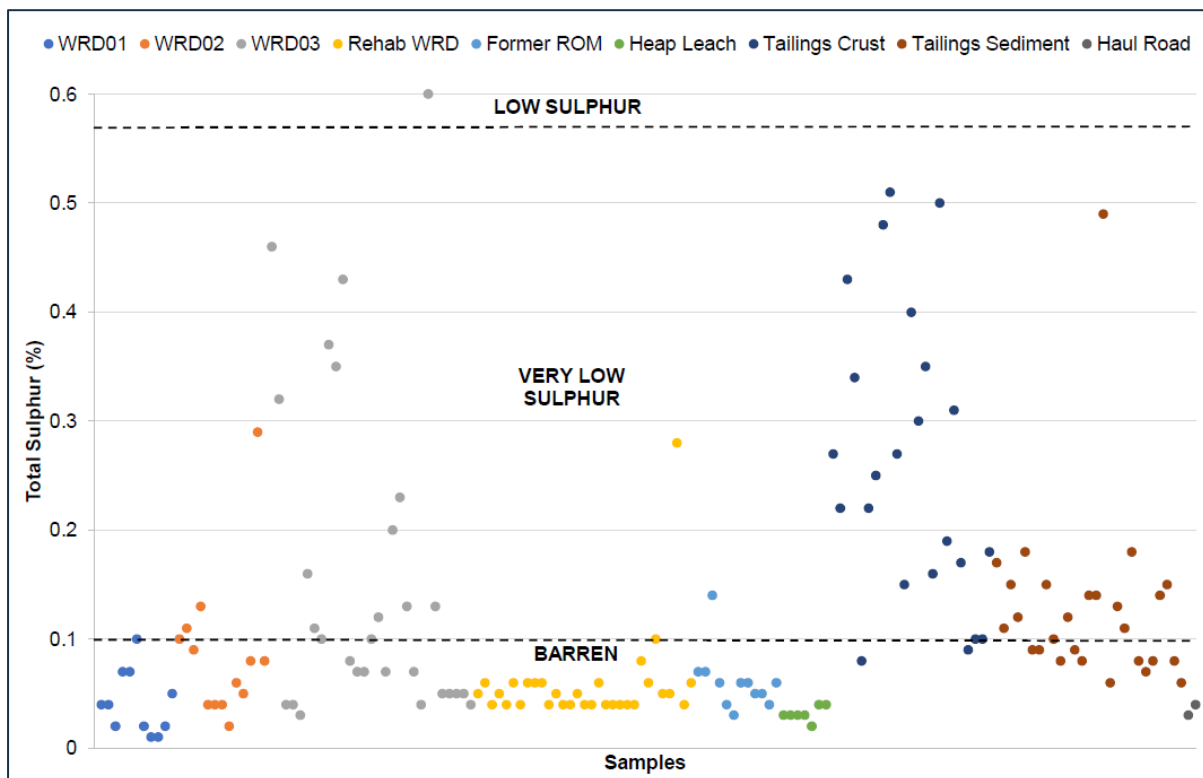


Figure 25. Total sulphur concentration (C&R Consulting,2021)

The Maximum Potential Acidity (MPA) is the maximum amount of acid that can be generated by the oxidation of sulphur within rock, calculated from the total sulphur content. MPA for the Project waste rock ranges from 0.3 to 18.4 kg H₂SO₄/t and has a low median value of 2.1 kg H₂SO₄/t.

Acid Neutralising Capacity (ANC) is the amount of acid neutralising minerals (i.e., carbonates) in waste rock capable of neutralising acid generated by the waste rock. Waste rock samples ranged from 0.6 to 9.6 kg H₂SO₄/t eq., with a low median of 2.0 kg H₂SO₄/t eq.

The ANC:MPA ratio can assist in classifying the potential for waste rock samples to generate acid. Samples with an ANC:MPA ratio <1 are likely to be acid forming because as they contain more acid-generating than acid-neutralising minerals. Samples with an ANC:MPA ratio of >2 are generally low risk however, samples with an MPA of <3.1 kg H₂SO₄/t are considered to contain insufficient acid forming potential (i.e. they are barren), and samples with an MPA of >3.1 but <10 kg H₂SO₄/t would, at worst, be classified as low capacity, potentially acid forming (PAF) material.

Waste rock samples from the Project express ANC:MPA ratios ranging from 0 to 3.9, with a median value of 0.8. According to these ANC:MPA ratios, more than half of the Project's waste samples could

be considered to be potentially acid forming. However, given the low MPA values, most of these samples are considered either barren or of low capacity with respect to acid forming potential (C&R Consulting,2021) (Figure 26).

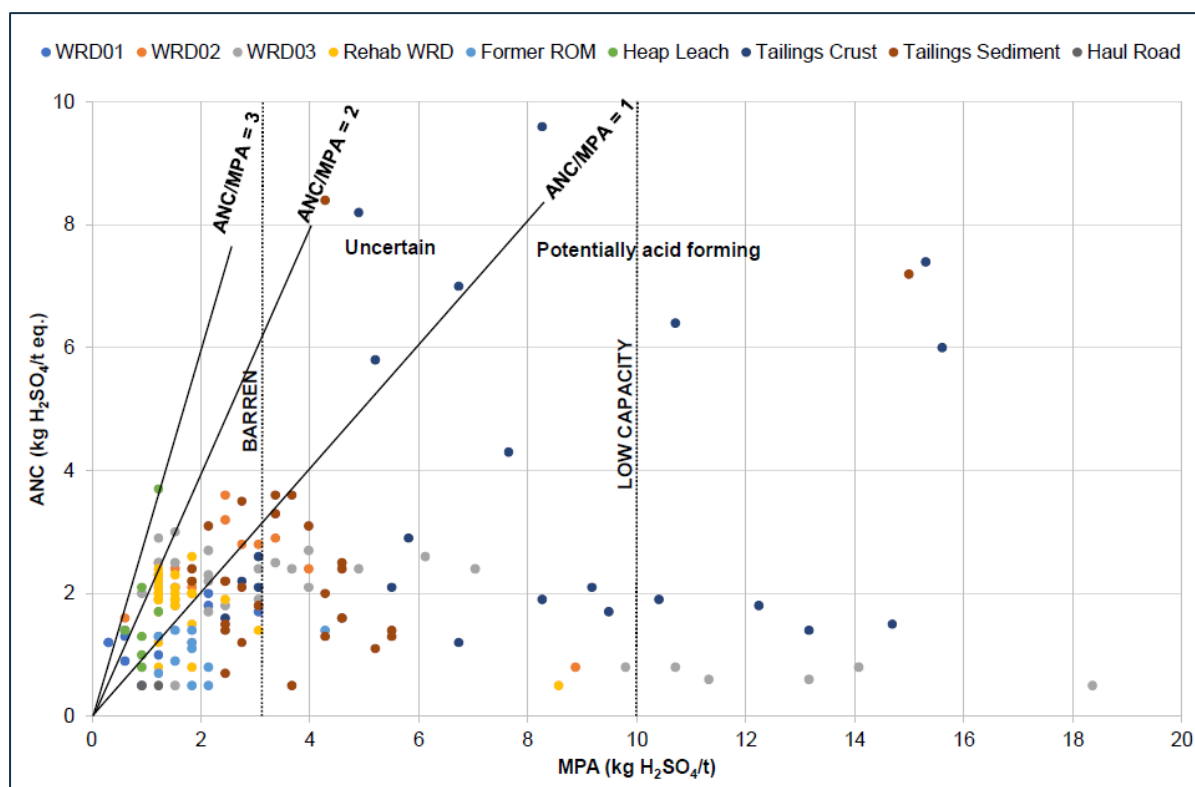


Figure 26.MPA versus ANC (C&R Consulting,2021)

Net acid producing potential (NAPP) is a theoretical calculation of the net acid producing (or consuming) value of a waste rock. Waste rock with a negative NAPP value are non-acid forming (NAF), and those with a positive NAPP value are PAF. Categorisation of waste rock material based on the magnitude of the NAPP value is detailed in Table 36.

Table 36. ARD Classification

ARD Classification	NAPP Value (kg H ₂ SO ₄ /t)
Potentially Acid Forming (PAF)	> 10
Uncertain	0 to 10
Non-Acid Forming (NAF)	-50 to 0
Acid Consuming Material	< -50

85 samples have positive NAPP values. However, most of these positive samples are in the uncertain range, with only seven samples having values greater than 10. These are associated with either WRD03 or the TSF (C&R Consulting,2021).

5.1.3.5. Net Acid Generation Test

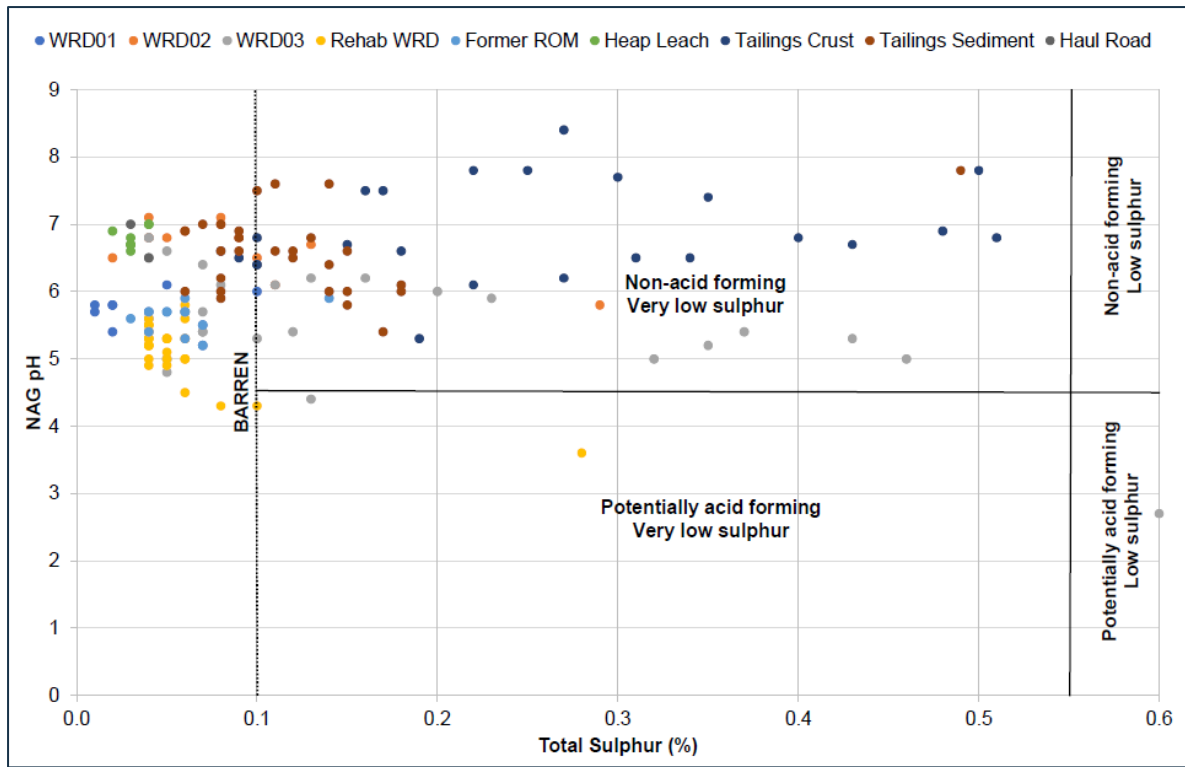
The net acid generation (NAG) test is used to directly measure the net amount of acid produced by a sample. Samples with a NAG(pH) below 4.5 may be acid generating and samples with a NAG(pH) equal or greater than 4.5 (≥ 4.5) are unlikely to be acid generating (C&R Consulting, 2021).

Project NAG(pH) versus total sulphur geochemical classification criteria for samples is presented in Table 37.

Table 37. Geochemical Classification Criteria for Waste Rock Samples (C&R Consulting,2021).

Geochemical Classification	Total Sulphur (%)	NAG _(pH)	WRD01	WRD02	WRD03	Rehab WRD	Former ROM	Heap leach	TSF Crust	TSF Sed.	Haul road
NAF (barren)	≤ 0.1	-	11	10	15	30	11	7	4	12	2
NAF (very low sulphur)	>0.1 to ≤ 0.55	≥ 4.5	0	3	11	0	1	0	19	15	0
NAF (low sulphur)	0.55 to 1.5	≥ 4.5	0	0	0	0	0	0	0	0	0
PAF (very low sulphur)	0.1 to ≤ 0.55	< 4.5	0	0	1	1	0	0	0	0	0
PAF (low sulphur)	0.55 to 1.5	< 4.5	0	0	1	0	0	0	0	0	0
Percentage of NAF samples			100%	100%	93%	97%	100%	100%	100%	100%	100%
Percentage of very low sulphur PAF samples			0%	0%	3.5%	3%	0%	0%	0%	0%	0%
Percentage of low sulphur PAF samples			0%	0%	3.5%	0%	0%	0%	0%	0%	0%

Of the 155 Wirralie waste rock samples, only three samples can be categorised as PAF when the NAG (pH) (Figure 27 and



and total sulphur values are considered:

- Two samples on WRD03, both of which occur in the same hole; and
- One sample on the rehabilitated WRD.

PAF samples make up <4% of the total sample size for their respective areas, and their sulphur values are very low to low. It is therefore expected that these three samples will not present an acid drainage issue because:

- The amount of produced acid will be negligible; and
- Any acid produced by the samples will be buffered by the surrounding NAF rock that makes up more than 90% of the waste rock (C&R Consulting,2021).

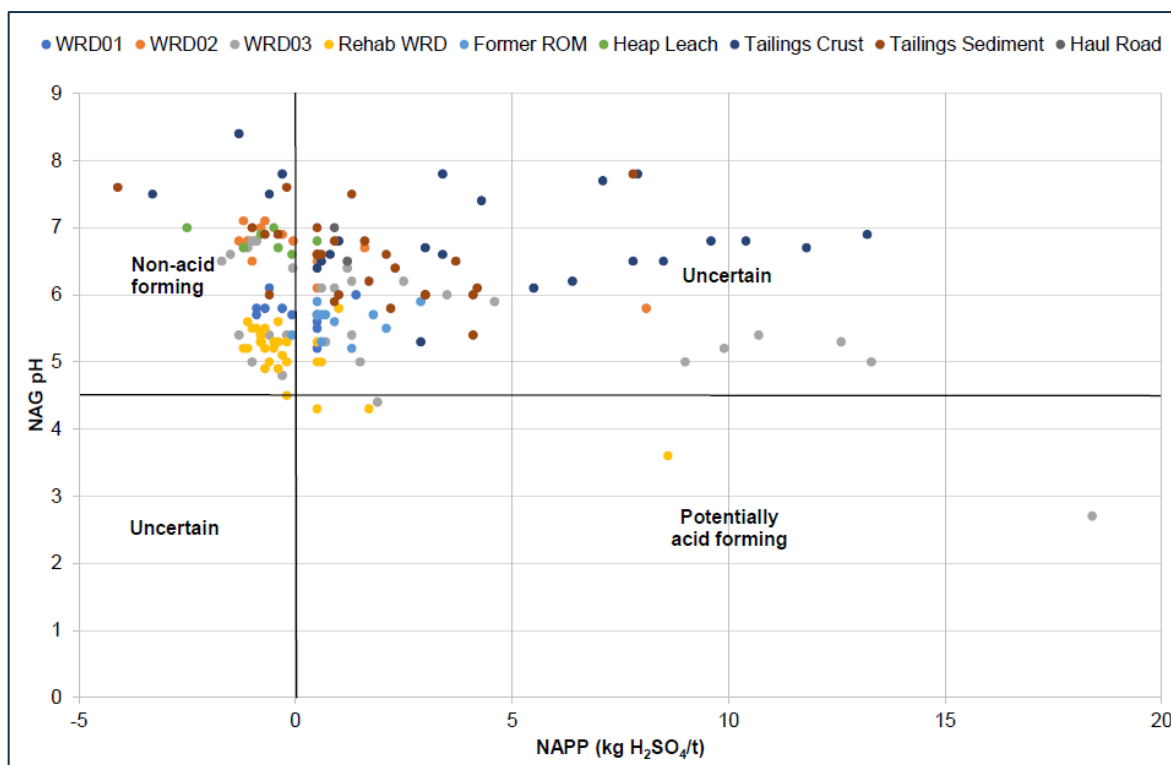


Figure 27. NAG(pH) versus NAPP (C&R Consulting,2021)

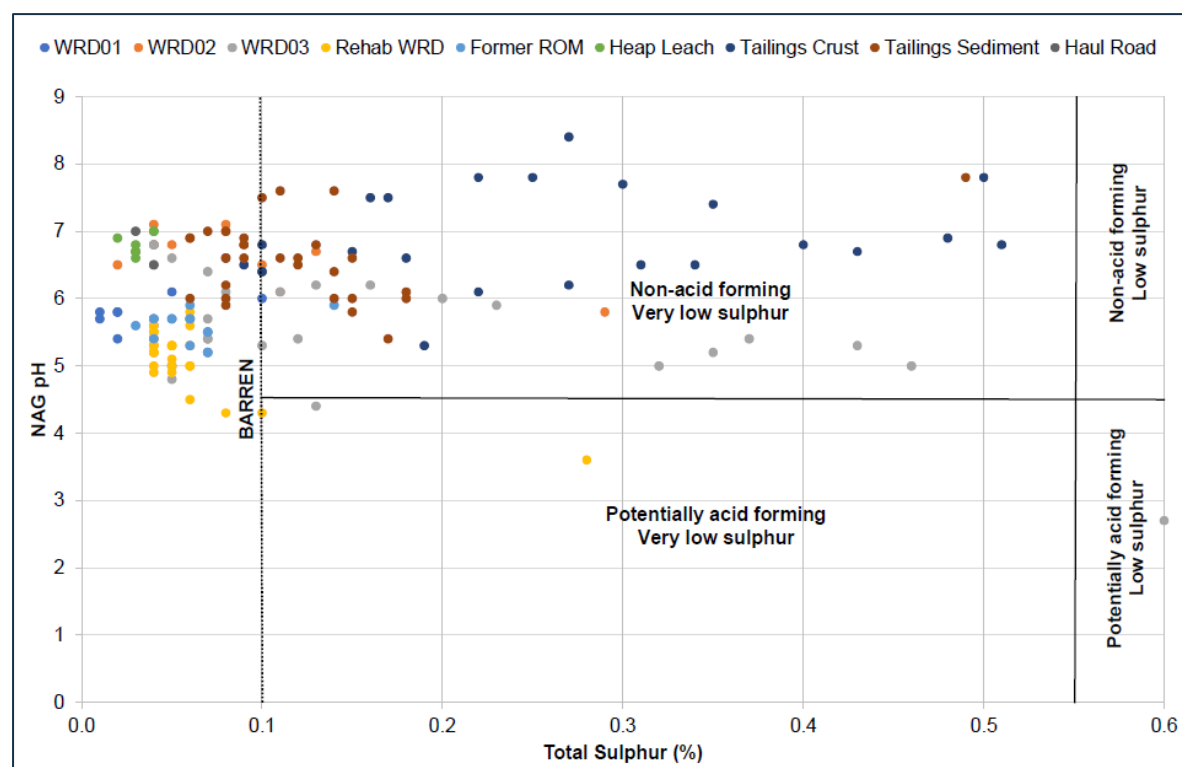


Figure 28. NAG(pH) versus sulphur (C&R Consulting,2021)

5.1.3.6. Metal/ Metalloid Analyses

Total metal and metalloid concentrations in the waste rock can be compared to the average crustal abundance of unmineralized soils (INAP, 2014). The geochemical abundance index (GAI) is used to report on the extent of elemental enrichment, by relating the actual concentration in a sample with the average crustal abundance on a log² scale (C&R Consulting,2021).

Samples with a GAI of 3 or greater indicate enrichment that may warrant further investigation. However, elements identified as enriched may not necessarily be a reason for concern regarding revegetation and/or water quality because:

- The average crustal abundance varies between different literature sources;
- Some elements are more environmentally important than others (i.e. As, Al, Cr, Cd, Cu, Pb, Se and Zn are more important than Ca, Fe, Mg and Na);
- If a sample is shown to be enriched in a particular element, there is no direct correlation that the sample will leach the element at elevated concentrations; and
- The nature of an ore deposit means that the background levels for some elements are expected to be elevated (C&R Consulting,2021)

Summaries of the multi-element scans and GAIs for the Wirralie waste rock samples are presented in Table 38.

Table 38. Summary of Multi-Element Analyses

Limit of reporting			ACA*	n#	Concentration Statistics			NEPM Guideline HIL~ Recreational C	Min.GAI	GAI Statistics		
					Min.	Median	Max.			Median GAI	Max.GAI	Number ofGAIs ≥3
Aluminium	mg/kg	50	82,000	155	180	1,060	2,450	-	0	0	0	0
Arsenic	mg/kg	5	1.5	129	BLOR^	72	214	300	1	5	6	120
Barium	mg/kg	10	500	137	BLOR	30	280	-	0	0	0	0
Chromium	mg/kg	2	100	92	BLOR	6	19	300	0	0	0	0
Copper	mg/kg	5	50	29	BLOR	6	25	17,000	0	0	0	0
Iron	mg/kg	50	41,000	155	140	3,400	18,700	-	0	0	0	0
Manganese	mg/kg	50	950	67	BLOR	9	65	19,000	0	0	0	0
Mercury	mg/kg	0.1	0.05	64	BLOR	0.5	2.1	80	0	2	4	26
Nickel	mg/kg	2	80	53	BLOR	4	15	1,200	0	0	0	0
Vanadium	mg/kg	0.1	2.4	79	BLOR	8	38	-	0	0	0	0
Zinc	mg/kg	5	75	9	BLOR	7	36	30,000	0	0	0	0

Waste rock at the Project is enriched with respect to arsenic, and to some extent, mercury with 77% of samples having an arsenic GAI ≥ 3 and 17% of samples have a mercury GAI ≥ 3 . Arsenic values in waste rock are not a particular concern because they remain below the NEPM HIL for 'Recreational C' (public open space scenario) of 300 mg/kg (NEPC, 2013). Additionally, the KLC results indicate that the arsenic contained in the waste rock is relatively immobile.

The mercury enrichments are not a concern either because all mercury concentrations remain well below the HIL 'Residential A' (residential garden scenario) threshold of 10 mg/kg. For enrichment to be of environmental concern (water quality, revegetation etc.), a significant portion of the elements would need to be leached from the waste rock in order to enter the soil, surface water or groundwater (C&R Consulting, 2021). Additionally, the KLC results indicate that the mercury contained in the TSF is relatively immobile.

5.1.3.7. Kinetic Leach Column Water Quality Analyses

Kinetic leach column testwork was completed on 11 samples to understand the potential risk of leach from the waste rock to the surrounding environment.

The kinetic results demonstrates that the waste rock is slightly acidic with majority of the pH values outside of the EA receiving water contaminant limits. However, C&R (2021) discusses the increasing pH when reacting to the leachate solution giving the possibility of, as the reaction continues, the pH value may reach the EA limit. This is further justified by the waste rock static samples being predominately NAF.

The TSF kinetic samples react with the leachate solution, decreasing in pH or sustaining a relatively low pH value (< 4.5 pH) likely attributable to acid forming reactions occurring in the samples. Therefore, a minor PAF component may be associated with weathering of the TSF.

Salinity results exceeded the EA receiving water contaminant limits for three TSF samples. Salinity is not of environmental concern for the waste rock material.

The heap leach pad kinetic results indicated an arsenic exceedance, however it is not considered of environmental concern as it is likely attributed to natural background concentrations and the results show that the arsenic is relatively immobile.

Cadmium and selenium exceeded in some of the TSF samples; EGI (2002) previously reported that the TSF was enriched with selenium. Neither element was detected in the waste rock static results.

5.1.3.8. Summary of Waste Rock Characterisation

Acid base account results demonstrate that although most pH values are slightly acidic, results tend to be misleading due to the nature of the analysis. It is expected that – under normal conditions (i.e. dissolution and erosion of the waste rock), pH of the surface runoff would not be as acidic as that represented by the 1:5 (pulverised soil:water) extracts. The overwhelming majority (98%) of waste rock samples at Wirralie are considered NAF. These samples represent material with a very low to low risk

of acid generation and a high safety factor with respect to potential acid mine drainage. Although AMD is unlikely to occur in the TSF, it must be noted that the KLC results indicate that there is minor (developing or residual) acidity associated with the TSF (C&R Consulting,2021).

Most EC measurements for the Project waste rock samples, apart from the TSF, are generally low (<300 $\mu\text{S}/\text{cm}$). In contrast, the TSF waste rock samples tend to have much higher ECs, ranging from 195 $\mu\text{S}/\text{cm}$ to 4,860 $\mu\text{S}/\text{cm}$, with a median value of 1,175 $\mu\text{S}/\text{cm}$. Therefore, it is considered that there is a very low risk of salinity issues in all waste rock areas, apart from the TSF (C&R Consulting,2021).

Significant arsenic enrichment in the Project waste rock is likely geological because it occurs in most of the volcanoclastic waste, but not the Tertiary clay. The kinetic leach arsenic results indicate that the waste rock is significantly enriched with arsenic, however, the arsenic is relatively immobile and therefore is not of environmental concern. Significant mercury enrichments predominantly occur in the TSF. Therefore, it is assumed that the mercury enrichment is associated with the ore rather than the mined waste, which is why it is almost entirely constrained to the TSF. Nonetheless, the kinetic results indicate that the mercury is relatively immobile (C&R Consulting,2021).

High arsenic values in the Project waste rock are not a particular concern because they remain below the NEPM HIL for 'Recreational C' (public open space scenario) of 300 mg/kg (NEPC, 2013). The mercury enrichments are not a concern either because all mercury concentrations remain well below the HIL 'Residential A' (residential garden scenario) threshold of 10 mg/kg (C&R Consulting,2021).

The full reports supporting this information is provided in Appendix G, Appendix J, and Appendix K.

5.1.4. Capping and Material Assessment

5.1.4.1. Waste Rock Balance

As discussed in Section 5.1.3, the waste rock material is considered low risk and suitable for rehabilitation activities.

Waste rock is to be used for:

- Backfill of Deep Lead Pit:
 - 1,315,902 m³ of waste rock required to return void to natural level.
- Working layer of TSF cap
 - 1 m thickness
 - 840,000 m³ required
- Abandonment bund incorporated into perimeter of three voids
 - 219,132.5 m³ of waste rock required to construct the bunds

Pit B has a waste rock volume of 3,636,766 m³ available; 1,699,997 m³ of material is required for rehabilitation of the above domains which gives a surplus of 1,936,769.5 m³ which will remain in the RA2 WRDs as permanent features.

5.1.4.2. Soil Resources

As per Section 3.2.5.1, WTS identified four soil map units across the Project. Representative soil profiles are described in Table 39.

Table 39. Project Soil Types

Australian Soil Classification	Reference Site	Area (ha)	Area (%)
Eutrophic Brown Dermosol, Deep	S4	137.78	12.18
Leptic Brown Rudosol	S6	365.22	32.30
Leptic Brown-Orthic Tenosol, Shallow	S10	394.86	34.93
Sodic Brown Dermosol, Deep	S11	148.40	13.12
Self-Mulching Brown Vertosol	S14	84.15	7.44

5.1.4.2.1. Topsoil Striping

Topsoil resources were identified as a part of the Soil and Land Suitability Assessment (Section 3.2.5.1). Topsoil depths and volumes available for rehabilitation are detailed in Table 40.

Table 40. Topsoil Depths and Volumes

Soil Type	Area (m ²)	Stripping Depth	Volume (m ³)
Undisturbed Soil Resource			
Eutrophic Brown Dermosol, Deep	1,377,800	1.10	1,515,580
Leptic Brown Rudosol	3,652,200	0.2	730,440
Leptic Brown-Orthic Tenosol, Shallow	3,948,600	0.5	1,974,300
Sodic Brown Dermosol, Deep	1,484,000	0.5	742,000
Self-Mulching Brown Vertosol	841,500	0.2	168,300
Stockpiled Resource			
N/A	32,866	N/A	65,732
Total			5,169,352

5.1.4.2.2. Topsoil management

Topsoil will be stored at a maximum height of 2m, and only in locations that have been previously designated by site plans or in the Plan of Operations. A register of topsoil stockpiles will be kept and maintained on-site, recording stockpile number, placement date, source location, subsoil and topsoil type, and any relevant comments. Long-term stockpiling should be avoided as much as is practicable. Other potential uses for topsoil, including indirect use for rehabilitation will be investigated prior to stripping. Topsoils and subsoils will not be mixed, and stockpiles will not be located in drainage lines. Stockpiles will be designed and located to minimise topsoil loss through runoff and erosion, and will be marked and identifiable with signage. Active stockpiles will be inspected as part of ongoing environmental inspections.

5.1.4.2.3. Topsoil Application

Where land is adequately prepared for rehabilitation, the application of topsoil will occur in essentially the reverse sequence to topsoil stripping. The process for the application of topsoil to Project surfaces is as follows:

- Prior to recovered topsoil being applied to surfaces, Solomons Gold will ensure that the amount of topsoil available for rehabilitation matches the amount of area requiring rehabilitation.
- Solomons Gold will ensure that the mining domain/area has been decommissioned (infrastructure removed).

- The landform is shaped to final landform design either using insitu material or burden (nonacid forming).
- Landform will then be ripped. Ripping will occur via dozer with ripper attachment parallel to surface contours.
- Secondary material will be applied as required to achieve final landform design.
- Topsoil will be applied at a minimum depth of 150mm and ripped to promote vegetation strike.
- After application, stabilise with a sterile cover crop, pasture grasses and/or native species to establish revegetation cover as early as possible.
- Install appropriate ESCs.
- Install signage which includes the stockpile number (e.g., TP-01) and date of stockpile completion.

5.1.4.3. Erosion and Sediment Control

Erosion and sediment control measures will be carried out and documented using environmental inspection forms. Permanent erosion and sediment controls have been incorporated into the Projects design, and are based off catchment characterisation.

Revegetation and ensuring success of revegetated areas will be implemented to minimise erosion and act as a sediment control, and ensure landforms are both geochemically and geophysically stable.

Effective erosion and sediment control structures are installed surrounding the site. An allowance has been made to retain four additional sediment controls post mine closure, with some minor earthworks required to ensure these controls are safe and effective. The site runoff dam is the primary sediment control on the Project. Site affected water will continue to be directed to this structure.

Erosion and sediment control plans should be considered when conducting rehabilitation activities, and should include the following:

- Contours and drainage lines;
- Disturbance limits;
- Earthwork extents;
- Control measure locations;
- Order of work schedule;
- Construction details and notes; and
- Specific operating procedures.

5.1.5.Final landform design

5.1.5.1. Landform Structures

The final landforms were determined based on community, economic and environmental factors, as well as the relevant activities and PMLU of each domain. Final designs will be refined closer to closure, utilising information gathered over the course of operations. This includes the results of ongoing geochemical analysis of tailings, surveys, and environmental monitoring results.

Landform structures for the PMLU and NUMAs of the Project are detailed respectively in Table 41 and Table 42. The final landform and pit design

Table 41. Landform structures for PMLU of the Project

RA	Domains	Area (ha)	Landform Design and Rehabilitation
RA1	Deep Lead Pit	13.14	• Void to be backfilled to natural ground level and stable. • Landform to be free draining, following natural flow path. • Topsoil will be spread and ripped parallel to the contour to promote vegetation strike. • Landform will be seeded with pasture species • Domain to be monitored for rehabilitation success.
RA2	Overburden Dumps and Piles Rehabilitated Former WRD	40.15	• Landform to be shaped to a stable landform. • Landform to be shaped with subsoil to become free draining. • Topsoil will be applied to bring the domain to final landform elevation. • Topsoil will be ripped parallel to the contour to promote vegetation strike. • Landform will be seeded with pasture species • Domain to be monitored for rehabilitation success.
RA3 & RA4	ROM & MIA	19.33	• Areas to be progressively rehabilitated during time domains are no longer required. • Infrastructure is to be decommissioned and removed from site. Access tracks, fence lines and hardstands required for the PMLU to be retained. • Contaminated land (if any) is to be removed and disposed of in the TSF. • Landform to be shaped with subsoil to become free draining.

RA	Domains	Area (ha)	Landform Design and Rehabilitation
			- Topsoil will be applied to bring the domain to final landform elevation. - Topsoil will be ripped parallel to the contour to promote vegetation strike. - Landform will be seeded with pasture and native species. - Domain to be monitored for rehabilitation success.
RA5	Storages	8.99	- All associated infrastructure is to be removed from the domain. - Mine affected material is to be disposed of the in TSF. - Runoff Dam is to be lined with an engineered impervious liner. - RAW Water Dam to be desilted, infilled and revegetated.
RA6	Tailings Storage Facility Heap Leach Pad	72.21	- TSF to be filled until the design capacity is reached. - TSF to be capped with an impervious clay layer to prevent the infiltration of runoff. - Landform to be shaped with subsoil to become free draining. - Topsoil will be applied to bring the domain to final landform elevation. - Topsoil will be ripped parallel to the contour to promote vegetation strike. - Landform will be seeded with pasture species. - Domain to be monitored for rehabilitation success.

Table 42. Landform design for NUMAs of the Project

IA	Domains	Area	Landform Design and Improvement
IA1	Pit A, Pit B and North Pit	16.26	- Pit A, Pit B and North Pits are to be stabilised by removing securing the highwalls to ensure a safe, stable landform. - Once deemed stable, a fence and signage shall be erected around the open cut to prevent ingress.

Final landforms have been determined based on the final land uses defined in Schedule F – Table 1 of the EA (Table 43). Due to the majority of the PLMUs for the Project being light grazing, rehabilitation of the Project will incorporate both native habitats, and include some pasture species, in order to meet these requirements. Final landforms will be designed and built to be both geochemically and geotechnically stable. These structures will be resistant to weathering, oxidation, and will not generate seepage, or leach contaminants to surface water or groundwater. Design also includes

consideration to minimise or, where possible, eliminate potential impact to the environment. Conceptual designs for the WRDs are displayed in

Figure 29. Design plans will be finalised, taking into consideration:

- Modelling of the long-term stability of the final landform
- Methods of construction
- QAQC requirements
- Trial methodology to verify the predicted success of rehabilitation
- Limitations and assumptions of the landform design.

The rehabilitation strategy for the TSF is described below in Table 43.

Table 43 Rehabilitation landform criteria

Tenure ID	Disturbance Type	Projective Surface Area	Post-Mine land Description	Post Mine Land Classification
ML1107	Tailings Dam	72	Open Pasture	VII
	Infrastructure	69	Open Pasture	VII
	Waste Dump	22	Low Hill	VII
	Exploration	19	Open Pasture	VII
	Open Cut Pit	19	Open void	VIII
	Stockpile Area	14	Open Pasture	VII
	Village	12	Low Hill	VII
	Borrow Pit	8	Open Pasture	VII
	Processing Plant	7	Open Pasture	VII
	Runoff dam	5	Water Storage	VIII
	ROM Pad	3	Low HHI	VII

5.1.5.2. Method of Construction

5.1.5.2.1. Waste Rock Dumps

On closure, any remaining waste rock or other materials at the overburden dumps and piles will be reshaped to a low-gradient landform, reflecting the surrounding environment. The final landforms have been conceptualised for each WRD as shown in Figure 18.

The rehabilitation works will include reshaping, topsoil, and revegetating. Surface water management will continue during rehabilitation to convey runoff and minimise the potential for erosion and weathering.

The design, management, and rehabilitation phases enable the ability for the overburden dumps to remain safe, structurally stable, and non-polluting during the life of mine. The final landforms will be assessed by a suitably qualified person during rehabilitation efforts to assure it is stable and non-polluting.

5.1.5.2.2. Tailings Storage Facility

Construction for rehabilitation will be carried out progressively, splitting up the TSF into eastern and western catchment areas. The eastern catchment (Stage 1) should be rehabilitated first, with the western catchment (Stage 2) being used as a water and sediment storage area to capture runoff from the disturbed areas. Following Stage 1 achieving suitable vegetation cover, Stage 2 can be rehabilitated, and a temporary High Efficiency Sediment (HES) basin would likely be required to temporarily capture Stage 2 dirty water runoff during the rehabilitation works.

During operation the TSF will continue to be filled until the design capacity is reached. The cover will be constructed using waste rock material to provide a working layer with topsoil layered on top to bring the domain to the final landform shape and elevation. Each layer will be shaped to follow the natural landscape and to be free draining. The topsoil will be ripped and seeded with the appropriate species.

The final landforms will be assessed by a suitably qualified person during rehabilitation efforts to assure it is stable and non-polluting along with required monitoring.

5.1.5.3. Quality Assurance

Some of the key risks associated with final landform construction are failing to follow to design, non-conformance of construction materials to specifications, inadequate quality of construction, failure to correctly implement a QA/QA procedure to identify construction inadequacies. Construction management, technical supervision, and QA/QC of final landforms will be done by an AQP, to ensure that construction aligns with the design plan. An AQP will prepare a QA/QC document to verify landform design is stable and has been constructed in accordance with the design plan.

5.1.5.4. Determining Landform Establishment Success

Section F1-1 of the EA states that final landforms must be both geochemically and geotechnically stable, and have self-sustaining vegetation cover, in alignment with designated PLMUs. Rehabilitation milestones and monitoring programs will be developed to provide objective measurement of these requirements.

Criteria for determining the success of rehabilitation works will be developed, and will include the following:

- Water leaving rehabilitated landforms will meet acceptable standards and will not pose adverse impacts to surrounding water sources. Water quality will be demonstrated to be stable or improving over several wet/dry seasons cycles.
- Achievement of agree PLMUs
- Rehabilitation final landforms show trends towards long-term stability.

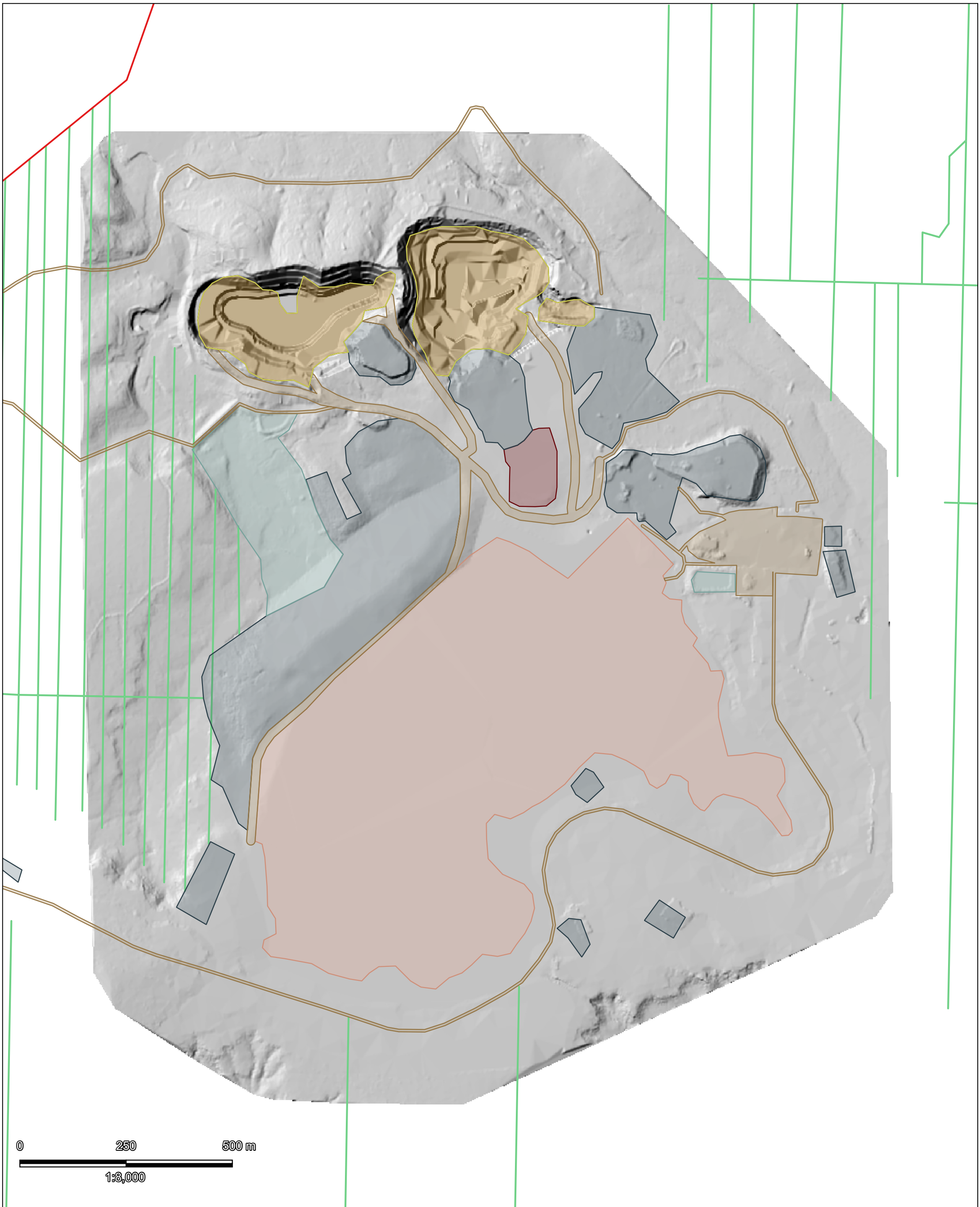
5.1.5.5. Limitations

Limitations of final landform design are as follows:

- Accuracy of soil quality and availability at closure;
- Future impacts of climate change on rainfall event intensity, duration, and frequency; and
- The nature of final waste material

The following assumptions have been made for the final landform design:

- sufficient cover material is available;
- cover and waste material nature is conformant to current assessments; and
- progressive rehabilitation will commence as soon as land becomes available.



Client: Wirralie Gold Mine
Project number: 2020.10003
CRS: GDA2020 / MGA zone 55 EPSG:7855
Date: 10 December 2023

Print as A3

Figure 30. Final Landform and Pit Design

Legend

Mine Lease

Rehabilitation and Improvement Areas

RA1

RA2

RA3

RA4

RA5

RA6

IA1

Disclaimer:
Whilst every effort and care has been taken to ensure the accuracy of this report, Wulguru Technical Services Pty Ltd makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incur as a result of the product being inaccurate or incomplete in any way and for any reason.
Digital data for this report is available on the Queensland Government Spatial Portal at <https://qldspatial.information.qld.gov.au>.



5.1.6. Landform cover systems

Landform covers have been designed based on the geochemical characterisation of the material, as well as the nature of the disturbance and proposed PMLUs.

5.1.6.1. Tailings Storage Facility

The results of tailings geochemical characterisations show that tailings are relatively barren in terms of acid generation, and the acid rock drainage risk from the tailings storage is considered to be low. However, the material is saline and contains relatively soluble arsenic at concentrations that may be of concern for closure and rehabilitation. Due to the risk of contaminant exposure from the TSF, the surface will be capped with inert material and compacted to ensure an impervious seal. The cap will be engineered appropriately and accepted by suitably qualified engineer prior to the topsoiling and revegetation of the domain.

5.1.6.2. Waste Rock Dumps

As discussed in 5.1.3, waste rock samples were assessed as having a very low to low risk of acid generation as well as a very low risk of salinity issues. Therefore, WRDs will not require any impervious capping material prior to topsoil. The WRDs will be shaped, topsoiled, ripped, and seeded.

Areas that have previously had topsoil removed (eg. MIA) will have topsoil placed prior to rip and seed to promote vegetation success. Due to the nature of disturbance, exploration areas will not require topsoil. Tracks and pads will be ripped and the areas allowed to revegetate naturally.

To maximise success, a diversity of suitable species for revegetation have been identified during site surveys and were determined to be suitable, for example: *Aristida calycina*, *Eriachne mucronata*, *Sporobolus contiguus*, *Themeda triandra* and *Paspalum caespitosum*.

Ongoing rehabilitation monitoring will guide intervention, as necessary, such as reapplying topsoil, application of fertilisers or reseeded.

5.1.7. Water management

The water management approach at the Project separates clean stormwater from potentially affected site water. Clean water is separated from the site through the construction of large diversion bunds and drains, preventing water from accessing the mining area. Site water, including stormwater, is kept separate from clean water, and is captured in the site water system.

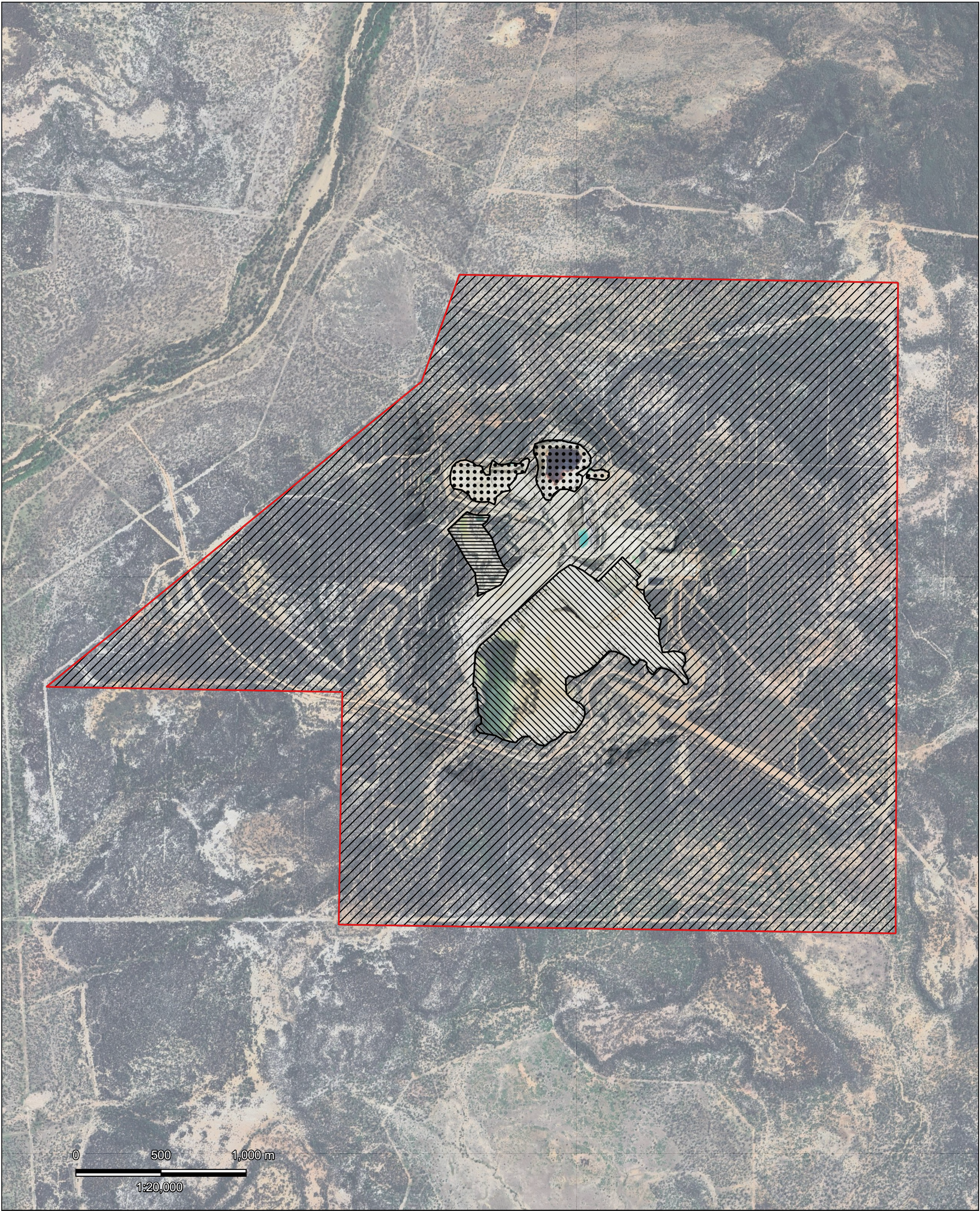
Closure objectives for the Project stipulate final landforms are to be geochemically stable and will be not generate seepage or leaching to surface water or groundwater.

During a previous site closure of approximately 10 years, water across site continued to be diverted to existing unused pits, the TSF, and runoff dam. No discharge to the environment occurred during this period and drains and bunds continued to divert clean water around and away from site. These remain in place. It is likely that a similar approach to post-closure water management will be adopted. Pit voids will continue to act as sinks for potentially contaminated water, and subject to landholder agreement,

the runoff dam will be used as water storage for agricultural purposes. Any drains that become redundant will be rehabilitated, however the major cut-off drain will remain in place to continue functioning as a diversion.

5.1.8. Revegetation

Appropriate plant species will be used for seeding, and seeding will occur as detailed in the rehabilitation program (Section 7.4), established through rehabilitation trials. When possible, areas will be seeded directly with selected species. Where direct seeding is not possible, seeds will be manually broadcast.



Client: Wirralie Gold Mine
Project number: 2020.10003
CRS: GDA2020 / MGA zone 55 EPSG:7855
Date: 7 December 2023

Print as A3



Figure 31. Post Mining Land Use

- Legend Title
- | | |
|---------|------------------|
| PMLU | WTR_ST |
| GRAZ | Mine Lease |
| NAT_ECO | Google Satellite |
| NUMA | |

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Whilst every effort and care has been taken to ensure the accuracy of this report, Wulguru Technical Services Pty Ltd makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incur as a result of the product being inaccurate or incomplete in any way and for any reason.
Digital data for this report is available on the Queensland Government Spatial Portal at <https://qldspatial.information.qld.gov.au>.



5.2. Voids

5.2.1. Minimising Final Voids

There are four main open pits, at a total of 18 ha. Pit B is the focus for current mining activities.

Waste Rock from mining activities has historically been disposed of within Deep Lead Pit. Where possible, Deep Lead Pit will continue to be backfilled with waste rock and returned to PMLU of light intensity grazing.

The remaining residual voids Pit A, Pit B and North Pit are NUMAs, as pits will still have a considerable amount of gold resources remaining. Not backfilling the pits avoids sterilisation of the resource, enabling the potential for future resource exploitation.

5.2.2. Rehabilitation and Management Strategies

The final voids for the pits will be left in safe condition with stock exclusion fences, and 2m high abandonment bunds constructed around the perimeter of each pit.

It is currently anticipated that only access to Pit B will be required for mining. Existing fences and bunds for the other voids will remain in place during operation and fencing and bunding will be reconstructed around Pit B post-closure. Appropriate signage will also be installed as per the other three voids.

5.2.2.1. Abandonment Bunding

Bunding has been utilised throughout the operation of the Project. Bunding will be retained post closure for controlling water movement, erosion, safety purposes, and to support the PMLUs.

Bunding is maintained throughout the life of the Project and will continue to be maintained including regular inspections, repairs and general maintenance where required until mine relinquishment.

As an element of the rehabilitation activities, a suitably qualified person will inspect the bunding to verify its stability and ability to continue to divert flow in a 1% AEP event. The bunding is to meet a safety factor of 1.5 before mine relinquishment.

Bunding is discussed in Appendix I with maps included.

5.2.3. Void Closure Plan

The final void is discussed in Section 5.1.5. and depicted in Figure 29. Mining has ceased in North Pit and Pit A; mining is focuses on Pit B.

AGE (2023) developed a Hydrogeological Report for the Project which has been used to inform this Void Closure Plan. The full report is provided in Appendix H.

Each void will have abandonment bunding constructed on the perimeter of the final voids during rehabilitation activities for the purpose of creating a safe and stable landform. The abandonment bunds will be constructed using waste rock material.

Table 44 provides a summary of the IA1 void status, present and post closure.

Table 44. Summary of IA1 Voids and Void Status, Present and Post Closure (AGE, 2023).

Pit	Current status	Closure status	How status is addressed within this report
Pit A	Flow-through (seasonal changing between source and sink)	Pit will remain in its current state in closure, but will be disconnected from the Deep Lead pit	A water budget to address overflow in closure is presented; the equilibrium closure water level should remain similar to current conditions
North Pit	This is a small seasonal lake, conceptualised as perched above the water table	This pit will remain in its current state (a source) in closure.	This pit is considered part of the Pit A catchment area for overflow modelling
Pit B	A small, mostly dry pit, with a small ephemeral perched pit lake. This pit is currently conceptualised as disconnected from the water table	This pit will deepen significantly before closure.	The equilibrium water level and potential for overflow for this pit are modelled.

5.2.3.1. Void Hydrology and Balance

Groundwater movement is dependent on the elevations of the water level within the pit compared to the groundwater table. Voids intersecting groundwater can be classified as: sources, sinks, or flow-through systems (AGE, 2023).

During operation, the pits are dewatered to provide safe and dry working conditions. With the cessation of dewatering activities, groundwater recovery occurs in which water levels in the pit increasing from inflows of runoff and groundwater, weakening the hydraulic gradient towards the pit. As the pit fills, groundwater inflows diminish eventually meeting pit water balance equilibrium (or near) (AGE, 2023).

AGE (2023) completed groundwater modelling (full report and findings provided in Appendix H). A summary of the modelled status is provided in Table 45. North Pit is included in the Pit A catchment.

Table 45. Summary of existing and closure void status (AGE, 2023).

Pit	Current status	Equilibrium water level - closure conditions (mAHD)	Regional potentiometric surface (mAHD)	Closure status
Pit A	Flow-through	<243.6 (assumed to drawdown slightly due to influence of Pit B)	238	Flow-through (seasonally alternating between a source and a sink)
Pit B	Mostly dry pit	215 mAHD	242	Sink

5.2.3.1.1. Risk of Overtopping

The risk of overtopping was evaluated by AGE (2023) by simulating a yearly water budget for 1 % Annual Exceedance Probability (AEP) and 5% AEP of precipitation on a pit lake at equilibrium water level (Table 45). North Pit is included in the water budget for Pit A. Both pits are predicted to remain well below their crest, with significant remaining capacity under 5% and 1% AEP climate conditions as summarised in Table 46 (AGE, 2023).

Table 46. Summary of Overtopping Risk Assessment (AGE, 2023).

Pit	Equilibrium Pit water level (mAHD)	Pit Crest (mAHD)	Water level after 5%AEP year (mAHD)	Remaining capacity after 5% AEP year (m3)	Water level after 1%AEP year (mAHD)	Remaining capacity after 1% AEP year (m3)
Pit A	243.6	250	246.0	167,000	246.3	156,000
Pit B	215	253	216	1,800,000	216	1,786,000

5.2.3.2. Conceptual Hydrogeological Model Post Closure

AGE (2023) completed groundwater modelling to understand the hydrogeology of the Project area post closure. AGE (2023) expect that the hydrogeology of the area will be significantly different in closure as, on completion, Pit B will be mined to well below the local water table. Pit B is expected to act as a sink which will lead to a cone of depression extending to approximately 340 m from Pit B, capturing groundwater from Pit A.

The conceptual post mining model is depicted in Figure 31.

5.2.3.3. Impact Assessment

The Pits, WRDs, and TSFs are the main potential sources of contaminants; the heap leach pad, water storages, and ROM are potential lesser sources. The waste rock characterisation (Section 5.1.3) indicates that the waste rock material and tailings is generally NAF and is not of environmental concern. PAF material is limited to the area directly adjacent to the Pit. The major potential solutes from the Project are acidity, sulfate, salinity, and metals (AGE, 2023).

Potential receptors may include:

- Potential GDEs;
- Groundwater bores; and
- Water used for industrial purposes.

Table 47 considers groundwater as a potential pathway; the main findings are:

- There is highly unlikely past or future impact predicted for aquatic GDEs due to sources of solutes;

- There is potential past or future impact predicted for terrestrial GDEs due to sources of solutes; and
- There are inconsequential past and future impacts for groundwater used for industrial uses regarding water access and solute concentration (AGE, 2023).

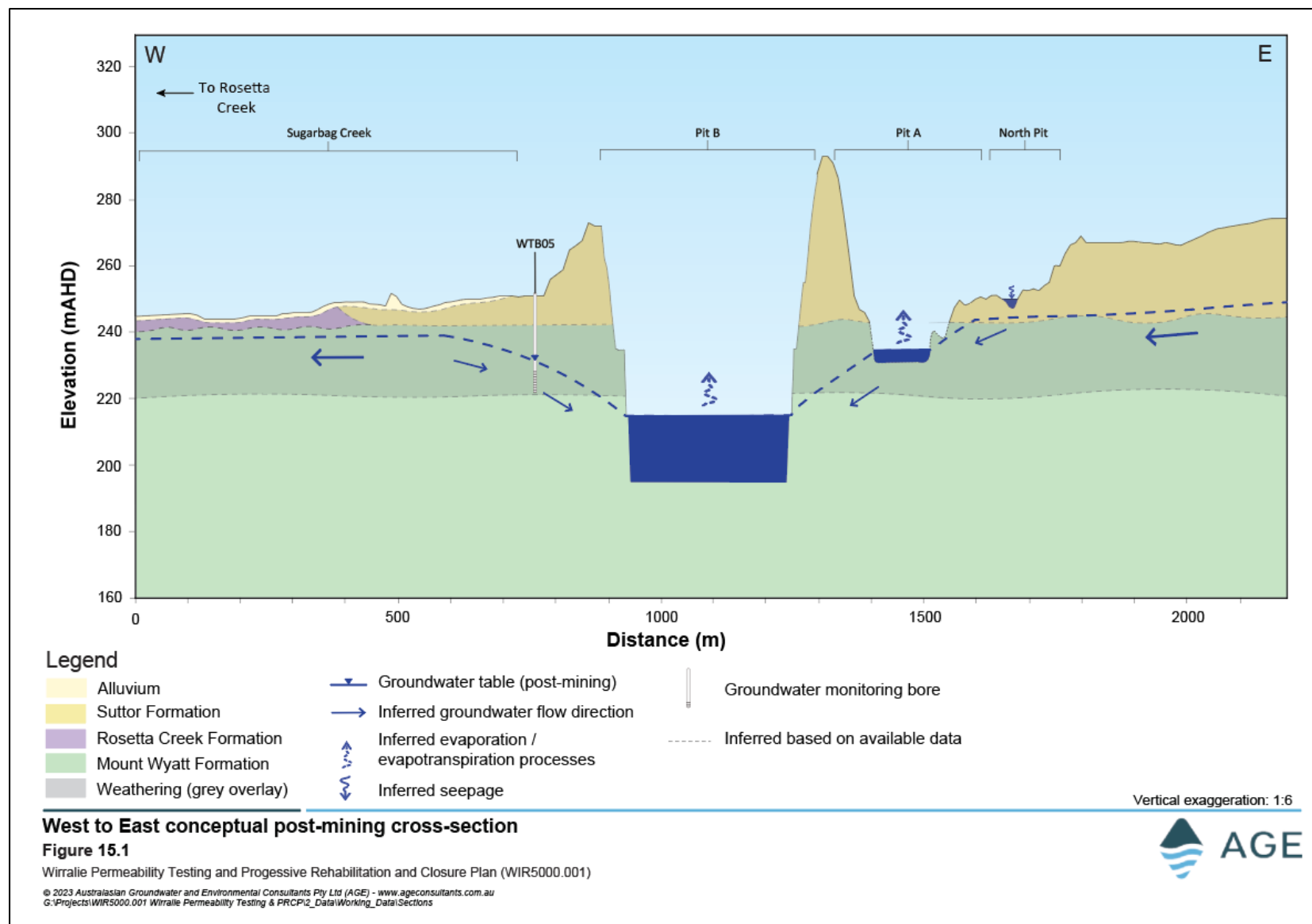


Figure 31. West to East Conceptual Post-Mining Cross Sections (AGE, 2023).

Table 47. Source Pathway Receptor Analysis for Wirralie (AGE, 2023).

Source (and associated risk)	Receptor (and likelihood that receptor is present)	Potential Pathway	Evidence that pathway is present / absent	Predicted Impact
Drawdown from development of Pit B As groundwater is extracted during periods of mining, a cone of depression will develop and intermittently changed in depth and extent. In closure the pit will stabilise as groundwater sink	Mapped areas with potential for aquatic GDEs Very low: These potential receptors do not exist onsite as groundwater levels are too deep. These potential receptors are unlikely to exist along Rosetta Creek and if they do exist the closest potential GDEs are approximately 1.3 km away from Pit B.	If groundwater discharge to the surface water features in question had been reduced as a consequence of drawdown, there could be impacts to the GDE.	Not present: The predicted radius of influence (Ro) of the drawdown for Pit B is 440 m, which is considerably less than the distance to the nearest potential GDE.	No past or future impact is predicted.
Pits Acid and sulfate-enriched drainage generation is occurring in the pits due to the exposure of sulfide-bearing ore to oxidation.	Mapped areas with potential for aquatic GDEs Very low: These potential receptors do not exist onsite as groundwater levels are too deep. These potential receptors are unlikely to exist along Rosetta Creek and if they do exist the closest potential GDEs are approximately 1.3 km away from Pit B.	If groundwater which is discharging to the surface water features in question had a change in quality as a consequence of solutes source from the pits, there could be impacts to the GDE. This pathway requires a groundwater flow direction towards the receptor.	Possibly present: The receptor along Rosetta Creek are hydraulically downgradient of the pits. The existing pits are considered flow-throughs and may be impacting groundwater quality either currently or historically. No order for impact to occur, solutes would need to travel ~1.4 km without significant attenuation. Preliminary calculations of groundwater flow rates suggest that this transport is possible.	Highly unlikely past/current impact due to receptor not likely to be present and the distance to receptor. No future impact is predicted.

			Not present in closure: The cone of depression around Pit B will act to contain any solutes from both Pit A and Pit B	
TSF, WRD, and other site Infrastructure Acid and sulfate-enriched drainage generation is possible for this infrastructure, although saline mine drainage is more likely	Mapped areas with potential for aquatic GDEs Very low: These potential receptors do not exist onsite as groundwater levels are too deep. These potential receptors are unlikely to exist along Rosetta Creek and if they do exist the closest potential GDEs are approximately 1.3 km away from the nearest site infrastructure.	If groundwater which is discharging to the surface water features in question had a change in quality as a consequence of solutes source from the pits, there could be impacts to the GDE. This pathway requires a groundwater flow direction towards the receptor.	Possibly present: The potential receptors along Rosetta Creek are hydraulically downgradient of the site and the groundwater monitoring bores have water quality indicators of mine sourced solutes. In order for impact to occur, mine sources solutes would need to travel ~1.4 km without significant attenuation. Preliminary calculations of groundwater flow rates, suggest that this transport is possible.	Highly unlikely past, current, and future impact due to receptor not likely to be present and the distance to receptor.
Drawdown from development of Pit B Risks as described above.	Mapped areas with potential for terrestrial GDEs Potentially present: regional groundwater is 10 to 30 m gbl, which is within the rooting zone of some GDEs.	a) If groundwater levels beneath the terrestrial GDEs had been lowered, vegetation access to water could have been restricted. b) If the terrestrial GDEs are reliant only on moisture in the	a) Drawdown present in the future but is likely not a pathway Predictions for a limited cone of depression around Pit B and it is unlikely that the mapped potential terrestrial GDEs are actually present with the predicted cone of depression. Even if they are present, they are likely to be reliant on moisture above the water table.	Highly unlikely future impact due to receptor not likely to be present within the zone of drawdown.

		unsaturated zone, drawdown of the water table is not a pathway that can affect the availability of that water.	b) Not present There is no pathway for mining activities to change the amount of soil moisture or vadose zone water that is available to the terrestrial GDEs. This is dictated by the amount of rainfall, infiltration, and evaporation. Although clearing for mining may have increased infiltration (e.g., due to decreased transpiration), this is not linked to impacts from groundwater changes.	
Pits Risks as described above.	Mapped areas with potential for terrestrial GDEs Potentially present: regional groundwater is 10 to 30 m gbl, which is within the rooting zone of some GDEs.	If impacted groundwater is present in the rooting zone of vegetation, then it could impact the GDEs. This pathway requires a groundwater flow direction towards the receptor.	Possibly present: The potential receptors in the northern portion of the mining lease and along Rosetta Creek are hydraulically downgradient of the site. The existing pits are considered flow-throughs and may be impacting groundwater quality either currently or historically.	Potential past, current, and future impact, but the presence of the receptors is uncertain.
TSF, WRD, and other site Infrastructure Risks as described above.	Mapped areas with potential for terrestrial GDEs Potentially present: regional groundwater is 10 to 30 m gbl, which is within the rooting zone of some GDEs.	a) If impacted groundwater is present in the rooting zone of vegetation, then it could impact the GDEs. This pathway requires a groundwater flow direction towards the receptor.	a) The potential receptors in the northern portion of the mining lease and along Rosetta Creek are hydraulically downgradient of the site. Groundwater monitoring bores on the site have water quality indicators of mine sourced solutes.	Potential past, current, and future impact, but the presence of the receptors is uncertain.

		b) If the terrestrial GDEs are reliant only on infiltrating moisture in the unsaturated zone, then migration or diffusion from infiltrating seepage could form a viable pathway for impact.	b) The potential receptors in the northern portion of the mining lease are adjacent to site infrastructure.	
Drawdown from development of Pit B Risks as described above.	Water used for industrial purposes (mining) Water quality of the groundwater is saline, and therefore limits the beneficial use in for industrial purposes	If groundwater levels at the locations of potential industrial bores had been lowered, groundwater user access to water could have been restricted.	The predicted radius of influence (Ro) of the drawdown for Pit B is 440 m, which is very limited in extent.	Future impact is highly unlikely.
Pits, TSF, WRD, and other site Infrastructure Risks as described above.	Water used for industrial purposes (mining) Water quality of the groundwater is saline, and therefore limits the beneficial use in for industrial purposes.	If groundwater quality at the locations of potential industrial bores had been altered to exceed certain water quality objectives, impacts may be experienced by the groundwater user.	Not present: Water quality changes that may have occurred are unlikely to have changed the utility of water used for industrial purposes.	Past changes to groundwater quality beneath infrastructure is known, but this was not an impact to industrial users due to the original groundwater composition. Future impacts are unlikely.

5.3. Built Infrastructure

5.3.1. Site Services

As there will be no infrastructure, or roads, there is no need to identify on-going post rehabilitation maintenance requirements. The MIA will be decommissioned, removed, dismantled or salvaged. The following section describes methodology for removing site services.

5.3.2. Site Preparation

The following activities will be completed prior to decommissioning:

- AQP will produce a site investigation report to identify contamination (spills, hazardous substances etc.)
- All site services will be terminated where possible, or disconnected and isolated.

To ensure site safety, all services will be terminated, disconnected and isolated. Generators will be decommissioned and removed from site. Power substations will be removed, or to be sold or used as part of another project, and the switch room will be disconnected. Licence contractors will remove sewerage to a licensed offsite facility. Telecommunication services will be disconnected and removed.

5.3.2.1. Infrastructure and Buildings

Heap Leach Pads are to be rehabilitated to form part of the pasture of the TSF mixed landform. Material will potentially be used to rehabilitate the TSF, or will be used offsite for roadworks.

The processing plant tanks will be cut and removed in sections. Concrete footings will be left, and areas beneath the process plant and re-fuelling tanks will be excavated to 0.5m. This material will be disposed of in Pit A.

Concrete workshop, laboratory, and stores buildings footings will be removed or, if buried, left in-situ. Infrastructure will be removed, following which the area will be ripped and seeded. Hardstands used for explosives and cyanide storage will have infrastructure removed, after which the area will be deep ripped and directly seeded.

Abandoned and new village infrastructure occurs in such small quantities that it is not viable to recycle materials. If possible, some materials may be reused on site. Concrete footings will be removed or, if buried, cut at ground level, and left. The area will be ripped and seeded.

Roads and tracks will undergo minor earthworks, final trim, and ripping.

5.4. Rehabilitation Maintenance

Monitoring of rehabilitation must take place and demonstrate:

- Landform stability;
- Effective erosion control;
- No negative effects on EV of any waters from stormwater runoff and seepage; and
- Healthy growth and recruitment rates of vegetation, and management of declared plants.

Maintenance activities on rehabilitated areas post-closure will be guided by general site inspections and rehabilitation monitoring. Maintenance may include:

- Management of newly recruited vegetation (addition of fertiliser, re-planting of failed vegetation recruitment) prior to its establishment within the ecosystem;
- Repair eroded areas and damage drainage systems;
- Improved management of surface water runoff through modifying landforms or structures;
- Upkeep of water management structures;
- Removing drainage that is not needed for long-term stability; and
- Replacing and repairing fences and signage (where probable).

The objective for rehabilitative maintenance is to reduce long-term, to align with the PMLU and regional land uses. This will be achieved through effectively stabilising physical and chemical features. It is

expected that maintenance will be more intensive in first years following closure and will gradually decrease as PLMUs begin to establish.

5.5. Summary of Key Rehabilitation and Management Practices

Table 48 further details the key rehabilitation activities for each relevant activity at the Project. The rehabilitation activities drive achievement of the Project rehabilitation milestones and inform the associated PRCP schedule.

Table 48. Key Rehabilitation Activities to Drive Achieve Rehabilitation Milestones

Rehabilitation Area	Relevant Activities	Rehabilitation Activities	Rehabilitation Timing	Rehabilitation Milestones
RA1	Deep lead Pit	- Decommission any remnant infrastructure from mining. - Backfill with burden from the WRDs. - Backfill to a stable, safe landform. - Spread remaining burden over the WRD footprints. - Shape landform to be free draining and of similar shape to the surrounding topography or shape to a slightly sloped landform draining to Pit A. - Assessment of shaped landform to assess stability by suitably qualified person(s) - Monitor landform settlement and repair if required to achieve a stable landform. - Spread topsoil on landform to a minimum thickness of 0.15m. - Conduct analysis on spread topsoil to determine whether topsoil is suitable to achieve the PMLU, or whether ameliorants/ fertiliser is required. - Where required, apply ameliorants/ fertiliser. - Rip landform parallel to landform contours. - Apply selected pasture seed mix to landform. - Monitor to assess rehabilitation success and whether the PMLU has been achieved.	- The infill of Deep Lead Pit is planned to be completed by 2026. - Allow time for landform stabilisation. - PMLU achievement by 2043	RM1 RM3 RM5 RM8 RM9 RM10 RM11
RA2	WRDs ROM ROM Stockpiles Topsoil Stockpiles	- Undertake assessment for contaminated land and remediate if required. - Remove contaminated material and dispose in the TSF (if required). - Spread remaining burden (after Deep lead Pit backfill is complete) over the WRD areas. - Shape landform to be free draining and of similar shape to the surrounding topography. - Spread topsoil on landform to a minimum thickness of 0.15m. - Conduct analysis on spread topsoil to determine whether topsoil is suitable to achieve the PMLU, or whether ameliorants/ fertiliser is required. - Where required, apply ameliorants/ fertiliser.	- Area will be available for rehabilitation by end 2028 after Deep Lead Pit backfill is complete. - Landform establishment by 2030 - Seeding to be completed by end 2033	RM1 RM2 RM3 RM4 RM5 RM7 RM9 RM11

Rehabilitation Area	Relevant Activities	Rehabilitation Activities	Rehabilitation Timing	Rehabilitation Milestones
		- Rip landform parallel to landform contours. - Apply selected pasture seed mix to landform. - Monitor to assess rehabilitation success and whether the PMLU has been achieved.		
RA3	ROM	- Undertake assessment for contaminated land and remediate if required. - Remove contaminated material and dispose in the TSF (if required) or at an offsite licenced facility. - Decommission any remnant infrastructure and remove/dispose of. - Shape landform to be free draining and of similar shape to the surrounding topography. - Spread topsoil on landform to a minimum thickness of 0.15m. - Conduct analysis on spread topsoil to determine whether topsoil is suitable to achieve the PMLU, or whether ameliorants/ fertiliser is required. - Where required, apply ameliorants/ fertiliser. - Rip landform parallel to landform contours. - Apply selected pasture seed mix to landform. - Monitor to assess rehabilitation success and whether the PMLU has been achieved.	- Ore may be processed after mining has been completed. Area will be available for rehabilitation once processing has been complete. - Landform establishment by 2028 - Seeding completed by end of 2031	RM1 RM2 RM5 RM8 RM9 RM10 RM11
RA4	Access roads and tracks Mine haul road Laydown yards Camps/administration Processing plant	- Undertake assessment for contaminated land and remediate if required. - Remove contaminated material and dispose in the TSF (if required) or at an offsite licenced facility. - Decommission any remnant infrastructure and remove/dispose of. - Shape landform to be free draining and of similar shape to the surrounding topography. - Spread topsoil on landform to a minimum thickness of 0.15m - Conduct analysis on spread topsoil to determine whether topsoil is suitable to achieve the PMLU, or whether ameliorants/ fertiliser is required. - Where required, apply ameliorants/ fertiliser. - Rip landform parallel to landform contours.	- Ore may be processed after mining has been completed. Area will be available for rehabilitation once processing has been complete. - Landform establishment by 2028 - Seeding to be completed by end 2031.	RM1 RM2 RM5 RM8 RM9 RM10 RM11

Rehabilitation Area	Relevant Activities	Rehabilitation Activities	Rehabilitation Timing	Rehabilitation Milestones
		- Apply selected pasture seed mix to landform. - Monitor to assess rehabilitation success and whether the PMLU has been achieved.		
RA5	RAW Water Dam	- Decommission any remnant infrastructure from mining. - Remove water from dam and utilise in the rehabilitation of other mining domains. - Undertake assessment for contaminated land and remediate if required. - Remove contaminated material and dispose in the TSF or at an offsite licenced facility (if required). - Push Dam walls into the dam and shape landform to be similar to the surrounding topography. - Spread topsoil on landform to a minimum thickness of 200mm. - Conduct analysis on spread topsoil to determine whether topsoil is suitable to achieve the PMLU, or whether ameliorants/ fertiliser is required. - Where required, apply ameliorants/ fertiliser. - Rip landform parallel to landform contours. - Apply selected pasture seed mix to landform. - Monitor to assess rehabilitation success and whether the PMLU has been achieved.	- Required as a water supply for rehabilitation of other mining domains. To be decommissioned once rehabilitation of other mining domains is complete. - Landform establishment by 2035 - Seeding to be completed by end 2035	RM1 RM2 RM6 RM8 RM9 RM10 RM11
RA6	Runoff Dam	- Decommission any remnant infrastructure from mining. - Undertake assessment for contaminated land and remediate if required. - Remove contaminated material and dispose in the TSF (if required). - Desilt remaining sediment and dispose of in the TSF - Line runoff dam with clean material. - Allow runoff dam to fill with runoff from the rehabilitated mine domains. - Conduct water quality monitoring to determine whether the PMLU has been met.	Runoff dam will be a sink for runoff from the Project until domains have been adequately rehabilitated and are stable and non-polluting.	RM1 RM2 RM12

Rehabilitation Area	Relevant Activities	Rehabilitation Activities	Rehabilitation Timing	Rehabilitation Milestones
RA7	Tailing Storage Facility / Heap Leach	- Remove water via evaporation or other mechanical method - Decommission any remnant infrastructure. - Haul heap leach material from the Heap Leach Pads to the TSF. Dispose of heap leach material in TSF. - Cap TSF with 1.0m of waste rock material and - Shape landform to be free draining and of similar shape to the surrounding topography. - Spread topsoil on landform to a minimum thickness of 0.15m - Conduct analysis on spread topsoil to determine whether topsoil is suitable to achieve the PMLU, or whether ameliorants/ fertiliser is required. - Where required, apply ameliorants/ fertiliser. - Rip landform parallel to landform contours. - Apply selected pasture seed mix to landform. - Monitor to assess rehabilitation success and whether the PMLU has been achieved.	- Heap Leach and TSF may remain active upon the cessation of mining, as processing of mined ore may continue to occur. TSF and heap leach will be available for rehabilitation at the completion of processing. - Landform establishment to occur in 2034. - Seeding to be completed by end 2034.	RM1 RM7 RM8 RM9 RM10 RM11

Table 49. Key Activities to Drive Achieve Improvement Milestones

Rehabilitation Area	Relevant Activities	Area (Ha)	Rehabilitation Activities	Rehabilitation Timing	Improvement Milestones
IA1	Pit A Pit B North Pit	16.26	- Decommission any remnant infrastructure from mining. - Assessment of residual voids to assess stability by suitably qualified person(s). - Stabilise landform (where required) via mechanical reshaping. - Reassessment of landform to assess achievement of a stable landform. - Erect fencing to prevent ingress. - Undertake monitoring and maintenance to achieve demonstrate the achievement of the PMLU.	- Pit A, Pit B and North Pit may be required for future exploration or mining, with substantial ore to remain upon closure. Rehabilitation will commence as soon as practical with the completion of mining. - Land becomes available for rehabilitation in late 2032. - Rehabilitation activities are to be completed by late 2035	MM1 MM2 MM3

6. Risk Assessment

A closure and rehabilitation risk assessment has been prepared in accordance with Section 126C(1)(f) of the EP Act. The risk methodology utilised has been developed based on the *Australia and New Zealand Standard AS/NZS for Risk Management – Principles and Guidelines* (ISO 31000:2018).

The risk management process involves the systematic application of policies, procedures, and practices to the activities of communicating and consulting, establishing the context and assessing, treating, monitoring, reviewing, recording, and reporting risk.

Closure and rehabilitation risk assessments have the objective to identify and define specific risks from closure and rehabilitation and associated activities toward environmental, economic, and social values.

6.1.1. Risk Identification

The purpose of risk identification is to find, recognise and describe risks that might help or prevent an organisation achieving its objectives. Relevant, appropriate, and up-to-date information is important in identifying risks (Standards Australia, 2018).

The following factors have been considered by this risk assessment:

- Tangible and intangible sources of risk;
- Causes and events;
- Threats and opportunities;
- Vulnerabilities and capabilities;
- Changes in the external and internal context;
- Indicators or emerging risks;
- The nature and value of assets and resources;
- Consequences and their impacts on objectives;
- Limitations of knowledge and reliability of information;
- Time-related factors; and
- Biases, assumptions, and beliefs of those involved.

6.1.2. Risk Analysis and Evaluation

The purpose of risk analysis is to comprehend the nature of risk and its characteristics, including, where appropriate, the level of risk. Risk analysis can be undertaken with varying degrees of detail and complexity, depending on the purpose of the analysis, the availability and reliability of information and the resources available. Risk analysis techniques can be qualitative, quantitative or a combination of these and should include:

- the likelihood of events and consequences
- the nature and magnitude of consequences
- complexity and connectivity
- time-related factors and volatility
- the effectiveness of existing controls
- sensitivity and confidence levels.

A likelihood of occurrence and severity of consequence rating has been assigned to each identified risk in accordance with the risk matrix detailed in Table 50. Control measures have been developed following the identification of risks to achieve a level of risk that is considered to be an acceptable level, as described in Table 51.

Table 50. Risk Matrix

Likelihood of Occurrence	Severity of Consequence				
	Catastrophic (5)	Major (4)	Moderate (3)	Minor (2)	Insignificant (1)
Almost certain (5)	10	9	8	7	6
Likely (4)	9	8	7	6	5
Possible (3)	8	7	6	5	4
Unlikely (2)	7	6	5	4	3
Rare (1)	6	5	4	3	2
Risk Score	Risk Rating		Actions Required		
9 – 10	Extreme		Requires immediate action to reduce risk score.		
7 – 8	High		Requires an action plan approved by senior management.		
5 – 6	Moderate		Specific monitoring and procedures required.		
2 - 4	Low		Management through routine procedures and protocols.		

Table 51. Risk Evaluation

Potential Impact	Risk Rating			Risk Controls	Residual Risk Rating			Treatment	Comments
	L	C	R		L	C	R		
Deep Lead Pit									
Safe									
Slope angle in excess of design resulting in safety hazard to personnel and wildlife.	2	3	5	Return Pit to natural level. Construction QA/ QC and as constructed design verification.	1	3	4	Revegetation, completion criteria includes final geotechnical assessment, no failures observed during monitoring periods.	n/a
Surface condition insufficient to support safe use by personnel and wildlife.	2	2	4	Surface preparation measures, monitoring and maintenance carried out by suitably qualified persons.	1	2	3	n/a	n/a
Stable									
Slope failures resulting in localised land, and downstream water quality impacts.	2	3	5	Restore natural ground level as per final landform design. Adequate/effective subsoil and topsoil amelioration where required. Vegetation establishment, monitoring and management as required.	1	3	4	Revegetation, completion criteria includes final geotechnical assessment, no failures observed during monitoring periods.	n/a
Ongoing gully or rill erosion of rehabilitated areas resulting in localised land, and downstream water quality impacts.	2	3	5	Restore natural drainage network and sub-catchment design, effective revegetation techniques, rehabilitation	1	3	4	Revegetation, completion criteria includes final geotechnical assessment, no failures	n/a

Potential Impact	Risk Rating			Risk Controls	Residual Risk Rating			Treatment	Comments
	L	C	R		L	C	R		
				monitoring and management as required.				observed during monitoring periods.	
Significant slope failure as a result of adverse rainfall events resulting in localised land, and downstream water quality impacts.	1	4	5	Restore natural landform. Engineering designs to be implemented and verified on ground in line with as built construction requirements.	1	2	3	Revegetation, completion criteria includes final geotechnical assessment, no failures observed during monitoring periods.	n/a
Non-Polluting									
Waste rock generate acid or saline drainage resulting in localised impacts to downstream receptors.	2	4	6	Materials at the Project have been identified as Non Acid Forming and very low risk of saline drainage.	1	2	3	Regular water quality monitoring and assessment, water quality monitoring in receiving environment meets completion criteria.	n/a
Waste Rock Dumps									
Safe									
Slope angle in excess of design resulting in safety hazard to personnel and wildlife.	2	3	5	Landform design which considers final slope requirements (e.g. <17%). Construction QA/ QC and as constructed design verification.	1	3	4	Revegetation, completion criteria includes final geotechnical assessment, no failures observed during monitoring periods.	n/a

Potential Impact	Risk Rating			Risk Controls	Residual Risk Rating			Treatment	Comments
	L	C	R		L	C	R		
Surface condition insufficient to support safe use by personnel and wildlife.	2	2	4	Surface preparation measures, monitoring and maintenance carried out by suitably qualified persons.	1	2	3	n/a	n/a
Stable									
Slope failures resulting in localised land, and downstream water quality impacts.	2	3	5	Landform design moderating slope, adequate/effective subsoil and topsoil amelioration where required. Vegetation establishment, monitoring and management as required.	1	3	4	Revegetation, completion criteria includes final geotechnical assessment, no failures observed during monitoring periods.	n/a
Ongoing gully or rill erosion of rehabilitated areas resulting in localised land, and downstream water quality impacts.	2	3	5	Improved drainage network and sub-catchment design, effective revegetation techniques, rehabilitation monitoring and management as required.	1	3	4	Revegetation, completion criteria includes final geotechnical assessment, no failures observed during monitoring periods.	n/a
Significant slope failure as a result of adverse rainfall events resulting in localised land, and downstream water quality impacts.	1	4	5	Slope less than 17%, adequate drainage structures. Engineering designs to be implemented and verified on ground in line with as built construction requirements.	1	2	3	Revegetation, completion criteria includes final geotechnical assessment, no failures observed during monitoring periods.	n/a
Non-polluting									

Potential Impact	Risk Rating			Risk Controls	Residual Risk Rating			Treatment	Comments
	L	C	R		L	C	R		
Waste Rock Dumps generate acid or saline drainage resulting in localised impacts to downstream receptors.	2	4	6	Materials identified as Non Acid Forming and very low risk of saline drainage.	1	2	3	Regular water quality monitoring and assessment, water quality monitoring in receiving environment meets completion criteria.	n/a
Voids									
Safe									
Void areas still able to accessed by personnel and wildlife resulting in slips, trips, falls and injury or death to humans or wildlife.	3	3	6	Ensure sufficient fencing and signage around voids to prevent access to hazardous areas (e.g. pit lake or high walls).	1	3	4		
Void overtopping as a result of an extreme rainfall event beyond hydrological model predictions resulting in hazard to humans and wildlife.	2	5	7	Final void hydrological models indicate voids will not overtop.	1	2	3		
Stable									
Erosion of high walls resulting in impacts to pit lake water quality.	3	2	5	Void slopes to be established at a batter angle which minimises erosion. Geotechnical survey to be undertaken to confirm pit wall stability.	1	2	3		
Non-polluting									

Potential Impact	Risk Rating			Risk Controls	Residual Risk Rating			Treatment	Comments
	L	C	R		L	C	R		
Mine Affected Water contributes to local groundwater aquifer resulting in impacts to water quality.	2	3	5	Hydrogeological survey	1	3	4	Current water balance indicates voids act as a groundwater sink with a negative water balance.	
Tailings Storage Facilities									
Safe									
Slope angle in excess of design resulting in safety hazard to personnel and wildlife.	2	3	5	Landform design which considers final slope and capping requirements. Construction QA/ QC and as constructed design verification.	1	3	4	Revegetation, completion criteria includes final geotechnical assessment, no failures observed during monitoring periods.	n/a
Surface condition insufficient to support safe use by personnel and wildlife.	2	2	4	Surface preparation measures, monitoring and maintenance carried out by suitably qualified persons.	1	2	3	Verification of capping integrity and suitability by a RPEQ engineer.	n/a
Stable									
Slope failures resulting in localised land, and downstream water quality impacts.	2	3	5	Landform design moderating slope, adequate/effective subsoil and topsoil amelioration where required. Vegetation establishment, monitoring and management as required.	1	3	4	Revegetation, completion criteria includes final geotechnical assessment, no failures observed during monitoring periods.	n/a

Potential Impact	Risk Rating			Risk Controls	Residual Risk Rating			Treatment	Comments
	L	C	R		L	C	R		
Ongoing gully or rill erosion of rehabilitated areas resulting in localised land, and downstream water quality impacts.	2	3	5	Improved drainage network and sub-catchment design, effective revegetation techniques, rehabilitation monitoring and management as required.	1	3	4	Revegetation, completion criteria includes final geotechnical assessment, no failures observed during monitoring periods.	n/a
Significant slope failure as a result of adverse rainfall events resulting in localised land, and downstream water quality impacts.	1	4	5	Slope less than 17%, adequate drainage structures. Engineering designs to be implemented and verified on ground in line with as built construction requirements.	1	2	3	Revegetation, completion criteria includes final geotechnical assessment, no failures observed during monitoring periods.	n/a
Non-polluting									
Mine Affected Water contributes to local groundwater aquifer resulting in impacts to water quality.	2	3	5	Hydrogeological survey	1	3	4	Current water balance indicates voids act as a groundwater sink with a negative water balance.	
Tailings Storage Facility generates acid or saline drainage resulting in localised impacts to downstream receptors.	2	4	6	Materials identified as Non Acid Forming and very low risk of saline drainage.	1	2	3	Regular water quality monitoring and assessment, water quality monitoring in receiving environment meets completion criteria.	n/a

Potential Impact	Risk Rating			Risk Controls	Residual Risk Rating			Treatment	Comments
	L	C	R		L	C	R		
Overtopping as a result of an extreme rainfall event beyond hydrological model predictions resulting in hazard to humans and wildlife.	2	5	7	Final hydrological models indicate voids will not overtop.	1	2	3	n/a	n/a
General									
Failure to remove all infrastructure in accordance with schedule. Achievement of RM1 is delayed.	2	3	5	A register of infrastructure is to be developed to track which structures exist in each rehabilitation area. Demolition works to be scoped with area managers to identify all infrastructure.	1	2	3	Contractors will return to site to remove all infrastructure	The proposed actions will ensure the demolition works are correctly scoped and scheduled.
Previously unidentified contamination source discovered. Financial cost of remediation Achievement of RM2 is delayed.	3	3	6	Records are to be kept of all spills and other incidents occurring at the Project that might result in contamination. Employees and contractors are to be made aware of their reporting obligations through a Site Induction. Initial consultation with an approved contaminant land assessor to identify contamination targets for remediation or removal.	2	2	4	Disturbance is restricted to approved areas as defined on the EA. Initial contaminant land assessments will identify areas for further investigation and remediation. Conduct validation sampling to determine that contaminant removal has been successful.	Ongoing rehabilitation monitoring will identify presence of previously unidentified contaminants. Any contamination will be investigated and further contaminated land sampling/ removal will be conducted as required.

Potential Impact	Risk Rating			Risk Controls	Residual Risk Rating			Treatment	Comments
	L	C	R		L	C	R		
Water ponding Erosion leading to contamination of water ways.	4	3	7	A QAQC inspection will be completed after works to confirm landform has been appropriately shaped.	2	2	4	QAQC review will allow issues to be addressed prior to next RM Landform will be reshaped until stability is achieved.	
Insufficient topsoil Unsuccessfully revegetation	4	3	7	Additional topsoil will be obtained from borrow pits or an external source if required.	2	2	4	Ongoing erosion and vegetation monitoring will guide management interventions. Additional topsoil will be applied as required.	
Vehicles contaminated with weed seeds used for earthworks. Weeds invading rehabilitated sites, inhibiting the establishment of desirable species	3	2	5	Vehicles will be inspected prior to entering site. Vehicles will be cleaned in the site washdown bay if weeds or seeds are identified.	2	2	4	Site has established processes to minimise risk.	A weed treatment program will be implemented, if required
Heavy rainfall occurring prior to establishment of vegetative cover. Loss of topsoil Siltation of downstream waterways. Failure of vegetation to establish on eroded surfaces.	3	2	5	Earthworks will be completed during the dry season. Earthworks will be scheduled progressively so that areas are exposed for the least amount of time possible.	2	2	4	Rehabilitation monitoring will guide corrective action (reseeding, etc) as required.	The area has established wet/dry seasons and works can be scheduled.

Potential Impact	Risk Rating			Risk Controls	Residual Risk Rating			Treatment	Comments
	L	C	R		L	C	R		
Cost of reapplying topsoil to eroded surfaces									
Grazing could lead to poor seedling establishment	2	2	4	Areas will be fenced to allow vegetation to establish.	1	2	3	Rehabilitation monitoring will guide corrective action (reseeding, etc) as required.	
Significant erosion Loss of topsoil. Siltation of downstream waterways. Failure of vegetation to establish on eroded surfaces. Cost of reapplying topsoil and seed to eroded surfaces.	3	2	5	Low slope gradient in landform design to limit capacity for sediment loss. Annual monitoring to identify high risk areas	2	2	4	Monitoring will allow early identification and intervention. Rehabilitation monitoring will guide corrective action (topsoiling etc) as required.	
Unable to demonstrate receiving environment meeting stipulated water quality limits.	3	4	7	Monitoring of surface waters, groundwaters and sediments will continue post closure by SQP to identify potential impacts. Results to be analysed by a SQP	2	2	4	Ensuring all other RMs are met will allow for good water quality.	Monitoring throughout operation and the rehabilitation activities will allow early identification and intervention to meet the schedule

7. Monitoring and Maintenance Program

7.1.1. Rehabilitation Milestones

Rehabilitation milestones have been identified for each significant event necessary to rehabilitate the land to a stable condition. Completion criteria is used to determine if rehabilitation milestones have been achieved and ultimately shows if the mining domain has been rehabilitated to a point that the Final Landform PMLU has been achieved at surrender.

The Rehabilitation Milestones (RM) are outlined in Table 31 and the completion criteria for each milestone are defined in Table 32.

7.2. Rehabilitation Area Milestone Monitoring and Schedule

To achieve the RMs, MMs and in turn PMLUs and NUMAs set for the Project, a combination of rehabilitation monitoring and reporting will be required to demonstrate rehabilitation and management successes.

7.3. Rehabilitation Monitoring Phases

The Rehabilitation Monitoring Program (Section 7.4) has been designed to demonstrate that RM11, RM12 and MM3 have been achieved. There are three main phases to the Project's rehabilitation monitoring program as displayed in Figure 32.

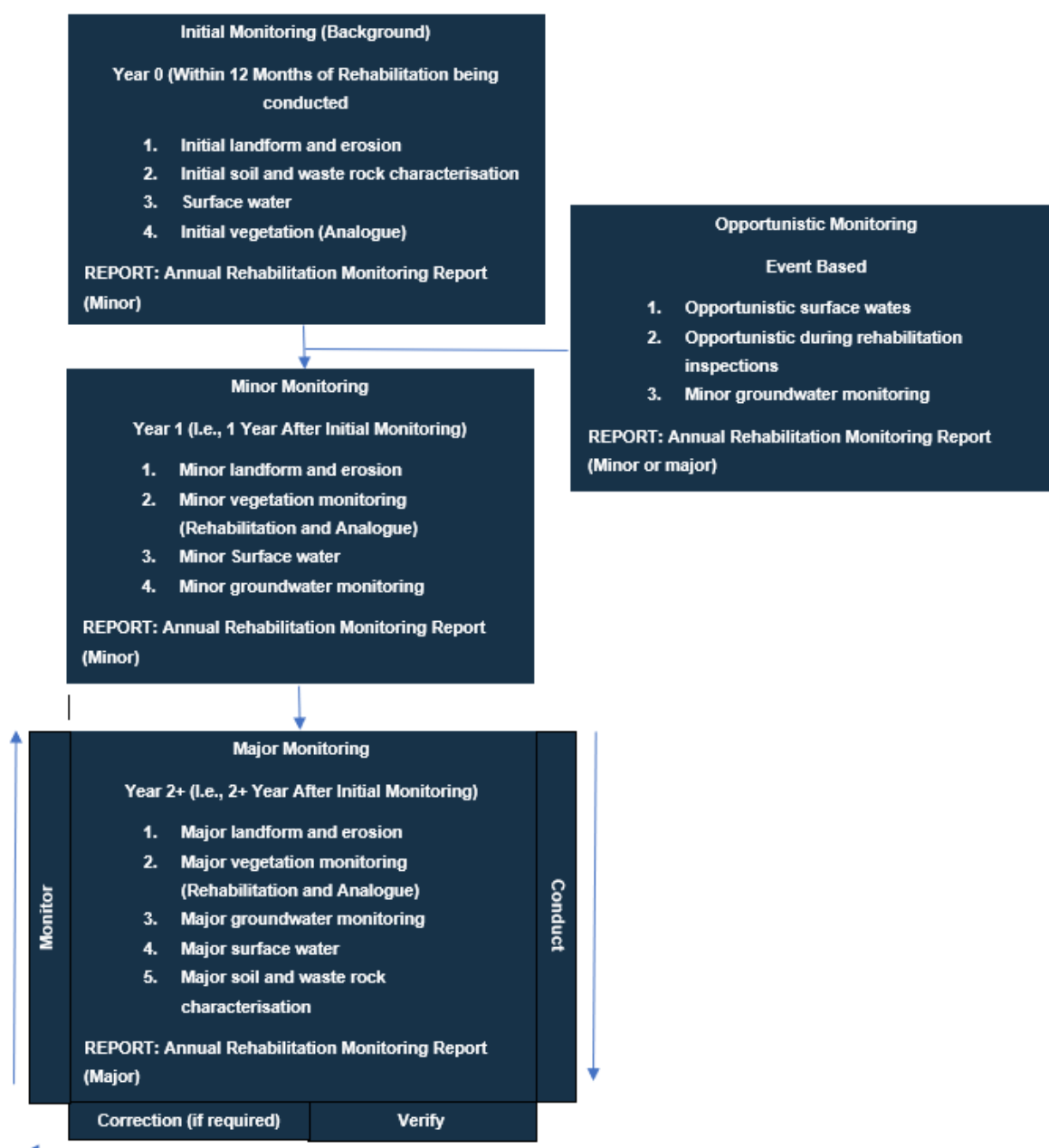


Figure 32. Wirralie Rehabilitation Monitoring Phases

7.4. Establishment of Reference Sites

Analogue sites will be used to compare rehabilitation success with regard to groundcover, carrying capacity, weed proportion and species mix. Analogue sites will be established for each SMU to be rehabilitated. Analogue sites will be recorded using GIS and signposted to prevent disturbance during operational activities.

Monitoring of analogue sites will be completed using the same monitoring methods employed at rehabilitation areas, as described below. Monitoring will be completed biannually, in the wet and dry

seasons, for the first five years of sites being established. Following this, this monitoring program will be spaced at 5-yearly intervals.

Early monitoring of reference sites will allow site specific milestone criteria to be developed for future rehabilitation works.

7.5. Monitoring Program

A regular monitoring program is to be designed to determine the success of rehabilitation activities, and act as a warning system to rehabilitation failures.

Rehabilitation monitoring has previously been undertaken on site. However, this was suspended when the site was placed under care and maintenance. The Project will look at reinstating this monitoring program to further the understanding of previous rehabilitation attempts, and guide future activities.

Landscape function analysis will be used to assess the biophysical functioning of the rehabilitated ecosystems, in terms of soil habitat. These assessments will determine how resilient rehabilitated areas are when posed with possible disturbance, high rainfall events, and various climatic conditions. The process provides a snapshot of rehabilitation performance, and how sustainable vegetation will be long-term.

The success of rehabilitated areas will be determined by continued progression, stability, and self-sustainability, with analogue sites providing a comparative basis. Rehabilitated areas are expected to reach the same landscape functionality as a given analogue sites. A rehabilitation acceptance criterion will be developed based on these principles.

7.5.1. Initial Monitoring Program

Early detection and correction of issues that would otherwise grow and lead to rehabilitation failure can be undertaken during the initial monitoring program. Initial monitoring will occur at newly established rehabilitation monitoring sites to observe the success, identify risks, and develop baseline data.

The elements of rehabilitation that will be assessed during this program are:

- Landform and erosion;
- Soils;
- Vegetation; and
- Groundwater.

7.5.1.1. Desktop Monitoring

The initial monitoring program will involve desktop monitoring prior to on-site monitoring work. Using LiDAR and aerial imagery, an understanding of the following can be gained:

- Assessing landform design through a Digital Elevation Slope Model;
- Potential erosion areas to be confirmed during field surveys;

- Representative locations to establish permanent monitoring plots in respect to the rehabilitation slope, PMLUs, and accessibility.

An erosion monitoring program will be developed, focusing on areas with high erosion potential, such as final landforms with steep slopes.

7.5.1.2. Landform and Erosion

Areas to be assessed will be determined during the desktop monitoring with a focus towards areas assessed as potential initial erosion occurrences.

As discussed in Section 3.5.3., all soil types identified within the Project, with the exception of Self-Mulching Brown Vertosol, expresses a high erosion risk. It is therefore imperative that erosion monitoring is included in the initial program for any areas of potential erosion identified.

Monitoring will include measuring distances between patches and inter-patches, to gauge potential energy that could be caused in a high rainfall event. Areas with larger distances between patches and inter-patches are more at risk of erosion, based on hill-slope assessment.

The field survey involves establishing an erosion monitoring transect by running a 50m tape perpendicular to the slope and across the erosional activity identified during the LiDAR analysis.

7.5.1.3. Soil

Monitoring of rehabilitated soils will commence during the initial rehabilitation phase, and continue through to all rehabilitation phases (i.e., Initial to Major). Soil monitoring will be conducted for all mining domains except for residual voids.

A soil monitoring program will be developed for the Project, and will aim to:

- Optimise rehabilitation processes;
- Accurately measure utilisation of stockpile storage and soil reuse; and
- Optimise stockpile management and reuse.

The soil monitoring program will involve the physical sampling of soils and annual reporting. Samples will be acquired, and soil profiles logged by an appropriately qualified person, with samples collected to be analysed at an accredited laboratory. Analytes proposed to be tested are detailed in Table 52.

The soil monitoring program report will include:

- Background to soils and land suitability of the Project;
- Monitoring methodologies for soil stockpiles, placed rehabilitated soils, soil stability, flora, and seed viability;
- Monitoring program outcomes as well as stockpile management and maintenance strategies;
- success criteria for stockpile management and reuse to optimise rehabilitation outcomes; and
- Measure of stockpile performance and reuse.

Table 52. Analysis Parameters for the Soil Monitoring Program

Parameter	Purpose	Monitoring phase			
		Topsoil	Subsoil	Initial	Major
pH	Identify variations that may inhibit plant growth and sustainability.	x	x	x	x
EC and Chloride	Identify areas that may inhibit germination and establishment.	x	x	x	x
Exchangeable cations	Links to soil stability, fertility, nutrient availability, and structure.	x	x	x	x
Organic carbon	Indicates soil nutrient stores and soil structure. Variations can indicate successfulness.	x		x	x
Major elements including N, P, K, S, Ca, and Mg.	Indicator of nutrients and potential for runoff or acid Metalliferous drainage.	x		x	x
Trace elements including Mn, Fe, Zn, and Cu	All are important to the vegetation success.	x		x	x
Metals	Metals that have been identified as occurring at elevated levels during material characterisation should be tested for during monitoring.	x	x	x	x
Physical parameters	Soil texture and other characteristics will effect water entry and storage as well as impact on erosion, dispersion, and success.	x	x	x	
Field analysis	Gain an understanding of soil profile characteristics for interpretation purposes.	x	x	x	

7.5.1.4. Vegetation

Vegetation establishment is anticipated to be limited during the initial monitoring due to the timing. The initial program will entail identifying germinates present and the relative germination success rate to the species level where possible.

7.5.1.5. Surface Waters

Surface Water monitoring is required as per C1-1 of the EA. Surface waters will continue to be monitored in accordance with the EA during the initial phase of rehabilitation. Parameters and trigger limits for surface waters is detailed in Table 53.

Table 53. Surface Water Trigger Limits

Parameter	Units	Limit Type	Contaminant Limits
pH		Range	6 – 9
Total Dissolved Solids	mg/L	Maximum	4000
Sulfate			
Arsenic			
Cadmium			
Copper			
Lead			
Mercury			

Parameter	Units	Limit Type	Contaminant Limits
Molybdenum	mg/L	Maximum	0.05
Selenium	mg/L	Maximum	0.02
Zinc	mg/L	Maximum	20
WAD Cyanide	mg/L	Maximum	0.2

7.5.1.6. Groundwater

Groundwater monitoring during the initial program will involve utilise the existing groundwater monitoring network. The data will provide post-mining groundwater data and ability to track trends over time. The locations of the existing groundwater bores are displayed on Figure 34.

7.5.2.Minor Monitoring Methods

The minor monitoring methods has been designed with two aims; to quickly identify and resolve issues as well as create a replicable record of the condition and success. The permanent monitoring points from the initial monitoring program will continue along with new erosion areas identified during monitoring. The aspects of focus are:

- Landform and erosion;
- Vegetation; and
- Groundwater.

7.5.2.1. Desktop Monitoring

The minor monitoring may involve desktop monitoring prior to on-site monitoring work. Through the use of LiDAR and aerial imagery, the following can be achieved:

- Update the Digital Elevation Slope Model;
- Identify new areas of potential sedimentation and/or ponding; and
- Identify new areas of erosion for observation.

7.5.2.2. Landform and Erosion

Along with the permanent monitoring sites created during the initial program, other points identified during the desktop monitoring may be added. The data to be collected includes the coordinates, estimated topsoil coverage, and erosional process, size, state (active, partly stabilised, or stabilised), and severity.

7.5.2.3. Soils and Spoil

Sampling is undertaken in the initial and major monitoring programs; only surface condition is necessary in the minor monitoring phase.

7.5.2.4. Vegetation

At the fixed points determined in the initial program, the acceptance criteria will be utilised as required to determine the level of success and ensure the rehabilitation areas are on a trajectory to meet the milestone criteria.

Acceptance criteria are rehabilitation performance goals presented as criterion completion scores for relevant attributes of vegetation. They provide measures: to which rehabilitation progress can be compared to determine success of the rehabilitation; to identify the need for intervention and management actions; and by which rehabilitated land is deemed to be complete.

Acceptance criteria have been derived from Queensland Herbarium Benchmarks for regional ecosystems and adjusted for local representation of vegetation based the results of reference site BioCondition assessments is detailed in Table 54.

Table 54 Completion Criteria Summary

Criterion	Completion Score
T1 Height	8
Total Native Tree Species	3
Shrub Species Richness	3
Grass Species Richness	5
Forbes and Other Species Richness	4
Non-native Plant Cover (%)	20
Native Perennial Grass Cover (%)	15
Native Forbes and Other Species Cover (%)	3
Native Shrubs Cover (%)	4
Non-native Grass Cover (%)	<15
Non-native Forbes and Other Species Cover (%)	<5
Litter (%)	20
Canopy	40
Subcanopy	4
Total Canopy	44
Shrub	4
Exotic Shrub	<5
Stems/hectare (tree)	400
Stems/hectare (shrub)	50
Stems/hectare (eucalypt)	40

7.5.2.5. Surface Water

Monitoring of surface waters is to continue as per the initial monitoring phase.

7.5.2.6. Groundwater

The existing groundwater monitoring network will be sampled in accordance with the Queensland Monitoring and Sampling Manual or appropriate Queensland Government guideline. The locations of the existing groundwater bores are displayed on Figure 34.

7.5.3. Major Monitoring Methods

The purpose for the major monitoring is to provide assess in detail the performance of the rehabilitation program this includes identifying risks to success, evaluating the progress, and evaluating the PMLU. The points to be monitored will continue from the previous phases as well as any additional erosion areas identified during monitoring. The focus of the major monitoring includes:

- Landform and erosion;
- Soil and spoil;
- Vegetation;
- Grazing Land Suitability Assessment; and
- Groundwater.

7.5.3.1. Desktop Monitoring

The major monitoring will involve desktop monitoring prior to on-site monitoring work. Through the use of LiDAR and aerial imagery, the following can be gained:

- An understanding of historic conditions through a review of previous monitoring reports;
- Update the Digital Elevation Slope Model and compare against previous models to detect changes;
- Identify new areas of erosion for field validation.

7.5.3.2. Landform and Erosion

The focus will be towards assessing erosion at previous monitoring locations as well as any other areas identified during desktop monitoring.

7.5.3.3. Soil and Spoil

The major monitoring will follow the procedures, sampling, and analysis of the initial program. The data can be compared to the baseline data to evaluate the rehabilitation performance as well as identify trends. The data will indicate the level of achievement or if remediation action is required.

7.5.3.4. Vegetation

Acceptance criteria are rehabilitation performance goals presented as criterion completion scores for relevant attributes of vegetation. They provide measures: to which rehabilitation progress can be

compared to determine success of the rehabilitation; to identify the need for intervention and management actions; and by which rehabilitated land is deemed to be complete.

The following acceptance criteria have been derived from Queensland Herbarium Benchmarks for regional ecosystems and adjusted for local representation of vegetation based the results of reference site BioCondition assessments. This will be utilized during the major monitoring program to ensure the rehabilitation areas are on a trajectory to meet the milestone criteria.

Rehabilitation achieving these criterion for a period of three years could be considered self-sustaining and likely to persist in the long term and may be deemed to be complete in accordance with the conditions of the EA.

7.5.3.5. Grazing Land Suitability Assessment

A land suitability assessment will demonstrate achieving the RM9 milestone criteria for a PMLU of cattle grazing at:

- Year six of the major monitoring to allow vegetation to establish; and
- Each scheduled major monitoring from Year 10+ until the rehabilitation meets the milestone criteria.

7.5.3.6. Surface Water

Monitoring of surface waters is to continue as per the initial monitoring phase. Water Quality during the major rehabilitation monitoring phase is to show a significant improvement in water quality. To achieve the PMLU, water quality of the rehabilitated runoff dam is to meet the stock drinking water guidelines of the ANZESCC 2000.

7.5.1.Receiving Environment

A receiving environment monitoring program (REMP) is being developed for the Project, and will include biannual aquatic ecology sampling, in alignment with relevant guidelines (Department of Natural Resources DNR, 2001) (Department of Environment and Science, 2014). Personnel conducting REMF will be appropriately trained in AusRivAs (2001).

7.5.1.1. Groundwater

The existing groundwater monitoring network will be sampled in accordance with the Queensland Monitoring and Sampling Manual or appropriate Queensland Government guideline. Groundwater samples will be collected and analysed to achieve milestone criteria. A revaluation of the groundwater monitoring requirements will be undertaken at major monitoring events.

7.5.2.Opportunistic Monitoring

The creeks and drainage lines at the Project are ephemeral therefore inhibiting the ability to collect and assess surface water samples within fixed timings. Resultingly, surface water monitoring is required to

be undertaken at nominated points when available and accessible. The data can be assessed against the EA values or, if more appropriate, against relevant Water Quality Objectives.

A surface water monitoring program currently exists for the Project, in accordance with C1-1 of the EA. Solomons Gold will continue to monitor surface waters at the designated monitoring locations displayed in Figure 33, in accordance with C1-1 of the EA throughout the rehabilitation of the Project.

7.5.3.Achieving Monitoring Across the PRCP Schedule

Within the 10-year timeframe from revegetation, milestone RM6 – surface requirements, is envisaged to be achieved. RM7 – achieving a stable condition for cattle grazing is planned within a 15-year timeframe from revegetation, relying on achievement of RM6 within the timeframe.

7.5.4.Maintenance

Maintenance activities will occur where required after identifying issues with the rehabilitation during the monitoring programs. Remedial actions are highly dependent on the likely cause which may include:

- Climate conditions;
- Invasive species;
- Drainage design;
- Insufficient vegetative cover;
- Surrounding land use influence; and
- Soils.



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Date: 15 December 2021

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Figure 34. Surface Water Monitoring

- Mine Lease
- Mine Features
- Surface Water Monitoring

- Watercourse Stream Order
- 1
 - 2
 - 5

ESRI Satellite

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Figure 35. Groundwater Monitoring

-  Mine Lease
-  Mine Features
-  Groundwater Bores

ESRI Satellite

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Digital data for this report is available on the Queensland Government Spatial Portal at <http://www.information.qld.gov.au>.



7.5.5. Analysis, Recording, and Reporting

All actions will occur in accordance with relevant Queensland Guidelines including the Queensland Monitoring and Sampling Manual. This includes appropriately qualified personnel collecting and analysing the samples and data. The data will be analysed to identify trends, changes, anomalies, and to track progress. Throughout the process, the data and achievements will be assessed against the milestone criteria; remedial actions will occur where necessary.

The relevant data will be stored and processes within internal geospatial and document management systems.

7.5.6. Quality Assurance

All staff undertaking monitoring and reporting activities will be suitably qualified for that task. Quality assurance / quality control (QAQC) methodologies will be followed and acted upon should breaches in QAQC procedures occur.

Samples collected will be sent to NATA accredited laboratory ALS Environmental Townsville for analysis. For surface water and groundwater samples, at a minimum, for every 10 sites sampled, one field blank, travel blank, and duplicate sample will be taken.

Results from this monitoring program will provide information for future and post-mine closure monitoring requirements.

The monitoring and maintenance allows for a repetitive execution-verification-monitoring QAQC approach to ensure rehabilitation areas progress and achieve the milestone criteria.

7.5.7. Review

This Plan will be reviewed by an SQP should an amendment to the PRCP be made or under timed renewal of the PRCP. In the context of monitoring, a review of the plan must consider:

- Environmental performance;
- Rehabilitation objectives and indicators;
- Environmental inspection outcomes;
- Changes in relevant legislation, policy and guidelines;
- Changes in the mine plan; and
- Rehabilitation completion criteria.

7.5.8. EA Relinquishment

Prior to certification of progressive rehabilitation for part of the Project, or acceptance of EA surrender for part or the whole of the Project tenure, DES must be satisfied with the rehabilitation. The decision is based on either a final rehabilitation report (section 264 of the EP Act) for the whole Project tenure or a

part being surrendered, or a progressive rehabilitation report for part of the Project (section 318Z of the EP Act).

The Proponent is required to prepare either of the above, including a compliance statement, and submit to DES for assessment. Relevant rehabilitation requirements (section 318Z or section 268 of the Ep Act) will be considered by DES when deciding whether to certify progressive rehabilitation or to approve surrender application. A post-relinquishment plan will also need to be developed by the proponent to assist with ongoing land management beyond the surrender of the Project tenure

8. References

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Appendix A: PRCP Schedule

Post-mining land uses (PMLU)									
Rehabilitation area				RA1					
Relevant activities				Open Cut Pit Areas (Deep Lead Pit)					
Total rehabilitation area size (ha)				18.09					
Commencement of first milestone: <insert milestone reference>				31/12/2033					
PMLU				Low Intensity Grazing					
Date area is available	31/12/26	1/01/29	1/01/31	1/01/34	1/01/39				
Cumulative area available (ha)	18.09	18.09	18.09	18.09	18.09				
Milestone completed by	31/12/28	31/12/30	31/12/33	31/12/38	31/12/43				
Milestone Reference	Cumulative area achieved (ha)								
RM1	18.09								
RM3	18.09								
RM8		18.09							
RM9			18.09						
RM10				18.09					
RM11					18.09				

Post-mining land uses (PMLU)									
Rehabilitation area				RA2					
Relevant activities				Waste Rock Dumps					
Total rehabilitation area size (ha)				40.54					
Commencement of first milestone: <insert milestone reference>				31/12/2028					
PMLU				Low intensity grazing on native pasture					
Date area is available	31/12/28	1/01/31	1/01/34	1/01/39					
Cumulative area available (ha)	40.54	40.54	40.54	40.54					
Milestone completed by	31/12/30	31/12/33	31/12/38	31/12/43					
Milestone Reference	Cumulative area achieved (ha)								
RM1	4.85								
RM4	4.85								
RM8	4.85								
RM9		4.85							
RM10			4.85						
RM11				4.85					

Post-mining land uses (PMLU)									
Rehabilitation area				RA3					
Relevant activities				Run Of Mine					
Total rehabilitation area size (ha)				2.46					
Commencement of first milestone: <insert milestone reference>				31/12/2026					
PMLU				Low intensity grazing					
Date area is available	31/12/26	1/01/29	1/01/32	1/01/37					
Cumulative area available (ha)	2.46	2.46	2.46	2.46					
Milestone completed by	31/12/28	31/12/31	31/12/36	31/12/41					
Milestone Reference	Cumulative area achieved (ha)								
RM1	2.46								
RM2	2.46								
RM5	2.46								
RM8		2.46							
RM9		2.46							
RM10			2.46						
RM11				2.46					

Post-mining land uses (PMLU)									
Rehabilitation area				RA4					
Relevant activities				Mine Infrastructure Area					
Total rehabilitation area size (ha)				19.33					
Commencement of first milestone: <insert milestone reference>				31/12/2026					
PMLU				Low intensity grazing					
Date area is available	31/12/26	1/01/29	1/01/32	1/01/37	1/01/42	1/01/45	1/01/50		
Cumulative area available (ha)	19.33	11.68	11.68	11.68	7.65	7.65	7.65		
Milestone completed by	31/12/28	31/12/31	31/12/36	31/12/41	31/12/44	31/12/49	31/12/54		
Milestone Reference	Cumulative area achieved (ha)								
RM1	19.33								
RM2	19.33								
RM5	19.33								
RM8		11.68			7.65				
RM9		11.68			7.65				
RM10			11.68			7.65			
RM11				11.68			7.65		

Post-mining land uses (PMLU)									
Rehabilitation area				RA5					
Relevant activities				Storages (RAW Dam)					
Total rehabilitation area size (ha)				0.45					
Commencement of first milestone: <insert milestone reference>				31/12/2026					
PMLU				Low Intensity Grazing					
Date area is available	31/12/26	1/01/31	1/01/36	1/01/41					
Cumulative area available (ha)	0.45	0.45	0.45	0.45					
Milestone completed by	31/12/30	31/12/35	31/12/40	31/12/45					
Milestone Reference	Cumulative area achieved (ha)								
RM1	0.45								
RM2	0.45								
RM6		0.45							
RM8		0.45							
RM9		0.45							
RM10			0.45						
RM11				0.45					

Post-mining land uses (PMLU)									
Rehabilitation area				RA6					
Relevant activities				Run Off Dam					
Total rehabilitation area size (ha)				8.54					
Commencement of first milestone: <insert milestone reference>				31/12/2026					
PMLU				Water Storage					
Date area is available	31/12/26	1/01/31							
Cumulative area available (ha)	8.54	8.54							
Milestone completed by	31/12/30	31/12/34							
Milestone Reference	Cumulative area achieved (ha)								
RM1	8.54								
RM2	8.54								
RM12		8.54							

Post-mining land uses (PMLU)									
Rehabilitation area				RA7					
Relevant activities				Tailings Storage Facility					
Total rehabilitation area size (ha)				72.21					
Commencement of first milestone: <insert milestone reference>				31/12/2026					
PMLU				Low intensity grazing					
Date area is available	31/12/26	1/01/29	1/01/35	1/01/40					
Cumulative area available (ha)	72.21	72.21	72.21	72.21					
Milestone completed by	31/12/28	31/12/34	31/12/39	31/12/44					
Milestone Reference	Cumulative area achieved (ha)								
RM1	72.21								
RM7		72.21							
RM8		72.21							
RM9		72.21							
RM10			72.21						
RM11				72.21					

Non-use management area (NUMA)									
Improvement area				IA1					
Relevant activities				Open Cut Pit Areas (Pit A, Pit B, and North Pit)					
Total size (ha)				16.26					
Commencement of first milestone: <insert milestone reference>				31/12/2033					
NUMA				Residual Void/Non-use management areas					
Date area is available	31/12/26	1/01/31							
Cumulative area available (ha)	16.26	16.26							
Milestone completed by	31/12/30	31/12/35							
Milestone Reference	Cumulative area achieved (ha)								
MM1	16.26								
MM2	16.26								
MM3		16.26							

Milestone reference	Rehabilitation milestone
RM1	Infrastructure decommissioning and removal
RM2	Remediation of contaminated land/sediment
RM3	Backfill of Deep Lead Pit
RM4	Landform development and reshaping (RA2)
RM5	Landform development and reshaping (RA3, RA4)

RM6	Landform development and reshaping (RA6)
RM7	Landform development and reshaping (RA7)
RM8	Surface preparation
RM9	Revegetation
RM10	Achievement of surface requirements
RM11	Achievement of PMLU to a stable condition
RM12	Achievement of PMLU to a stable condition (water storage)

Milestone criteria

- All services disconnected
- All buildings and associated infrastructure dismantled and removed offsite
- All hardstand and concrete areas demolished and removed
- Pipelines removed
- Waste removed and disposed of within the WRDs or offsite at a licenced waste facility
- All road materials removed
- All stockpiled material not a part of the PMLU removed
- Machinery / equipment not required for rehabilitation removed from site

- Contaminated land assessment is completed by a suitably qualified person
- Identified contaminated material removed from the mine domain and disposed of either within the TSF or offsite at a licenced facility.
- Validation sampling determines that contaminant removal has been successful.

- Deep Lead Pit is backfilled with waste rock material to surface level
- Landform is shaped to pre-mining landform
- Domain is certified by geotechnical engineer to be a safe and stable landform

- Landform is shaped to encourage natural drainage and limit erosion.
- Target slopes of <70 % are achieved
- Maximum of 10 m high lifts
- Benches at every 10 m and 10 m wide
- 3 % slope on benches.

- Landform is shaped to pre-mining landform
- Re-establish natural drainage pathways
- Landform ripped parallel to landform
- Ensure land is free draining Land is free draining

- ~~W~~ater removed from dam through evaporation or use on site
- ~~D~~am walls pushed in and reprofiled to be gently sloping
- ~~L~~andform is shaped to encourage natural drainage and limit erosion
- ~~D~~omain is certified by geotechnical engineer to be a safe and stable landform

- ~~W~~ater is removed from TSF through evaporation or other mechanical methods
- ~~W~~aste rock is layered over TSF to 1.0 m thickness
- ~~L~~andform is graded to be free draining, directing water to existing spillway
- ~~T~~opsoil is applied to 0.15 m thickness
- ~~D~~omain is certified by geotechnical engineer to be a safe and stable landform

- ~~E~~xisting soil erosion, rills and gullies repaired prior to seeding
- ~~N~~o active gullies >1.0 m depth
- ~~A~~ny gullies <1.0 m >0.3m have shown progressive stabilisation (i.e., have become partly stabilised or stabilised) over successive annual monitoring events
- ~~A~~ soil health and suitability assessment completed by a SOP and confirms that the soil is suitable for target vegetation establishment or whether there

- ~~R~~evegetation strikes creates a groundcover >30% of analogue sites
- ~~S~~eeding rate of 6 – 8 kg/ha achieved (if natural revegetation unsuccessful).

- ~~W~~eed species in densities less than 10 % total coverage
- ~~V~~egetation percentage cover is 50 % of the ground surface area or >70 % of the rehabilitation reference sites for 3 consecutive years.
- ~~G~~roundcover biomass and tree density is equal to, or greater than, 50 % of reference sites for three consecutive years
- ~~S~~pecies richness is equal to, or greater than, 50% of reference sites for three consecutive years
- ~~N~~o active gullies >1.0 m depth
- ~~R~~A has maintained a stable, safe condition.

- ~~V~~egetation percentage cover is 50 % of the ground surface area or >70 % of the rehabilitation reference sites.
- ~~S~~urface water quality measured at Environmental Authority EPML00557513 surface water sites (Schedule C - Table 1) complies with ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality for a consecutive two years
- ~~S~~stream sediment at Environmental Authority EPML00557513 sites complies with ANZECC/ARMCANZ (2000) Interim Sediment Quality Guidelines – low

- ~~D~~am meets ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality during biannual sampling events for a consecutive two years.

Milestone reference	Management milestone	Milestone criteria
MM1	Highwall treatment	•IA is certified as safe and stable by a suitably qualified person.
		•All services disconnected •Water management infrastructure removed (i.e., pumps) •Safety bund constructed at 1m high •Fencing of 2m high is erected around the perimeter of the residual void •Warning signage posted every 10m of the perimeter
MM2	Achievement of surface requirements	•IA is certified as safe and stable by a suitably qualified person. •Pit water quality sampling complies with ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality
		•Groundwater water quality measured at EA sites complies with ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality
MM3	Achievement of sufficient improvement	

- 1) Insert new rows below the table to record more Improvement Area Milestones for the project
- 2) Ensure all Management Milestones recorded in this table align with those included in the IA sheets in this form.
- 3) See the PRCP guideline before developing site-specific Improvement Area Milestones

Appendix B: Soils and Land Suitability Assessment



SOIL AND LAND SUITABILITY ASSESSMENT

WIRRALIE GOLD MINE

SOLOMONS GOLD PTY LTD

DECEMBER 2021



**WULGURU TECHNICAL
SERVICES**

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1. Introduction

Solomons Gold Pty Ltd (Solomons) is the owner and operator of the Wirralie Gold Mine (WGM) – Environmental Authority (EA) EPML00772413. Wulguru Technical Services Pty Ltd (WTS) has been engaged to undertake a soils and land suitability assessment (the Assessment) of the WGM to inform components of the WGM Progressive Rehabilitation and Closure Plan (PRCP).

This report provides a baseline understanding of soil and land resources, and their suitability for use in rehabilitation activities at the WGM. The Assessment focused on areas of minimal and previously undisturbed land, evaluating resources such as topsoil and capping material availability, suitability for use in rehabilitation and potential constraints to plant growth.

1.1. Purpose and Objectives

The purpose of this report is to evaluate the soil mapping units and land resources available within the WGM Mining Lease (ML). The objectives of this Assessment is:

- Identify and map soil mapping units and terrain that occurs within the WGM ML;
- Classify and determine soil types according to observed and analysed physical and chemical characteristics;
- Validate Land Suitability Classifications within the ML;
- Validate topsoil resources and rehabilitation materials; and
- Assess suitability of clay material available within the ML as potentially suitable for capping structures.

1.2. Project Description

WGM is located in the Drummond Basin, approximately 200 km south of Townsville, Queensland and 200 km west of Mackay. Access to WGM is via the Burdekin Falls Dam Road from Townsville or via Bowen Development Road from Mackay. The nearest township is Mt Coolon, approximately 40 km south of WGM.

WGM is located on ML 1079, covering approximately 1,301 ha on Lot 3272 on Plan PH2090 (referred to as Wirralie Station).

The WGM Plan of Operations September 2016 – September 2021 (Northern Resources Consultants Pty Limited, 2016) describes the WGM history as a low-grade, low-sulfidation epithermal system, which lies within cycle one rocks in the central part of the eastern Drummond Basin, and close to the basal unconformity with basement rocks of the Anakie Inlier.

Originally discovered in 1986, mining began at WGM in 1987 and continued until 1998, when the processing plant was relocated to the Yandan mine site, 30 km west of WGM. An upgraded 1.5 million tonne per annum treatment plant was reinstated at WGM in 1999. The plant treated low-grade oxide and Deep-Lead Pit mineralisation until January 2002, at which time WGM was placed into care and maintenance.



Client: Solomons Gold Pty Ltd
Project number: 2021.02011
Coordinate Reference System: GDA 2020 Z 55
Date: 2021-12-10

Map provided for interpretation purposes only.
Print as A0

Soil and land Suitability Assessment
Figure 1: Project Location

Legend

-  Land parcel
-  Mining Lease

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Whilst every effort and care has been taken to ensure the accuracy of this report, Wulguru Technical Services Pty Ltd makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incur as a result of the product being inaccurate or incomplete in any way and for any reason.
Digital data for this report is available on the Queensland Government Spatial Portal at <http://www.information.qld.gov.au>.



2. Existing Environment

2.1. Climate

The nearest Bureau of Meteorology (BoM) weather station is at Collinsville, Queensland (Station ID: 033013), approximately 85 km north-east of WGM. Climate statistics are available for a 82 year period from 1939 to 2021.

The mean maximum monthly temperature for the summer period (i.e. December to February) is 33.5°C, and the mean minimum monthly temperature for the same period is 21.7°C. The mean maximum monthly temperature for the winter period (i.e. June to August) is 25.7°C, and the mean minimum monthly temperature for the same period is 10.1°C (Bureau of Meteorology, 2021).

Mean annual rainfall for the location is 701.7 mm (Figure 2).

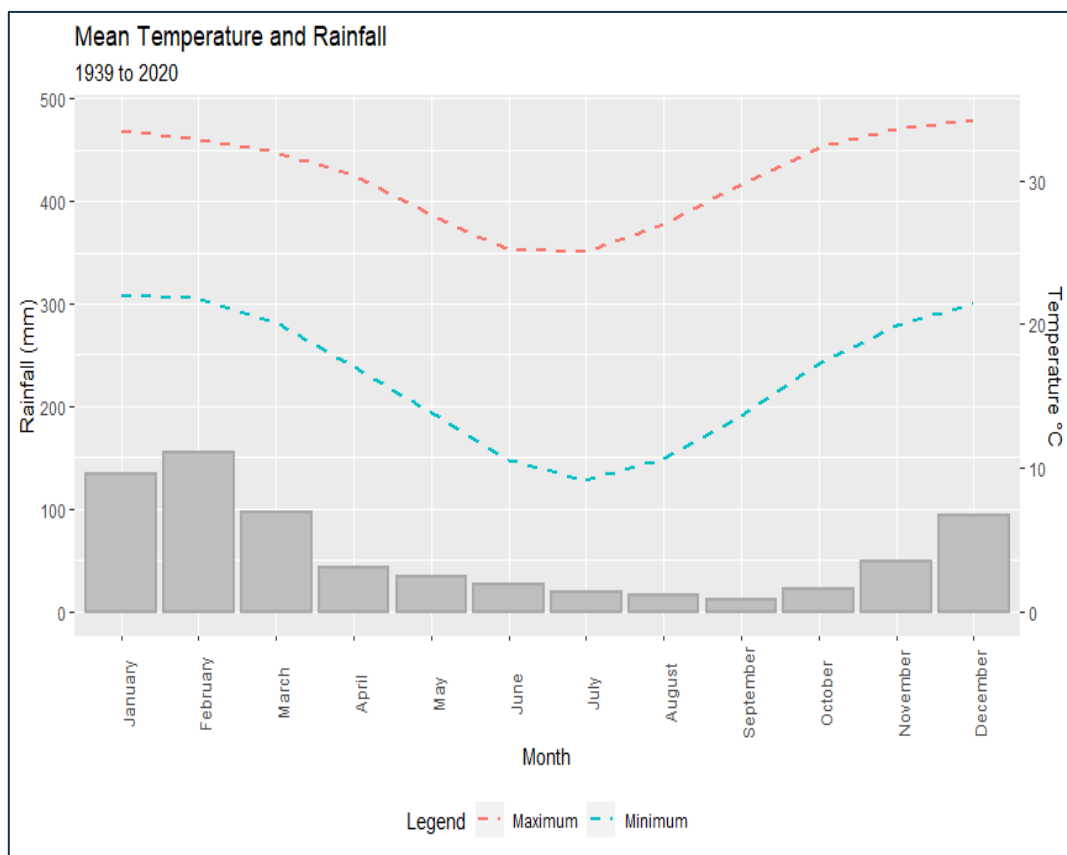


Figure 2. Mean monthly temperature and rainfall (Bureau of Meteorology, 2021)

2.2. Geology and Topography

The Project is regionally situated in the Drummond Basin, a 26,000 km² area of central Queensland. The Drummond Basin is from the Upper Devonian to Lower Carboniferous periods that underwent 3 cycles (Olgers 1969). The Project has been historically described as a low-grade, low-sulfidation epithermal system, which lies within cycle one rocks in the central part of the eastern Drummond Basin, and close to the basal unconformity with basement rocks of the Anakie Inlier (NRC 2026).

Water bore establishment and publicly available information confirmed that ML1079 surface geology is predominately consisted of the Suttor Formation Formation, underlain by both the Rosetta Creek and Mt Rankin Formation (Queensland Government, 2021). Project geology is described below:

- Alluvium (Cz) – Alluvium, soil, sand, lateritic soils and gravels.
- Suttor Formation (Ta) – Quartz Sandstone, conglomerate, sandy claystone, silicified claystone.
- Rosetta Formation - Late Devonian interbedded siltstone to pebbly sandstone and relatively thin rhyolitic ignimbrite sheets.
- Mt Rankin Formation (C/Cr) – Siliceous Tuff, ashstone, tuffaceous conglomerate and sandstone, Ryolite, Andesite

2.3. Topography

Regionally the Project lies to the east of the Great Dividing Range and is surrounded by low mountains ranging from 296 m AHD (Rodborough Hill) to 552 m AHD (Mount Landsborough).

The topography of ML1079 is variable with rolling rises and hills dominating the site transitioning to flats and plains. The highest local features are ~290 m AHD transitioning to ~260 m AHD north and south of the lease (

Figure 3).

2.4. Hydrology

Surface waters are characterised by predominantly unnamed Stream Order (SO) 1 watercourses and one SO2 watercourse. Drainage is generally in a westerly direction towards the nearby SO5, Rosetta Creek and contributes to the Suttor River sub-basin of the Burdekin River basin (Figure 4).

2.5. Regional Ecosystems

Regional ecosystems are vegetation communities within a Queensland bioregion that are consistently associated with a particular combination of geology, landform and soil (Queensland Government, 2021a). Regional ecosystems are managed under the *Vegetation Management Act 1999* (QLD) and detail the Vegetation management (VM) status of each Regional Ecosystem (RE) as either *Endangered*, *Of Concern*, *Least Concern* or *Non remnant*. Biodiversity Status (BD status) is utilised for regulation of mining activities under the *Environmental Protection Act 1994* (QLD). BD status is described as either *Endangered*, *Of Concern* and *No concern at present*.

Current mining disturbances at WGM are classified as non-remnant, the remainder of RE within the ML but outside mining disturbances are classified as either Least Concerned, Of Concern or Endangered (Table 1, Table 5)

Regional ecosystems broadly describe a landform morphology of scarps, mesas and rises with lateritic duricrusts, scarp retreat zones and alluvial plains, consistent with geology and topography descriptions within the WGM ML.

Table 1. Regional ecosystem codes and descriptions found within the WGM ML (Queensland Herbarium, 2019)

RE Code	Short Description	VM Status	BD Status
11.7.3/ 11.5.10/ 11.7.2	11.7.3 – <i>Eucalyptus persistens</i> , <i>Triodia mitchellii</i> open woodland on stripped margins of Cainozoic lateritic duricrust. 11.5.10 – <i>Melaleuca tamariscina</i> shrubland on Cainozoic sand plains and/or remnant surfaces. 11.7.2 – <i>Acacia</i> spp. Woodland on Cainozoic lateritic duricrust. Scarp retreat zone.	Least Concern	No concern at present
11.7.2	11.7.2 – <i>Acacia</i> spp. Woodland on Cainozoic lateritic duricrust. Scarp retreat zone.	Least Concern	No concern at present
11.5.9b/ 11.7.3/ 11.7.2	11.5.9b – <i>Eucalyptus crebra</i> and other <i>Eucalyptus</i> spp. And <i>Corymbia</i> spp. Woodland on Cainozoic sand plains and/or remnant surfaces. 11.7.3 – <i>Eucalyptus persistens</i> , <i>Triodia mitchellii</i> open woodland on stripped margins of Cainozoic lateritic duricrust. 11.7.2 – <i>Acacia</i> spp. Woodland on Cainozoic lateritic duricrust. Scarp retreat zone.	Least Concern	No concern at present
11.5.9b/ 11.7.2	11.5.9b – <i>Eucalyptus crebra</i> and other <i>Eucalyptus</i> spp. And <i>Corymbia</i> spp. Woodland on Cainozoic sand plains and/or remnant surfaces. 11.7.2 – <i>Acacia</i> spp. Woodland on Cainozoic lateritic duricrust. Scarp retreat zone.	Least Concern	No concern at present
11.4.9	11.4.9 – <i>Acacia harpophylla</i> shrubby woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains.	Endangered	Endangered
11.3.2	11.3.2 – <i>Eucalyptus populnea</i> woodland on alluvial plains.	Of Concern	Of Concern
11.11.10	11.11.10 – <i>Eucalyptus melanophloia</i> woodland on deformed and metamorphosed sediments and interbedded volcanics.	Of Concern	Of Concern



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Soil and land Suitability Assessment Figure 3: Surface Geology

Legend

- Land parcel
- Mining Lease

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Soil and land Suitability Assessment

Figure 4. Hydrology and Topograpgy

Legend

- Land parcel
- Mining Lease

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Figure 5. Regional Ecosystems (VM Status)

3. Soil Survey

The distribution of main soil types within the Assessment area were identified, validated and refined from the field survey, which was conducted according to land resource assessment guidelines (The National Committee on Soil and Terrain, 2009). Locations observed to contain high clay content were also assessed during the field survey with collection of samples for construction testing undertaken at specific locations. The methods and results for the field and laboratory assessment are described herein.

3.1. Methodology

3.1.1. Background Information

Descriptions of soil types/ units and their distribution with landforms and parent material refer to the Australian Soil Resource Information System (ASRIS) and other regional surveys as relevant. Preliminary soil unit boundaries were developed from:

- Satellite imagery – Qld Globe and recent high-resolution imagery (SPOT6/7 1.5m RGB orthomosaic current at 22 September 2020);
- Publicly available reports and data sources – Geological mapping, Qspatial databases, etc.; and
- Topographic mapping.

3.1.2. Field Investigations

A ‘free survey’ was adopted that complied with land suitability assessment criteria. Soil unit boundaries varied from abrupt to gradual and trends were associated with variations along geological mapping units and topographic sequences. Professional judgement was utilised to identify appropriate reference and detailed observation sites, check sites were utilised to confirm soil boundaries and points of interest.

Survey design details relating to map scale and survey density were developed in accordance with McKenzie et al. (2008b) (

Figure 6). 12 detailed observation sites were recorded with seven submitted for laboratory analysis. 24 check sites were collected to determine soil boundaries and units. On this basis it is considered that the survey design was sufficiently detailed to assess soil properties and their distribution across the Assessment area.

In addition to the soil survey, sampling was undertaken at locations of high clay content to assess suitability as a future capping/ rehabilitation material. Three locations were sampled based on field observations and discussions with Solomons operational personnel with approximately 60 kg sample submitted to a construction materials laboratory for analysis.

Table 2. Field survey observations.

Class	Observations	Land Suitability	Actual for Project
	Minimum map scale	1:50,000	1:50,000
	Site density	1 site/ 20 ha	1 site/ 20ha
	Total number	55	59
I	Detailed profiles	13	13
II	Reference profiles with laboratory data ¹	3	7
III	Check sites	39	39

¹ One reference site with laboratory analysis for each soil type identified.

3.1.3. Laboratory Analytes

Soils were classified from profile morphology and laboratory analyses according to the Australian Soil Classification (ASC) system. Laboratory samples were collected and submitted to a National Association of Testing Authorities (NATA) laboratory, ALS Environmental, including:

- pH;
- Chloride;
- Electrical Conductivity (EC);
- Exchange Acidity;
- Exchangeable Cations/ Cation Exchange Capacity (CEC);
- Sulphur as SO₄;
- Total metals – As, Cd, Cr, Cu, Fe, Hg, Ni, Pb and Zn;
- Nitrate and Nitrite (N as NO_x);
- Total Kjeldahl Nitrogen (TKN);
- Total Phosphorus;
- Bicarbonate Extractable Phosphorus;
- Total Organic Carbon; and
- Particle Size Analysis.

Additional clay material was collected for capping material suitability testing and provided to Construction Sciences for analysis.



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Soil and land Suitability Assessment Figure 7. Survey Design

- Legend**
- Mining Lease
 - Sampling Locations

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4. Results

4.1. Soil Map Units

WTS identified four soil map units across the Project. Representative soil profiles are described in Table 3 and distribution of soils is mapped in Figure 7.

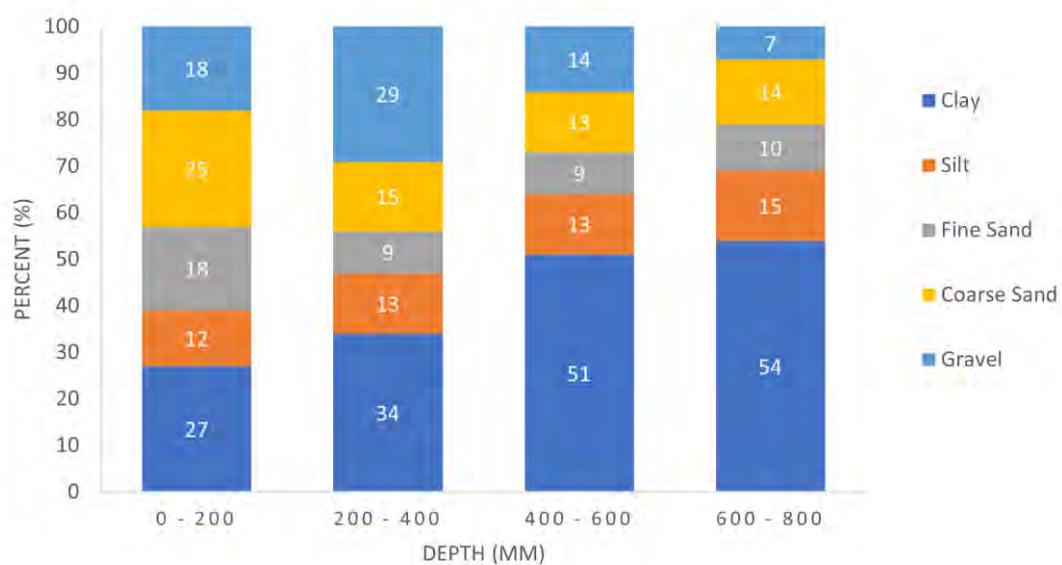
Table 3. Representative soil profiles

Australian Soil Classification	Reference Site	Area (ha)	Area (percentage)
Eutrophic Brown Dermosol, Deep	S4	137.78	12.1885
Leptic Brown Rudosol	S6	365.22	32.30863
Leptic Brown-Orthic Tenosol, Shallow	S10	394.86	34.93069
Sodic Brown Dermosol, Deep	S11	148.40	13.12798
Self-Mulching Brown Vertosol, Moderate	S14	84.15	7.444202

4.2. Soil Profile 1 – Brown Dermosol

Project: Wirralie		Site: S4						
Location: Mt Coolon, Qld Described by: Scott Hayes-Stanley Date: 28/02/2021								
Site Description								
Geology: DCr Landform pattern: Level plain Element: Flat Permeability: Moderate Microrelief: None Microrelief component: No record. Drainage: Moderate Slope: 0 – 1% Rock outcrops: nil. Surface coarse fragments: nil. Surface condition: soft – loose. Ground cover: 20 – 50% Disturbances: grazing impacts.								
Australian Soil Classification: Eutrophic Brown Dermosol, Deep [AH] [AB] [DE] [W]								
Profile Morphology								
Horizon	Depth (m)	Description						
A1	0.00 – 0.30	Grey (5/1 7.5YR) Clay loam, weak, 2-5 mm sub angular blocky structure; nil roots, nil mottles; moderately well drained with gradual transition to B21 horizon.						
B21	0.30 – 0.50	Brown (4/2 7.5YR) Clay loam, weak, 5-10 mm angular blocky structure; nil roots, nil mottles; moderately well drained with diffuse transition to B22 horizon.						
B22	0.50 – 1.10	Brown (4/2 7.5YR) Clay loam, weak, 2-5 mm sub angular blocky structure; nil roots, nil mottles; moderately well drained with diffuse transition to C horizon.						
Depth (m)	pH	EC (µS/cm)	NOx as N (mg/kg)	TKN (mg/kg)	TN (mg/kg)	TP (mg/kg)	TOC (%w/w)	Colwell K (mg/kg)
0.00 – 0.30	5.3	15	1.0	490	490	117	0.83	<5
0.30 – 0.50	5.7	12	0.6	350	350	101	0.78	<5
0.50 – 0.80	5.8	12	0.7	310	310	95	0.84	<5
0.80 – 1.10	6.0	12	0.6	260	260	82	0.63	<5
Depth (m)	Exc. Na (meq/100g)	Exc. K (meq/100g)	Exc. Ca (meq/100g)	Exc. Mg (meq/100g)	Cation Exc. Capacity (meq/100g)	ESP (%)	Ca:Mg Ratio	S (mg/kg)
0.00 – 0.30	<0.1	<0.1	2.2	0.9	3.3	<0.1	2.4	0.03
0.30 – 0.50	<0.1	<0.1	2.3	0.9	3.2	<0.1	2.6	0.03
0.50 – 0.80	<0.1	<0.1	2.4	1.0	3.5	<0.1	2.4	0.03
0.80 – 1.10	<0.1	0.1	1.7	1.5	3.3	<0.1	1.1	0.03
Particle Size Distribution								

S1 - PARTICLE SIZE PERCENTAGE

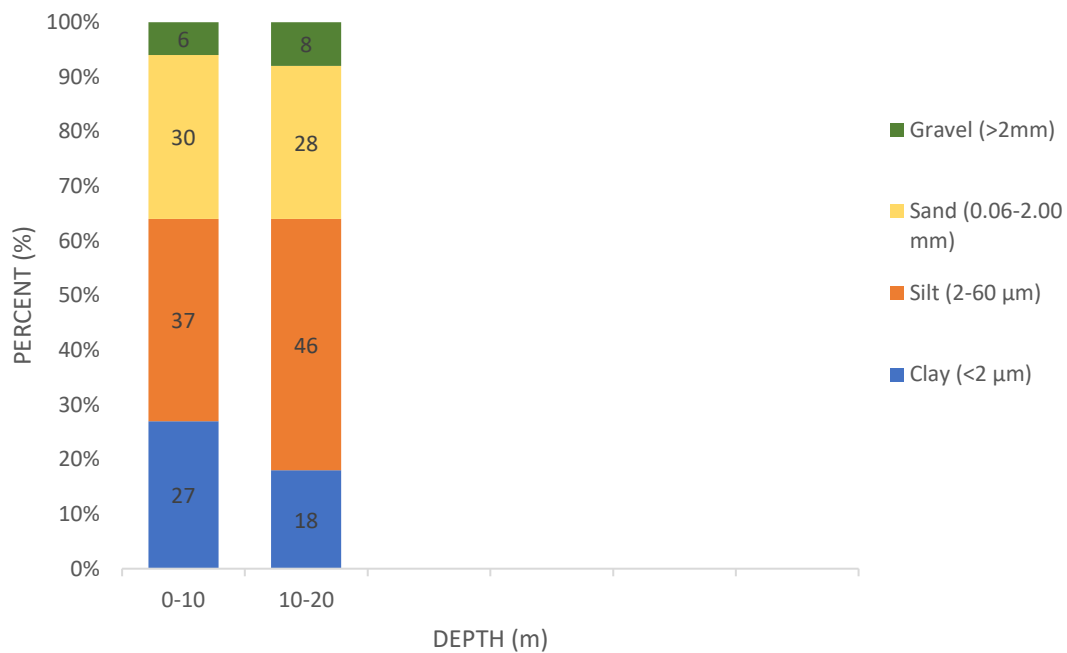


4.3. Soil Profile 1 – Brown Rudosol

Project: Wirralie		Site: S10						
Location: Mt Coolon, Qld Described by: Scott Hayes-Stanley Date: 28/02/2021		 						
Site Description								
Geology: Tu Landform pattern: Crest Element: Flat Permeability: Moderately well Microrelief: None Microrelief component: No Record Drainage: Moderately well Slope: 0 – 1 % Rock outcrops: Slightly Rocky Surface coarse fragments: Nil Surface condition: Firm Ground cover:10 - 20% Disturbances: grazing impacts.								
Australian Soil Classification: Leptic Brown Rudosol, Very Shallow [CY] [AB] [RU] [T]								
Profile Morphology								
Horizon	Depth (m)	Description						
A1	0-20	Brown (4/2 7.5YR) clay loam, weak, 5-10 mm, subangular blocky, nil roots, nil mottles, few ferruginous nodules, moderately well drained with clear transition to R horizon.						
R	>20							
Depth (m)	pH	EC (µS/cm)	NOx as N (mg/kg)	TKN (mg/kg)	TN (mg/kg)	TP (mg/kg)	TOC (%w/w)	Colwell P (mg/kg)
0 - 10	4.4	234	69.4	1100	1170	104	1.98	<5
10 - 20	4.4	142	36.6	890	930	99	1.46	5
Depth (m)	Exc. Na (meq/100g)	Exc. K (meq/100g)	Exc. Ca (meq/100g)	Exc. Mg (meq/100g)	Cation Exc. Capacity (meq/100g)	ESP (%)	Ca:Mg Ratio	S (mg/kg)
0 - 10	0.3	0.2	0.5	0.7	3.6	16.2	0.7	0.02
10 - 20	<0.1	0.2	0.2	0.4	2.9	<0.1	0.5	0.02

Particle Size Distribution

S6 - PARTICLE SIZE PERCENTAGE

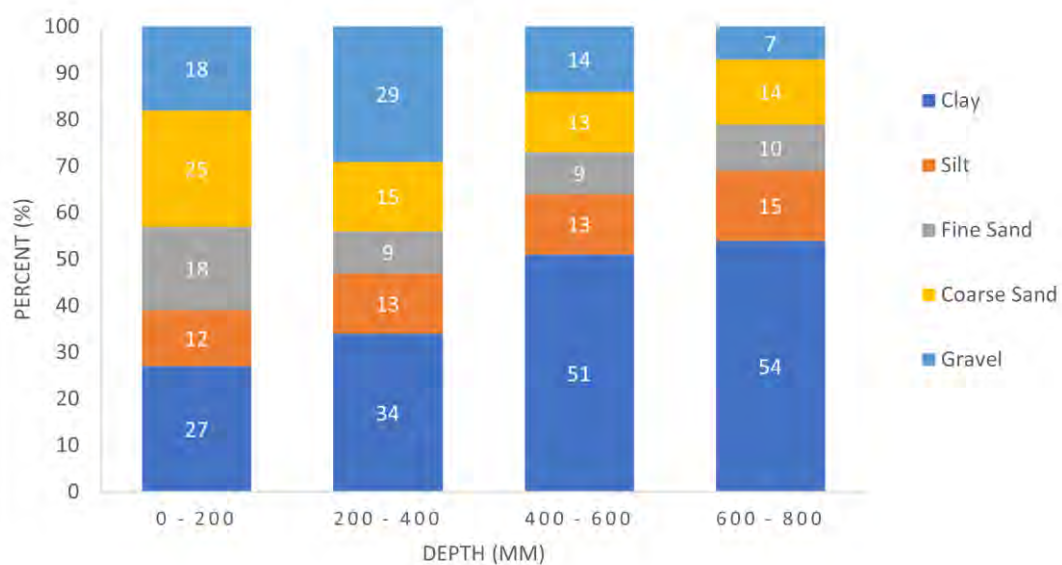


4.4. Soil Profile 3 – Brown Tenosol

Project: Wirralie		Site: S10						
Location: Mt Coolon, Qld Described by: Scott Hayes-Stanley Date: 28/02/2021								
Site Description								
Geology: Tu Landform pattern: Level plain Element: Flat Permeability: Poor Microrelief: None Microrelief component: No record. Drainage: Poor Slope: 0 – 1% Rock outcrops: nil. Surface coarse fragments: nil. Surface condition: Seasonally hard setting. Ground cover: <2% Disturbances: grazing impacts, pest impacts.								
Australian Soil Classification: Leptic Brown-Orthic Tenosol, Shallow [CY] [IO] [TE] [U]								
Profile Morphology								
Horizon	Depth (m)	Description						
A1	0.00 – 0.30	Light yellowish brown (6/4 10YR) Loamy silt, weak, 2-5 mm angular blocky structure; nil roots, nil mottles; poorly drained with abrupt transition to R horizon.						
R	0.30 – 0.50	Light yellowish brown (6/4 10YR) Silt, weak, 2-5 mm angular blocky structure; nil roots, nil mottles; poorly drained – refusal met.						
Depth (m)	pH	EC (µS/cm)	NOx as N (mg/kg)	TKN (mg/kg)	TN (mg/kg)	TP (mg/kg)	TOC (%w/w)	Colwell K (mg/kg)
0.00 – 0.30	4.9	20	1.2	350	350	71	0.46	<5
0.30 – 0.50	4.7	19	0.6	270	270	78	0.29	<5
Depth (m)	Exc. Na (meq/100g)	Exc. K (meq/100g)	Exc. Ca (meq/100g)	Exc. Mg (meq/100g)	Cation Exc. Capacity (meq/100g)	ESP (%)	Ca:Mg Ratio	S (mg/kg)
0.00 – 0.30	<0.1	<0.1	0.7	<0.1	1.5	<0.1	-	0.01
0.30 – 0.50	<0.1	<0.1	0.2	<0.1	1.3	<0.1	-	0.01

Particle Size Distribution

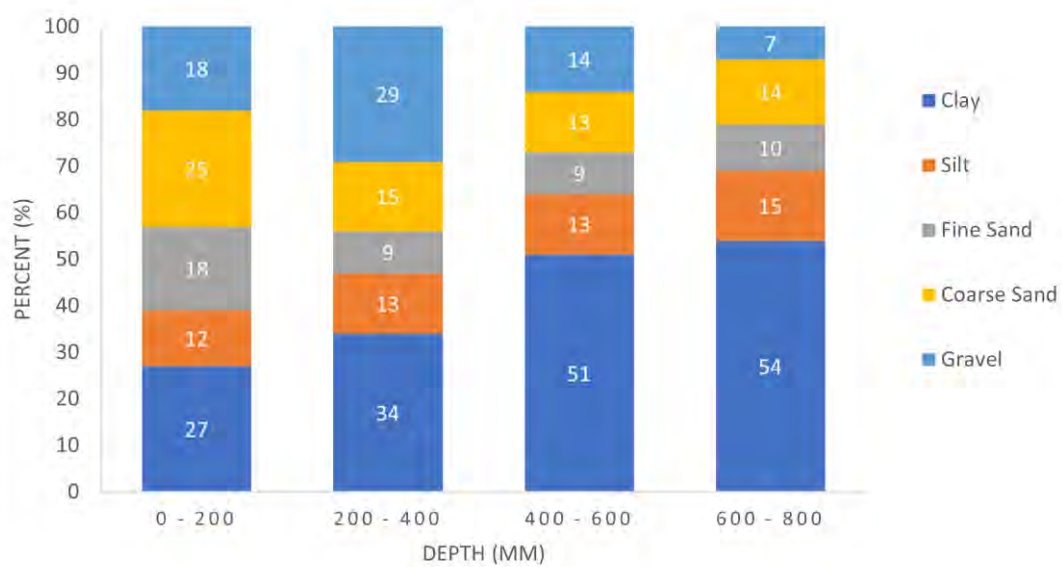
S1 - PARTICLE SIZE PERCENTAGE



4.5. Soil Profile 4 – Brown Dermosol

Project: Wirralie		Site: S11						
Location: Mt Coolon, Qld Described by: Scott Hayes-Stanley Date: 01/03/2021		 						
Site Description								
Geology: DCr Landform pattern: Level plain Element: Flat Permeability: Poor Microrelief: None Microrelief component: No record. Drainage: Poor Slope: 0 – 1% Rock outcrops: nil. Surface coarse fragments: nil. Surface condition: Seasonally hard setting. Ground cover: <2% Disturbances: grazing impacts, pest impacts.								
Australian Soil Classification: Sodic Brown Dermosol, Deep [EO] [AB] [DE] [V]								
Profile Morphology								
Horizon	Depth (m)	Description						
A2	0.00 – 0.10	Brown (4/2 7.5YR) silty loam, weak, 2-5 mm angular blocky structure; some roots, nil mottles; moderately well drained with gradual transition to B21 horizon.						
B21	0.10 – 0.30	Grey (5/1 7.5YR) Loamy silt, massive, weak consistency, nil structure; nil roots, nil mottles; moderately well drained with gradual transition to B22 horizon.						
B22	0.30 – 0.50	Light yellowish brown (6/4 10YR) Loamy silt, massive, firm consistency, nil structure; nil roots, nil mottles; moderately well drained with gradual transition to C horizon.						
C	0.50 – 0.70	Light yellowish brown (6/4 10YR) – Weathered siltstone.						
Depth (m)	pH	EC (µS/cm)	NOx as N (mg/kg)	TKN (mg/kg)	TN (mg/kg)	TP (mg/kg)	TOC (%w/w)	Colwell K (mg/kg)
0.00 – 0.10	6.2	13	4.5	460	460	110	0.43	<5
0.10 – 0.30	6.4	22	5.8	270	280	82	0.26	<5
0.30 – 0.50	6.1	87	12.6	270	280	87	0.14	<5
0.50 – 0.75	6.0	108	11.4	160	170	77	0.17	<5
Depth (m)	Exc. Na (meq/100g)	Exc. K (meq/100g)	Exc. Ca (meq/100g)	Exc. Mg (meq/100g)	Cation Exc. Capacity (meq/100g)	ESP (%)	Ca:Mg Ratio	S (mg/kg)
0.00 – 0.30	0.2	0.3	4.3	1.2	6.0	2.9	3.6	<0.01
0.30 – 0.50	0.6	0.1	3.0	1.8	5.6	11.0	1.7	<0.01
0.30 – 0.50	2.5	<0.1	1.3	4.6	8.6	29.3	0.3	<0.01
0.50 – 0.75	2.9	<0.1	0.8	5.1	9.2	32.4	0.2	<0.01
Particle Size Distribution								

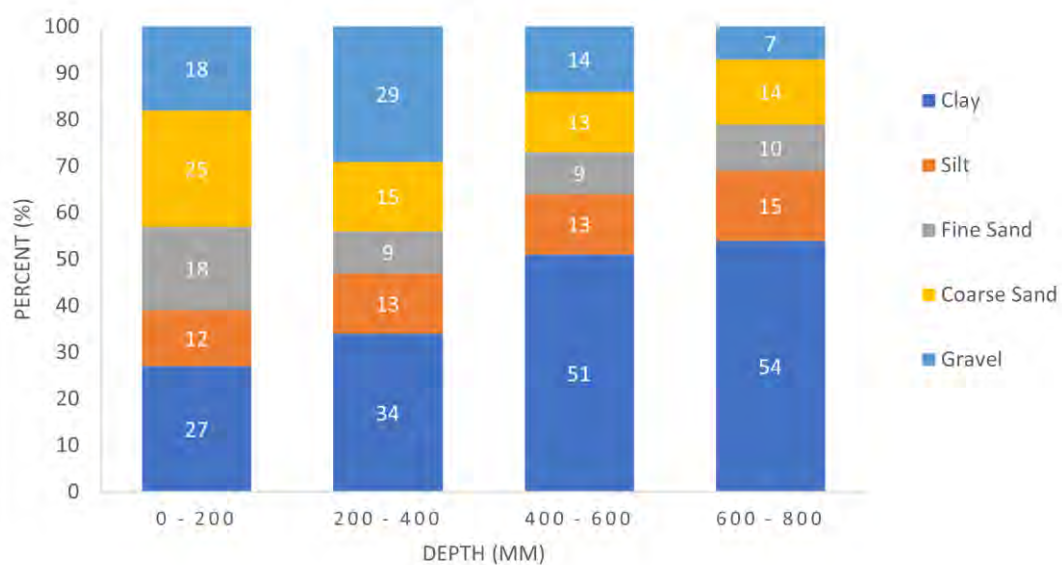
S1 - PARTICLE SIZE PERCENTAGE

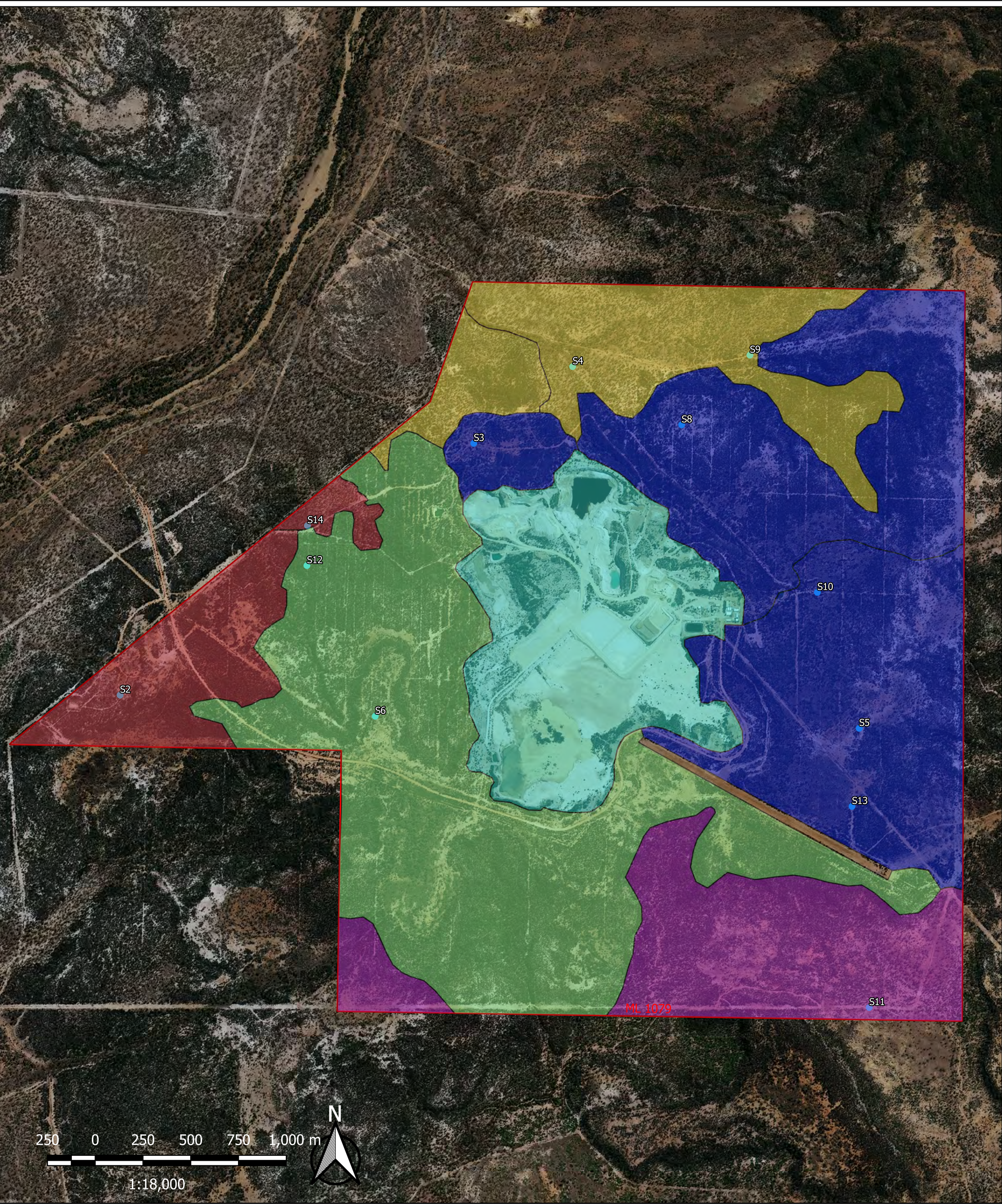


4.6. Soil Profile 5 – Brown Vertosol

Project: Wirralie		Site: S14						
Location: Mt Coolon, Qld Described by: Scott Hayes-Stanley Date: 28/02/2021		 						
Site Description								
Geology: DCr Landform pattern: Level plain Element: Flat Permeability: Poor Microrelief: None Microrelief component: No record. Drainage: Poor Slope: 0 – 1% Rock outcrops: nil. Surface coarse fragments: nil. Surface condition: self-mulching Ground cover: 20 – 50% Disturbances: grazing impacts, pest impacts.								
Australian Soil Classification: Self-Mulching Brown Vertosol, Moderate [EI] [AD] [VE] [V]								
Profile Morphology								
Horizon	Depth (m)	Description						
A2	0.00 – 0.20	Brown (4/2 7.5YR) Clay loam, moderate, 5-10 mm sub angular blocky structure; some roots, nil mottles; imperfectly drained with clear transition to B21 horizon.						
B21	0.20 – 0.50	Grey (5/1 7.5YR) Light clay, moderate, 10-25 mm sub angular blocky, firm consistency; nil roots, nil mottles; poorly drained with gradual transition to B22 horizon.						
B22	0.50 – 0.90	Light grey (7/1 7.5YR) Medium clay, massive, firm consistency, nil structure; nil roots, nil mottles; poorly drained – practical refusal met.						
Depth (m)	pH	EC (µS/cm)	NOx as N (mg/kg)	TKN (mg/kg)	TN (mg/kg)	TP (mg/kg)	TOC (%w/w)	Colwell K (mg/kg)
0.00 – 0.20	6.4	60	1.1	710	710	199	0.83	<5
0.20 – 0.50	6.4	222	0.5	390	390	170	0.28	<5
0.50 – 0.80	6.4	226	0.4	390	390	185	0.24	<5
0.80 – 1.00	6.6	265	0.2	200	200	136	0.11	<5
Depth (m)	Exc. Na (meq/100g)	Exc. K (meq/100g)	Exc. Ca (meq/100g)	Exc. Mg (meq/100g)	Cation Exc. Capacity (meq/100g)	ESP (%)	Ca:Mg Ratio	S (mg/kg)
0.00 – 0.20	0.4	0.1	1.9	2.3	4.9	8.8	0.8	0.04
0.20 – 0.50	1.4	0.1	1.4	2.9	5.9	23.6	0.5	0.04
0.50 – 0.80	1.5	0.2	1.2	2.7	5.7	26.7	0.4	0.04
0.80 – 1.00	1.7	0.2	1.0	2.5	5.5	31.7	0.4	0.04
Particle Size Distribution								

S1 - PARTICLE SIZE PERCENTAGE





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Soil and land Suitability Assessment
Figure 7. Survey Design

Legend

- | | |
|--|--|
|  Mining Lease |  Leptic Brown Rudosol |
|  Sampling Locations |  Eutrophic Brown Dermosol |
| |  Leptic Brown-Orthic Tenosol |
| |  Sodic Brown Dermosol |
| |  Self-Mulching Brown Vertosol |

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5. Land Assessment

5.1. Land Suitability Assessment

Land Suitability has been assessed using the methods and criteria provided in the Guideline for Agricultural Land Evaluation (Department of Science Information Technology and Innovation and Department of Natural Resources and Mines, 2015) and Guideline for Land Suitability Assessment Techniques (Department of Mines and Energy, 1995). This assesses how suitable an area of land is for two major rural agricultural enterprises: rainfed broadacre cropping and beef cattle grazing.

The Land Suitability assessment cross-references each soil unit's characteristics with suitability criteria from Department of Mines and Energy (1995). The Land Suitability assessment uses a five-class system, where Class 1 indicates that the land is most suitable for the enterprise and Class 5 the least suitable. The overall land suitability ranking for each specific soil unit is determined by the most severe limitation, or a combination of the varying limitations. Land is considered less suitable as the severity of limitations for a land use increases. The increasing limitations may reflect any combination of:

- Reduced potential for production;
- Increased inputs to achieve an acceptable level of production; and/or
- Increased inputs required to prevent land degradation.

The Land Suitability Classes are described in Table 4.

Table 4. Land Suitability Classes

Class	Suitability	Limitations	Description
1	Suitable	Negligible	Highly productive land requiring only simple management practices to maintain economic production.
2	Suitable	Minor	Land with limitations that either constrain production, or require more than the simple management practices of class 1 land to maintain economic production.
3	Suitable	Moderate	Land with limitations that either further constrain production, or require more than those management practices of class 2 land to maintain economic production.
4	Unsuitable	Severe	Currently unsuitable land. The limitations are so severe that the sustainable use of the land in the proposed manner is precluded. In some circumstances, the limitations may be surmountable with changes to knowledge, economics or technology.

5	Unsuitable	Extreme	Land with extreme limitations that preclude any possibility of successful sustained use of the land in the proposed manner.
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WTS' analysis provides a considered approach to land suitability assessments whereby each soil management unit's characteristics have been cross-referenced against Department of Mines and Energy (1995) and Guidelines for Agricultural Land Evaluation in Queensland (Department of Science Information Technology and Innovation and Department of Natural Resources and Mines, 2015). The overall land suitability class for each SMU is determined by the most severe limitation, or a combination of varying limiting components under both the rainfed broadacre cropping and beef cattle grazing.

5.1.1. Plant Available Water Capacity and Effective Rooting Depth

The primary land suitability assessment attribute is 'moisture'. The indicator for moisture is Plant Available Water Capacity (PAWC). PAWC is an estimate of the amount of moisture stored in the soil profile that is available for plant extraction. It is generally defined as the difference between field capacity and permanent wilting point. PAWC is calculated for the soil profile by summing the available water capacity over the soil's effective rooting depth (ERD). For the purposes of this assessment, PAWC is calculated based on the soil texture methods detailed in *How to demonstrate that land in the strategic cropping area does not meet the criteria for strategic cropping land* (Department of State Development Manufacturing Infrastructure and Planning, 2014). Soil water storage based on field texture is outlined in Table 5.

Table 5. Soil Texture Table (Department of State Development Manufacturing Infrastructure and Planning, 2014)

Soil Texture	Soil Water Storage
Sand; clayey sand; loamy sand	4 mm / 100 mm
Sandy loam	5 mm / 100 mm
Loam; silty loam; sandy clay loam	6 mm / 100 mm
Clay loam; clay loam, sandy; silty clay loam	8 mm / 100 mm
Silty clay; clays with <45% clay fraction	10 mm / 100 mm
Clays with >45% clay fraction	12 mm / 100 mm

Effective rooting depth is defined as the soil depth to which 90% of the plant roots will extract water and can be estimated through observed rooting depth, soil chemical parameters or a standardised soil rooting depth (McKenzie et al., 2008a). For the purposes of this assessment methodologies employed to determine ERD, and subsequently PAWC are determined based on guideline *How to demonstrate that land in the strategic cropping area does not meet the criteria for strategic cropping land* (Department of State Development Manufacturing Infrastructure and Planning, 2014) (Table 6).

Table 6. Effective Rooting Depth Criteria

Descriptor	ERD Limitation Threshold
Electrical Conductivity	> 0.8 dS/cm
Chloride	> 800 ppm
Sodicity	> 15%
pH	<= 5.0
Soil Structure	Moderate or strong columnar structure. Sandy free draining horizons. Significant rock content.

5.1.2. Beef Cattle Grazing

Limitations for Beef Cattle Grazing suitability on improved pastures have been assessed in accordance with Department of Mines and Energy (1995), including categories:

- Water availability;
- Nutrient deficiency;
- Soil physical factors;
- Salinity;
- Rockiness;
- Microrelief;
- pH;
- ESP;
- Wetness;
- Topography;
- Water erosion;
- Flooding; and
- Vegetation.

Note: a depth of 0.6 m has been assumed for root zone depth for any profile in which weathered rock, and/ or a salt bulge was absent as outlined in Department of Mines and Energy (1995).

5.1.2.1. Water Availability

PAWC thresholds for land suitability classes are as follows:

- **Class 1:** > 125 mm;
- **Class 2:** 100 – 125 mm;
- **Class 3:** 75 – 100 mm;
- **Class 4:** 50 – 75 mm;
- **Class 5:** <50 mm.

The thresholds stated are based on pasture generally, and do not account for specific pasture species. Land Suitability Classes are described in Table 7.

Table 7. PAWC, ERD and Land Suitability Classes

SMU	ERD (m)	PAWC (mm)	Land Suitability Class
Eutrophic Brown Dermosol, Deep	1.10	66	4
Leptic Brown Rudosol	0.2	8	5
Leptic Brown-Orthic Tenosol, Shallow	0.50	30	5
Sodic Brown Dermosol, Deep	0.50	30	5
Self-Mulching Brown Vertosol, Moderate	0.20	20	5

5.1.2.2. Nutrient Deficiency

Nutrient deficiency for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 8.

Table 8. Nutrient Deficiency

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	Brigalow, gidgee, blackwood or softwood scrub soils and former scrub soils with Bicarbonate P > 10 ppm.	1
Leptic Brown Rudosol	Euclyptus woodland on shallow soils wit Bicarbonate P <5 ppm	5
Leptic Brown-Orthic Tenosol, Shallow	Sands and loams at least 75 cm dep or overlying rock at shallow depth, with Bicarbonate P 5 – 10 ppm, or Bicarbonate P <=4 ppm.	4
Sodic Brown Dermosol, Deep	Brigalow, gidgee, blackwood or softwood scrub soils and former scrub soils with Bicarbonate P > 10 ppm.	1
Self-Mulching Brown Vertosol, Moderate	Brigalow, gidgee, blackwood or softwood scrub soils and former scrub soils with Bicarbonate P > 10 ppm.	1

5.1.2.3. Soil Physical Factors

Soil physical factors for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 9.

Table 9. Soil Physical Factors

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	Cracking clays with very fine self-mulch (peds <2mm), or Rigid soils with a loose, soft or firm surface when dry.	1
Leptic Brown Rudosol	Clay Loam with a firm surface when dry	1
Leptic Brown-Orthic Tenosol, Shallow	Cracking clays with very fine self-mulch (peds <2mm), or Rigid soils with a hard setting surface when dry.	2
Sodic Brown Dermosol, Deep	Rigid soils with a loose, soft or firm surface when dry.	1
Self-Mulching Brown Vertosol, Moderate	Cracking clays with very fine self-mulch (peds <2mm), or	1

5.1.2.4. Salinity

Salinity limitations for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 10.

Table 10. Salinity

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	Rootzone EC < 0.15 mS/cm, or Rootzone CI < 300 ppm.	1
Leptic Brown Rudosol	Rootzone EC < 0.15 mS/cm, or Rootzone CI < 300 ppm.	1
Leptic Brown-Orthic Tenosol, Shallow	Rootzone EC < 0.15 mS/cm, or Rootzone CI < 300 ppm.	1
Sodic Brown Dermosol, Deep	Rootzone EC < 0.15 mS/cm, or Rootzone CI < 300 ppm.	1
Self-Mulching Brown Vertosol, Moderate	Rootzone EC 0.15 – 0.3 mS/cm, or Rootzone CI 300 – 600 ppm.	2

5.1.2.5. Rockiness

Salinity limitations for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 11.

Table 11. Rockiness

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	<20% coarse surface gravel (>6 cm diam.) and rock outcrop.	1
Leptic Brown Rudosol	<20% coarse surface gravel (>6 cm diam.) and rock outcrop.	1
Leptic Brown-Orthic Tenosol, Shallow	<20% coarse surface gravel (>6 cm diam.) and rock outcrop.	1
Sodic Brown Dermosol, Deep	<20% coarse surface gravel (>6 cm diam.) and rock outcrop.	1
Self-Mulching Brown Vertosol, Moderate	<20% coarse surface gravel (>6 cm diam.) and rock outcrop.	1

5.1.2.6. Microrelief

Microrelief limitations for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 12.

Table 12. Microrelief

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	Melonholes cover <20% surface area (semi-circular depressions at least 30 cm deep and usually surrounded by mounds).	1
Leptic Brown Rudosol	Melonholes cover <20% surface area (semi-circular depressions at least 30 cm deep and usually surrounded by mounds)	1
Leptic Brown-Orthic Tenosol, Shallow	Melonholes cover <20% surface area (semi-circular depressions at least 30 cm deep and usually surrounded by mounds).	1
Sodic Brown Dermosol, Deep	Melonholes cover <20% surface area (semi-circular depressions at least 30 cm deep and usually surrounded by mounds).	1

Self-Mulching Brown Vertosol, Moderate	Melonholes cover <20% surface area (semi-circular depressions at least 30 cm deep and usually surrounded by mounds).	1
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5.1.2.7. pH

pH limitations for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 13.

Table 13. pH

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	5.6 – 6.6	1
Leptic Brown Rudosol	4.4	3
Leptic Brown-Orthic Tenosol, Shallow	8.0 – 9.0/ 4.5 – 5.0	3
Sodic Brown Dermosol, Deep	5.6 – 6.6	1
Self-Mulching Brown Vertosol, Moderate	5.6 – 6.6	1

5.1.2.8. Exchangeable Sodium Percentage (ESP)

ESP limitations for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 14.

Table 14. Exchangeable Sodium Percentage

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	<5.0	1
Leptic Brown Rudosol	16	4
Leptic Brown-Orthic Tenosol, Shallow	<5.0	1
Sodic Brown Dermosol, Deep	10 – 15	3
Self-Mulching Brown Vertosol, Moderate	15 – 30	4

5.1.2.9. Wetness

Wetness limitations for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 15.

Table 15. Wetness

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	Undulating terrain or elevated plains.	1
Leptic Brown Rudosol	Undulating terrain or elevated plains	1
Leptic Brown-Orthic Tenosol, Shallow	Undulating terrain or elevated plains.	1
Sodic Brown Dermosol, Deep	Low-lying level plains, or Rigid soils with strongly sodic (ESP ≥ 15) within 60 cm of the surface, or Non-sodic rigid soils with coarse pale grey and yellow mottles within 50 cm of the surface.	2
Self-Mulching Brown Vertosol, Moderate	Low-lying level plains, or Rigid soils with strongly sodic (ESP ≥ 15) within 60 cm of the surface, or Non-sodic rigid soils with coarse pale grey and yellow mottles within 50 cm of the surface.	2

5.1.2.10. Topography

Topography limitations for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 16.

Table 16. Topography

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	Strongly dissected terrain over 75% of the area preventing adequate herd management.	5
Leptic Brown Rudosol	Strongly dissected terrain over 75% of the area preventing adequate herd management.	5

Leptic Brown-Orthic Tenosol, Shallow	Strongly dissected terrain over 75% of the area preventing adequate herd management.	5
Sodic Brown Dermosol, Deep	Strongly dissected terrain over 75% of the area preventing adequate herd management.	5
Self-Mulching Brown Vertosol, Moderate	Strongly dissected terrain over 75% of the area preventing adequate herd management.	5

5.1.2.11. Water Erosion

Water erosion limitations for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 17.

Table 17. Water Erosion

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	Slopes <1% on sodic rigid soils, or Slopes on <3% on all other soils.	1
Leptic Brown Rudosol	Slopes on <3% on all other soils.	1
Leptic Brown-Orthic Tenosol, Shallow	Slopes <1% on sodic rigid soils, or	1
Sodic Brown Dermosol, Deep	Slopes on <3% on all other soils.	1
Self-Mulching Brown Vertosol, Moderate	Slopes <1% on sodic rigid soils, or	1

5.1.2.12. Flooding

Flooding limitations for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 18.

Table 18. Flooding

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	No flooding.	1
Leptic Brown Rudosol	No flooding	1
Leptic Brown-Orthic Tenosol, Shallow	No flooding.	1
Sodic Brown Dermosol, Deep	No flooding.	1
Self-Mulching Brown Vertosol, Moderate	No flooding.	1

5.1.2.13. Vegetation

Vegetation limitations for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 19.

Table 19. Vegetation

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	Eucalypt woodlands with wattle understorey, or Broad-leaved teatree woodlands.	4
Leptic Brown Rudosol	Eucalypt woodlands with wattle understorey,	4
Leptic Brown-Orthic Tenosol, Shallow	Eucalypt woodlands with wattle understorey, or	4
Sodic Brown Dermosol, Deep	Broad-leaved teatree woodlands.	4
Self-Mulching Brown Vertosol, Moderate	Eucalypt woodlands with wattle understorey, or	4

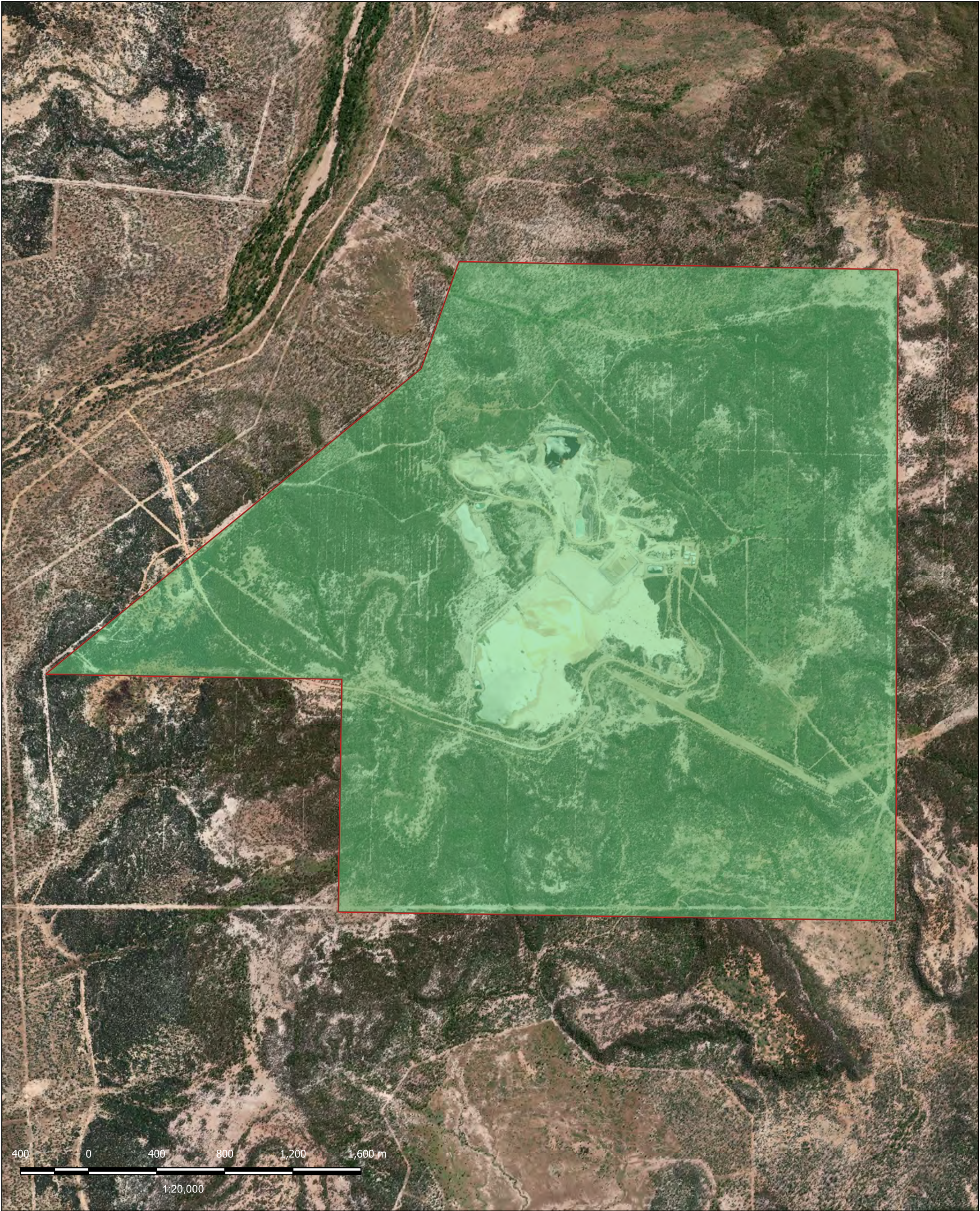
5.1.2.14. Summary of Land Suitability Class for Beef Cattle Grazing

Overall, SMUs were found to be limited by Vegetation, Water Availability and Topography. These factors combined have the potential to limit pasture and therefore livestock production across much of the Site. Vegetation is dominated by woody species on undulating terrain with highly erosive properties, making SMUs unsuitable for grazing.

No land was identified within the Site that was deemed suitable for beef cattle grazing (i.e. Class 1, 2 or 3), with approx.. 50.1 % (67.75 ha) of the Site found to require significant inputs to maintain production, 49.9 % (65.25 ha) encountering extreme limitations (Class 5) (Table 20, Figure 8).

Table 20. Summary of Land Suitability Classes for Beef Cattle Grazing

Limitation	Eutrophic Dermosol, Deep	Brown Leptic Brown Rudosol	Leptic Tenosol, Shallow	Brown-Orthic Sodic Brown Dermosol, Deep	Self-Mulching Vertosol, Moderate	Brown
Water Availability	4	5	5	5	5	
Nutrient Deficiency	1	5	4	1	1	
Soil Physical Factors	1	1	2	1	1	
Salinity	1	1	1	1	2	
Rockiness	1	1	1	1	1	
Mocirorelief	1	1	1	1	1	
pH	1	3	3	1	1	
ESP (10cm)	1	4	1	3	4	
Wetness	1	1	1	2	2	
Topography	5	5	5	5	5	
Water Erosion	1	1	1	1	1	
Flooding	1	1	1	1	1	
Vegetation	4	4	4	4	4	
Land Suitability Class	5	5	5	5	5	



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Figure 8. Land Suitability

-  Mine Lease
- Land Suitability Class
-  Class 5
- ESRI Satellite

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5.1.3. Rainfed Broadacre Cropping

Limitations for Rainfed Broadacre Cropping (Cropping) have been assessed in accordance with thresholds detailed in Department of Mines and Energy (1995), including:

- Water Availability;
- Nutrient Deficiency;
- Soil physical factors;
- Soil workability;
- Salinity;
- Rockiness;
- Microrelief;
- Wetness;
- Topography;
- Water Erosion; and
- Flooding.

Assessment of the SMUs suitability for cropping has been conducted in accordance with Department of Science Information Technology and Innovation and Department of Natural Resources and Mines (2015).

Note: a depth of 0.6 m has been assumed for root zone depth for any profile in which weathered rock, and/ or a salt bulge was absent as outlined in Department of Mines and Energy (1995).

5.1.3.1. Water Availability

PAWC thresholds for land suitability classes are as follows:

- **Class 1:** > 150 mm;
- **Class 2:** 125 - 150 mm;
- **Class 3:** 100 - 125 mm;
- **Class 4:** 75 - 100 mm;
- **Class 5:** <75 mm.

The thresholds stated are based on pasture generally, and do not account for specific pasture species. Land Suitability Classes are described in Table 21.

Table 21. PAWC, ERD and Land Suitability Class

SMU	ERD	PAWC	Land Suitability Class
Eutrophic Brown Dermosol, Deep	1.10	66	5
Leptic Brown Rudosol	0.2	8	5
Leptic Brown-Orthic Tenosol, Shallow	0.50	30	5
Sodic Brown Dermosol, Deep	0.50	30	5
Self-Mulching Brown Vertosol, Moderate	0.20	20	5

5.1.3.2. Nutrient Deficiency

Nutrient deficiency for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 22.

Table 22. Nutrient Deficiency

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	Brigalow, gidgee, blackwood or softwood scrub soils and former scrub soils with Bicarbonate P > 10 ppm.	1
Leptic Brown Rudosol	Euclyptus woodland on shallow soils wit Bicarbonate P <5 ppm	5
Leptic Brown-Orthic Tenosol, Shallow	Sands and loams at least 75 cm dep or overlying rock at shallow depth, with Bicarbonate P 5 – 10 ppm, or Bicarbonate P <=4 ppm.	4
Sodic Brown Dermosol, Deep	Brigalow, gidgee, blackwood or softwood scrub soils and former scrub soils with Bicarbonate P > 10 ppm.	1
Self-Mulching Brown Vertosol, Moderate	Brigalow, gidgee, blackwood or softwood scrub soils and former scrub soils with Bicarbonate P > 10 ppm.	1
Eutrophic Brown Dermosol, Deep	Brigalow, gidgee, blackwood or softwood scrub soils and former scrub soils with Bicarbonate P > 10 ppm.	1

5.1.3.3. Soil Physical Factors

Soil physical factors for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 23.

Table 23. Soil Physical Factors

SMU	Limitation	Land Class	Suitability
Eutrophic Brown Dermosol, Deep	Cracking clays with very fine self-mulch (peds <2mm), or Rigid soils with a loose, soft or firm surface when dry.	1	
Leptic Brown Rudosol	Clay Loam with a firm surface when dry	1	
Leptic Brown-Orthic Tenosol, Shallow	Cracking clays with very fine self-mulch (peds <2mm), or Rigid soils with a hard setting surface when dry.	2	
Sodic Brown Dermosol, Deep	Rigid soils with a loose, soft or firm surface when dry.	1	
Self-Mulching Brown Vertosol, Moderate	Cracking clays with very fine self-mulch (peds <2mm), or	1	

5.1.3.4. Soil Workability

Soil workability limitations for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 24.

Table 24. Soil Workability

SMU	Limitation	Land Class	Suitability
Eutrophic Brown Dermosol, Deep	Friable cracking clays (indicated by very fine self-mulch), or Rigid soils with a loose, soft or firm surface when dry.	1	
Leptic Brown Rudosol	Rigid soils with a loose, soft or firm surface when dry.	1	
Leptic Brown-Orthic Tenosol, Shallow	Firm cracking clays (indicated by fine self-mulch), or Rigid soils with a hard setting surface when dry.	2	
Sodic Brown Dermosol, Deep	Friable cracking clays (indicated by very fine self-mulch), or	1	

Self-Mulching Brown Vertosol, Moderate	Rigid soils with a loose, soft or firm surface when dry.	1
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5.1.3.5. Salinity

Salinity limitations for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 25.

Table 25. Salinity

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	Rootzone EC < 0.15 mS/cm, or Rootzone Cl < 300 ppm.	1
Leptic Brown Rudosol	Rootzone EC < 0.15 mS/cm, or Rootzone Cl < 300 ppm.	1
Leptic Brown-Orthic Tenosol, Shallow	Rootzone EC < 0.15 mS/cm, or Rootzone Cl < 300 ppm.	1
Sodic Brown Dermosol, Deep	Rootzone EC < 0.15 mS/cm, or Rootzone Cl < 300 ppm.	1
Self-Mulching Brown Vertosol, Moderate	Rootzone EC 0.15 – 0.3 mS/cm, or Rootzone Cl 300 – 600 ppm.	2

5.1.3.6. Rockiness

Salinity limitations for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 11.

Table 26. Rockiness

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	<20% coarse surface gravel (>6 cm diam.) and rock outcrop.	1
Leptic Brown Rudosol	<20% coarse surface gravel (>6 cm diam.) and rock outcrop.	1
Leptic Brown-Orthic Tenosol, Shallow	<20% coarse surface gravel (>6 cm diam.) and rock outcrop.	1
Sodic Brown Dermosol, Deep	<20% coarse surface gravel (>6 cm diam.) and rock outcrop.	1
Self-Mulching Brown Vertosol, Moderate	<20% coarse surface gravel (>6 cm diam.) and rock outcrop.	1

5.1.3.7. Microrelief

Microrelief limitations for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 27.

Table 27. Microrelief

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	Melonholes cover <20% surface area (semi-circular depressions at least 30 cm deep and usually surrounded by mounds).	1
Leptic Brown Rudosol	Melonholes cover <20% surface area (semi-circular depressions at least 30 cm deep and usually surrounded by mounds)	1
Leptic Brown-Orthic Tenosol, Shallow	Melonholes cover <20% surface area (semi-circular depressions at least 30 cm deep and usually surrounded by mounds).	1
Sodic Brown Dermosol, Deep	Melonholes cover <20% surface area (semi-circular depressions at least 30 cm deep and usually surrounded by mounds).	1
Self-Mulching Brown Vertosol, Moderate	Melonholes cover <20% surface area (semi-circular depressions at least 30 cm deep and usually surrounded by mounds).	1

5.1.3.8. Wetness

Wetness limitations for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 28.

Table 28. Wetness

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	Undulating terrain or elevated plains.	1
Leptic Brown Rudosol	Undulating terrain or elevated plains	1
Leptic Brown-Orthic Tenosol, Shallow	Undulating terrain or elevated plains.	1
Sodic Brown Dermosol, Deep	Low-lying level plains, or	2

SMU	Limitation	Land Suitability Class
	Rigid soils with strongly sodic (ESP ≥ 15) within 60 cm of the surface, or Non-sodic rigid soils with coarse pale grey and yellow mottles within 50 cm of the surface.	
Self-Mulching Brown Vertosol, Moderate	Low-lying level plains, or Rigid soils with strongly sodic (ESP ≥ 15) within 60 cm of the surface, or Non-sodic rigid soils with coarse pale grey and yellow mottles within 50 cm of the surface.	2

5.1.3.9. Topography

Topography limitations for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 29.

Table 29. Topography

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	Strongly dissected terrain over 75% of the area preventing adequate herd management.	5
Leptic Brown Rudosol	Strongly dissected terrain over 75% of the area preventing adequate herd management.	5
Leptic Brown-Orthic Tenosol, Shallow	Strongly dissected terrain over 75% of the area preventing adequate herd management.	5
Sodic Brown Dermosol, Deep	Strongly dissected terrain over 75% of the area preventing adequate herd management.	5
Self-Mulching Brown Vertosol, Moderate	Strongly dissected terrain over 75% of the area preventing adequate herd management.	5

5.1.3.10. Water erosion

Water erosion limitations for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 30.

Table 30. Water Erosion

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	Slopes <1% on sodic rigid soils, or Slopes on <3% on all other soils.	1
Leptic Brown Rudosol	Slopes on <3% on all other soils.	1
Leptic Brown-Orthic Tenosol, Shallow	Slopes <1% on sodic rigid soils, or	1
Sodic Brown Dermosol, Deep	Slopes on <3% on all other soils.	1
Self-Mulching Brown Vertosol, Moderate	Slopes <1% on sodic rigid soils, or	1

5.1.3.11. Flooding

Flooding limitations for each SMU is based on thresholds in Department of Mines and Energy (1995) and presented in Table 31.

Table 31. Flooding

SMU	Limitation	Land Suitability Class
Eutrophic Brown Dermosol, Deep	No flooding.	1
Leptic Brown Rudosol	No flooding	1
Leptic Brown-Orthic Tenosol, Shallow	No flooding.	1
Sodic Brown Dermosol, Deep	No flooding.	1
Self-Mulching Brown Vertosol, Moderate	No flooding.	1

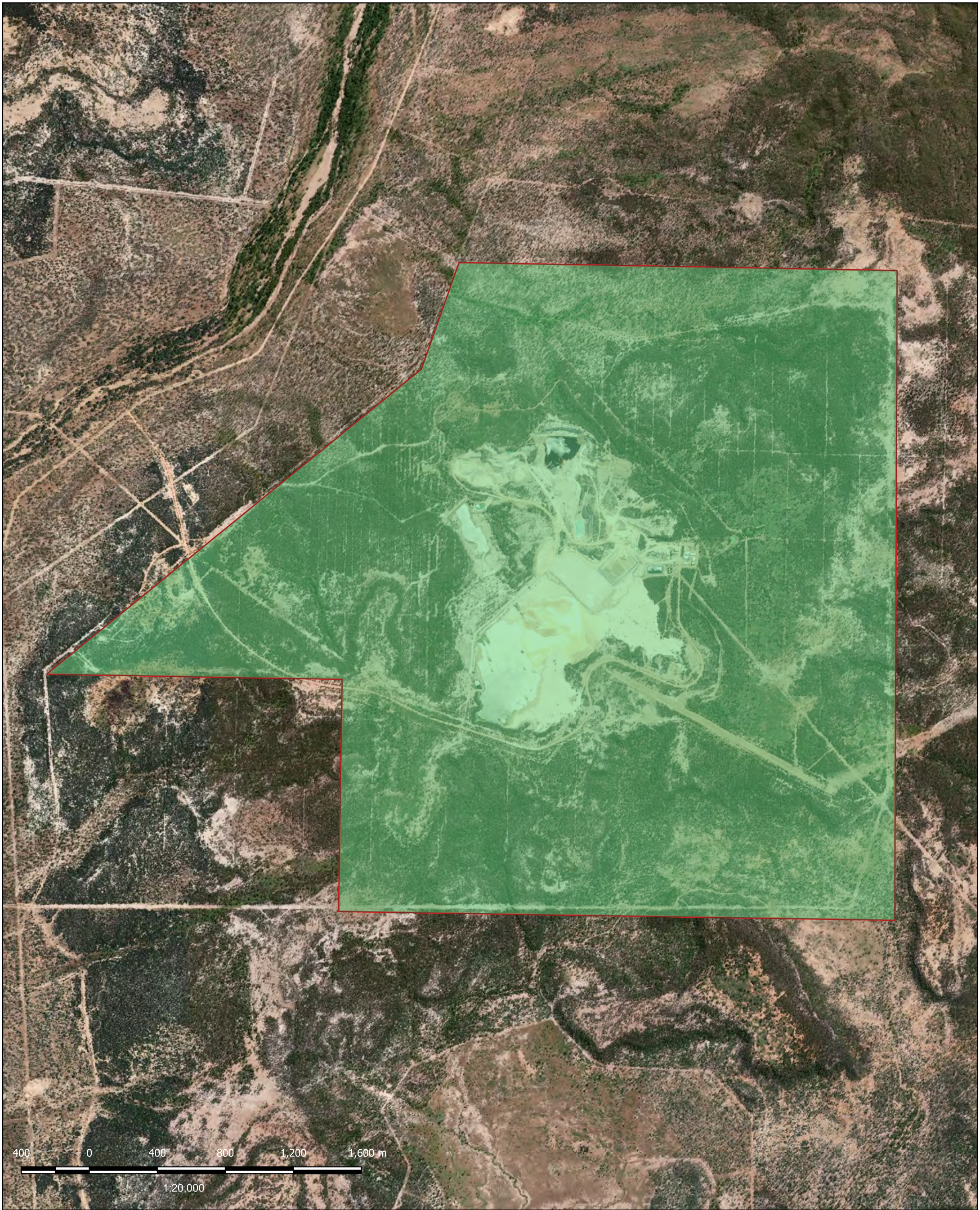
5.1.3.12. Summary of Land Suitability Class for Rainfed Broadacre Cropping

Overall, SMUs were found to be limited by Vegetation, Topography and Erosion. These factors combined have the potential to limit production across much of the Site. Vegetation is dominated by woody species on undulating terrain with highly erosive properties, making SMUs unsuitable for grazing.

No land was identified within the Site that was deemed suitable for rainfed broadacre grazing (i.e. Class 1, 2 or 3), with approx. 82.1 % (109.14 ha) of the Site found to require extreme inputs to maintain production (Class 5), 17.9 % (23.86 ha) encountering significant limitations (Class 4) (Table 32).

Table 32. Summary of Land Suitability Classes for Rainfed Broadacre Cropping

Limitation	Eutrophic Dermosol, Deep	Brown Leptic Brown Rudosol	Eutrophic Dermosol, Deep	Brown Dermosol, Deep	Eutrophic Dermosol, Deep	Brown Dermosol, Deep
Water Availability	5	5	5	5	5	5
Nutrient Deficiency	1	4	1	1	1	1
Soil Physical Factors	1	1	3	1	1	1
Soil Workability	1	1	2	1	1	1
Salinity	1	1	1	1	2	1
Rockiness	1	1	1	1	1	1
Microrelief	1	1	1	1	1	1
Wetness	1	1	1	2	2	1
Topography	1	5	2	1	1	1
Water Erosion	1	1	1	1	1	1
Flooding	1	1	1	1	1	1
Land Suitability Class	5	5	5	5	5	5



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Figure 9. Land Suitability

- Mine Lease
- Land Suitability Class
- Class 5
- ESRI Satellite

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5.2. Soil Resource Assessment

Topsoil resources are predominantly limited to surface soil horizons, with the upper horizons maintaining seedbank, micro-organisms, nutrients and organics necessary for plant growth and establishment. Generally, soil nutrients and micro-organism activity decrease with depth.

Soil resources are based on factors such as ERD, PAWC, nutrient availability, sodicity, etc. and represent the recommended maximum stripping depth for stockpiling and future rehabilitation. Generally, soil stripping should be timed based on favourable climatic conditions to avoid soil loss, compaction or erosion. Two stage stripping is recommended where sub soils may be encountered, unless topsoil can be recovered in a single pass. Topsoil resources should be placed directly onto rehabilitation areas as soon as possible to limit handling. Where stockpiling is required, it is recommended that stockpiles be shaped to no greater than 2 m high, and stabilised using suitable erosion and sediment controls (e.g. hydromulch, jute mesh, etc.).

Table 33 details the maximum soil resources stripping depths and potential volumes available for use.

Table 33. Maximum Soil Resource Stripping Depths and Potential Volumes Available

SMU	Stripping Depth (m)	SMU Area (m ²)	Potential Volume Available (m ³)
Eutrophic Brown Dermosol, Deep	1.10	1,377,800	1,515, 580
Leptic Brown Rudosol	0.2	3,652,200	730,440
Leptic Brown-Orthic Tenosol, Shallow	0.50	3,948,600	1,974,300
Sodic Brown Dermosol, Deep	0.50	1,484,000	742,000
Self-Mulching Brown Vertosol, Moderate	0.20	841,500	168,300

Respreding of soil resources should occur on prepared, reshaped areas as soon as possible. Where soil resources allow, soils should be spread to a nominal depth of 0.10 m on all re-graded spoil or disturbance areas. Soil resources should be spread with fertiliser and seed in one consecutive operation to reduce the potential for soil losses to wind and water erosion.

5.3. Land Stability

5.3.1. Soil Erosion Hazard

An assessment of soil erosion susceptibility is given in Table 34, which lists influencing factors for both soil types that have been identified.

Table 34. Soil Erosion Susceptibility

Soil Type	Sodicity	Texture	Landform	Groundcover	Erosion Susceptibility
Eutrophic Brown Dermosol, Deep	Non- Sodic	Clay Loam	Flat to gently undulated	20-50%	Low susceptibility
Leptic Brown Rudosol	Highly Sodic	Clay Loam	Flat to gently undulated	10-20%	Moderate susceptibility
Leptic Brown-Orthic Tenosol, Shallow	Non- Sodic	Loamy Silt	Flat to gently undulated	<2%	High susceptibility due sparse erosion protection
Sodic Brown Dermosol, Deep	Non sodic topsoil. Moderately sodic subsoil	Silty Loam	Flat to gently undulated	<2%	High susceptibility due sparse erosion protection
Self-Mulching Brown Vertosol, Moderate	sodic to highly sodic	Clay Loam to light/medium clay	Flat to gently undulated	20-50%	Moderate susceptibility

5.3.2. Erosion Hazard (Average Rainfall)

The International Erosion Control Association's (IECA) Best Practice Erosion and Sediment Control Guidelines (IECA 2008) sets erosion hazard based on average rainfalls for regions around Australia. IECA erosion hazard for the Charters Towers region is detailed in Table 35.

Table 35. Erosion Hazard (IECA, 2008)

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
H	H	H	L	VL	VL	VL	VL	VL	VL	L	H

5.3.3. Erosion Hazard (Calculated)

Soil erosion presents a significant hazard on downstream receptors, particularly where ground cover is disturbed, and the soil is subject to erosive agents of wind and water. Soil erosion occurs when soil particles detach and are transported off site. This detachment and subsequent entrainment of sediment is affected by a range of factors, predominantly soil erodibility and steepness of terrain. Soil Erosion Hazard has been assessed for each soil type using the RUSLE equation to determine soil loss (t/ha/yr) and assess erosion risk. The RUSLE equation is outlined below:

$$A = R \times K \times LS \times C \times P$$

Where:

A = estimated average soil loss in tons per hectare per year

R = rainfall-runoff erosivity factor

K = soil erodibility factor

L = slope length factor

S = slope steepness factor

C = cover-management factor

P = support practice factor

RUSLE calculations for each soil type are detailed in Table 36.

Table 36. RUSLE Calculations

Soil Type	R	K	LS	C	P	A
Eutrophic Brown Dermosol, Deep	1804	0.030	3.5	0.1	0.8	15.5
Leptic Brown Rudosol	1804	0.055	1.0	0.19	0.8	15.0
Leptic Brown-Orthic Tenosol, Shallow	1804	0.055	1.0	0.40	0.8	31.75
Sodic Brown Dermosol, Deep	1804	0.055	1.2	0.40	0.8	38.1
Self-Mulching Brown Vertosol, Moderate	1804	0.030	2.4	0.10	0.8	10.39

Regarding erosion risk, it is considered that:

- the average Australian rate of erosion is 6.3 t/ha/yr;
- a low rate of erosion is defined as less than (<) 0.5 t/ha/yr;
- a medium rate of erosion is defined as 0.5-10 t/ha/yr ; and
- a high rate of erosion is defined as greater than (>) 10 t/ha/yr (Lu et al. 2001).

All soil types identified at the Project, with the exception of Self-Mulching Brown Vertosol, express a high erosion risk. It is noted that high erosion rates in reflects the seasonal variance in climate, vegetation cover and seasonal rainfall. With a vegetation cover spare with coverage dominantly between <2 – 20 %, and seasonal heavy rainfall (November – April) soil may readily be lost naturally due to naturally low erosion protection. Self-Mulching Brown Vertosols have significantly higher vegetation cover and intern good erosion protection resulting in a lower erosion rate. However, erosion is still considered moderate for Self-Mulching Brown Vertosols due to soil Sodicity and the risk of dispersion where groundcover is disturbed.

5.3.4. Erosion Management

Soil erosion presents a significant hazard on downstream receptors, particularly where ground cover is disturbed, and the soil is subject to erosive agents of wind and water. Soil erosion occurs when soil particles detach and are transported off site. This detachment and subsequent entrainment of sediment is affected by a range of factors, predominantly soil erodibility and steepness of terrain.

Management recommendations to reduce the likelihood and potential impact of erosion include:

- Prioritising land clearing so as to only disturb areas necessary for development;
- Divert clean water and upstream catchments around proposed disturbances;
- Manage on site “dirty/ impacted” waters in such a way as to capture and treat sediment laden waters prior to leaving site;
- Ensure soil resources stockpiled are placed away from drainage areas, roads, machinery, transport, and grazing areas;
- Undertake progressive rehabilitation activities on landforms no longer required for operations.
- Staging the clearing activities where possible such that this is limited only in areas which are being actively cleared, therefore, limiting the time such areas are exposed;
- Erosion and Sediment Control Plans will be developed in accordance with IECA best practice guidelines such that these will highlight how far in advance vegetation clearing can be undertaken prior to construction works; and
- Develop and implement management strategies (as above) through an EM Plan and Erosion and Sediment Control Management Plan in line with all statutory legislation and regulations;
- General vegetation clearing and soil stripping should not be undertaken until earthwork and construction operations are ready to commence. All proposed erosion and sediment control measures will be implemented prior to, or in conjunction with, clearing activities.
- Prior to commencement of clearing and soil stripping, the limits of these works need to be clearly delineated by pegs placed at intervals on each side of the disturbed area by a suitably qualified supervisor.
- All operations will be planned to ensure that there is no damage to any trees, cropping or pasture areas outside the limits to be cleared.

Erosion of rehabilitated landforms/ domains reduces the potential for rehabilitation success and closure. In extreme instances, erosion can lead to the failure of structures (e.g. Tailings Storage Facility embankments), resulting in potential for environmental harm via release of sediment and contaminants to downstream receptors.

Pre-development landform is required to be re-established at post-development or post-land use as practical as possible. In areas where infrastructures maybe required for retention (i.e. dams or ponds), a provision for landform design in rehabilitation for such areas is recommended.

6. References

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Appendix A – Certificates of Analysis

CERTIFICATE OF ANALYSIS

Work Order	: EB2105900	Page	: 1 of 13
Client	: WULGURU TECHNICAL SERVICES PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: SCOTT HAYES-STANLEY	Contact	: Customer Services EB
Address	: 17 MUELLER ST WULGURU QLD 4811	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: 2021.02011 - WGM Soil Survey	Date Samples Received	: 04-Mar-2021 08:30
Order number	: ----	Date Analysis Commenced	: 08-Mar-2021
C-O-C number	: ----	Issue Date	: 22-Mar-2021 14:17
Sampler	: SCOTT HAYES-STANLEY		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 23		
No. of samples analysed	: 23		



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.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Inorganics, Stafford, QLD
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Mark Hallas	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Mark Hallas	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 Contact 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.

- ED007 (Exchangeable Cations): Unable to calculate Magnesium/Potassium Ratio for sample S11_30_50 (EB2105900-015) as the required results for Magnesium/Potassium are below limit of reporting.
- EA150H: Soil particle density results fell outside the scope of AS1289.3.6.3. Results should be scrutinised accordingly.
- ALS is not NATA accredited for the analysis of Exchangeable Aluminium and Exchange Acidity in soils when performed under ALS Method ED005.
- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- EK067G: EB2105900 #2 Poor matrix spike recovery for TP due to matrix effects.
- EG005T (Total Metals by ICP-AES): Sample S4_0_30 (EB2105900_001) shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- ED007 (Exchangeable Cations by ICP-AES): Unable to calculate Exchangeable Percent results for sample S12_40_60 (E EB2105900-019) as required Calcium, Magnesium, Potassium & Sodium results are less than the limit of reporting.
- ED007 (Exchangeable Cations by ICP-AES): Unable to calculate Magnesium/Potassium Ratio for some samples as required Exchangeable Magnesium and/or Potassium results are less than the limit of reporting.
- ED007 (Exchangeable Cations by ICP-AES): Unable to calculate Calcium/Magnesium Ratio for some samples as required Exchangeable Calcium and/or Magnesium results are less than the limit of reporting.
- ED007 (Exchangeable Cations by ICP-AES): Limit of reporting has been raised some samples due to matrix interference.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H⁺ + Al³⁺).



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	S4_0_30	S4_30_50	S4_50_80	S4_80_110	S6_0_10
Sampling date / time					28-Feb-2021 00:00	28-Feb-2021 00:00	28-Feb-2021 00:00	28-Feb-2021 00:00	01-Mar-2021 00:00
Compound	CAS Number	LOR	Unit		EB2105900-001	EB2105900-002	EB2105900-003	EB2105900-004	EB2105900-005
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		5.3	5.7	5.8	6.0	4.4
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		15	12	12	12	234
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		5.0	5.1	4.8	5.0	6.9
EA150: Particle Sizing									
+75µm	----	1	%		44	49	49	53	33
+150µm	----	1	%		37	42	41	44	25
+300µm	----	1	%		29	33	32	33	19
+425µm	----	1	%		24	28	26	26	17
+600µm	----	1	%		19	22	20	20	14
+1180µm	----	1	%		8	10	8	8	9
+2.36mm	----	1	%		2	3	2	3	5
+4.75mm	----	1	%		1	1	<1	<1	2
+9.5mm	----	1	%		<1	<1	<1	<1	<1
+19.0mm	----	1	%		<1	<1	<1	<1	<1
+37.5mm	----	1	%		<1	<1	<1	<1	<1
+75.0mm	----	1	%		<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%		15	23	12	14	27
Silt (2-60 µm)	----	1	%		38	26	37	31	37
Sand (0.06-2.00 mm)	----	1	%		43	46	47	51	30
Gravel (>2mm)	----	1	%		4	5	4	4	6
Cobbles (>6cm)	----	1	%		<1	<1	<1	<1	<1
EA152: Soil Particle Density									
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3		2.40	2.66	2.50	2.60	2.43
ED005: Exchange Acidity									
Ø Exchange Acidity	----	0.1	meq/100g		<0.1	<0.1	<0.1	<0.1	1.9
Ø Exchangeable Aluminium	----	0.1	meq/100g		<0.1	<0.1	<0.1	<0.1	1.5
ED007: Exchangeable Cations									
Exchangeable Calcium	----	0.1	meq/100g		2.2	2.3	2.4	1.7	0.5
Exchangeable Magnesium	----	0.1	meq/100g		0.9	0.9	1.0	1.5	0.7
Exchangeable Potassium	----	0.1	meq/100g		<0.1	<0.1	<0.1	0.1	0.2
Exchangeable Sodium	----	0.1	meq/100g		<0.1	<0.1	<0.1	<0.1	0.3



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	S4_0_30	S4_30_50	S4_50_80	S4_80_110	S6_0_10
Sampling date / time					28-Feb-2021 00:00	28-Feb-2021 00:00	28-Feb-2021 00:00	28-Feb-2021 00:00	01-Mar-2021 00:00
Compound	CAS Number	LOR	Unit		EB2105900-001	EB2105900-002	EB2105900-003	EB2105900-004	EB2105900-005
					Result	Result	Result	Result	Result
ED007: Exchangeable Cations - Continued									
Cation Exchange Capacity	----	0.1	meq/100g		3.3	3.2	3.5	3.3	3.6
Exchangeable Sodium Percent	----	0.1	%		<0.1	<0.1	<0.1	<0.1	16.2
Calcium/Magnesium Ratio	----	0.1	-		2.4	2.6	2.4	1.1	0.7
Magnesium/Potassium Ratio	----	0.1	-		----	----	----	13.9	4.2
ED040: Sulfur as SO4 2-									
Sulfate as SO4 2-	14808-79-8	100	mg/kg		110	<100	<100	<100	220
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.03	0.03	0.03	0.03	0.02
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	10	mg/kg		<10	<10	<10	<10	120
EG005(ED093)T: Total Metals by ICP-AES									
Iron	7439-89-6	50	mg/kg		4240	7450	3380	6470	5050
Arsenic	7440-38-2	5	mg/kg		<5	6	<5	6	<5
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		6	6	6	6	2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Lead	7439-92-1	5	mg/kg		7	10	6	10	8
Nickel	7440-02-0	2	mg/kg		<2	<2	<2	<2	<2
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<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
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		1.0	0.6	0.7	0.6	69.4
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg		490	350	310	260	1100
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg		490	350	310	260	1170
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	2	mg/kg		117	101	95	82	104
EK080: Bicarbonate Extractable Phosphorus (Colwell)									
Bicarbonate Ext. P (Colwell)	----	5	mg/kg		<5	<5	<5	<5	<5
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%		0.83	0.78	0.84	0.63	1.98



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	S6_10_20	S9_0_20	S9_20_40	S9_40_70	S9_70_90
Sampling date / time					01-Mar-2021 00:00	01-Mar-2021 00:00	01-Mar-2021 00:00	01-Mar-2021 00:00	01-Mar-2021 00:00
Compound	CAS Number	LOR	Unit		EB2105900-006	EB2105900-007	EB2105900-008	EB2105900-009	EB2105900-010
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		4.4	5.1	5.1	5.3	5.5
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		142	76	64	60	49
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		6.6	5.0	3.8	3.9	3.7
EA150: Particle Sizing									
+75µm	----	1	%		33	68	66	66	66
+150µm	----	1	%		24	55	54	55	57
+300µm	----	1	%		19	41	35	38	41
+425µm	----	1	%		17	32	25	28	33
+600µm	----	1	%		14	25	18	21	26
+1180µm	----	1	%		11	14	8	10	15
+2.36mm	----	1	%		7	7	3	3	6
+4.75mm	----	1	%		4	2	<1	<1	1
+9.5mm	----	1	%		<1	<1	<1	<1	<1
+19.0mm	----	1	%		<1	<1	<1	<1	<1
+37.5mm	----	1	%		<1	<1	<1	<1	<1
+75.0mm	----	1	%		<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%		18	13	12	12	7
Silt (2-60 µm)	----	1	%		46	19	20	20	24
Sand (0.06-2.00 mm)	----	1	%		28	59	63	63	60
Gravel (>2mm)	----	1	%		8	9	5	5	9
Cobbles (>6cm)	----	1	%		<1	<1	<1	<1	<1
EA152: Soil Particle Density									
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3		2.41	2.53	2.43	2.46	2.48
ED005: Exchange Acidity									
Ø Exchange Acidity	----	0.1	meq/100g		2.1	0.1	0.2	<0.1	<0.1
Ø Exchangeable Aluminium	----	0.1	meq/100g		1.8	<0.1	<0.1	<0.1	<0.1
ED007: Exchangeable Cations									
Exchangeable Calcium	----	0.1	meq/100g		0.2	1.5	1.6	1.9	1.8
Exchangeable Magnesium	----	0.1	meq/100g		0.4	0.7	1.1	1.4	1.5
Exchangeable Potassium	----	0.1	meq/100g		0.2	0.3	0.2	0.2	0.1
Exchangeable Sodium	----	0.1	meq/100g		<0.1	<0.1	<0.1	<0.1	<0.1



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	S6_10_20	S9_0_20	S9_20_40	S9_40_70	S9_70_90
Sampling date / time					01-Mar-2021 00:00	01-Mar-2021 00:00	01-Mar-2021 00:00	01-Mar-2021 00:00	01-Mar-2021 00:00
Compound	CAS Number	LOR	Unit		EB2105900-006	EB2105900-007	EB2105900-008	EB2105900-009	EB2105900-010
					Result	Result	Result	Result	Result
ED007: Exchangeable Cations - Continued									
Cation Exchange Capacity	----	0.1	meq/100g		2.9	2.6	3.1	3.4	3.4
Exchangeable Sodium Percent	----	0.1	%		<0.1	<0.1	<0.1	<0.1	<0.1
Calcium/Magnesium Ratio	----	0.1	-		0.5	2.1	1.4	1.4	1.2
Magnesium/Potassium Ratio	----	0.1	-		2.4	2.2	4.3	7.7	13.0
ED040: Sulfur as SO4 2-									
Sulfate as SO4 2-	14808-79-8	100	mg/kg		140	<100	<100	<100	<100
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.02	0.02	0.01	0.02	0.01
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	10	mg/kg		70	10	<10	<10	<10
EG005(ED093)T: Total Metals by ICP-AES									
Iron	7439-89-6	50	mg/kg		6200	9020	7910	8200	7140
Arsenic	7440-38-2	5	mg/kg		<5	<5	5	5	<5
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Lead	7439-92-1	5	mg/kg		9	7	8	8	7
Nickel	7440-02-0	2	mg/kg		<2	<2	<2	<2	<2
Zinc	7440-66-6	5	mg/kg		<5	15	14	13	12
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		36.6	29.2	29.8	29.6	24.9
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg		890	410	290	250	200
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg		930	440	320	280	220
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	2	mg/kg		99	139	120	108	112
EK080: Bicarbonate Extractable Phosphorus (Colwell)									
Bicarbonate Ext. P (Colwell)	----	5	mg/kg		5	<5	<5	<5	<5
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%		1.46	0.57	0.54	0.42	0.65



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	S10_0_30	S10_30_50	S11_0_10	S11_10_30	S11_30_50
Sampling date / time					28-Feb-2021 00:00	28-Feb-2021 00:00	01-Mar-2021 00:00	01-Mar-2021 00:00	01-Mar-2021 00:00
Compound	CAS Number	LOR	Unit		EB2105900-011	EB2105900-012	EB2105900-013	EB2105900-014	EB2105900-015
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		4.9	4.7	6.2	6.4	6.1
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		20	19	13	22	87
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		3.3	2.8	8.0	4.5	5.8
EA150: Particle Sizing									
+75µm	----	1	%		47	47	62	67	59
+150µm	----	1	%		40	40	56	62	54
+300µm	----	1	%		31	32	48	56	49
+425µm	----	1	%		25	27	42	52	44
+600µm	----	1	%		19	20	35	46	38
+1180µm	----	1	%		6	7	18	29	21
+2.36mm	----	1	%		<1	<1	3	12	4
+4.75mm	----	1	%		<1	<1	<1	3	<1
+9.5mm	----	1	%		<1	<1	<1	<1	<1
+19.0mm	----	1	%		<1	<1	<1	<1	<1
+37.5mm	----	1	%		<1	<1	<1	<1	<1
+75.0mm	----	1	%		<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%		12	15	6	10	14
Silt (2-60 µm)	----	1	%		37	36	29	22	24
Sand (0.06-2.00 mm)	----	1	%		49	47	57	51	52
Gravel (>2mm)	----	1	%		2	2	8	17	10
Cobbles (>6cm)	----	1	%		<1	<1	<1	<1	<1
EA152: Soil Particle Density									
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3		2.54	2.70	2.58	2.62	2.54
ED005: Exchange Acidity									
Ø Exchange Acidity	----	0.1	meq/100g		0.8	1.1	----	----	----
Ø Exchangeable Aluminium	----	0.1	meq/100g		0.6	0.8	----	----	----
ED007: Exchangeable Cations									
Exchangeable Calcium	----	0.1	meq/100g		0.7	0.2	4.3	3.0	1.3
Exchangeable Magnesium	----	0.1	meq/100g		<0.1	<0.1	1.2	1.8	4.6
Exchangeable Potassium	----	0.1	meq/100g		<0.1	<0.1	0.3	0.1	<0.1
Exchangeable Sodium	----	0.1	meq/100g		<0.1	<0.1	0.2	0.6	2.5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	S10_0_30	S10_30_50	S11_0_10	S11_10_30	S11_30_50
Sampling date / time					28-Feb-2021 00:00	28-Feb-2021 00:00	01-Mar-2021 00:00	01-Mar-2021 00:00	01-Mar-2021 00:00
Compound	CAS Number	LOR	Unit		EB2105900-011	EB2105900-012	EB2105900-013	EB2105900-014	EB2105900-015
					Result	Result	Result	Result	Result
ED007: Exchangeable Cations - Continued									
Cation Exchange Capacity	----	0.1	meq/100g		1.5	1.3	6.0	5.6	8.6
Exchangeable Sodium Percent	----	0.1	%		<0.1	<0.1	2.9	11.0	29.3
Calcium/Magnesium Ratio	----	0.1	-		----	----	3.6	1.7	0.3
Magnesium/Potassium Ratio	----	0.1	-		----	----	4.6	17.9	----
ED040: Sulfur as SO4 2-									
Sulfate as SO4 2-	14808-79-8	100	mg/kg		<100	<100	<100	<100	<100
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.01	0.01	<0.01	<0.01	<0.01
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	10	mg/kg		10	10	<10	10	50
EG005(ED093)T: Total Metals by ICP-AES									
Iron	7439-89-6	50	mg/kg		4720	4340	11200	10800	9800
Arsenic	7440-38-2	5	mg/kg		<5	<5	<5	<5	<5
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		4	4	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Lead	7439-92-1	5	mg/kg		8	9	9	12	8
Nickel	7440-02-0	2	mg/kg		<2	<2	<2	<2	<2
Zinc	7440-66-6	5	mg/kg		<5	<5	17	18	17
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		1.2	0.6	4.5	5.8	12.6
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg		350	270	460	270	270
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg		350	270	460	280	280
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	2	mg/kg		71	78	110	82	87
EK080: Bicarbonate Extractable Phosphorus (Colwell)									
Bicarbonate Ext. P (Colwell)	----	5	mg/kg		<5	<5	<5	<5	<5
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%		0.46	0.29	0.43	0.26	0.14



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	S11_50_70	S12_0_20	S12_20_40	S12_40_60	S14_0_20
Sampling date / time					01-Mar-2021 00:00	01-Mar-2021 00:00	01-Mar-2021 00:00	01-Mar-2021 00:00	28-Feb-2021 00:00
Compound	CAS Number	LOR	Unit		EB2105900-016	EB2105900-017	EB2105900-018	EB2105900-019	EB2105900-020
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		6.0	4.5	4.5	4.4	6.4
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		108	15	14	17	60
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		6.6	7.5	8.0	8.8	8.8
EA150: Particle Sizing									
+75µm	----	1	%		53	54	48	43	27
+150µm	----	1	%		47	44	39	35	21
+300µm	----	1	%		41	34	29	28	14
+425µm	----	1	%		36	26	23	23	11
+600µm	----	1	%		31	18	17	19	8
+1180µm	----	1	%		18	5	6	9	3
+2.36mm	----	1	%		4	<1	<1	<1	<1
+4.75mm	----	1	%		<1	<1	<1	<1	<1
+9.5mm	----	1	%		<1	<1	<1	<1	<1
+19.0mm	----	1	%		<1	<1	<1	<1	<1
+37.5mm	----	1	%		<1	<1	<1	<1	<1
+75.0mm	----	1	%		<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%		24	25	28	36	29
Silt (2-60 µm)	----	1	%		21	20	22	19	43
Sand (0.06-2.00 mm)	----	1	%		47	53	48	42	27
Gravel (>2mm)	----	1	%		8	2	2	3	1
Cobbles (>6cm)	----	1	%		<1	<1	<1	<1	<1
EA152: Soil Particle Density									
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3		2.58	2.60	2.53	2.61	2.65
ED005: Exchange Acidity									
Ø Exchange Acidity	----	0.1	meq/100g		0.4	1.8	2.0	1.8	----
Ø Exchangeable Aluminium	----	0.1	meq/100g		0.1	1.5	1.8	1.8	----
ED007: Exchangeable Cations									
Exchangeable Calcium	----	0.1	meq/100g		0.8	<0.1	<0.1	<0.1	1.9
Exchangeable Magnesium	----	0.1	meq/100g		5.1	<0.1	<0.1	<0.1	2.3
Exchangeable Potassium	----	0.1	meq/100g		<0.1	0.1	<0.1	<0.1	0.1
Exchangeable Sodium	----	0.1	meq/100g		2.9	<0.1	<0.1	<0.1	0.4



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	S11_50_70	S12_0_20	S12_20_40	S12_40_60	S14_0_20
Sampling date / time					01-Mar-2021 00:00	01-Mar-2021 00:00	01-Mar-2021 00:00	01-Mar-2021 00:00	28-Feb-2021 00:00
Compound	CAS Number	LOR	Unit		EB2105900-016	EB2105900-017	EB2105900-018	EB2105900-019	EB2105900-020
					Result	Result	Result	Result	Result
ED007: Exchangeable Cations - Continued									
Cation Exchange Capacity	----	0.1	meq/100g		9.2	1.9	2.0	1.8	4.9
Exchangeable Sodium Percent	----	0.1	%		32.4	<0.1	<0.1	----	8.8
Calcium/Magnesium Ratio	----	0.1	-		0.2	----	----	----	0.8
Magnesium/Potassium Ratio	----	0.1	-		----	<0.1	----	----	18.9
ED040: Sulfur as SO4 2-									
Sulfate as SO4 2-	14808-79-8	100	mg/kg		<100	110	130	110	260
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		<0.01	0.02	0.02	0.02	0.04
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	10	mg/kg		80	<10	20	<10	50
EG005(ED093)T: Total Metals by ICP-AES									
Iron	7439-89-6	50	mg/kg		7950	2020	2800	3760	620
Arsenic	7440-38-2	5	mg/kg		<5	<5	<5	<5	<5
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		<2	2	3	4	2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Lead	7439-92-1	5	mg/kg		7	<5	<5	<5	<5
Nickel	7440-02-0	2	mg/kg		<2	<2	<2	<2	<2
Zinc	7440-66-6	5	mg/kg		12	<5	<5	<5	<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
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		11.4	2.5	1.6	0.4	1.1
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg		160	960	810	430	710
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg		170	960	810	430	710
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	2	mg/kg		77	119	127	118	199
EK080: Bicarbonate Extractable Phosphorus (Colwell)									
Bicarbonate Ext. P (Colwell)	----	5	mg/kg		<5	<5	<5	<5	<5
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%		0.17	1.55	1.13	0.49	0.83



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	S14_20_50	S14_50_80	S14_80_100	----	----
Sampling date / time					28-Feb-2021 00:00	28-Feb-2021 00:00	28-Feb-2021 00:00	----	----
Compound	CAS Number	LOR	Unit		EB2105900-021	EB2105900-022	EB2105900-023	-----	-----
				Result	Result	Result	Result	----	----
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		6.4	6.4	6.6	----	----
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		222	226	265	----	----
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		11.2	11.1	10.5	----	----
EA150: Particle Sizing									
+75µm	----	1	%		18	22	27	----	----
+150µm	----	1	%		13	14	19	----	----
+300µm	----	1	%		9	9	12	----	----
+425µm	----	1	%		7	6	9	----	----
+600µm	----	1	%		5	4	6	----	----
+1180µm	----	1	%		2	1	3	----	----
+2.36mm	----	1	%		<1	<1	2	----	----
+4.75mm	----	1	%		<1	<1	1	----	----
+9.5mm	----	1	%		<1	<1	<1	----	----
+19.0mm	----	1	%		<1	<1	<1	----	----
+37.5mm	----	1	%		<1	<1	<1	----	----
+75.0mm	----	1	%		<1	<1	<1	----	----
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%		47	44	43	----	----
Silt (2-60 µm)	----	1	%		34	34	29	----	----
Sand (0.06-2.00 mm)	----	1	%		18	22	26	----	----
Gravel (>2mm)	----	1	%		1	<1	2	----	----
Cobbles (>6cm)	----	1	%		<1	<1	<1	----	----
EA152: Soil Particle Density									
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3		2.71	2.57	2.53	----	----
ED007: Exchangeable Cations									
Exchangeable Calcium	----	0.1	meq/100g		1.4	1.2	1.0	----	----
Exchangeable Magnesium	----	0.1	meq/100g		2.9	2.7	2.5	----	----
Exchangeable Potassium	----	0.1	meq/100g		0.1	0.2	0.2	----	----
Exchangeable Sodium	----	0.1	meq/100g		1.4	1.5	1.7	----	----
Cation Exchange Capacity	----	0.1	meq/100g		5.9	5.7	5.5	----	----
Exchangeable Sodium Percent	----	0.1	%		23.6	26.7	31.7	----	----
Calcium/Magnesium Ratio	----	0.1	-		0.5	0.4	0.4	----	----



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	S14_20_50	S14_50_80	S14_80_100	----	----
Sampling date / time					28-Feb-2021 00:00	28-Feb-2021 00:00	28-Feb-2021 00:00	----	----
Compound	CAS Number	LOR	Unit		EB2105900-021	EB2105900-022	EB2105900-023	-----	-----
				Result	Result	Result	Result	----	----
ED007: Exchangeable Cations - Continued									
Magnesium/Potassium Ratio	----	0.1	-		22.6	17.2	16.8	----	----
ED040: Sulfur as SO4 2-									
Sulfate as SO4 2-	14808-79-8	100	mg/kg		520	390	360	----	----
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.04	0.04	0.04	----	----
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	10	mg/kg		300	340	400	----	----
EG005(ED093)T: Total Metals by ICP-AES									
Iron	7439-89-6	50	mg/kg		840	650	1760	----	----
Arsenic	7440-38-2	5	mg/kg		<5	<5	<5	----	----
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	----	----
Chromium	7440-47-3	2	mg/kg		3	<2	<2	----	----
Copper	7440-50-8	5	mg/kg		<5	<5	<5	----	----
Lead	7439-92-1	5	mg/kg		6	<5	<5	----	----
Nickel	7440-02-0	2	mg/kg		<2	<2	<2	----	----
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	<0.1	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		0.5	0.4	0.2	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg		390	390	200	----	----
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg		390	390	200	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	2	mg/kg		170	185	136	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)									
Bicarbonate Ext. P (Colwell)	----	5	mg/kg		<5	<5	<5	----	----
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%		0.28	0.24	0.11	----	----

Page : 13 of 13
Work Order : EB2105900
Client : WULGURU TECHNICAL SERVICES PTY LTD
Project : 2021.02011 - WGM Soil Survey



Inter-Laboratory Testing

Analysis conducted by ALS Melbourne, NATA accreditation no. 825, site no. 13778 (Chemistry).

(SOIL) EK067G: Total Phosphorus as P by Discrete Analyser

(SOIL) EK062: Total Nitrogen as N (TKN + NOx)

(SOIL) EK061G: Total Kjeldahl Nitrogen By Discrete Analyser

Appendix C: Community Consultation Management Plan



COMMUNITY CONSULTATION MANAGEMENT PLAN

WIRRALIE GOLD MINE

SOLOMONS GOLD PTY LTD

**ENVIRONMENTAL AUTHORITY: EPML00772413
MINING LEASE: 1079**

AUGUST 2022

PREPARED FOR: DEPARTMENT OF
ENVIRONMENT AND SCIENCE
PREPARED BY: WULGURU TECHNICAL
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Document Control and History

Version	Date	Description	Prepared By	Reviewed By
1.0	21/06/2022	Final	Travis Bailey	Matthew Ayre

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1. Introduction

1.1. Overview

Wirralie Gold Project (Wirralie) is owned and operated by Solomons Gold Pty Ltd (Solomons Gold). Wirralie is operating under an active Environmental Authority EMPL00772413 (the EA). Wulguru Technical Services Pty Ltd (WTS) was engaged by Solomons Gold, owner and operator of Wirralie, to prepare a Progressive Rehabilitation and Closure Plan (PRCP) for activities conducted under Environmental Authority EPML00772413 (the EA). This Community Consultation Management Plan (CCMP) forms part of the PRCP.

This document details how the community consultation in relation to rehabilitation will be carried out under the PRCP. Solomons Gold has considered the Department of Environment and Science (DES) Guideline ESR/2019/4964 – *Progressive rehabilitation and closure plans (PRC plans)*, Version 2.00 – 17 March 2021.

1.2. Scope

The CCMP applies to all Solomons Gold employees, contractors, visitors, and processes at the Project.

1.3. Purpose

Social license is a valued element of the Wirralie operation. Solomons Gold aims to enhance social outcomes in the surrounding region in which they operate. To achieve this, Wirralie will target local employment, engagement, and spending as a priority with a view to promote sustainable development of the local workforce and businesses.

1.4. Accountabilities

Solomons Gold management is ultimately responsible for this CCMP. To fulfill this responsibility, Solomons Gold may delegate tasks to the Senior Representative and, where required, will coordinate with other site personnel.

1.5. Project Description

Wirralie is located approximately 40km north of the township of Mount Coolon, and approximately 200km west of Mackay, North Queensland. Wirralie is an owner-operated mine, with approximately 10 staff. Personnel living locally are given preference to those on DIDO rosters, where suitably experienced/qualified.

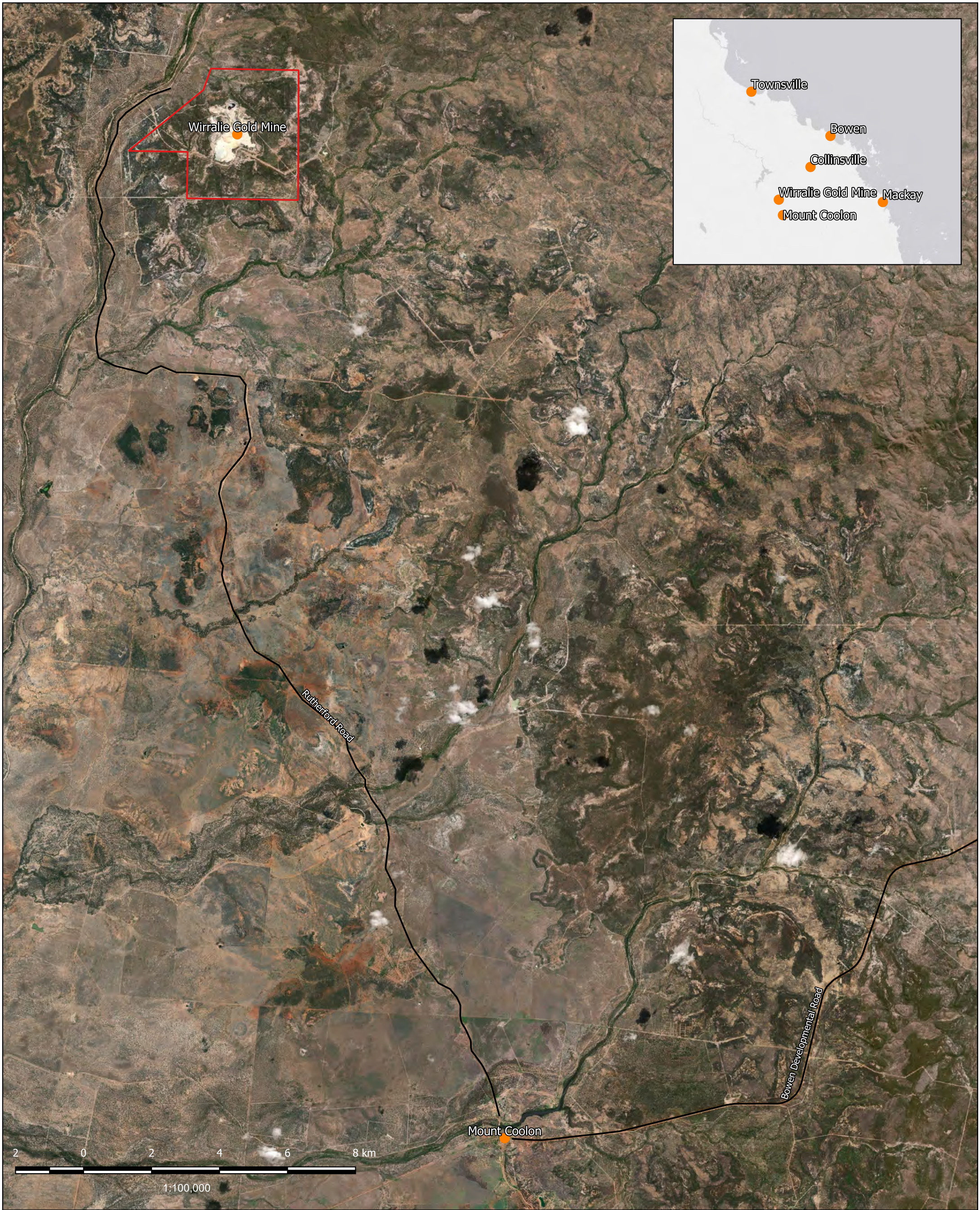
The region is administered by the Whitsunday Regional Council and is located in a primarily rural zone, consistent the Whitsunday Regional Council Planning Scheme. The main access route to the Project is via Rutherford Road and the Bowen or Suttor Developmental Roads.

Wirralie was discovered in 1986 during exploration activities to identify the source to a regional stream sediment-sampling anomaly. Mining began at the Project in 1987 and continued until 1993, when the processing plant was relocated to the Yandan mine site, 30km west. An upgraded 1.5 million tonne per annum treatment plant was reinstated at Wirralie in 1999. The plant treated low-grade oxide and Deep Lead mineralisation until early 2002, when the site was placed in care and maintenance.

Solomons Gold acquired the Wirralie Project in December 2013 and continued to manage the site in care and maintenance. Wirralie is an owner-operated mine and currently employs approximately 10 staff. Personnel living locally are given preference to those on DIDO rosters, where suitably experienced and qualified.

Table 1. Property Description

Company Name - ACN	Solomons Gold Pty Ltd – 82 601 398 841
Landholders	Wirralie Station
Lot on Plan	Lot 3272 on Plan SP237696
Property Size	20,100 ha
Local Government Area	Whitsunday Regional Council
Zoning Information	Freehold



Client: Solomons Gold Pty Ltd
Project number: 2020.10003
CRS: GDA2020 z54
Date: 15 December 2021

Print as A3



Figure 1. Project Location

- Key Features
 - Major Roads
 - Mine Lease
- ESRI Satellite

Disclaimer:
Whilst every effort and care has been taken to ensure the accuracy of this report, Wulguru Technical Services Pty Ltd makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incur as a result of the product being inaccurate or incomplete in any way and for any reason.
Digital data for this report is available on the Queensland Government Spatial Portal at <http://www.information.qld.gov.au>.



2. Relevant Legislation

2.1. *Environmental Protection Act 1994*

The *Environmental Protection Act 1994* (Qld) (EP Act) is Queensland's primary piece of environmental legislation. The object of the EP Act is to 'protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends'. 'Environment' is defined under the EP Act as:

- Ecosystems and their constituent parts, including people and communities;
- All natural and physical resources;
- The qualities and characteristics of locations, places and areas, however large or small, that contribute to their biological diversity and integrity, intrinsic or attributed scientific value or interest, amenity, harmony and sense of community
- The social, economic, aesthetic and cultural conditions that affect, or are affected by, things mentioned in paragraphs (a) to (c) (Queensland Government, 1994)

To ensure the protection of Environmental Values, Solomons Gold is required to ensure they meet the requirements of the EP Act and its subordinate legislations (Queensland Government, 1994).

2.1.1. Environmental Authority

ERAs are industrial, resource or intensive agricultural activities with the potential to release contaminants into the environment. To conduct an ERA in Queensland, the operator of the ERA is required to obtain an Environmental Authority (EA) which sets out a range of conditions of which the operator of the ERA is required to be in compliance with. Solomons Gold currently hold EA EPML00772413 for the Wirralie Gold Mine. EA conditions F and G relevant to this CCMP and are

Shown	in	Table	2.
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Table 2. Relevant EA Conditions

Condition	Description																																																		
(F1-1)	All areas significantly disturbed by mining activities must be rehabilitated to a stable landform with a self-sustaining vegetation cover in accordance with Schedule F Table 1. Schedule F - Table 1 (Final Land Use and Rehabilitation Approval Schedule) <table><tr><th>Tenure ID</th><th>Disturbance type</th><th>Projective surface area (ha)</th><th>Post-mine land description</th><th>Post mine land classification</th></tr><tr><td rowspan="11">ML1107</td><td>Tailings Dam</td><td>72</td><td>Open Pasture</td><td>VII</td></tr><tr><td>Infrastructure</td><td>69</td><td>Open Pasture</td><td>VII</td></tr><tr><td>Waste Dump</td><td>22</td><td>Low Hill</td><td>VII</td></tr><tr><td>Exploration</td><td>19</td><td>Open Pasture</td><td>VII</td></tr><tr><td>Open Cut Pit</td><td>19</td><td>Open void</td><td>VIII</td></tr><tr><td>Stockpile Area</td><td>14</td><td>Open Pasture</td><td>VII</td></tr><tr><td>Village</td><td>12</td><td>Low Hill</td><td>VII</td></tr><tr><td>Borrow Pit</td><td>8</td><td>Open Pasture</td><td>VII</td></tr><tr><td>Processing Plant</td><td>7</td><td>Open Pasture</td><td>VII</td></tr><tr><td>Runoff dam</td><td>5</td><td>Water Storage</td><td>VIII</td></tr><tr><td>ROM Pad</td><td>3</td><td>Low Hill</td><td>VII</td></tr></table>	Tenure ID	Disturbance type	Projective surface area (ha)	Post-mine land description	Post mine land classification	ML1107	Tailings Dam	72	Open Pasture	VII	Infrastructure	69	Open Pasture	VII	Waste Dump	22	Low Hill	VII	Exploration	19	Open Pasture	VII	Open Cut Pit	19	Open void	VIII	Stockpile Area	14	Open Pasture	VII	Village	12	Low Hill	VII	Borrow Pit	8	Open Pasture	VII	Processing Plant	7	Open Pasture	VII	Runoff dam	5	Water Storage	VIII	ROM Pad	3	Low Hill	VII
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(F4-1)	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. Note: This is not applicable where the landowner/ holder is also the environmental authority holder.																																																		
(G1-1)	All complaints received must be recorded including details of complainant, reasons for the complaint, investigations undertaken, conclusions formed and actions taken. This information must be made available for inspection by the administering authority on request.																																																		

3. Community Consultation

3.1. Stakeholders

Initial scoping has identified key stakeholders to who would be potentially directly and/or indirectly affected by rehabilitation activities at Wirralie. The stakeholders that are available to participate in the consultation process are summarised in Table 3.

Table 3. Key Stakeholders

Community Stakeholder	Details	Potential Issues
Relevant Community Stakeholders		
Wirralie Station	Wirralie Gold Mine is on Wirralie Station. Land within the ML is used for grazing. Compensation Agreements are in place between Solomons Gold and Wirralie Station.	• Access to agistment land under Wirralie MLs not required for mining • Future access to land covered by the ML • Rehabilitation outcomes • Environmental issues and management • Water access
Traditional owners	The Jangga people are the traditional owners of the land on which Wirralie is situated. During 2012 a Native Title claim for the region was implemented (Fed Court NoQUD6230/1998).	• Cultural heritage impacts • Environmental impact and management • PMLU • Impacts on Native Title
Utility owners • Department of Transport and Main Roads • Ergon Energy	Department of Transport and Main Roads, and Ergon Energy own assets within or adjacent to Wirralie (Rutherford Road). Solomons Gold engage with utility owners on an as needs basis. The PRCP will not require an update to any agreements.	• Rehabilitation and impacts to assets • Disruption of access to assets • Impacts to asset value
Local Government	Whitsunday Regional Council is the local government for the LGA Wirralie is situated within.	• Local opportunities • Economic and community sustainability • Environmental impact and management • Effects on Council assets • Mine rehabilitation • PMLU • Compliance with the Whitsunday Regional Council Planning Scheme

Community Stakeholder	Details	Potential Issues
Other stakeholders		
Nearby Landowners	There are four other properties surrounding Wirralie including Pyramid, Bungobine, Olderfleet and Ill L Ra Stations. Solomons Gold has means to provide correspondence with the surrounding landholders on a as needs basis.	• Future access to land covered by the ML • Rehabilitation outcomes • Environmental issues and management • Potential water access
Solomons Gold Employees	All Solomons Gold personnel are expected to be interested in closure planning where it may be thought to impact employment security.	• Job retention • Loss of jobs with closure • Living conditions
Community members and group	Affiliated communities' members and organisations of the Mt Coolon region.	• Job opportunities • Job retention • Loss of jobs with closure • Environmental impact and management • PMLU • Rehabilitation
Queensland Government	Government organisations with invested interest in Wirralie including: • Department of Resources • Department of Environment and Science • Whitsunday Regional Council • Mayors and Councillors of Whitsunday Regional Council • Electorate member for Burdekin • Minister for Natural Resources, Mines and Energy • Minister for the Environment and the Great Barrier Reef and Minister for Science and Youth Affairs	• Resource development • Job opportunities • Job retention • Environmental impacts and management • Rehabilitation cost • Environmental risk • PMLU
Federal Government	Department of Agriculture Water and Environment (DAWE)	• Resource development • Job opportunities • Job retention • Environmental impacts and management • Rehabilitation cost • Environmental risk • PMLU

3.2. Engagement Objectives

The objectives of the CCMP are to:

- Identify stakeholders who have an interest in the Project;
- Facilitate two-way engagement with stakeholders;
- Provide accurate, timely and relevant information on the Project;
- Identify any concerns or potential issues stakeholders may have with the Project;
- Explore areas of the Project with the potential to have a positive impact on the region;
- Develop appropriate strategies to mitigate any concerns

3.3. Engagement Frequency

Due to the low intensity nature of operations, it is not anticipated that routine engagement will be required. Community consultation will occur as requested by the relevant parties or if changes are proposed to operations or rehabilitation outcomes.

3.4. Engagement Tools

Due to the small nature of operations, Solomons have identified email as being the most effective tool of communication, as well as specific in person information sessions, as required.

3.5. Engagement Actions

Notice will be provided on request to key stakeholders regarding any major changes to operations at Wirralie. Details of how this is communicated is outlined in this CCMP.

3.6. Community Consultation Register

In order to comply with section 126C(1)(c)(iii) of the EP Act, the rehabilitation planning part must include a community consultation register identifying the consultation carried out in developing the PRC plan. The community consultation register must include:

- Consultation date(s)
- Identification of each community member
- Description of consultation type (workshop, quarterly meetings, etc.)
- Information provided to the community
- Issues raised/discussed by the community
- How issues have been considered
- Decisions/outcomes of engagement

- Commitments made by the applicant.

3.7. Complaints Management Process

Solomons Gold is committed to working with stakeholders that may be impacted by Wirralie. The Solomons Gold is responsible for all stakeholder liaison and will be the first point of contact for dealing with complaints, enquiries and comments related to the Wirralie. Solomons Gold is responsible for coordinating responses to complaints received and for monitoring the frequency and number of complaints received. Issues and concerns that may affect staff, employees and contractors shall be treated confidentially. All complaints or personal concerns are to be handled in a sensitive, fair, timely and confidential manner.

Should complaints be received, which are directly related to the operation or decommissioning phases of the Wirralie, the following detail will be logged within the Project's complaints register:

- Name, address and contact number for the complainant;
- Time and date of complaint;
- Reason for the complaint;
- Investigations undertaken;
- Conclusions formed;
- Actions taken to resolve the complaint;
- Any abatement or mitigation measures implemented; and
- Person responsible for resolving the complaint.

All complaints will be investigated to determine validity, the source and underlying cause, provide a summary of corrective actions and follow-up to ensure corrective actions are implemented. Additional investigation/s will be carried out where necessary. Where complaints cannot be resolved by this process, third party mediation will be undertaken. Solomons Gold will maintain a Community Complaints Register.

3.8. Plan Summary

The objectives, key performance indicators, actions, responsibilities, monitoring, feedback, and reporting for the CCMP are shown in Table 4. The CCMP is a dynamic working document and will be revised on an annual basis.

Table 4. Summary of Community Consultation Management Plan.

Summary of Issues		Objectives	
- Engaging with stakeholders about Project progress; - Communicating key data to government; - Communicating opportunities for local employment and business engagement opportunities.		Ensure transparent community and stakeholder engagement informs the ongoing management and monitoring of potential social impacts during the throughout the Project.	
Actions	KPI's	Responsibility	Timeframe
Establish a detailed program incorporating Consultation and Complaints Register	Agree on the metrics for ongoing tracking of CCP.	The Senior Representative	Life of operation
Provide regular updates to direct landowners regarding Project operations	Communication with landowners is undertaken to advise of activities.	The Senior Representative	Life of operation
Review and update community engagement program prior to operations	Engagement program amended based on feedback to ensure it continues to be fit for operations.	The Senior Representative	Life of operation
Performance Monitoring and Review			
Goals	Evidence	Frequency	
Engagement program remains current and relevant to operation for stakeholders.	Revision of document	Annual	

3.9. Review

The CCMP will be reviewed annually, or in response to any significant changes in management or operations at Wirralie.

References

QUEENSLAND GOVERNMENT 1994. Environmental Protection Act 1994. Current as at 23 April 2021 ed.

QUEENSLAND GOVERNMENT 2019b. Environmental Protection Regulation 2019.

QUEENSLAND GOVERNMENT 2021. Guideline ESR/2019/4964 – Progressive rehabilitation and closure plans (PRC plans), Version 2.00 – 17 March 2021Last reviewed: 17 MAR 2021

Appendix A – Environmental Authority



Schedule C - Water

Release to waters

(C1-1) Receiving waters affected by the release of process water or storm water contaminated by the mining activities or both must be monitored at the locations and frequencies defined in Schedule C - Table 1 and comply with the contaminant limits defined in Schedule C - Table 2.

Schedule C - Table 1
(Receiving water monitoring locations and frequency)

Monitoring point	AMG North	AMG East	Monitoring frequency
SW1 – Tailings dam spillway	7663974	526752	Monthly when flowing
SW2 – Tailings dam runoff dam	7664998	526747	Monthly when flowing
Tailing dam ponded water	7664832	527793	Six Monthly
SW4 – Rosetta Creek	7665490	524242	Monthly when flowing
SW5 – Sugar Bag Creek	7665405	526557	Monthly when flowing
Sugar Bag Creek (Release Point 1)	7665700	526350	Opportunistic rising stage sampler at 1.8 m
Drainage to Pit (Release Point 2)	7665094	527800	Monthly when flowing

NOTE: This does not apply to dams containing hazardous waste

Schedule C - Table 2
(Receiving water contaminant limits)

Parameter	Units	Limit Type	Contaminant Limits
pH		Range	6 - 9
Total Dissolved Solids	mg/L	Maximum	4000
Sulfate	mg/L	Maximum	1000 ¹
Arsenic	mg/L	Maximum	0.5 ¹
Cadmium	mg/L	Maximum	0.01 ¹
Copper	mg/L	Maximum	0.5 ¹
Lead	mg/L	Maximum	0.1 ¹
Mercury	mg/L	Maximum	0.002 ¹
Molybdenum	mg/L	Maximum	0.05 ¹
Selenium	mg/L	Maximum	0.02 ¹
Zinc	mg/L	Maximum	20 ¹
WAD Cyanide	mg/L	Maximum	0.2

¹ Measured as a total unfiltered concentration

NOTE: This does not apply to dams containing hazardous waste

DS

Stream sediment contaminant levels

- (C2-1) All reasonable and practicable erosion protection measures and sediment control measures must be implemented and maintained to minimise erosion and the release of sediment
- (C2-2) The bed of the receiving waters, affected by the release of process water and storm water contaminated by the mining activities must be monitored at the locations and frequencies defined in Schedule C – Table 3.

Schedule C - Table 3

(Receiving stream sediment monitoring locations and frequency)

Monitoring point	AMG North	AMG East	Monitoring frequency
Sugar Bag Creek	7665702	526345	Annually
Rosetta Creek (upstream)	7668809	526448	Annually
Rosetta Creek (downstream)	TBA	TBA	Annually

- (C2-3) Subject to Condition (C2-2), if the stream sediment contaminant trigger levels defined in Schedule C – Table 4 are exceeded then the environmental authority holder must complete an investigation into the potential for environmental harm and notify the administering authority within 3 months of receiving the analysis results.

Schedule C - Table 4

(Receiving stream sediment contaminant trigger levels)

Parameter	Units	Contaminant Limits
Antimony	mg/kg	25
Arsenic	mg/kg	70
Cadmium	mg/kg	10
Chromium	mg/kg	370
Copper	mg/kg	270
Lead	mg/kg	220
Mercury	mg/kg	1
Nickel	mg/kg	52
Zinc	mg/kg	410

- (C2-4) All stream sediment sampling must be undertaken in accordance with AS 5667.1 Guidance on Sampling of Bottom Sediments of 1998.

Sewage Effluent

- (C3-1) All effluent released from the treatment plant must be monitored at the frequency and for the parameters specified in Schedule C - Table 5.

Schedule C - Table 5

(Sewage effluent quality targets for dust suppression and irrigation)

Quality characteristics	Release limit	Units	Limit type	Monitoring frequency
pH	6.5 - 8.5		range	Biannually
Free Chlorine Residual	2	mg/L	max	Biannually
Faecal Coliforms, based on the average of a minimum of five samples collected	1000	Colonies /100mL	max	Biannually

- (C3-2) Sewage effluent used for dust suppression or irrigation must not exceed sewage effluent release limits defined in Schedule C - Table 5.
- (C3-3) Subject to Conditions (C3-1) and (C3-2), sewage effluent from sewage treatment facilities must be reused or evaporated and must not be directly released from the sewage treatment plant to any waterway.

Groundwater

- (C4-1) Groundwater, affected by the mining activities must be monitored at the locations and frequencies defined in Schedule C - Table 6.

Schedule C - Table 6

(Groundwater Monitoring Locations and Frequency)

Monitoring point	AMG North	AMG East	Surface RL(m)	Monitoring frequency
Tailings Dam monitoring bore (to be replaced)	7664981	526642	TBA	Six Monthly

- (C4-2) Subject to Condition (C4-1), groundwater contaminant limits must not exceed the contaminant limits defined in Schedule C – Table 7.

DS

Schedule C - Table 7
(Groundwater Contaminant Trigger Levels)

Parameter	Units	Limit Type	Contaminant Limits
pH		Range	6 - 9
Total Dissolved Solids	mg/L	Maximum	4000
Sulfate	mg/L	Maximum	1000 ¹
Arsenic	mg/L	Maximum	0.5 ¹
Cadmium	mg/L	Maximum	0.01 ¹
Copper	mg/L	Maximum	0.5 ¹
Lead	mg/L	Maximum	0.1 ¹
Mercury	mg/L	Maximum	0.002 ¹
Molybdenum	mg/L	Maximum	0.05 ¹
Selenium	mg/L	Maximum	0.02 ¹
Zinc	mg/L	Maximum	20 ¹
WAD Cyanide	mg/L	Maximum	0.2

¹Measured as a total unfiltered concentration

- (C4-3) Subject to Condition (C4-1), groundwater levels must be monitored and groundwater draw down fluctuations in excess of 2m per year, not resulting from the pumping of licensed bores, must be notified within 14 days to the administering authority following completion of monitoring.
- (C4-4) The method of water sampling required by this environmental authority must comply with that set out in the latest edition of the Environmental Protection Agency's Water Quality Sampling Manual.

DS

Schedule D – Noise and vibration

There are no conditions prescribed for this Schedule



Schedule E – Waste

Storage of tyres

- (E1-1) Tyres stored awaiting disposal or transport for take-back and, recycling, or waste-to-energy options - should be stockpiled in volumes less than 3m in height and 200m² in area and at least 10m from any other tyre storage area.
- (E1-2) All reasonable and practicable fire prevention measures must be implemented, including removal of grass and other materials within a 10m radius of the scrap tyre storage area.

Disposal of tyres

- (E2-1) Disposing of scrap tyres resulting from the mining activities in spoil emplacements is acceptable, provided tyres are placed as deep in the spoil as reasonably practicable.
- (E2-2) Scrap tyres resulting from the mining activities disposed within the operational land must not impede saturated aquifers or compromise the stability of the consolidated landform.



Schedule F – Land

Rehabilitation landform criteria

(F1-1) All areas significantly disturbed by mining activities must be rehabilitated to a stable landform with a self-sustaining vegetation cover in accordance with Schedule F – Table 1.

Schedule F - Table 1
(Final Land Use and Rehabilitation Approval Schedule)

Tenure ID	Disturbance type	Projective surface area (ha)	Post-mine land description	Post mine land classification
ML1107	Tailings Dam	72	Open Pasture	VII
	Infrastructure	69	Open Pasture	VII
	Waste Dump	22	Low Hill	VII
	Exploration	19	Open Pasture	VII
	Open Cut Pit	19	Open void	VIII
	Stockpile Area	14	Open Pasture	VII
	Village	12	Low Hill	VII
	Borrow Pit	8	Open Pasture	VII
	Processing Plant	7	Open Pasture	VII
	Runoff dam	5	Water Storage	VIII
	ROM Pad	3	Low Hill	VII

(F1-2) Progressive rehabilitation must commence when areas become available within the operational land.

(F1-3) Complete an investigation into rehabilitation of disturbed areas and submit a report to the administering authority proposing acceptance criteria to meet the outcomes in Schedule F – Table 1 by March 2004.

Residual void outcome

(F2-1) 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

Dams containing hazardous waste

(F3-1) The construction or operation of any dam containing hazardous waste within the operational land must comply with Schedule F – Table 2.

DC

Schedule F - Table 2
(Size and purpose of dams containing hazardous waste)

Name of dam containing hazardous waste ⁽¹⁾	Maximum surface area of dam (ha)	Maximum surface area of dam (m ³)	Maximum depth of dam (m) ⁽²⁾	Purpose of dam ⁽³⁾
Tailings Storage	71	9,300,000	26	Containment of tailings
Wirralie Run-off Dam	4.7	450,000	7	Run-off from catchment containing plant site
Pit A	10.8	1,500,000	75	Containment of pit water
Pit B	5.3	250,000 (approx)	20	Containment of pit water

(F3-2) Any dam containing hazardous waste constructed or operated within the operational land must be located within the control points defined in Schedule F – Table 3.

Schedule F - Table 3
(Location of dams containing hazardous waste)

Name of dam containing hazardous waste ⁽¹⁾	Latitude ⁽⁴⁾ (GDA 94)	Longitude ⁽⁴⁾ (GDA 94)
Tailings Storage	7664832 Additional boundary points to be identified	527793 Additional boundary points to be identified
Wirralie Run-off Dam	7665011 Additional boundary points to be identified	526713 Additional boundary points to be identified
Pit A	7665172 Additional boundary points to be identified	527128 Additional boundary points to be identified
Pit B	7665297 Additional boundary points to be identified	527094 Additional boundary points to be identified

Note ⁽⁴⁾: A minimum of 3 control points is required to constrain the location of all activities associated with the dam containing hazardous waste. Additional infrastructure which forms part of any dam containing hazardous waste may include appurtenant works consisting of tailings discharge pipelines, seepage collection systems, runoff diversion bunds, containment systems, pressure relief wells, decant and recycle water systems.

(F3-3) The holder of the environmental authority must design, construct and operate all high-hazard dams containing hazardous waste in accordance with the Code of Environmental Compliance for High Hazard Dams Containing Hazardous Waste.

(F3-4) The holder of the environmental authority must design, construct and operate all low-hazard dams containing hazardous waste and non-hazardous dams in accordance with the criteria outlined in Appendix B of the Code of Environmental of Mining Activities.

Infrastructure

- (F4-1) 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.

Note: This is not applicable where the landowner/ holder is also the environmental authority holder.



Schedule G – Community

Complaint response

- (G1-1) All complaints received must be recorded including details of complainant, reasons for the complaint, investigations undertaken, conclusions formed and actions taken. This information must be made available for inspection by the administering authority on request.



Definitions

“acceptance criteria” means the measures by which the actions implemented to rehabilitate the land are deemed to be complete. The acceptance criteria indicate the success of the rehabilitation outcome or remediation of areas which have been significantly been disturbed by the mining activities. Acceptance criteria may include information regarding:

- vegetation establishment, survival and succession;
- vegetation productivity, sustained growth and structure development;
- fauna colonisation and habitat development;
- ecosystem processes such as soil development and nutrient cycling, and the recolonisation of specific fauna groups such as collembola, mites and termites which are involved in these processes;
- microbiological studies including recolonisation by mycorrhizal fungi, microbial biomass and respiration;
- effects of various establishment treatments such as deep ripping, topsoil handling, seeding and fertiliser application on vegetation growth and development;
- resilience of vegetation to disease, insect attack, drought and fire;
- vegetation water use and effects on ground water levels and catchment yields.

“airblast overpressure” means energy transmitted from the blast site within the atmosphere in the form of pressure waves. The maximum excess pressure in this wave, above ambient pressure is the peak airblast overpressure measured in decibels linear (dB).

“ambient (or total) noise” at a place, means the level of noise at the place from all sources (near and far), measured as the Leq for an appropriate time interval.

“competent person” means a person with the demonstrated skill and knowledge required to carry out the task to a standard necessary for the reliance upon collected data or protection of the environment.

“authority” means environmental authority (mining activities) under the Environmental Protection Act 1994.

“blasting” means the use of explosive materials to fracture-

- (a) rock, coal and other minerals for later recovery; or
- (b) structural components or other items to facilitate removal from a site or for reuse.

“commercial place” means a work place used as an office or for business or commercial purposes, which is not part of the mining activity and does not include employees accommodation or public roads.

“dam” means a containment or proposed containment whether permanent or temporary, which is designed to contain, divert or control flowable substances. However this does not include a fabricated or manufactured tank or container designed to a recognised standard.

“environmental authority holder” means the holder of this environmental authority.

“hazardous waste” means any substance, whether liquid, solid or gaseous, derived by or resulting from, the processing of minerals that tends to destroy life or impair or endanger health.

“ $L_{A10, adj, 10 mins}$ ” means the A-weighted sound pressure level, (adjusted for tonal character and impulsiveness of the sound) exceeded for 10% of any 10-minute measurement period, using Fast response.

“**L_A 1, adj, 10 mins**” means the A-weighted sound pressure level, (adjusted for tonal character and impulsiveness of the sound) exceeded for 1% of any 10-minute measurement period, using Fast response

“**L_A, max adj, T**” means the average maximum A-weighted sound pressure level, adjusted for noise character and measured over any 10 minute period, using Fast response.

“**land**” in the “land schedule” of this document means land excluding waters and the atmosphere.

“**land capability**” as defined in the DME 1995 Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland.

“**land suitability**” as defined in the DME 1995 Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland.

“**land use**” term to describe the selected post mining use of the land, which is planned to occur after the cessation of mining operations.

“**mandatory reporting level**” means the volume below the spillway crest, equivalent to the lower of the AEP, 72 hour storm or the AEP wave allowance (AEP is the annual exceedance probability).

“**mineral**” means a substance which normally occurs naturally as part of the earth’s crust or is dissolved or suspended in water within or upon the earth’s crust and includes a substance which may be extracted from such a substance, and includes –

- (a) clay if mined for use for its ceramic properties, kaolin and bentonite;
- (b) foundry sand;
- (c) hydrocarbons and other substances or matter occurring in association with shale or coal and necessarily mined, extracted, produced or released by or in connection with mining for shale or coal or for the purpose of enhancing the safety of current or future mining operations for coal or the extraction or production of mineral oil therefrom;
- (d) limestone if mined for use for its chemical properties;
- (e) marble;
- (f) mineral oil or gas extracted or produced from shale or coal by in situ processes;
- (g) peat;
- (h) salt including brine;
- (i) shale from which mineral oil may be extracted or produced;
- (j) silica, including silica sand, if mined for use for its chemical properties;
- (k) rock mined in block or slab form for building or monumental purposes;

but does not include –

- (l) living matter;
- (m) petroleum within the meaning of the Petroleum Act 1923;
- (n) soil, sand, gravel or rock (other than rock mined in block or slab form for building or monumental purposes) to be used or to be supplied for use as such, whether intact or in broken form;
- (o) water.

“**noxious**” means harmful or injurious to health or physical well being, other than trivial harm.

“**non-standard**” means a mining operation that if in the opinion of the administering authority does not have a low risk of serious environmental harm and the activities can not comply with the criteria for standard mining activities prescribed in schedule 1A of the Environmental Protection Regulation 1998. The standard mining activity trigger criteria are as follows;

- the mining activities do not or will not cause more than 10 ha of land to be significantly disturbed at any one time;
- the mining activities do not or will not cause more than 5 ha of land to be significantly disturbed at any one time;
 - (a) in a riverine area;
 - (b) because of mine workings;
- the mining activities are not or will not be carried out in, or within 2 km of a category A Environmentally Sensitive Area;
- the mining activities are not or will not be carried out in, or within 1 km of a category B environmentally sensitive area;
- the mining activities do not include a level 1 environmentally relevant activity
- no more than 20 persons are carrying out or will, at any one time, carry out the mining activities;

“offensive” means causing reasonable offence or displeasure; is disagreeable to the sense; disgusting, nauseous or repulsive, other than trivial harm.

“peak particle velocity (ppv)” means a measure of ground vibration magnitude which is the maximum rate of change of ground displacement with time, usually measured in millimetres/second (mms^{-1}).

“protected area” means - a protected area under the Nature Conservation Act 1992; or

- a marine park under the Marine Parks Act 1992; or
- a World Heritage Area.

“progressive rehabilitation” means rehabilitation (defined below) undertaken progressively or a staged approach to rehabilitation as mining operations are ongoing.

“reference site” (or analogue site) may reflect the original location, adjacent area or another area where rehabilitation success has been completed for a similar biodiversity. Details of the reference site may be as photographs, computer generated images and vegetation models etc.

“rehabilitation” the process of reshaping and revegetating land to restore it to a stable landform and in accordance with the acceptance criteria set out in this environmental authority and, where relevant, includes remediation of contaminated land.

“representative” means a sample set which covers the variance in monitoring or other data either due to natural changes or operational phases of the mining activities.

“residual void” means an open pit resulting from the removal of ore and/or waste rock which will remain following the cessation of all mining activities and completion of rehabilitation processes.

“self sustaining” means an area of land which has been rehabilitated and has maintained the required acceptance criteria without human intervention for a period nominated by the administering authority.

“sensitive place” means;

- a dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises; or
- a motel, hotel or hostel; or
- an educational institution; or
- a medical centre or hospital; or
- a protected area under the Nature Conservation Act 1992, the Marine Parks Act 1992 or a World Heritage Area; or
- a public park or gardens; or

“significant disturbance” – includes land

- (a) if it is contaminated land; or
- (b) it has been disturbed and human intervention is needed to rehabilitate it.
 - i. to a state required under the relevant environmental authority; or
 - ii. if the environmental authority does not require the land to be rehabilitated to a particular state – to its state immediately before the disturbance.

Some examples of disturbed land include:

- areas where soil has been compacted, removed, covered, exposed or stockpiled;
- areas where vegetation has been removed or destroyed to an extent where the land has been made susceptible to erosion; (vegetation & topsoil)
- areas where land use suitability or capability has been diminished;
- areas within a watercourse, waterway, wetland or lake where mining activities occur;
- areas submerged by tailings or hazardous contaminant storage and dam walls in all cases;
- areas under temporary infrastructure. Temporary infrastructure includes any infrastructure (roads, tracks, bridges, culverts, dams, bores, buildings, fixed machinery, hardstand areas, airstrips, helipads etc) which is to be removed after mining activities have ceased; or
- areas where land has been contaminated and a suitability statement has not been issued.

However, the following areas are not included:

- areas off lease (e.g. roads or tracks which provide access to the mining lease);
- areas previously significantly disturbed which have achieved the rehabilitation outcomes;
- by agreement with the EPA, areas previously significantly disturbed which have not achieved the rehabilitation objective(s) due to circumstances beyond the control of the mine operator (such as climatic conditions);
- areas under permanent infrastructure. Permanent infrastructure includes any infrastructure (roads, tracks, bridges, culverts, dams, bores, buildings, fixed machinery, hardstand areas, airstrips, helipads etc) which is to be left by agreement with the landowner. The agreement to leave permanent infrastructure must be recorded in the Landowner Agreement and lodged with the EPA;
- disturbances that pre-existed the grant of the tenure unless those areas are disturbed during the term of the tenure.

“spillway” means passage or outlet from the dam through which surplus water flows.

“stable” means geotechnical stability of the rehabilitated landform where instability related to the excessive settlement and subsidence caused by consolidation/ settlement of the wastes deposited, and sliding / slumping instability has ceased.

“trivial harm” means environmental harm which is not material or serious environmental harm and will not cause actual or potential loss or damage to property of an amount of, or amounts totalling more than \$5,000.

“watercourse” – Means a river, creek or stream in which water flows permanently or intermittently in a visibly defined channel (natural, artificial or artificially improved) with:

- (a) continuous bed and banks
- (b) And extended period of flow for some months after rain ceases, and
- (c) An adequacy of flow that sustains basic ecological processes and maintains biodiversity.

“waters” - includes river, stream, lake, lagoon, pond, swamp, wetland, unconfined surface water, bed and bank of any waters, dams, non-tidal or tidal waters (including the sea) or any part thereof.

END OF PERMIT

Appendix B – Community Consultation Register

Date	Community member(s)	Consultation type	Information provided	Issues raised	Outcome of engagement	Commitment made by Solomons Gold
18 Sep 2021	Wirralie Station Property Owners	Face to face meeting	Seeking input on post mining land uses and potential infrastructure to be retained	Closure is far away, consultation will be more meaningful and relevant closer to closure date.	Solomons will consult with landholder every 5 years in relation to the PRCP.	Continue to keep informed

Appendix C – Complaints Register

Contact Information	Time and Date	Compliant	Investigation	Conclusion	Abatement/Mitigation	Person in charge of Compliant

Appendix D: Flood Hazard Overlay Assessment

MEMORANDUM

TO	Scott Hayes-Stanley	COMPANY	Wulguru Technical Services Pty Ltd
FROM	Nick Brown / Matt Johnson	OFFICE	Sunshine Coast
EMAIL	nickb@atcwilliams.com.au	PHONE	07 5406 7000
PROJECT TITLE	Wirralie Gold Mine		
SUBJECT	Flood Hazard Overlay Assessment		
DATE	1 March 2022	OUR REF	121130-01M001.rev0

1 INTRODUCTION

1.1 Background

Australian Solomons Gold Pty Ltd (Solomons) owns and operates the Wirralie Gold Mine (WGM) site under EPML00772413 and took over the site in late 2013. The mine has had several operating owners over the years, including multiple owner changes from 1987 to 1993 before a break in operations. The mine operated again from 1999 to 2001, before being placed into care and maintenance in 2002. Rehabilitation efforts were initiated in 1993 and again in 2001 to targeted areas within the site, such as the waste rock dumps, final voids, the Tailings Storage Facility (TSF), process and ancillary areas. Operations by Solomons plan to process up to 400,000 tonnes of ore per annum over a minimum 10 year life of mine. This volume of processing is on a significantly reduced scale when compared to past mining campaigns. Refer **Attachment A** which illustrates the mine site layout plan.

Solomons have commissioned Wulguru Technical Services (WTS) to provide assistance with the completion of the Progressive Rehabilitation Closure Plan (PRCP) and Estimated Rehabilitation Cost (ERC) submitted (reference no. 101/0008112). As part of the PRCP and ERC requirements, ATC Williams (ATCW) have been engaged by WTS to develop a Flood Hazard Overlay assessment as a Technical Memorandum. This memorandum outlines conceptual findings based on the limited background information and site data available at the time of reporting. Therefore, this memorandum requires revision following further site investigations to confirm the outcomes stated in this memorandum meet DES requirements.

1.2 Project Site and Legal Requirements

Under the Environmental Protection Act (EPA) 1994 [4], a PRCP is required for the site. Item 126C 1(j) of the EPA requests that the PRCP is to *include any 'other' information the administering authority reasonably considers necessary to decide whether to approve the PRCP schedule for the plan*. This flood overlay assessment forms part of the 'other' information required and has been addressed in accordance with Section 3.4 of the PRCP guidelines [3]. This states that any voids that are wholly or partly within the floodplain must be rehabilitated to provide safe and stable land. The WGM site generally sits along a ridgeline towards the southern extent of disturbance, and has four pits that are proposed to be left as residual voids for the post-closure phase. The majority of runoff from the site initially discharges to surrounding localised flow paths of first order streams, before flowing north-west into Rosetta Creek approximately 2 km downstream. Rosetta Creek is a significant watercourse with an estimated 700 km² upstream catchment and is expected to have a large floodplain. Small areas of the WGM also flow to the south and discharge to Bungobine Creek, that has an estimated upstream catchment of 100 km² and is approximately 3.5 km downstream of the site.



A desktop assessment of the regional flood extents was therefore conducted to determine if the voids are in the regional floodplain (for events up to and including the 0.1% AEP Event).

2 REGIONAL FLOOD OVERLAY

2.1 Queensland FloodCheck Mapping

Queensland Government's FloodCheck mapping service [1] was used to estimate the regional flood extents adjacent to the WGM site. The flood mapping overlay includes regional flood data for the 1% AEP and Probable Maximum Flood (PMF) events. The data adopts Shuttle Radar Topography Mission (SRTM) elevation information which is quite coarse (~30 m grid), due to the lack of elevation data in rural areas [2]. The accuracy of the available flood mapping is considered suitable for the purposes of this memorandum, as detailed hydraulic (flood velocities/depths etc.) information is not required. However, detailed site survey should be undertaken for the site to confirm the outcomes stated in this memorandum meet DES requirements.

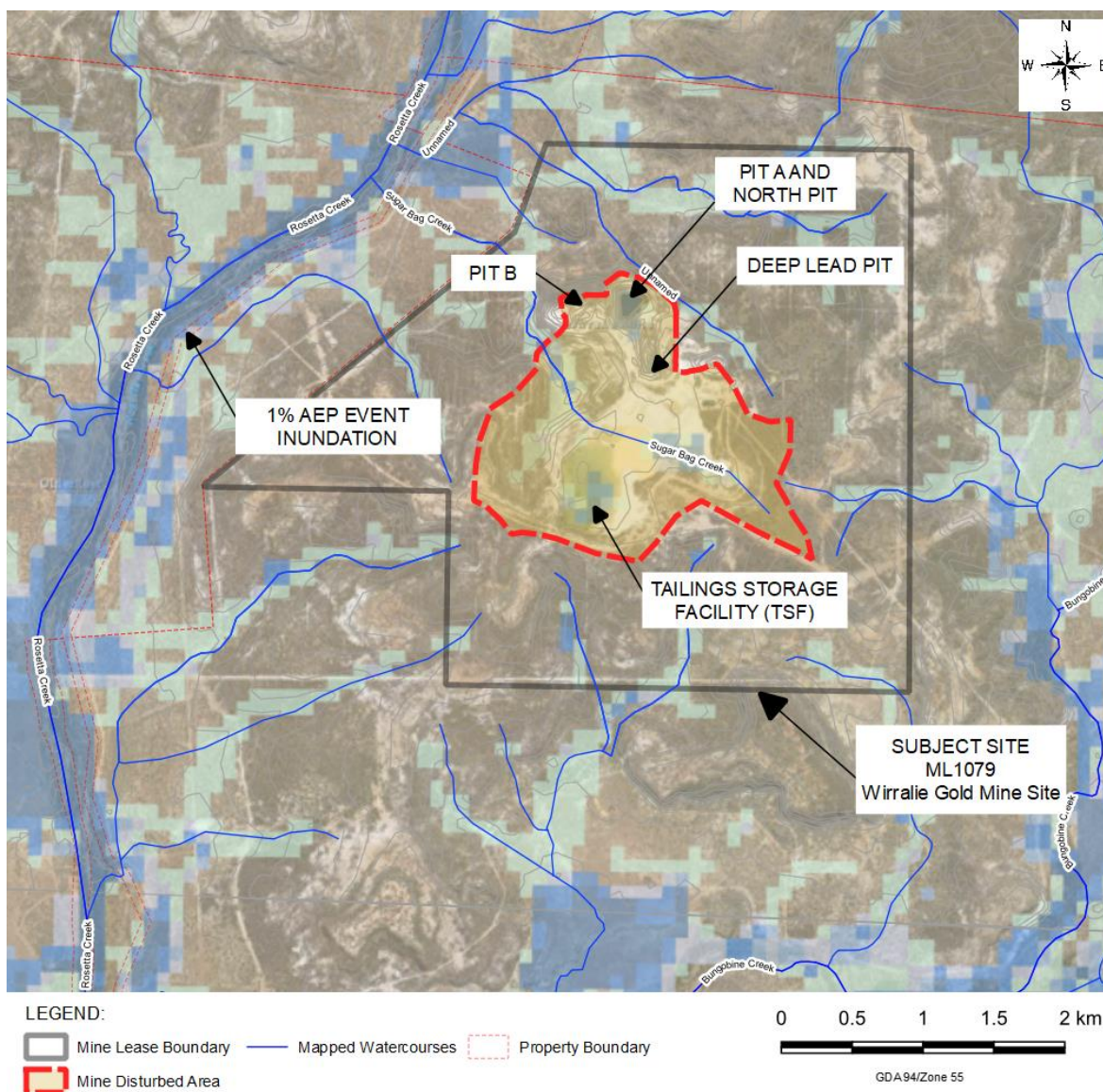
The intent of this memorandum is to define the 'floodplain' of the adjacent watercourse/s and compare the flood extent to the void locations. **Map 1** and **Map 2** illustrate outputs from the FloodCheck mapping with the 1% AEP Event and PMF (Extreme Event) outlines, respectively. Noting that this represents a rain-on-grid model conducted by Kellogg Brown & Root (2015) [2], and therefore includes flood mapping for local watercourses that are not considered part of the regional floodplain (refer **Map 1** and **2**).

Figure 001 attached to this memorandum illustrates the assumed 1% AEP and PMF flood extent and indicated levels.

Attachment B also illustrates the FloodCheck estimated floodplain extent, and further confirms that the WGM is outside of the regional floodplain.



Map 1 – 1% AEP Event Inundation



FloodCheck [1]



Map 2 –PMF Event Inundation

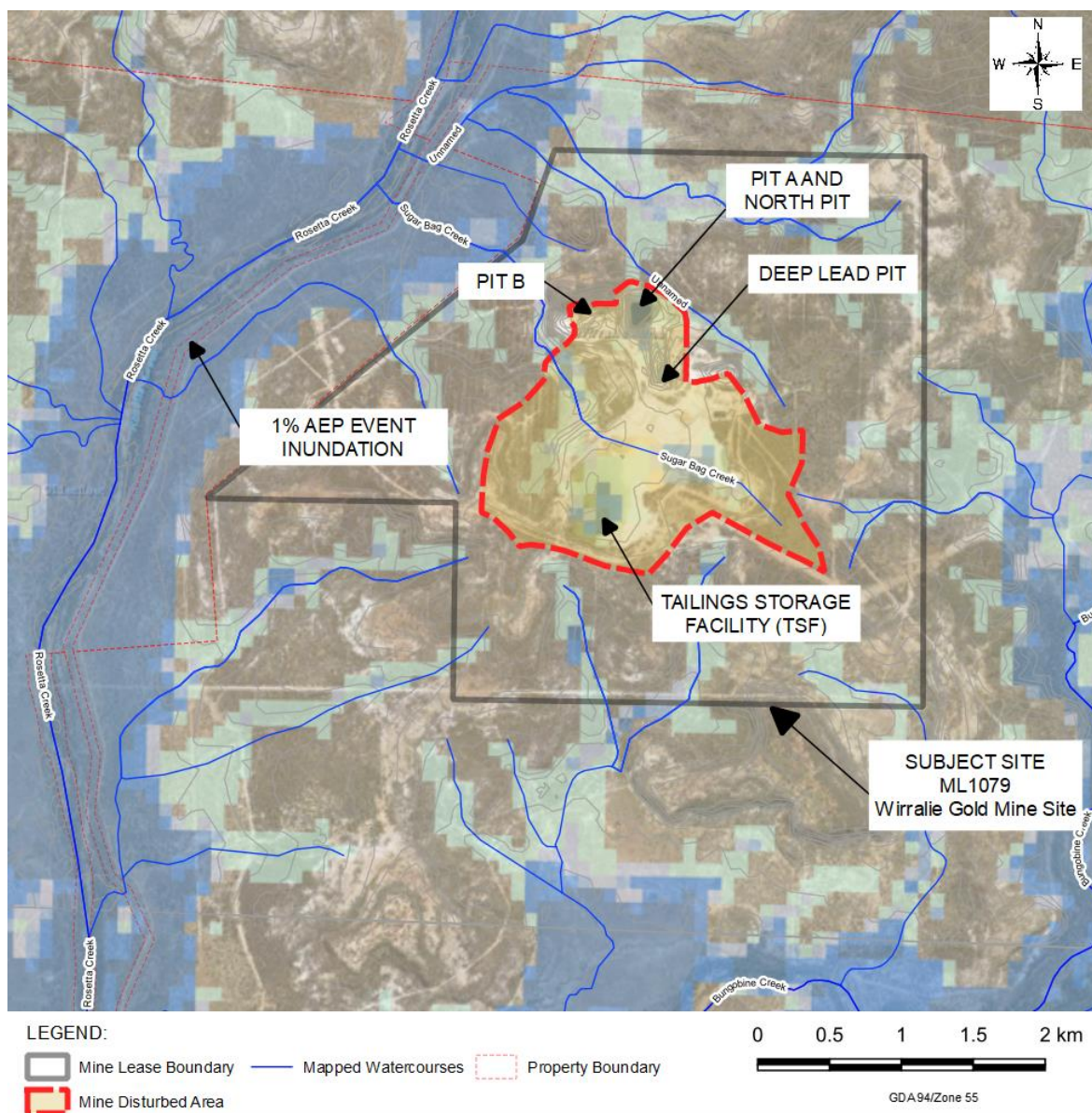




Figure 001 attached to this memorandum illustrates that the WGM voids are well above Rosetta Creek flood levels (~20 m from the PMF level to Pit A's spillway level), and well above Bungobine Creek PMF levels (~30 m from the PMF level to the southern mine extent). No other watercourses nearby to the mine site are considered major flow paths, and any other local watercourses such as the unnamed flow path to the north of the site are considered minor and not part of the regional floodplain. The WGM voids are therefore considered outside of the regional floodplain for all events up to and including the PMF event.

Flow diversion measures such as bunding along the void edge(s) must be maintained as part of the rehabilitation and post-closure scenario to prevent minor external catchments entering the site pits. A stability and capacity assessment of the existing bunding along the void(s) edges should be undertaken to ensure the existing bunding remains suitable, stable and vegetated for the WGM operational phase. As part of the rehabilitation requirements for the WGM closure the bunds should again be assessed, and any maintenance actioned as part of the WGM rehabilitation works.

CONCLUSIONS AND RECOMMENDATIONS

The WGM site voids are not considered wholly or partly within the regional floodplain, and are therefore not required to meet the requirements of Section 3.4 of the PRCP [3]. That is, no rehabilitation of the voids as a result of regional flooding is warranted. It is recommended that a stability and capacity assessment of the existing bunding along the void(s) edges should be undertaken to ensure the existing bunding remains suitable, stable and vegetated for the WGM operational phase. As part of the rehabilitation requirements for the WGM closure the bunds should again be assessed, and any maintenance actioned as part of the WGM rehabilitation works.

This technical memorandum should also be read in conjunction with the Closure Methodology and Water Balance Model report by ATCW (with reference 121130-01R001.rev0)

CLOSURE

Should you have any queries please contact the undersigned.

MATT JOHNSON

Senior Engineer

ATC Williams Pty Ltd

Attachments:

Attachment A – Mine Site Layout Plans

Attachment B – FloodCheck Regional Flood Map

Figures

Figure 001 –Estimated 1% AEP and PMF Event Flood Extents

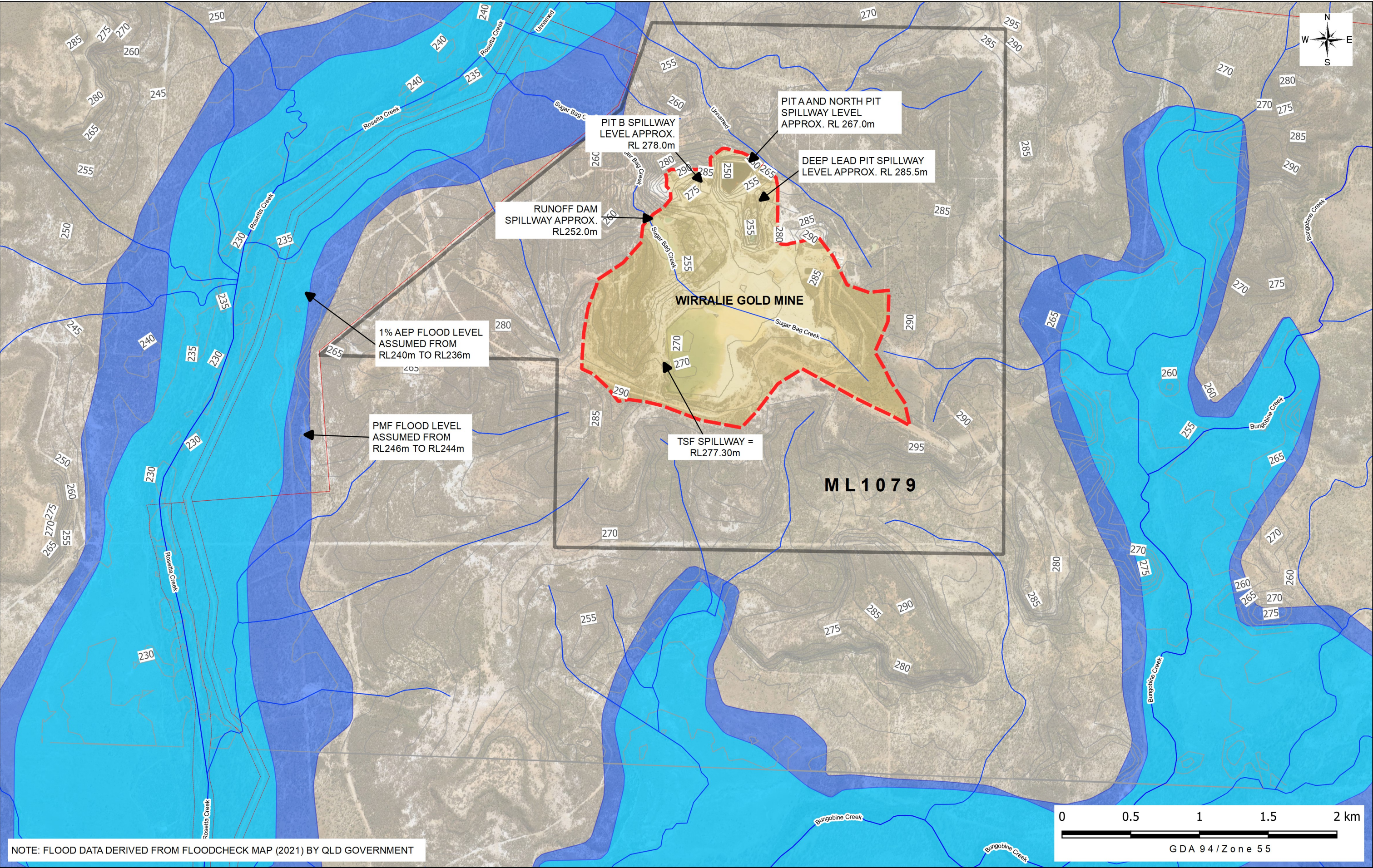


REFERENCES

- [1] Department of Natural Resources and Mines (2021), FloodCheck Mapping, available from:
<https://floodcheck.information.qld.gov.au/>
- [2] Kellogg Brown & Root Pty Ltd (2015), 'Flood Mapping for the Burdekin River Basin',
Department of Natural Resources and Mines
- [3] Queensland Government (2021), 'Progressive rehabilitation and closure plans (PRC plans)',
Department of Environment and Science
- [4] Queensland Government (1994), 'Environmental Protection Act'



FIGURES



LEGEND:

1% Flood Extents

Extreme Flood Extent (PMF)

Mine Disturbed Area

Mine Lease Boundary

Satellite Contours (5m)

Mapped Watercourses

WIRRALIE GOLD MINE
REGIONAL FLOOD EXTENTS



FIGURE 001
121130-01
DATE: 2021-09-29



ATTACHMENTS



ATTACHMENT A – MINE SITE LAYOUT PLANS



Document Path: \\nrc-desktop\lib_gis\GIS Projects\Solomons\NRC_data\Wirralie\Maps_mxd\160922_Wirralie_Cadastral.mxd

SOLOMONS GOLD

WIRRALIE
GOLD MINE
MOUNT
COOLON

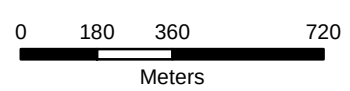
CADASTRE

Legend

-  Wirralie Mining Lease
-  Cadastre Whitsunday Shire

Credits:
Mine Lease boundary and
QLD Cadastre
© State of Queensland
(Department of Natural
Resources and Mines) 2016.

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 22-Sep-16



Scale: 1:18,000 at A3





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SOLOMONS GOLD

WIRRALIE GOLD MINE MOUNT COOLON

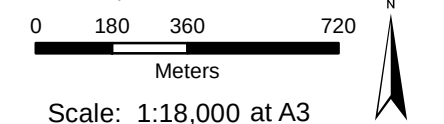
REHABILITATION
OCTOBER 2001

Legend

-  Wirralie Mining Lease
-  Contoured - No topsoil
-  Never Disturbed
-  Previously rehabilitated - ACM
-  Topsoil Stockpile
-  Topsoil by Delta
-  Safety Bund

Credits:
Mine Lease boundary
© State of Queensland
(Department of Natural
Resources and Mines) 2016
Imagery supplied by Client
30/09/2010

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 22-Sep-16





Document Path: \\Nrc-desktop\lib_gis\GIS Projects\Solomons\NRC_data\Wirralie\Maps_mxd\160922_Wirralie_Remnant Vegetation2.mxd

SOLOMONS GOLD

WIRRALIE GOLD MINE MOUNT COOLON

REMNANT VEGETATION

Legend

 Wirralie Mining Lease

 Watercourse

Remnant Vegetation

Status

 Endangered-dominant

 Endangered-subdominant

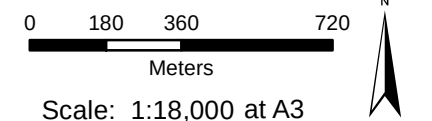
 Of Concern - dominant

 Of Concern - subdominant

 Least Concern

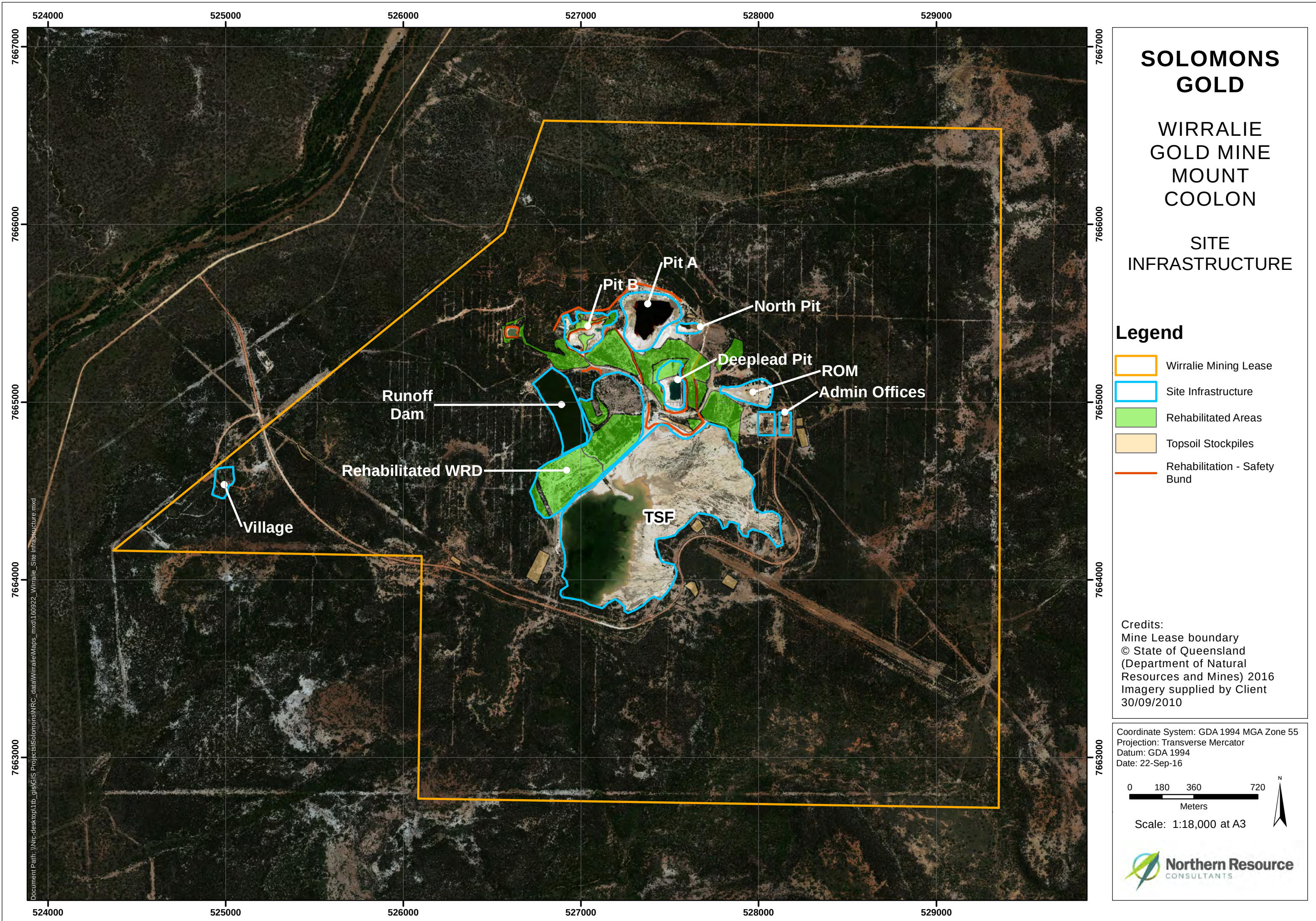
Credits:
Mine Lease boundary
© State of Queensland
(Department of Natural
Resources and Mines) 2016
Imagery supplied by Client
30/09/2010

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 22-Sep-16



Scale: 1:18,000 at A3







SOLOMONS GOLD

WIRRALIE GOLD MINE MOUNT COOLON

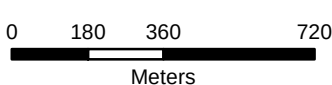
TOPOGRAPHY AND WATERCOURSES

Legend

-  Wirralie Mining Lease
-  Elevation contours (10m intervals)
-  Watercourses

Credits:
 Mine Lease boundary
 © State of Queensland
 (Department of Natural
 Resources and Mines) 2016
 Imagery supplied by Client
 30/09/2010

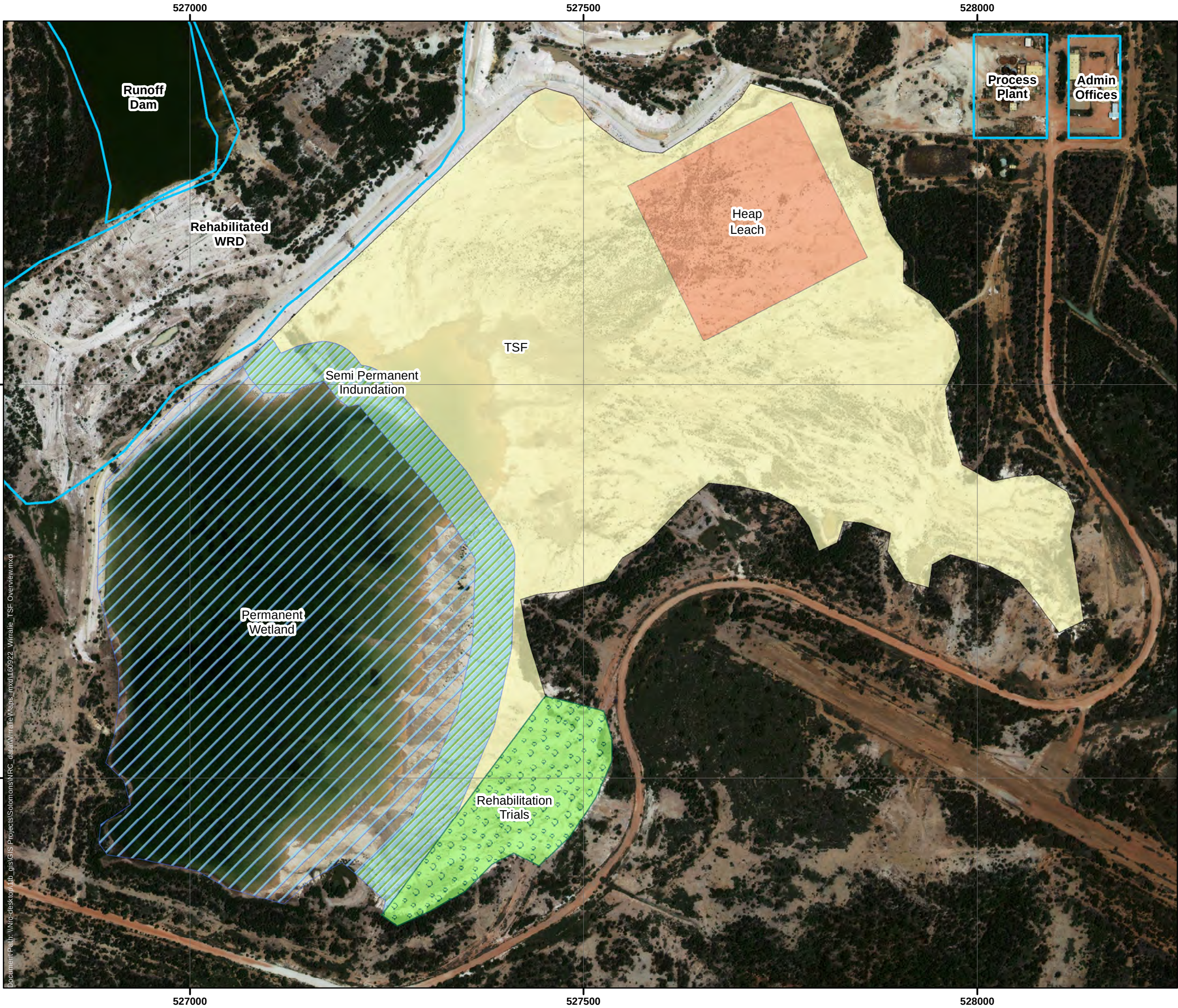
Coordinate System: GDA 1994 MGA Zone 55
 Projection: Transverse Mercator
 Datum: GDA 1994
 Date: 22-Sep-16



Scale: 1:18,000 at A3



Document Path: \\nrc-desktop\lib_gis\GIS Projects\Solomons\NRC_data\Wirralie\Maps_mxd\160922_Wirralie_Topo and Water.mxd



**SOLOMONS
GOLD**

**WIRRALIE
GOLD MINE
MOUNT
COOLON**

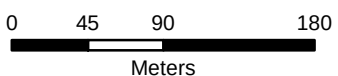
**TAILING STORAGE
FACILITY OVERVIEW**

Legend

- Site Infrastructure
- Tailing Storage Facility Overview**
 - TSF - 42Ha
 - Heap Leach - 5Ha
 - Rehabilitation Trials - 3.5Ha
 - Semi Permanent Indundation - 5Ha
 - Permanent Wetland - 25Ha

Credits:
Imagery supplied by Client
30/09/2010

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 22-Sep-16



Scale: 1:4,500 at A3

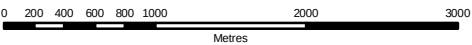




ATTACHMENT B – FLOODCHECK REGIONAL FLOOD MAP



**INTERIM FLOODPLAIN ASSESSMENT OVERLAY
SUTOR RIVER SUB-BASIN
2011 V1.0**



SCALE 1:50000
Original Size is A3

© The State of Queensland (Department of Environment and Resource Management) 2011. Imagery © ESRI 2009.
Produced for the Queensland Reconstruction Authority by the Department of Environment and Resource Management, September 2011.

- LEGEND**
- Interim Floodplain Assessment Overlay
 - Cadastral
 - Planning Scheme Boundaries
 - Locality Boundaries
 - Current Local Government Boundaries
 - Watercourses
 - Drainage Divisions
 - Drainage Basins
 - Gauging Station

MAP INFORMATION

Imagery: ESRI ArcGIS Online Imagery Basemap

Cadastral: Digital Cadastral Database (DCDB) is current at September 2011. Positional accuracy representing the 'maximum error' has been calculated at ± 57 metres.

Floodplain Assessment Overlay: For more information regarding the capture of this line please see the Foreword at the front of this atlas.

Watercourses: The average accuracy of the data is plus or minus 25 metres in the horizontal position

Drainage Sub-Basin: Sutor River

Drainage Basin: Burdekin

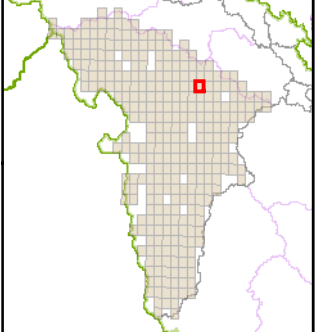
Drainage Division: North East Coast

Datum: Horizontal - Geocentric Datum of Australia 1994 (GDA94)

Projection: Horizontal - Map Grid of Australia (MGA94), which is a standard Universal Transverse Mercator (UTM) projection in Zone 55 with Central Meridian 147° East

Grid: Grid lines are at 5 kilometre intervals

Technical enquiries:
The Manager
GIS Mapping Services (Client Outcomes), Spatial Information Group
Department of Environment and Resource Management
GPO Box 2454, Brisbane QLD 4001



Queensland Reconstruction Authority



Map No.:
1203.102

Appendix E: Vegetation Survey Report



VEGETATION SURVEY REPORT

**WIRRALIE GOLD MINE
SOLOMONS GOLD PTY LTD**

JANUARY 2022



**WULGURU TECHNICAL
SERVICES**

Contact Details

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Document Control and History

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V1.0	6 January 2021	Final	Delwyn Windridge	Delwyn Windridge

Citation

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Definitions

Term	Definition
ECM	Eloise Copper Mine
EO Act	<i>Environmental Offsets Act 2014</i> (Queensland)
EP Act	<i>Environmental Protection Act 1994</i> (Queensland)
EP Regulation	<i>Environmental Protection Regulation 2019</i> (Queensland)
EPBC Act	<i>Environmental Protection Biodiversity Conservation Act 1999</i> (Australia)
ESA	Environmentally Sensitive Area
NC Act	<i>Nature Conservation Act 1992</i>
NEAC	Northern Environmental Assessment and Compliance
ML	Mining Lease
MERFP Act	<i>Mineral and Energy Resources (Financial Provisioning) Act 2018</i> (Queensland)
PMAV	Property Map of Assessable Vegetation
PMST	Protected Matters Search Tool
PRCP	Progressing Rehabilitation Closure Plan
RE	Regional Ecosystem
SPRAT	Species Profile and Threats Database (Dept. of Agriculture, Water and the Environment)
TEC	Threatened Ecological Community (EPBC listed)
TSF	Tailings Storage Facility
VM Act	<i>Vegetation Management Act 1999</i> (Queensland)
WTS	Wulguru Technical Services

1. Introduction

Wirralie Gold Mine (WGM) (the Project) is owned and operated by Solomons Gold Pty Ltd (Solomons). The Project is operating under an active Environmental Authority EMPL00772413 (the EA). Solomons acquired the Project in December 2013 and continued to manage the site in care and maintenance, until recommencement of operations in 2014.

The Project recently received notice from the Department of Environment and Science for the provision of a Progressive Rehabilitation Closure Plan (PRCP) to meet the requirements of new legislation to improve financial assurance outcomes within the resources sector. Under the transitional provisions of the *Mineral and Energy Resources (Financial Provisioning) Act 2018* holders of existing EAs are required to submit a PRCP by a specified date. A gap analysis undertaken by Wulguru Technical services (WTS) identified the requirement for vegetation assessment across the site to inform rehabilitation planning. WTS were engaged to undertake a vegetation survey to verify the regional ecosystems present and provide recommendations with respect to suitable species, species composition and rehabilitation methodology for progressive rehabilitation of the site.

This report provides a detailed summary of general site information and environmental values identified during a desktop assessment and the results of the field-based ground-truthing survey to inform the development of the PRCP.

1.1. Objectives

The objective of this assessment was to identify potential environmental values with respect to the vegetation communities mapped within the project area and to confirm the presence or absence of these via a field-based survey. This was achieved via the following:

- A desktop assessment of environmental values including:
 - o Matters of National Environmental Significance (MNES);
 - o Matters of State Environmental Significance (MSES);
 - o Online database searches;
 - o Literature review of available sources;
- A desktop assessment of conservation significant fauna and likelihood of occurrence analysis
- A field-based survey to ground-truth:
 - o MNES/MSES where required including:
 - Threatened Ecological Communities (TECs); and
 - Habitat for threatened fauna and incidental fauna species list;
 - o Regional Ecosystems;

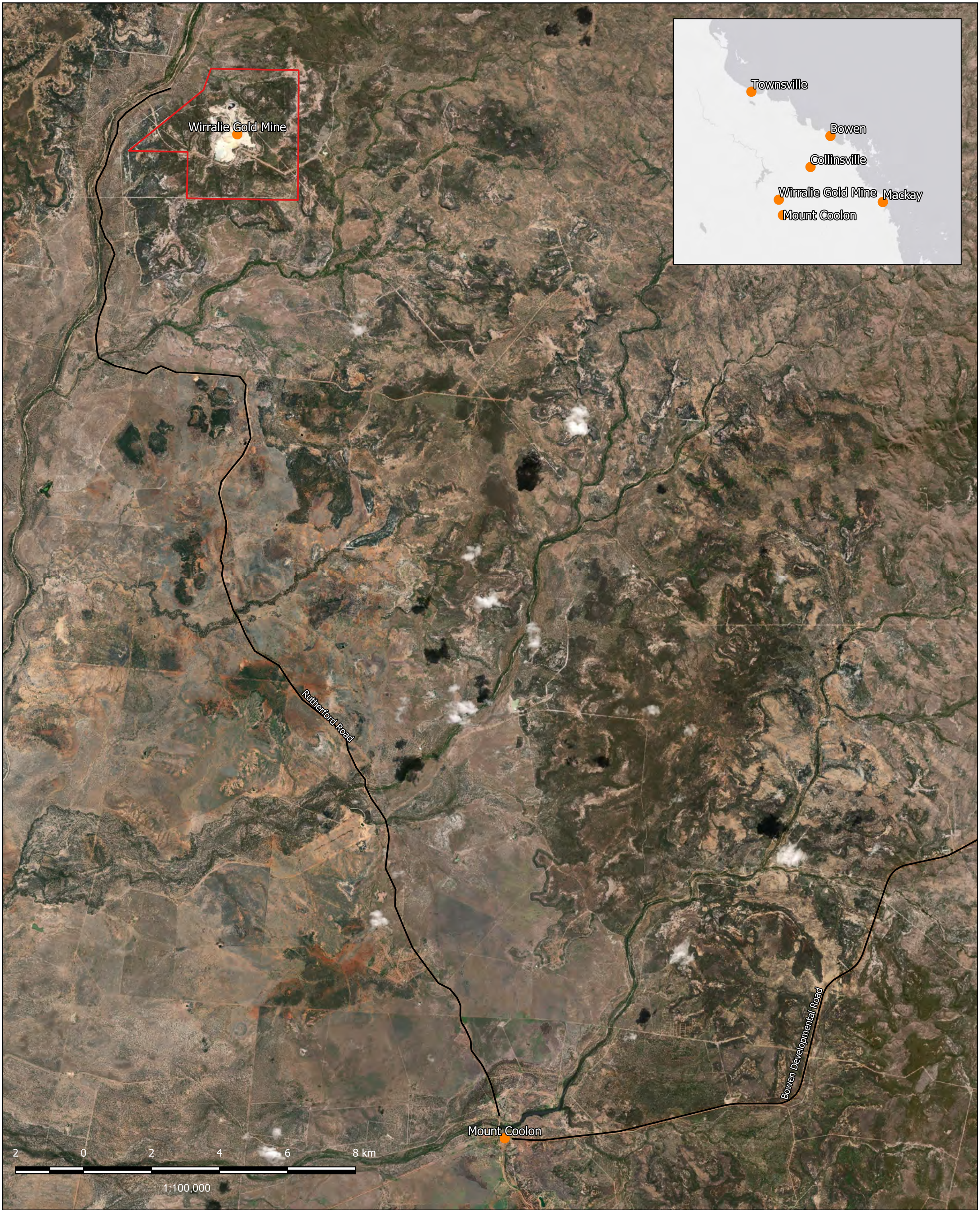
- Establishment of rehabilitation and analogue sites;
- Undertake baseline BioCondition assessments to inform rehab acceptance criteria; and
- Ground-truthing of flora species present to inform suitable species list for rehabilitation

1.2. Project Description

The WGM project is located in the Drummond Basin, approximately 200 km west of Mackay and 30 km North of Mount Coolon, Queensland (Figure 1). The Project is located on a single mining lease, ML1079, which covers an area of approximately 1,300 ha on Wirralie Station on freehold land, Lot 3272 on Plan SP237696. The property is zoned as a primary Rural zone under the Whitsunday Regional Council land zoning.

The Project is a metalliferous open cut gold mine, consisting of pits, one of which is currently active, and processing operations. Mining began in 1987 and continued until 1993, when the processing plant was relocated to the Yandan mine site, 30km west. An upgraded 1.5 million tonne per annum treatment plant was reinstated at Wirralie in 1999. The plant treated low-grade oxide and deep lead mineralisation until early 2002, when the site was placed in care and maintenance.

Solomons acquired the Project in December 2013, recommencing mining and processing operations in 2014. Planned activities include the mining and processing of 400 kt of ore annually. Under current conditions, surface waste rock dumps are not required. Instead, a pit dumping strategy is utilised where necessary. Existing waste dumps have been rehabilitated by previous mine operators with varying degrees of success.



Client: Solomons Gold Pty Ltd
Project number: 2020.10003
CRS: GDA2020 z54
Date: 15 December 2021

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Figure 1. Project Location

- Key Features
 - Major Roads
 - Mine Lease
- ESRI Satellite

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2. Legislation

2.1. Environmental Protection Act 1994

The *Environmental Protection Act 1994* (EP Act) provides for the protection of Queensland's environment through the regulation of prescribed environmentally relevant activities that may harm the environment. It does so by establishing standards and guidelines with respect to management of impacts to ecological processes and the regulation and administration of compliance to ensure environmental outcomes are achieved.

Under Section 125 of the EP Act:

- (1) An application for an environmental authority must—
 - (n) if the application is a site-specific application for a mining activity relating to a mining lease—be accompanied by a proposed PRCP plan;

And, under Section 126C:

- (c) include—
 - (i) a proposed PRCP schedule that complies with section 126D.

Environmental values requiring consideration in an EA application include:

- Category A and category B environmentally sensitive areas (ESAs) as defined under Schedule 19 of the *Environmental Protection Regulation 2019* (EP Regulation);
- Category C ESAs, where defined in a relevant model conditions document or ERA standard; and
- Matters of State environmental significance MSES as defined in Schedule 2 of the *Environmental Offsets Regulation 2014* (EO Regulation).

Regional ecosystems with a biodiversity status of Endangered are listed as a Category B ESA under the EP Act. The Code of Environmental Compliance for Mining Lease Projects indicates that environmental approvals are typically conditioned on the relevant environmental activity not being carried out within a Category A or Category B ESAs. Where activities are carried out within 1 km of a Category B ESA, a site-specific level of assessment may be triggered. Where impacts to regional ecosystems with a biodiversity status of endangered are unavoidable, an offset in accordance with the *Environmental Offsets Act 2014* may be required. In cases where the regional ecosystem is not listed as endangered or of concern under the *Vegetation Management Act 1999*, the requirement for an offset may not be triggered.

2.2. Mineral and Energy Resources (Financial Provisioning) Act 2018.

The *Mineral and Energy Resources (Financial Provisioning) Act 2018* was introduced in November 2018 in response to the findings of a Review of Queensland's Financial Assurance Framework conducted by the Queensland Treasury Corporation. Recommendations from the review identified significant financial risks associated with the failure to deliver rehabilitation outcomes at mine closure and the increasing gap between disturbed and rehabilitated land associated with mining activities.

The object of the MERFP Act is to provide financial surety and reduce financial risk to the State with respect to end of life of mine rehabilitation, the delivery of environmental outcomes and to provide a source of income to the state to address the rehabilitation of existing abandoned mines and impacts, and to further research in the area of mine site rehabilitation.

The MERFP Act:

1. Replaces the financial assurance arrangements for resource activities under the Environmental Protection Act 1994 (EP Act) with a new financial provisioning scheme;
2. Changes how the estimated rehabilitation cost for an environmental authority (EA) is calculated; and
3. Amends the EP Act to introduce new requirements for the progressive rehabilitation and closure of mined land. (Department of Environment and Science 2021).

In addition:

“The MERFP Act includes transitional provisions for the application of the PRC plan requirement concerning existing mines. Holders of an existing EA, for a mining activity relating to a mining lease approved through a site-specific application, will be issued with a notice from the administering authority, within the first three years following the PRCP start date. Where an applicant applied for an EA before 1 November 2019 and the EA is issued on or after the PRCP start date, the holder will be issued a notice from the administering authority within 6 months after the EA is issued.”

2.3. Vegetation Management Act 1999

The *Vegetation Management Act 1999* (VM Act) works in conjunction with the *Vegetation Management Regulation 2012* the *Planning Act 2016* and the *Planning Regulation 2017* to form the Vegetation Management Framework (VMF).

- (1) The purpose of this Act is to regulate the clearing of vegetation in a way that—
- (a) conserves remnant vegetation that is—
 - (i) an endangered regional ecosystem; or (ii) an of concern regional ecosystem; or
 - (iii) a least concern regional ecosystem; and
 - (b) conserves vegetation in declared areas; and
 - (c) ensures the clearing does not cause land degradation; and
 - (d) prevents the loss of biodiversity; and
 - (e) maintains ecological processes; and
 - (f) manages the environmental effects of the clearing to achieve the matters mentioned in paragraphs (a) to (e); and (g) reduces greenhouse gas emissions; and
 - (h) allows for sustainable land use.

A regional ecosystem is given a vegetation management class (VM class) of 'endangered' under the VM Act if:

- remnant vegetation is less than 10% of its pre-clearing extent across the bioregion; or
- 10-30% of its pre-clearing extent remains and the remnant vegetation is less than 10,000 hectares.

A regional ecosystem is given a VM class of 'of concern' under the VM Act if:

- Remnant vegetation is 10-30% of its pre-clearing extent across the bioregion; or
- More than 30% of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares.

In addition to VM class, each regional ecosystem is given a biodiversity status (BD status) which considers the relevant condition of the remnant extent with respect to degradation and/ or biodiversity loss. BD status may therefore differ to the VM class, though will always provide added (rather than less) protection. With respect to the EP Act and related legislation, 'endangered' and 'of concern' regional ecosystems are those with that specific BD status.

Existing remnant vegetation, high value regrowth, high value regrowth (watercourse), vegetation watercourse and drainage features and essential habitat are regulated vegetation under the VM Act and can only be cleared if clearing: is considered exempt clearing in accordance with the VMF; meets

the criteria under an accepted development clearing codes, or under a development or environmental approval.

2.4. Environmental Offsets Act 2014

The main purpose of the *Environmental Offsets Act 2014* (EO Act) is to counterbalance the significant residual impacts of particular activities on prescribed environmental matters through the use of environmental offsets.

This purpose is achieved primarily by:

- (a) establishing a framework for environmental offsets; and
- (b) recognising the level of protection given to prescribed environmental matters under other legislation; and
- (c) providing for national, State and local matters of environmental significance to be prescribed environmental matters for the purpose of this Act; and
- (d) coordinating the implementation of the framework in conjunction with other legislation.

2.5. Nature Conservation Act 1992

The *Nature Conservation Act 1992* (NC Act) and the *Nature Conservation (Animals) Regulation 2020* and *Nature Conservation (Plants) Regulation 2020* provide a legislative framework for the protection and conservation of Queensland's native plants and animals. Under the framework species of conservation significance are assessed and categorised with respect to population, distribution and potential threats and impacts. The objectives of the NC Act are achieved through an integrated and comprehensive conservation strategy that protects and conserves threatened and special interest species and their habitat and protected areas.

2.6. Environmental Protection and Biodiversity Conservation Act 1999

The *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides for the protection of the environment at a national level and focuses interest on the protecting Matters of National Environmental Significance (MNES) MNES include:

- World heritage properties;
- National heritage places;
- Wetlands of international importance (often called 'ramsar' wetlands after the international treaty under which such wetlands are listed);
- Nationally threatened species and ecological communities;
- Migratory species;
- Commonwealth marine areas;

- The great barrier reef marine park;
- Nuclear actions (including uranium mining); and
- a water resource, in relation to coal seam gas development and large coal mining development.

3. Methodology

3.1. Desktop analysis

A desktop analysis of the site was undertaken to identify matters of conservation significance and to inform survey effort. The following searches were undertaken, and resources used for the purposes of the analysis (Table 1).

Table 1 Desktop assessment resources and search criteria

Search/Resource	Source	Search Criteria
MNES database (Matters of National Environmental Significance)	Protected Matters Search Tool https://www.environment.gov.au/epbc/protected-matters-search-tool	10 km radius
MSES database (Matters of State Environmental Significant)	https://www.qld.gov.au/environment/pollution/management/environmental-reports-online	10 km radius
ESAs database (Environmentally Sensitive Areas)	Environmentally sensitive areas report https://environment.des.qld.gov.au/management/maps-of-environmentally-sensitive-areas	ML1079
QLD Species List	https://apps.des.qld.gov.au/report-request/species-list/	40km buffer
QLD regional ecosystem search	https://www.qld.gov.au/environment/pollution/management/environmental-reports-online	Sub-basin
Regional Ecosystem as mapped by Vegetation Regional Ecosystem version 12.00	Mapping available via QSpatial https://qldspatial.information.qld.gov.au/catalogue/custom/index.page	ML1079 and immediate areas

3.1.1. Likelihood of Occurrence Analysis

A 'likelihood of occurrence' (LOO) analysis was undertaken for all listed species of conservation significance to inform the survey design and effort and consideration given to:

- Modelled habitat and species distribution;
- Habitat preferences and habitat suitability; and
- Location of known records and species distribution;

Each species assessed will be categorised according to the potential for presence within the study area as per the following criteria:

Table 2: Likelihood of occurrence criteria

Status	Definition
Known	Species known to occur from recent records within the study area.
Likely	Species recorded within 1km of the study area and/or preferred habitat known to be present, and species recorded within 5 km.
Possible	Species recorded within 50 km of the study area and suitable habitat mapped as present.
Unlikely	Species not recorded within 50 km of the study area and suitable habitat not mapped as present.

3.2. Field Assessment

Field surveys were conducted to ground-truth the regional ecosystems identified in the desktop analysis, conduct BioCondition assessments of previous rehabilitation sites, and conduct BioCondition surveys of reference (analogue) sites to inform acceptance criteria for rehabilitation.

The objectives of this assessment included:

- Verification of RE boundaries and identification of other relevant Protected Environmental Matters (PEM);
- Establishment of BioCondition assessment sites for rehabilitation; and
- Assess the rehabilitation site against acceptance criteria;
- Identification of key flora species for rehabilitation.

3.2.1. Timing and expertise

Field surveys occurred from the 23 to 26 July 2021 and were led by Grant Paterson (GAP Tree Change) with Keely Glass (Wulguru Tech Services) assisting. Grant Paterson has over 30 years' botanical experience, working both in government and in industry. Keely Glass is a qualified ecologist and environmental advisor with 2 years field experience.

3.2.2. Regional Ecosystem ground-truthing

Regional ecosystem ground-truthing assessments were undertaken over as much of the site that was safely accessible by vehicle. Twenty quaternary level surveys were undertaken at the 40000:1 scale equating to approximately 1.5 surveys per 100 Ha (Figure 4). Sites were chosen to capture sufficient representation of the vegetation communities present. Vegetation was assessed against RE descriptions in the Regional Ecosystem Description Database version 12.0 (REDD)⁸. Species lists were recorded at all relevant sites to both confirm RE description and provide species list for rehabilitation methodology. Should RE boundaries require re-mapping, a more comprehensive 5000:1 scale vegetation survey with will be required.

3.2.3. Rehabilitation monitoring

3.2.3.1. BioCondition Assessment

BioCondition Assessment was used as the standardised methodology of choice for assessing the values and condition of reference and rehabilitation sites in and completed in accordance with the guideline document *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual. Version 2.2* (Eyre, et. al, 2015). BioCondition assessment provides a way of assessing vegetation condition utilising key attributes that can be rapidly assessed in field (Eyre, et. al, 2015). Eucalypt tree, non-eucalypt tree and shrub species stem counts were also recorded as additional attributes relevant to the establishment of rehabilitation sites.

3.2.3.2. Reference sites

Three reference (analogue) sites were surveyed in accordance with the *Method for the Establishment and Survey of Reference Sites for BioCondition. Version 3.* (Eyre, et.al, 2017), and were assessed against benchmarks provided by the Queensland Herbarium to ensure appropriateness of the site and to establish local representation of the RE. Results from these assessments were used to determine acceptance criteria for rehabilitation sites (section 4.4).

3.2.3.3. Rehabilitation sites

One BioCondition assessment was conducted on a previously rehabilitated waste rock dump. The site was assessed against the selection criteria developed from the benchmark and reference site data (see section 4.4) to inform rehabilitation condition and recommendations for management actions.

3.2.3.4. Rehabilitation Analogue Site Selection

Three analogue (reference) sites were chosen to provide benchmarks for rehabilitation acceptance criteria (Figure 5). Sites were chosen to be representative of 'best on offer' remnant vegetation while ensuring that topography and soil type were similar to those conditions that would be seen in rehabilitation areas (e.g. waste rock dumps) to ensure the suitability of species recommended for rehabilitation as per the guideline document *Mine rehabilitation - Leading Practice Sustainable Development Program for the mining industry* (Australia. Dept. of Industry, Tourism and Resources. (2006).

3.2.4. Acceptance Criteria

Acceptance criteria are the outcome measures by which the rehabilitation of land is determined to be successful and therefore deemed to be complete in accordance with the conditions of an environmental authority. Acceptance criteria for rehabilitation establishment was developed using the results of the analogue BioCondition assessments. BioCondition Benchmarks for RE 11.7.2 have been developed by the Queensland Herbarium and are available in version 3.2 of the *BioCondition Benchmarks Database* (Queensland Herbarium, 2021). Benchmarks for each attribute relevant to the establishment of a rehabilitation site were used to determine acceptance criteria. Acceptance criteria was partially calculated using remnant vegetation definition values as per the *Vegetation Management Act 1999* which is:

‘vegetation, part of which forms the predominant canopy of the vegetation—

- (a) covering more than 50% of the undisturbed predominant canopy; and
- (b) averaging more than 70% of the vegetation’s undisturbed height; and
- (c) composed of species characteristic of the vegetation’s undisturbed predominant canopy.’

Acceptance criteria for other BioCondition attributes such as species richness and ground cover were based on the locally adapted benchmark measures as per the results of the reference site assessments.

Acceptance criteria for attributes additional to those of the BioCondition assessment were calculated as follows:

- Eucalypt tree stems per hectare – 33 % of rounded reference site averages;
- Non-eucalypt tree stems per hectare – 80% of rounded reference site averages; and
- Shrub stems per hectare – 50% of rounded reference site averages.

Sites achieving the prescribed acceptance criteria for a minimum period of three years are typically considered complete. Monitoring of rehabilitation sites is required at least annually for the period up to the determination of the site being complete.

4. Results

4.1. Desktop analysis

4.1.1. Climate

The Project is located in the Brigalow Belt bioregion, which is characterised by distinct wet and dry seasons, with hot summer and mild winter temperatures. The nearest Bureau of Meteorology (BoM) weather station is at the Collinsville Post Office, Queensland (Station ID: 033013), approximately 85 km north-east of the Project. Climate statistics are available from 1939 to 2021 (rainfall) and 1955 to 2021 (temperature). The mean maximum temperature for the summer period (December to February) is 33.5 °C, and the mean minimum monthly temperature for the same period is 21.7°C. The mean maximum monthly temperature for the winter period (June to August) is 25.7 °C, and the mean minimum monthly temperature for the same period is 10.1 °C. Mean annual rainfall for Collinsville is 701.7 mm with 52 days of rainfall ≤ 1 mm.

Climate data accessed via the Queensland Government's SILO database for location -21.10; 147.25 between 1955 to present day indicated a mean annual rainfall of 569mm and mean annual average evaporation of 2031mm (QLD 2021). This modelled data is consistent with the ephemeral nature of the area.

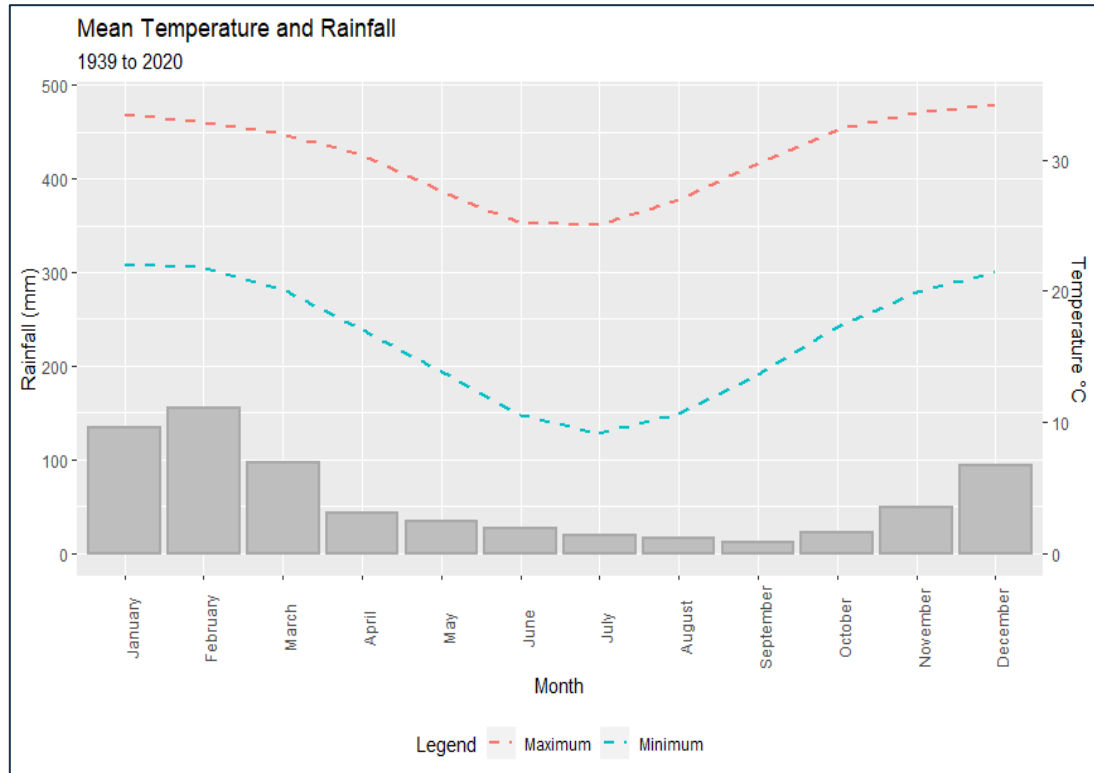


Figure 2 Climate averages for Collinsville

4.1.2. Topography

Regionally the Project lies to the east of the Great Dividing Range and is surrounded by low mountains ranging from 296 m AHD (Rodborough Hill) to 552 m AHD (Mount Landsborough). The topography of ML1079 is variable with rolling rises and hills dominating the site, transitioning to flats and plains. The highest local feature is ~290m AHD located directly north of Pit B and east of Pit A, which then transitions to ~260m AHD north and south of the lease.

4.1.3. Geological setting

The Project is situated in the Drummond Basin, a 26,000 km² area of central Queensland. The Drummond Basin is from the Upper Devonian to Lower Carboniferous periods that underwent three cycles (Olgers 1969). The Project has been historically described as a low-grade, low-sulfidation epithermal system, which lies within cycle one rocks in the central part of the eastern Drummond Basin, and close to the basal unconformity with basement rocks of the Anakie Inlier (NRC 2026).

ML1079 is predominately situated in the Suttor Formation and bordered to the northwest and southeast by the Rosetta Creek Formation (Queensland Government, 2021). The Suttor Formation is a sedimentary rock of the Palaeocene/ Eocene epoch that is described as quartz sandstone, clayey sandstone, mudstone and conglomerate, fluvial and lacustrine sediments with minor interbedded basalt. The Rosetta Formation is mixed volcanic and sedimentary rocks of the Late Devonian period and is described as siltstone to pebbly sandstone with locally abundant plant fossils, and numerous, relatively thin rhyolitic ignimbrite sheets.

4.1.4. Soil types and properties

A desktop analysis of detailed surface soil and geological mapping available via Queensland Globe (QLD, 2021) indicate the following soil and surface geology types. The predominant surface geologies across the project are quartz sandstone, clayey sandstone, mudstone and conglomerate, and fluvial and lacustrine sediments. Siltstone to pebbly sandstone, with relatively thin rhyolitic ignimbrite sheets are present at the northern end of the project, and the south-eastern corner. A small portion of clay, silt, sand, gravel (flood plain alluvial) occurs in the very northern end of the Project, and clay, silt, sand, and gravel (colluvial/residual deposits) occur in a very small amount on the south-western edge of the Project. Three soil types have been mapped within the mining lease of the Project (Table 3). The predominant soil type for the Project is hard pedal, mottled-yellow duplex soils (Tb119). Bleached sands (Cd14) are present in the south-eastern corner of the Project, and a small section of hard pedal yellow duplex soils (SI21) in the north-western corner.

Table 3: Summary of soil types and descriptions of the Project area

Soil Code	Soil Type	General Description
Cd14	Uniform coarse, non calc, A2 horizon conspic bleached with non calc pan below A2 horizon	Bleached sands
Tb119	Duplex yellow-grey, hard setting A horizon, A2 horizon conspic bleached, acid pedal mottled B horizon	Hard pedal mottled-yellow duplex soils
SI21	Duplex yellow-grey, hard setting A horizon, A2 horizon conspic bleached, alk pedal whole col B horizon	Hard pedal yellow duplex soils

4.1.5. Agricultural Land Class

The predominant agricultural land class on the Project and surrounding region is Class C. Classes C1, C2, and C3 can be found in the vicinity of the Project (Table 4). C3 is the dominant subclass within the mining lease, with the presence of a small patch of C2 in the north-western corner. There is little to no high-quality agricultural land in the region. The nearest areas of regional interest are located approximately 70km south-east of the Project, and as such are unlikely to be impacted by Project activities.

Table 4: Agricultural Land Classes and Description

Agricultural Land Class	Description
C1	Pasture land - sown pastures, and native pastures on high fertility soils
C2	Pasture land - native pastures
C3	Pasture land - native pastures, light grazing in accessible areas

4.1.6. Site hydrology and fluvial networks

The Project lies within the Belyando Suttor sub-catchment of the Burdekin catchment. Rosetta Creek is the major fluvial system draining into Suttor River which in turn flows into the Burdekin Dam. The Project overlies an area of gently sloping terrain, draining northwest and south west via several minor drainage lines, including Sugarbag Creek, which drain into Rosetta Creek. Existing water management infrastructure, including the TSF, were constructed to include clean water diversions that divert water around the site and into Sugarbag Creek.

The local drainage features are predominately of the first stream order and ephemeral in nature, typically flowing for short durations immediately following rainfall and remaining dry for the rest of the year. Some pools do persist along Sugarbag Creek however none of these are permanent.

4.1.7. Land Zones

Five land zones were identified within the Project ML: land zone 11, land zone 3, land zone 4, land zone 5, and land zone 7. Land zone 11 is characterised by metamorphosed rocks, forming ranges, hills and lowlands. Soils are typically of low to moderate fertility (Wilson and Taylor, 2012). Land zone 3 is characterised by recent Quaternary systems, including closed depressions, inland lakes, paleo-estuarine deposits under current freshwater influence. More generally described as alluvial river and creek flats (Wilson and Taylor, 2012). Land zone 4 is characterised by Tertiary to early Quaternary clay deposits. These deposits typically form level or gently undulating plains, not related to recent Quaternary alluvial systems. (Wilson and Taylor, 2012). Land zone 5 is characterised by Tertiary to early Quaternary uniform or near level, or gently undulating plains. Soils are typically sandy or loamy soils, and there may be a duricrust at depth. Land zone 7 is characterised by Cainozoic duricrusts that may form on a variety of rock types, often forming mesas or scarps. More generally described as ironstone jump-ups (Wilson and Taylor, 2012).

4.1.8. Vegetation and ecological communities

The Project is located within the Brigalow Belt bioregion (Bordering the Wyarra Hills and Beylondo Downs subregion). *Vegetation Management Regional Ecosystem (RE) map - version 12.0* indicates the Project is located within a mosaic of remnant and non-remnant vegetation (Figure 3). The mapped remnant vegetation areas are comprised of both homogenous (single RE) and heterogenous (multiple RE) polygons with apportioned values in terms of estimated percentage representation. (QLD, 2021). One endangered RE: 11.4.9 - *Acacia harpophylla* shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains (76.53 ha) and three of concern REs (VM class): 11.11.10 - *Eucalyptus melanophloia* woodland on deformed and metamorphosed sediments and interbedded volcanics (41.81 ha); 11.3.2 - *Eucalyptus populnea* woodland on alluvial plains (104.59); and 11.5.10 - *Melaleuca tamariscina* tall open shrubland to low woodland on Cainozoic sand plains and/or remnant surfaces (17.14 ha); are mapped within the ML (Table 5). A total area of 240 ha is mapped as comprised of or potentially comprised of endangered and of concern regional ecosystems.

It is noted that a property map of assessable vegetation (PMAV) was completed in 2006 to lock in areas mapped as category X, non-remnant vegetation.

Table 5 Desktop analysis regional ecosystems

Regional Ecosystem	Description	Vegetation Management Act Class	Biodiversity Status	Sum of Area (ha)
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains	Of concern	Of concern	104.59
11.4.9	<i>Acacia harpophylla</i> shrubby woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains	Endangered	Endangered	76.53
11.5.10	<i>Melaleuca tamariscina</i> tall open shrubland to low woodland on Cainozoic sand plains and/or remnant surfaces	Of concern	Of concern	17.14
11.5.9	<i>Eucalyptus crebra</i> and other <i>Eucalyptus</i> spp. and <i>Corymbia</i> spp. woodland on Cainozoic sand plains and/or remnant surfaces	Least concern	No concern at present	370.42
11.7.3	<i>Eucalyptus persistens</i> , <i>Triodia mitchellii</i> open woodland on stripped margins of Cainozoic lateritic duricrust	Least concern	No concern at present	138.92
11.7.2	<i>Acacia</i> spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone	Least concern	No concern at present	104.89
11.11.10	<i>Eucalyptus melanophloia</i> woodland on deformed and metamorphosed sediments and interbedded volcanics	Of concern	Of Concern	41.81
Non-remnant	None	None	none	473.3



Client: SMO
Project number: 2020.10003
Coordinate Reference System: GDA 94
Date: 14 December 2021

Map provided for interpretation purposes only.

Print as A0

Mapped Regional Ecosystems on Wirralie Gold Mine

-  ML1079
-  E-dom
-  E-subdom
-  LeastC
-  O-dom
-  O-subdom
-  non-rem

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Digital data for this report is available on the Queensland Government Spatial Portal at <http://www.information.qld.gov.au>.



4.1.9. Environmentally Sensitive Areas

Desktop review identified an environmentally sensitive area within the mining lease, and another within 2 km. Both ESAs were classified as “Endangered Regional Ecosystems – regrowth and remnant”. Endangered REs are considered Category B ESAs under the EP Act (Appendix A).

4.1.10. Matters of National Environmental Significance

A protected matters search of the project area including a 10km buffer identified several Matters of National Environmental Significance (MNES) as known to occur or possibly occurring within the search area (Table 6, Appendix B). The PMST report indicated two threatened ecological communities, seventeen listed threatened species, and 10 migratory species as MSES for consideration. Listed flora species are addressed below in sections 4.1.10.2 and 4.2.3.2. Listed fauna species are not addressed further as part of this report though incidental sightings were recorded during field surveys for reference.

Table 6 MNES Search Summary

MNES Search Summary	
World Heritage Properties	None
National Heritage Places	None
Wetlands of International Importance	None
Great Barrier Reef Marine Park	None
Commonwealth Marine Area	None
Listed Threatened Ecological Communities	2
Listed Threatened Species	17
Listed Migratory Species	10

4.1.10.1. Threatened Ecological Communities

Two listed threatened ecological communities were identified as being known to occur in the region: Brigalow (*Acacia harpophylla* dominant and co-dominant), first listed in 2001 (DAWE 2013); and Poplar Box Grassy Woodland on Alluvial Plains, which was newly listed in 2019 (DAWE 2019). Regional ecosystems associated with both communities are currently mapped within the Project ML (Table 7).

Table 7 Listed Threatened Ecological Communities

Name	Status	Description	Type of Presence
Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered (as of 2001)	Ranges from open woodland to open forest, characterised by the presence of Brigalow (Acacia harpophylla) as one of the three most dominant trees usually along with other Acacia, Eucalyptus, or Casuarina cristata. Relevant associated RE/s: 11.4.9.	Community known to occur within area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered (as of 2019)	Typically, grassy woodland with a canopy dominated by Eucalyptus populnea. Relevant associated RE/s: 11.3.2.	Community likely to occur within area

4.1.10.2. EPBC listed Flora

Three threatened flora species are listed as potentially present within 10km of the Project area.

Table 8: Listed Threatened Plant Species

Name	EPBC Status	NC Status	Act of Occurrence	Justification
Dichanthium setosum Bluegrass	Vulnerable	No concern	Possible	No records within 50km, suitable habitat mapped in region.
Eucalyptus raveretiana Black Ironbox	Vulnerable	No concern	Unlikely	No records within 50km, suitable habitat not mapped.
Samadera bidwillii Quassia	Vulnerable	No concern	Unlikely	No records within 50km, but suitable habitat mapped

Dichanthium setosum

Dichanthium setosum is an erect perennial grass to 30–70 cm (~1 m) tall commonly referred to as bluegrass. Bluegrass has leaves 2-3 mm wide, which are slightly rough to rough with tubercle-based hairs or can be glabrous, leaf sheaths are glabrous. Nodes of the erect stems are bearded and the ligule a fringed or ciliate membrane. The inflorescence is single or 2-3 branched, with hairs on the surface of the lower glume and an awn to 25 mm. (Sharpe and Simon, 2002, Jacobs and Wall, 2021, DAWE, 2021). The species typically occurs on heavy cracking clays or alluvium soils in woodland dominated by acacia or eucalyptus species (DAWE, 2021). Queensland distribution includes locations in the Brigalow Belt, Cape York Peninsula, Desert. No ALA records are reported within 50 km of the Project. The closest record occurs near Lake Dalrymple approximately 60 km north. Modelled potential habitat is mapped across much of the Project ML. Likelihood of occurrence within the Project area is considered 'possible'.

Eucalyptus raveretiana

Eucalyptus raveretiana is a medium-sized eucalypt tree growing up to 30 m tall with dark grey, rough, thick, longitudinally fissured bark on most or all of trunk and often on bases of large branches. Smooth bark persisting beyond the rough barked stocking is white to pale blue. (Euclid 2021, DAWE, 2021). Juvenile leaves are ovate and up to 10 cm x 3 cm. The adult leaves are up to 15 cm, narrower than the juvenile and discolourous dark blue/green above and paler below. Oil dots are small, intersecting the veins and island. Leaves are a dull dark blueish green on the upper surface with a paler underside. The inflorescence is terminal and compound with up to 7 buds per umbel. Buds and fruit are small < 0.5 cm. The bud operculum conical and the capsule valves exerted. Flowers are white. (Euclid, 2021, DES, 2021). The species has a varied soil preference ranging from sand to heavy clay, often growing along watercourses and occasionally river flats or open woodland. It is widely distributed in coastal and subcoastal Queensland from south of Townsville to Rockhampton (DAWE, 2021). There is one record located at the Burdekin Dam approximately 50 km from the Project area and modelled potential habitat is mapped along larger waterways adjacent to the Project. Likelihood of occurrence is considered 'possible' for the Project site.

Samadera bidwillii

Samadera bidwillii (formerly *Quassia bidwillii*) is a medium shrub to small tree (up to 6 m). One to several flowers emerge from the leaf axis on a 1-4 mm pedicel and are small and white with calyx bordered red or darkening to red on occasion. Fruit are group of 1-4 winged mericarp green when young and aging to yellow-red. Leaves are discolourous, being paler beneath with obvious venation. Lenticels are obvious on the branches, especially on the new growth, which is covered in pale brown, downy hairs (DAWE, 2008). *S.bidwillii* has been recorded in the dry rainforests and vine thickets in coastal islands off Mackay and south to Gympie. There are no records of *S.bidwillii* within 280 km of the Project and suitable habitat is not present nor modelled in the area. *S.bidwillii* is considered to be very 'unlikely' to be present in the Project area.

4.1.11. Matters of State Environmental Significance

The MSES Report indicated that Wildlife habitat (endangered or vulnerable) is present in the south-eastern corner of the ML. This mapped habitat area is modelled for the vulnerably listed ornamental snake (*Denisonia maculata*). Records of the ornamental snake occur in similar habitat within 50 km of the Project.

Regulated vegetation (category B - endangered or of concern) was also identified within the ML in MSES reports.

Wildlife habitat suitability models indicated habitat suitability for two threatened flora species: *Boronia keysii* (vulnerable); and *Melaleuca irbyana* (endangered); however, neither species has been recorded within several hundred kilometres of the project area.

4.2. Field results

Field based ground-truthing surveys of the Project area were undertaken by two ecologists in July 2021.

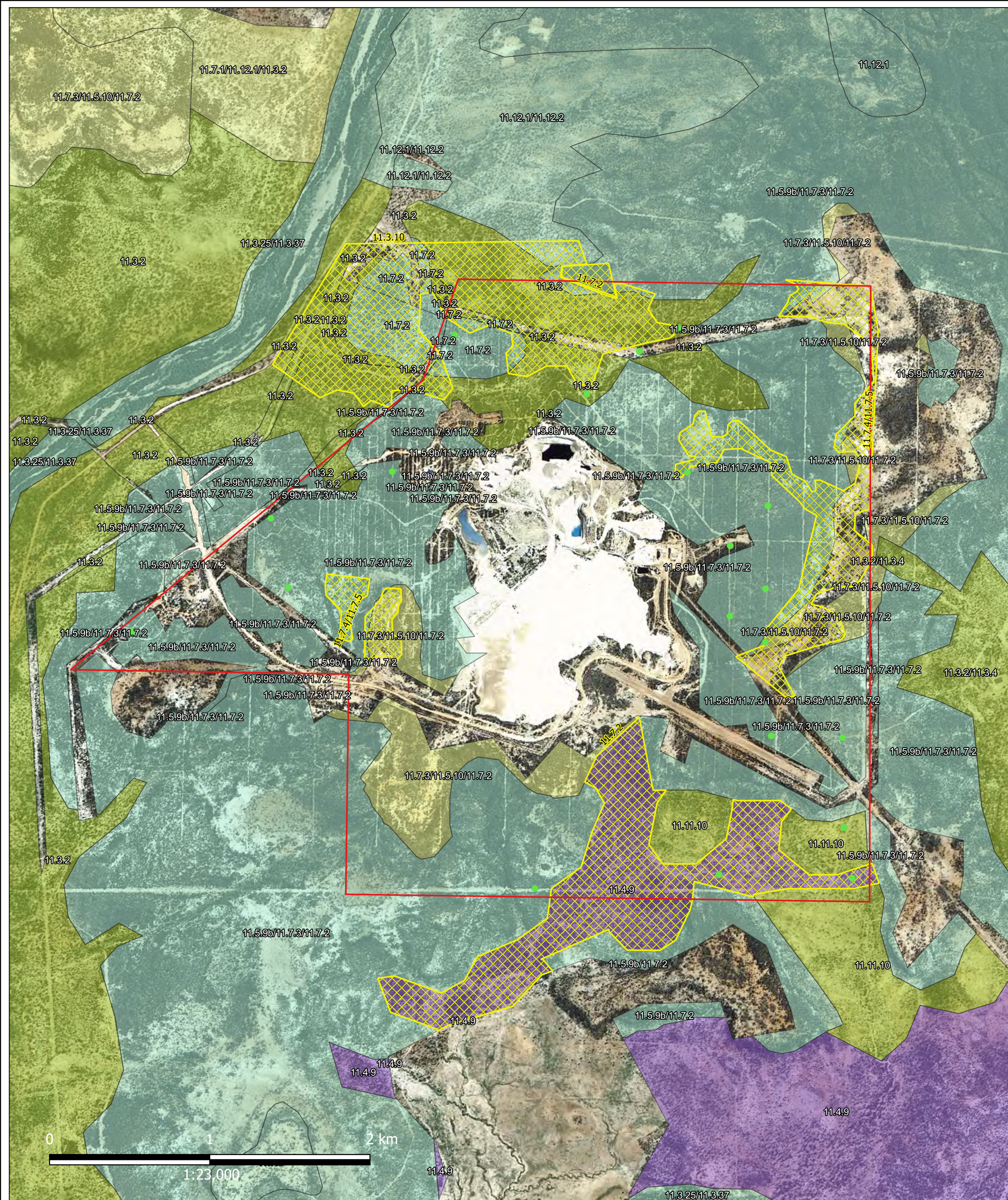
4.2.1. Ground-truthed Regional Ecosystems

A number of inconsistencies in the regional ecosystem mapping were observed during the the ground truthing surveys. Notably, an area currently mapped as endangered RE 11.4.9 - *Acacia harpophylla* shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains (also identified as a TEC, a category B ESA, an MSES and as Wildlife habitat (endangered or vulnerable)) in the southern section of the mining was ground-truthed as land zone 7: Cainozoic duricrusts. The RE for this area is therefore more consistent with Least Concern RE 11.7.2 - *Acacia* spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone (Figure 4).

Also noteworthy is an area in the northern section of the ML, much of which is currently mapped as of concern RE 11.3.2 - *Eucalyptus populnea* woodland on alluvial plains (also identified as a TEC, and an MSES) which was ground-truthed as least concern RE 11.3.10 - *Eucalyptus brownii* woodland on alluvial plains (Figure 4).

Several other areas were ground-truthed as land zone 7, consisting of a mosaic community of REs 11.7.4 - *Eucalyptus decorticans* and/or *Eucalyptus* spp., *Corymbia* spp., *Acacia* spp., *Lysicarpus angustifolius* woodland on Cainozoic lateritic duricrust (VM Act least concern) and 11.7.5 - Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks (VM Act least concern). These REs are not currently mapped for the Project area (Figure 4).

With the exception of the above-mentioned observations, REs were generally consistent with the mapped regional ecosystems. Where additional impacts to remnant vegetation are indicated, a more comprehensive survey of the vegetation likely to be impacted is recommended.



Client: SMO
Project number: 2020.10003
Coordinate Reference System: GDA 94 55K
14 December 2021

Map provided for interpretation purposes only.

Print as A3

Figure 4. Wirralie Gold Mine RE recommended changes

- Recommended changes**
- | | | | |
|---|--------------------------|---|----------|
|  | Groundtruth RE locations |  | E-subdom |
|  | ML1079 |  | LeastC |
|  | RE Edits |  | O-dom |
| | |  | O-subdom |
- Regional Ecosystems**
- | | | | |
|---|-------|---|---------|
|  | E-dom |  | non-rem |
|---|-------|---|---------|

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Digital data for this report is available on the Queensland Government Spatial Portal at <http://www.information.qld.gov.au>.



4.2.2. Environmentally Sensitive Areas

The category B ESA mapped for the project area is associated with the currently mapped endangered RE 11.4.9 - *Acacia harpophylla* shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains. Vegetation in this area was ground-truthed as 11.7.2 and should therefore not be considered a category B ESA under the EP Act.

4.2.3. Matters of National Environmental Significance

4.2.3.1. Threatened Ecological Communities

While regional ecosystems known to be associated with the two listed threatened ecological communities Brigalow (*Acacia harpophylla* dominant and co-dominant) (RE 11.4.9), and Poplar Box Grassy Woodland on Alluvial Plains (RE 11.3.2) are currently mapped for the Project ML, ground-truthing observations indicate that changes to the mapping are required.

RE 11.4.9 was ground-truthed as not present within the ML (confirmed as RE 11.7.2) and therefore the Brigalow TEC also does not occur.

RE 11.3.2 was ground-truthed in some locations as consisting instead of *Eucalyptus brownie* and therefore RE 11.3.10 and not consistent with the Poplar Box Grassy Woodland on Alluvial Plains TEC (Figure 4). Other areas mapped as 11.3.2 require further assessment to determine the status of the RE in accordance with the approved conservation advice (Dept. of Environment (2019)).

4.2.3.2. EPBC Listed Flora

All habitat types were visited during the field surveys. No listed threatened flora species were observed during these surveys.

4.2.3.3. Flora Species list

A total of 350 flora species were identified within the project area and was comprised of 56 exotic weed species and 294 native species. The following restricted invasive and other invasive weed species were recorded:

- Restricted invasive:
 - o Lantana (*Lantana camara*);
 - o Parthenium (*Parthenium hysterophorus*)
 - o Rubbervine (*Cryptostegia grandiflora*)
 - o Rat's tail grass (*Sporobolus natalensis*)
 - o Snakeweed (*Stachytarpheta jamaicensis*)
- Other invasive

- o Mimosa bush (*Vachellia farnesiana*)
- o Noogoora burr (*Xanthium occidentale*)

A comprehensive species list is included in Appendix D. This species list was used to develop propose species for rehabilitation (see section 4.5).

4.2.4. Matters of State Environmental Significance

The MSES Report indicated that Wildlife habitat (endangered or vulnerable) is present in the south-eastern corner of the ML. This mapped habitat area is modelled for the vulnerably listed ornamental snake (*Denisonia maculata*). While this mapped habitat relates to the mapped RE 11.4.9 - *Acacia harpophylla* shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains, which was ground-truthed during field surveys as RE 11.7.2 - *Acacia* spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone, the ornamental snake has been recorded in similar habitat and therefore remains a species for consideration.

Regulated vegetation (category B - endangered or of concern) was also identified within the ML in MSES reports. The area currently mapped as RE 11.4.9 - *Acacia harpophylla* shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains, was ground-truthed during field surveys as least concern RE 11.7.2 - *Acacia* spp. woodland on Cainozoic lateritic duricrust. Some areas of RE 11.3.2- *Eucalyptus populnea* woodland on alluvial plains were ground-truthed as least concern RE 11.3.10 - *Eucalyptus brownii* woodland on alluvial plains. Remaining areas not ground-truthed should be considered to remain category B of concern until otherwise confirmed.

No additional MSES were observed during the field-based surveys.

4.3. Rehabilitation monitoring

Rehabilitation and analogue monitoring sites were established and assessed as part of the field surveys undertaken in July 2021. Sites were assessed using BioCondition methodology and the collection of other appropriate attributes (see section 3.2.3.1). Data from analogue sites was used to develop acceptance criteria against which rehabilitation sites could be assessed. Site locations for each of the rehabilitation and analogue sites are included in Table 9

Table 9: Rehabilitation and analogue site locations

Name	Type	Latitude	Longitude
WA1 End	analogue	-21.1203736	147.2739684
WA1 Start	analogue	-21.1204735	147.2729814
WA2 End	analogue	-21.1100172	147.2663735
WA2 Start	analogue	-21.1105862	147.2671208
WA3 End	analogue	-21.1156580	147.2524314

Name	Type	Latitude	Longitude
WA3 Start	analogue	-21.1157310	147.2533743
WRH1 End	rehab	-21.1150082	147.2625682
WRH1 Start	rehab	-21.1157872	147.2620647

4.3.1. Analogue Sites

Three analogue sites were assessed, and the average of both sites presented below. analogue site BioCondition results are presented in Figure 6 and Figure 7. The complete data set is provided in Appendix C.

The average BioCondition scores for the analogue sites were used in conjunction with Regional Ecosystem benchmarks provided by the Queensland Herbarium to develop a rehabilitation acceptance criterion. This aim of this completion criteria is to provide a standardised way to measure and track rehabilitation success, working towards completion targets that are realistic for the area being rehabilitated, and representative of similar vegetation communities in the surrounding area.

Proposed acceptance criteria were calculated from the results of the analogue site assessments and have been outlined in Section 4.4



Figure 6 Representative vegetation of the analogue sites

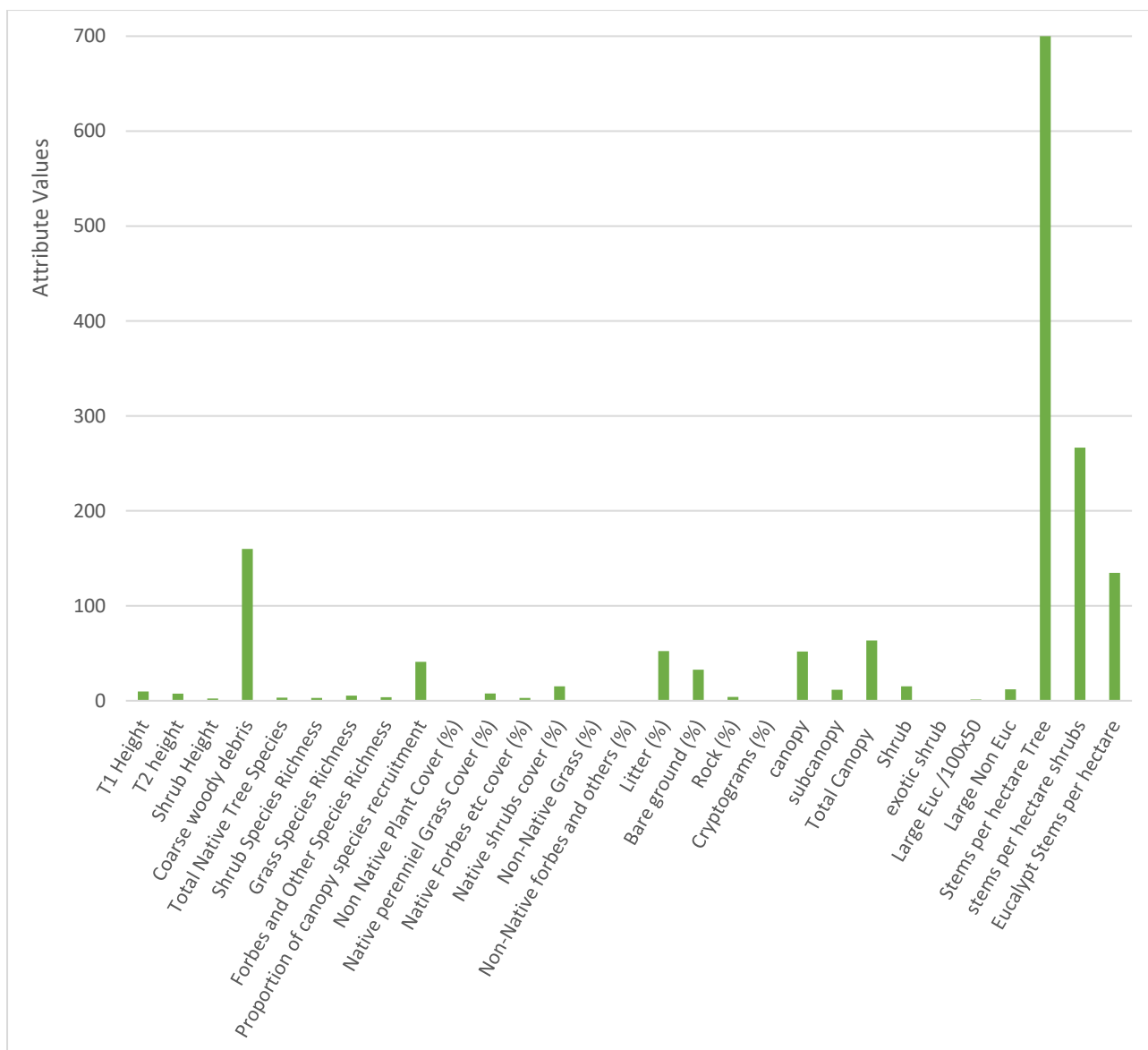


Figure 7: Analogue site BioCondition results

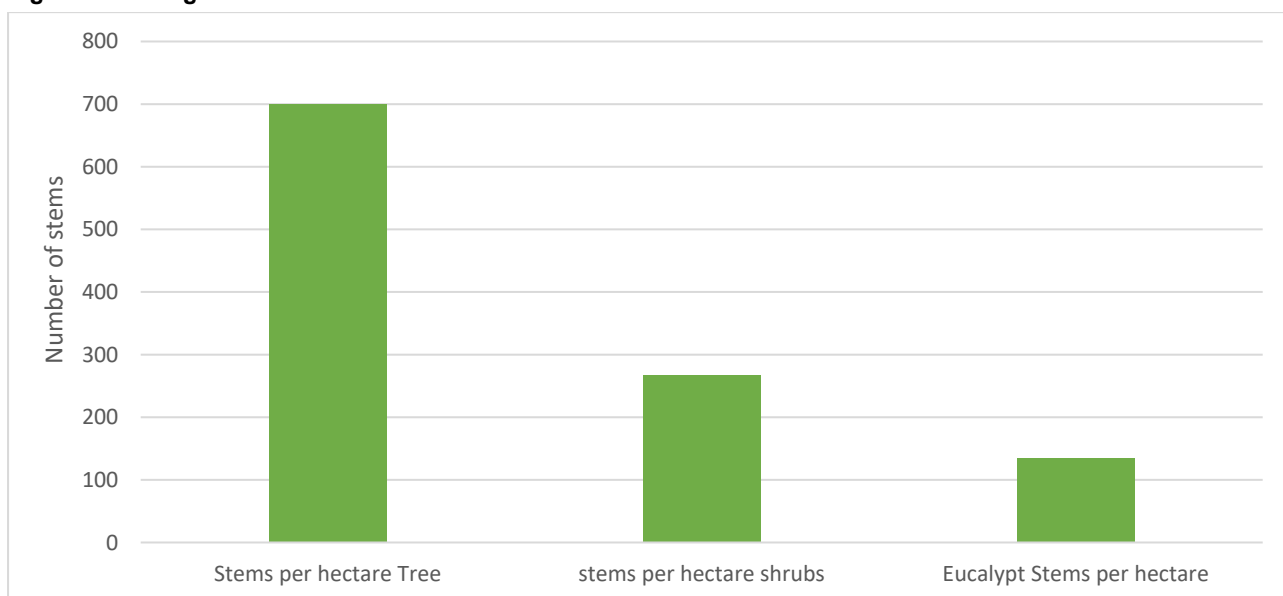


Figure 8: Analogue BioCondition assessment - stem count results

4.3.2. Rehabilitation – Waste Rock Sites

One monitoring transect (WRH 1) was established on a previously rehabilitated waste rock dump and assessed using the adapted BioCondition assessment methodology. Results from this survey were compared with the proposed acceptance criteria are summarised below. The complete data set has been provided in IntroductionC.

WRH1 species richness for trees, grasses, and forbes and other species, were either equal to or exceeding the acceptance criteria, with species richness for shrubs being only slightly less than that of the acceptance criteria (Figure 10). The dominant canopy species of WRH1 however, have not yet achieved the acceptance criteria for height.

Cover percentage for all strata is well below proposed acceptance criteria, indicating that while sufficient species are present to meet the richness criteria, they do not provide cover to achieve completion in this criterion (Figure 10). The results of the stem counts presented in Figure 11 show stem counts across the site to be higher than acceptance criteria.

Results of the assessment indicate that the rehabilitation site has not yet achieved maturity, there is sufficient species representation to reach maturity and achieve completion in due time.

It was also noted during the field surveys that rabbit scatts were abundant and likely to impact the rehabilitation site. Management of this pest species is likely to improve ground cover recruitment and health, and aid in restoring natural ecosystems to rehabilitation areas (Cooke, 2011).



Figure 9 Representative vegetation of the rehabilitation site WRD1

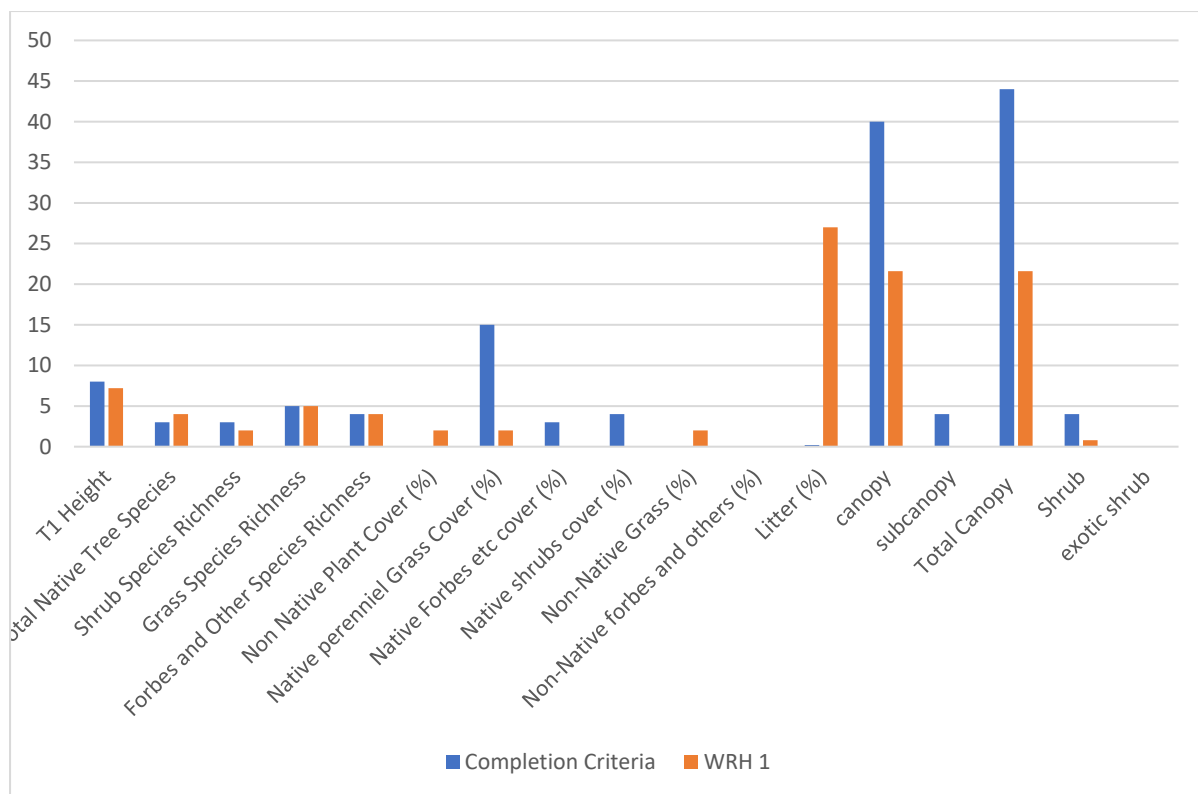


Figure 10 WRH 1 BioCondition results compared with rehabilitation acceptance criteria outcomes.

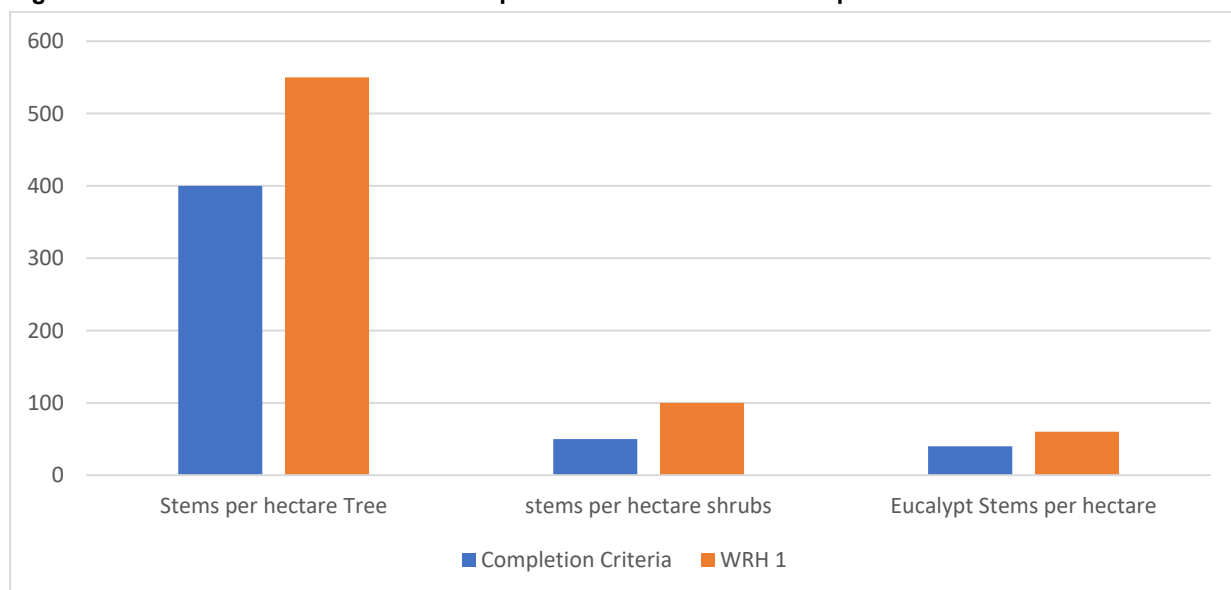


Figure 11 WRH 1 BioCondition stem count results compared with rehabilitation completion criteria outcomes, with x being the criteria being assessed, and y being the BioCondition score for each criterion.

4.4. Proposed Rehabilitation Acceptance Criteria

Acceptance criteria are rehabilitation performance goals presented as criterion completion scores for relevant attributes of vegetation. They provide measures: to which rehabilitation progress can be compared to determine success of the rehabilitation; to identify the need for intervention and management actions; and by which rehabilitated land is deemed to be complete.

The following acceptance criteria have been derived from Queensland Herbarium Benchmarks for regional ecosystems and adjusted for local representation of vegetation based the results of reference site BioCondition assessments (Table 10).

Table 10 Completion Criteria Summary

Criterion	Completion Score
T1 Height	8
Total Native Tree Species	3
Shrub Species Richness	3
Grass Species Richness	5
Forbes and Other Species Richness	4
Non-native Plant Cover (%)	20
Native Perennial Grass Cover (%)	15
Native Forbes and Other Species Cover (%)	3
Native Shrubs Cover (%)	4
Non-native Grass Cover (%)	<15
Non-native Forbes and Other Species Cover (%)	<5
Litter (%)	20
Canopy	40
Subcanopy	4
Total Canopy	44
Shrub	4
Exotic Shrub	<5
Stems/hectare (tree)	400
Stems/hectare (shrub)	50
Stems/hectare (eucalypt)	40

Rehabilitation achieving these criterion for a period of three years could be considered self-sustaining and likely to persist in the long term and may be deemed to be complete in accordance with the conditions of the EA.

4.5. Proposed Rehabilitation Species List

The following list of flora species that have been proposed as suitable species for rehabilitation for the Project area (Table 11). These species were identified in the analogue sites during surveys and were determined to be suitable for conditions found on the waste rock rehabilitation sites.

It is recommended that where possible seeds for these species be collected locally to ensure adaptation to the local environment. Not all recommended species are required for successful rehabilitation, but it is recommended to achieve as high a species richness as is practical.

Table 11 Proposed rehabilitation species list for the Project.

Family	Species Name	Common Name
Eucalypt trees		
Myrtaceae	<i>Eucalyptus brownii</i>	Reid River Box
Myrtaceae	<i>Eucalyptus exserta</i>	Queensland peppermint
Myrtaceae	<i>Corymbia dallchiana</i>	
Myrtaceae	<i>Eucalyptus melanophloia</i>	
Myrtaceae	<i>Eucalyptus persistens</i>	
Myrtaceae	<i>Eucalyptus thozetiana</i>	
Large shrubs/ small trees		
Mimosaceae	<i>Acacia catenulata</i>	Bendee
Mimosaceae	<i>Acacia decora</i>	Pretty Wattle
Mimosaceae	<i>Acacia excelsa</i>	
Mimosaceae	<i>Acacia flavescens</i>	Toothed wattle
Mimosaceae	<i>Acacia holosericea</i>	
Mimosaceae	<i>Acacia julifera</i>	
Mimosaceae	<i>Acacia leicocalyx</i>	
Mimosaceae	<i>Acacia leptostachya</i>	Townsville wattle
Mimosaceae	<i>Acacia macradenia</i>	Zig-zag wattle
Mimosaceae	<i>Acacia oswaldii</i>	Miljee
Mimosaceae	<i>Acacia rhodoxylon</i>	Ringy rosewood
Mimosaceae	<i>Acacia salicina</i>	Doolan
Mimosaceae	<i>Acacia shirleyi</i>	Lancewood
Mimosaceae	<i>Acacia sparsiflora</i>	
Picrodendraceae	<i>Petalostigma pubescens</i>	Quinine tree
Pittosporaceae	<i>Pittosporum spinescens</i>	
Rhamnaceae	<i>Ventilago viminalis</i>	Supplejack
Rhamnaceae	<i>Alphitonia excelsa</i>	Soap tree
Rubiaceae	<i>Larsenaikia ochreatea</i>	

Family	Species Name	Common Name
Sapindaceae	<i>Dodonaea viscosa</i> subsp. <i>spatulata</i>	
Sapindaceae	<i>Atalaya hemiglauca</i>	
Scrophulariaceae	<i>Eremophila mitchellii</i>	
Ulmaceae	<i>Trema tomentosa</i> var. <i>aspera</i>	
Small shrubs/ herbs		
Malvaceae	<i>Hibiscus sturtii</i>	
Malvaceae	<i>Hibiscus meraukensis</i>	Merauke hibiscus
Mimosaceae	<i>Neptunia gracilis</i>	
Moraceae	<i>Ficus opposita</i>	
Plumbaginaceae	<i>Plumbago zeylanica</i>	Native plumbago
Polygalaceae	<i>Polygala triflora</i>	
Sparrmanniaceae	<i>Grewia latifolia</i>	Dysentery plant
Grasses		
Poaceae	<i>Aristida jerichoensis</i>	
Poaceae	<i>Eragrostis sororia</i>	
Poaceae	<i>Eriachne mucronata</i>	
Poaceae	<i>Chrysopogon filipes</i>	
Poaceae	<i>Cymbopogon obtectus</i>	
Poaceae	<i>Leptochloa digitata</i>	
Poaceae	<i>Paspalidium distans</i>	Shotgrass
Poaceae	<i>Paspalidium gracile</i>	Slender panic
Poaceae	<i>Tragus australianus</i>	Small burr grass
Poaceae	<i>Cymbopogon refractus</i>	Barbed-wire grass
Poaceae	<i>Eragrostis lacunaria</i>	Purple lovegrass
Poaceae	<i>Eragrostis tenellula</i>	Delicate lovegrass
Poaceae	<i>Panicum decompositum</i>	
Poaceae	<i>Sporobolus contiguus</i>	
Poaceae	<i>Tripogon loliiformis</i>	Five minute grass
Poaceae	<i>Heteropogon contortus</i>	Black spear grass
Poaceae	<i>Aristida caput-medusae</i>	
Poaceae	<i>Bothriochloa decipiens</i>	
Poaceae	<i>Bothriochloa ewartiana</i>	Desert bluegrass
Poaceae	<i>Dactyloctenium radulans</i>	Button grass
Poaceae	<i>Paspalidium caespitosum</i>	Brigalow grass
Poaceae	<i>Themeda triandra</i>	Kangaroo grass
Poaceae	<i>Aristida calycina</i>	

5. Conclusion and Recommendations

Field surveys were undertaken at Wirralie Gold Mine in July 2022. The surveys included:

- Ground-truthing of regional ecosystems
- Ground-truthing MSES
- Establishing and monitoring rehabilitation and analogue sites.

Ground-truthing surveys identified the following:

- The vegetation communities present on site were generally consistent with the mapped regional ecosystems with the following exceptions:
 - o Endangered RE 11.4.9 was found to be not present, being ground-truthed as least concern RE 11.7.2;
 - o Of concern RE 11.3.2 was found to be incorrectly mapped in some areas and was identified instead as least concern RE 11.3.10;
- The Brigalow TEC was not found to be present on site;
- The Poplar Box Grassy Woodland on Alluvial Plains TEC was found not to occur in a large area in the north of the Project ML previously mapped as the TEC associated RE 11.3.2. Other areas of the Project ML still contain mapped areas of RE 11.3.2 and should be considered prior to disturbance.

Rehabilitation site establishment and monitoring found the following;

- Species richness of WRH1 sufficient to achieve the acceptance criterion however the site is not sufficiently mature to achieve the height criterion.
- Low levels of ground cover may be a result of intensive grazing from European rabbits (*Oryctolagus cuniculus*). Several individuals were observed, and extensive evidence of species presence was observed in the form of large amounts of scat (recent and aged), and evidence of grazing on new growth.
- Ongoing rehabilitation monitoring should be undertaken to determine trends in how rehabilitation is progressing towards rehabilitation completion criteria, and inform when intervention may be required if negative trends are observed.

The following recommendations are made regarding vegetation within the Project ML:

- Where additional impacts to remnant vegetation are indicated, a more comprehensive survey of the vegetation likely to be impacted is recommended;
- The TEC status of any vegetation mapped as RE 11.3.2 should be assessed prior to any potential disturbance.

- It is recommended that REs be updated to align with ground-truthed data via a PMAV, to provide accurate mapping and information for appropriate management of vegetation communities;

Rehabilitation monitoring and analogue reference sites were established and recommendations for rehabilitation acceptance criteria and flora species suitable for rehabilitation are provided in sections 4.4 and 4.5 of the report. Rehabilitation and analogue sites should be monitored annually in accordance with the conditions of the EA.

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Appendix A – Environmentally Sensitive Area map

Appendix B – Protected Matters Search

Appendix C – Vegetation Survey Results Summary

Table 12: BioCondition survey results summary.

Transect Number	WA 1	WA 2	WA 3	Average analogue sites	Benchmark	Rounded score	Success criteria	WRH 1
RE	11.7.2	11.7.2	11.7.2					
T1 Height (range)	9.5 (8-11)	9.8 (7.5-12)	10.2 (9-11)	9.83	15	9.8	8	7.2
T2 height (range)			7.5 (6-8)	7.50	5			
Shrub Height	1.8	2.1	3.2	2.37				
Coarse woody debris	148	65.4	266.4	159.93	1214			2.4
Total Native Tree Species	2	3	5	3.33	3	3	3	4
Shrub Species Richness	1	3	5	3.00	4	3	3	2
Grass Species Richness	6	4	6	5.33	5	5	5	5
Forbes and Other Species Richness	4	3	4	3.67	5	4	4	4
Proportion of canopy species recruitment	50	33	40	41.00				50
Non-native Plant Cover (%)	0	0	0	0.00			<20%	2
Native perennial Grass Cover (%)	20	3	0	7.67	15	8	15	2
Native Forbes etc cover (%)	5	0	4	3.00		3	3	0
Native shrubs cover (%)	7.9	7.1	30.4	15.13		15	4	0
Non-Native Grass (%)	0	0	0	0.00	0		<15%	2
Non-Native forbes and others (%)	0	0	0	0.00	0		<5%	0
Litter (%)	56	71	30	52.33	20	50	20%	27
Bare ground (%)	19	21	58	32.67				66
Rock (%)	0	5	7	4.00				3
Cryptograms (%)	0	0	1	0.33				0
canopy	59.3	66.9	29.2	51.80	40	50	40	21.6
subcanopy	0	0	34.9	11.63	4	10	4	0
Total Canopy	59.3	66.9	64.1	63.43	44	60	44	21.6
Shrub	7.9	7.1	30.4	15.13	4	15	4	0.8
exotic shrub	0	0	0	0.00			<5%	0
Large Euc /100x50	0	0	4	1.33	10			0
Large Non Euc	16	3	17	12.00	26			0
Tree stems/ha	440	920	740	700.00		500	400	550
Shrub stems/ha	40	320	440	266.67		100	50	100
Eucalypt Stems/ha	4	240	160	134.67		120	40	60

Appendix D – Flora Species List

Table 13: flora species list

Family	Scientific Name	Common Name
Acanthaceae	<i>Pseuderanthemum variabile</i>	pastel flower
Acanthaceae	<i>Rostellularia adscendens</i>	
Aizoaceae	<i>Tetragonia tetragonoides</i>	New Zealand spinach
Aizoaceae	<i>Trianthema portulacastrum</i>	black pigweed
Aizoaceae	<i>Trianthema triquetra</i>	red spinach
Amaranthaceae	<i>Alternanthera denticulata</i>	lesser joyweed
Amaranthaceae	<i>Alternanthera nodiflora</i>	joyweed
Amaranthaceae	<i>Deeringia amaranthoides</i>	redberry
Amaranthaceae	<i>Gomphrena celosioides</i>	gomphrena weed
Amaranthaceae	<i>Ptilotus semilanatus</i>	
Apocynaceae	<i>Carissa ovata</i>	currantbush
Apocynaceae	<i>Cryptostegia grandiflora</i>	rubber vine
Apocynaceae	<i>Parsonsia lanceolata</i>	northern silkpod
Asteraceae	<i>Bidens pilosa</i>	
Asteraceae	<i>Camptacra barbata</i>	
Asteraceae	<i>Centipeda minima subsp. minima</i>	
Asteraceae	<i>Coronidium lanosum</i>	
Asteraceae	<i>Cyanthillium cinereum</i>	
Asteraceae	<i>Eclipta prostrata</i>	white eclipta
Asteraceae	<i>Glossocardia bidens</i>	native cobbler's pegs
Asteraceae	<i>Glossocardia refracta</i>	
Asteraceae	<i>Parthenium hysterophorus</i>	parthenium weed
Asteraceae	<i>Peripleura hispidula</i>	
Asteraceae	<i>Peripleura obovata</i>	
Asteraceae	<i>Pluchea dentex</i>	bowl daisy
Asteraceae	<i>Pluchea xanthina</i>	
Asteraceae	<i>Pterocaulon redolens</i>	
Asteraceae	<i>Pterocaulon serrulatum</i>	
Asteraceae	<i>Sonchus oleraceus</i>	common sowthistle
Asteraceae	<i>Tridax procumbens</i>	tridax daisy
Asteraceae	<i>Xanthium occidentale</i>	
Bignoniaceae	<i>Pandorea pandorana</i>	wonga vine
Boraginaceae	<i>Ehretia membranifolia</i>	weeping koda
Boraginaceae	<i>Heliotropium cunninghamii</i>	
Boraginaceae	<i>Heliotropium indicum</i>	
Byttneriaceae	<i>Seringia hookeriana</i>	
Byttneriaceae	<i>Waltheria indica</i>	
Cactaceae	<i>Harrisia martinii</i>	
Cactaceae	<i>Opuntia stricta</i>	prickly pear

Cactaceae	<i>Opuntia tomentosa</i>	velvety tree pear
Caesalpiniaceae	<i>Cassia brewsteri</i>	
Caesalpiniaceae	<i>Chamaecrista rotundifolia</i>	
Caesalpiniaceae	<i>Lysiphyllum carronii</i>	ebony tree
Caesalpiniaceae	<i>Lysiphyllum hookeri</i>	Queensland ebony
Caesalpiniaceae	<i>Senna artemisioides subsp. filifolia</i>	
Caesalpiniaceae	<i>Senna artemisioides subsp. zygophylla</i>	
Caesalpiniaceae	<i>Senna gaudichaudii</i>	
Caesalpiniaceae	<i>Senna magnifolia</i>	
Caesalpiniaceae	<i>Senna occidentalis</i>	coffee senna
Caesalpiniaceae	<i>Senna planitiicola</i>	
Capparaceae	<i>Capparis arborea</i>	brush caper berry
Capparaceae	<i>Capparis lasiantha</i>	nipan
Capparaceae	<i>Capparis loranthifolia</i>	
Capparaceae	<i>Capparis mitchellii</i>	
Caryophyllaceae	<i>Polycarpaea spirostylis</i>	
Celastraceae	<i>Denhamia oleaster</i>	
Celastraceae	<i>Denhamia sp. (Mt Coolon D.Corr PA409)</i>	
Chenopodiaceae	<i>Atriplex lindleyi</i>	
Chenopodiaceae	<i>Atriplex muelleri</i>	lagoon saltbush
Chenopodiaceae	<i>Dysphania carinata</i>	
Chenopodiaceae	<i>Einadia nutans subsp. eremaea</i>	
Chenopodiaceae	<i>Einadia nutans subsp. linifolia</i>	
Chenopodiaceae	<i>Enchylaena tomentosa</i>	
Chenopodiaceae	<i>Maireana enchylaenoides</i>	
Chenopodiaceae	<i>Maireana microphylla</i>	
Chenopodiaceae	<i>Salsola australis</i>	
Chenopodiaceae	<i>Sclerolaena anisacanthoides</i>	yellow burr
Chenopodiaceae	<i>Sclerolaena bicornis</i>	
Chenopodiaceae	<i>Sclerolaena muricata var. muricata</i>	
Chenopodiaceae	<i>Sclerolaena ramulosa</i>	
Chenopodiaceae	<i>Sclerolaena tricuspis</i>	giant red burr
Cleomaceae	<i>Arivela viscosa</i>	
Colchicaceae	<i>Iphigenia indica</i>	
Combretaceae	<i>Combretum indicum</i>	
Combretaceae	<i>Terminalia oblongata</i>	
Commelinaceae	<i>Cyanotis axillaris</i>	
Convolvulaceae	<i>Bonamia media</i>	
Convolvulaceae	<i>Evolvulus alsinoides</i>	
Convolvulaceae	<i>Ipomoea nil</i>	
Convolvulaceae	<i>Ipomoea plebeia</i>	bellvine
Convolvulaceae	<i>Jacquemontia paniculata</i>	
Cucurbitaceae	<i>Diplocyclos palmatus subsp. palmatus</i>	

Cyperaceae	<i>Bulbostylis barbata</i>	
Cyperaceae	<i>Cyperus dactyloides</i>	
Cyperaceae	<i>Cyperus difformis</i>	rice sedge
Cyperaceae	<i>Cyperus fulvus</i>	
Cyperaceae	<i>Cyperus haspan</i>	
Cyperaceae	<i>Cyperus iria</i>	
Cyperaceae	<i>Cyperus javanicus</i>	
Cyperaceae	<i>Cyperus trinervis</i>	
Cyperaceae	<i>Eleocharis philippinensis</i>	
Cyperaceae	<i>Fimbristylis dichotoma</i>	common fringe-rush
Cyperaceae	<i>Scleria sphacelata</i>	
Ebenaceae	<i>Diospyros humilis</i>	small-leaved ebony
Erythroxylaceae	<i>Erythroxylum australe</i>	cocaine tree
Euphorbiaceae	<i>Acalypha eremorum</i>	soft acalypha
Euphorbiaceae	<i>Euphorbia</i>	
Euphorbiaceae	<i>Euphorbia drummondii</i>	
Euphorbiaceae	<i>Euphorbia hirta</i>	
Euphorbiaceae	<i>Euphorbia macdonaldii</i>	
Euphorbiaceae	<i>Euphorbia tannensis</i>	
Fabaceae	<i>Aeschynomene americana</i>	
Fabaceae	<i>Aeschynomene brevifolia</i>	
Fabaceae	<i>Crotalaria mitchellii</i>	
Fabaceae	<i>Crotalaria montana</i>	
Fabaceae	<i>Crotalaria verrucosa</i>	
Fabaceae	<i>Cullen australasicum</i>	
Fabaceae	<i>Cullen cinereum</i>	
Fabaceae	<i>Fabaceae</i>	
Fabaceae	<i>Galactia tenuiflora</i>	
Fabaceae	<i>Glycine tomentella</i>	woolly glycine
Fabaceae	<i>Indigofera colutea</i>	sticky indigo
Fabaceae	<i>Indigofera linifolia</i>	
Fabaceae	<i>Indigofera linnaei</i>	Birdsville indigo
Fabaceae	<i>Indigofera pratensis</i>	
Fabaceae	<i>Macroptilium atropurpureum</i>	siratro
Fabaceae	<i>Rhynchosia minima</i>	
Fabaceae	<i>Rhynchosia minima</i>	
Fabaceae	<i>Sesbania cannabina</i>	
Fabaceae	<i>Stylosanthes hamata</i>	
Fabaceae	<i>Stylosanthes scabra</i>	
Fabaceae	<i>Tephrosia brachyodon</i>	
Fabaceae	<i>Tephrosia filipes forma vestita</i>	
Fabaceae	<i>Vigna lanceolata</i>	
Lamiaceae	<i>Basilicum polystachyon</i>	

Lamiaceae	<i>Clerodendrum floribundum</i>	
Lamiaceae	<i>Glossocarya hemiderma</i>	
Lamiaceae	<i>Leucas lavandulifolia</i>	
Lamiaceae	<i>Ocimum caryophyllum</i>	
Loranthaceae	<i>Amyema congener</i>	
Loranthaceae	<i>Amyema quandang</i>	
Loranthaceae	<i>Amyema quandang</i>	broad-leaved grey mistletoe
Loranthaceae	<i>Dendrophthoe glabrescens</i>	
Malvaceae	<i>Abutilon hannii</i>	
Malvaceae	<i>Abutilon otocarpum</i>	
Malvaceae	<i>Abutilon oxycarpum</i>	
Malvaceae	<i>Abutilon subviscosum</i>	
Malvaceae	<i>Gossypium australe</i>	
Malvaceae	<i>Hibiscus meraukensis</i>	Merauke hibiscus
Malvaceae	<i>Hibiscus sturtii</i>	
Malvaceae	<i>Sida acuta</i>	spinyhead sida
Malvaceae	<i>Sida aprica</i>	
Malvaceae	<i>Sida atherophora</i>	
Malvaceae	<i>Sida cordifolia</i>	
Malvaceae	<i>Sida corrugata</i>	
Malvaceae	<i>Sida fibulifera</i>	
Malvaceae	<i>Sida hackettiana</i>	
Malvaceae	<i>Sida rhombifolia</i>	
Malvaceae	<i>Sida rohlenae</i>	
Malvaceae	<i>Sida spinosa</i>	spiny sida
Marsileaceae	<i>Marsilea drummondii</i>	common nardoo
Meliaceae	<i>Owenia acidula</i>	emu apple
Menyanthaceae	<i>Nymphoides crenata</i>	wavy marshwort
Mimosaceae	<i>Acacia blakei</i>	
Mimosaceae	<i>Acacia cambagei</i>	gidgee
Mimosaceae	<i>Acacia catenulata</i>	bendee
Mimosaceae	<i>Acacia conferta</i>	
Mimosaceae	<i>Acacia decora</i>	pretty wattle
Mimosaceae	<i>Acacia excelsa</i>	
Mimosaceae	<i>Acacia flavescens</i>	toothed wattle
Mimosaceae	<i>Acacia fodinalis</i>	
Mimosaceae	<i>Acacia harpophylla</i>	brigalow
Mimosaceae	<i>Acacia holosericea</i>	
Mimosaceae	<i>Acacia jackesiana</i>	
Mimosaceae	<i>Acacia julifera</i>	
Mimosaceae	<i>Acacia julifera</i>	
Mimosaceae	<i>Acacia leiocalyx</i>	
Mimosaceae	<i>Acacia leptostachya</i>	Townsville wattle

Mimosaceae	<i>Acacia macradenia</i>	zig-zag wattle
Mimosaceae	<i>Acacia oswaldii</i>	miljee
Mimosaceae	<i>Acacia rhodoxylon</i>	ringy rosewood
Mimosaceae	<i>Acacia rhodoxylon x Acacia shirleyi</i>	
Mimosaceae	<i>Acacia salicina</i>	doolan
Mimosaceae	<i>Acacia shirleyi</i>	lancewood
Mimosaceae	<i>Acacia sparsiflora</i>	
Mimosaceae	<i>Archidendropsis basaltica</i>	red lancewood
Mimosaceae	<i>Neptunia gracilis</i>	
Mimosaceae	<i>Vachellia bidwillii</i>	
Mimosaceae	<i>Vachellia farnesiana</i>	
Molluginaceae	<i>Glinus lotoides</i>	hairy carpet weed
Molluginaceae	<i>Glinus oppositifolius</i>	
Moraceae	<i>Ficus opposita</i>	
Myrtaceae	<i>Corymbia clarksoniana</i>	
Myrtaceae	<i>Corymbia dallachiana</i>	
Myrtaceae	<i>Corymbia erythrophloia</i>	variable-barked bloodwood
Myrtaceae	<i>Corymbia lamprophylla</i>	
Myrtaceae	<i>Corymbia leichhardtii</i>	rustyjacket
Myrtaceae	<i>Eucalyptus brownii</i>	Reid River box
Myrtaceae	<i>Eucalyptus brownii x Eucalyptus persistens</i>	
Myrtaceae	<i>Eucalyptus camaldulensis subsp. acuta</i>	
Myrtaceae	<i>Eucalyptus cambageana</i>	Dawson gum
Myrtaceae	<i>Eucalyptus coolabah</i>	coolabah
Myrtaceae	<i>Eucalyptus crebra</i>	narrow-leaved red ironbark
Myrtaceae	<i>Eucalyptus exserta</i>	Queensland peppermint
Myrtaceae	<i>Eucalyptus howittiana</i>	Howitt's box
Myrtaceae	<i>Eucalyptus melanophloia</i>	
Myrtaceae	<i>Eucalyptus melanophloia</i>	
Myrtaceae	<i>Eucalyptus persistens</i>	
Myrtaceae	<i>Eucalyptus platyphylla</i>	poplar gum
Myrtaceae	<i>Eucalyptus shirleyi</i>	
Myrtaceae	<i>Eucalyptus thozetiana</i>	
Myrtaceae	<i>Eucalyptus whitei</i>	White's ironbark
Myrtaceae	<i>Lysicarpus angustifolius</i>	budgeroo
Myrtaceae	<i>Melaleuca bracteata</i>	
Myrtaceae	<i>Melaleuca chisholmii</i>	
Myrtaceae	<i>Melaleuca pallescens</i>	
Myrtaceae	<i>Melaleuca tamariscina</i>	
Myrtaceae	<i>Melaleuca trichostachya</i>	
Myrtaceae	<i>Micromyrtus capricornia</i>	
Nyctaginaceae	<i>Boerhavia dominii</i>	
Olacaceae	<i>Ximenia americana</i>	

Oleaceae	<i>Jasminum didymum</i>	
Onagraceae	<i>Ludwigia octovalvis</i>	willow primrose
Orchidaceae	<i>Cymbidium caniculatum</i>	Black orchid
Papaveraceae	<i>Argemone ochroleuca</i>	Mexican poppy
Passifloraceae	<i>Passiflora foetida</i>	
Phyllanthaceae	<i>Breynia oblongifolia</i>	
Phyllanthaceae	<i>Flueggea leucopyrus</i>	
Phyllanthaceae	<i>Phyllanthus carpentariae</i>	
Phyllanthaceae	<i>Phyllanthus maderaspatensis</i>	
Phyllanthaceae	<i>Phyllanthus virgatus</i>	
Picrodendraceae	<i>Petalostigma pubescens</i>	quinine tree
Pittosporaceae	<i>Bursaria incana</i>	
Pittosporaceae	<i>Pittosporum angustifolium</i>	
Pittosporaceae	<i>Pittosporum spinescens</i>	
Plantaginaceae	<i>Scoparia dulcis</i>	scoparia
Plumbaginaceae	<i>Plumbago zeylanica</i>	native plumbago
Poaceae	<i>Alloteropsis cimicina</i>	
Poaceae	<i>Alloteropsis semialata</i>	cockatoo grass
Poaceae	<i>Ancistrachne uncinulata</i>	hooky grass
Poaceae	<i>Aristida benthamii</i> var. <i>spinulifera</i>	
Poaceae	<i>Aristida calycina</i>	
Poaceae	<i>Aristida calycina</i>	
Poaceae	<i>Aristida caput-medusae</i>	
Poaceae	<i>Aristida holathera</i> var. <i>holathera</i>	
Poaceae	<i>Aristida jerichoensis</i>	
Poaceae	<i>Aristida pernicioso</i>	
Poaceae	<i>Bothriochloa bladhii</i> subsp. <i>bladhii</i>	
Poaceae	<i>Bothriochloa decipiens</i>	
Poaceae	<i>Bothriochloa ewartiana</i>	desert bluegrass
Poaceae	<i>Bothriochloa pertusa</i>	
Poaceae	<i>Brachyachne convergens</i>	common native couch
Poaceae	<i>Calyptochloa gracillima</i>	
Poaceae	<i>Cenchrus ciliaris</i>	
Poaceae	<i>Chloris divaricata</i>	
Poaceae	<i>Chloris gayana</i>	rhodes grass
Poaceae	<i>Chloris inflata</i>	purpletop chloris
Poaceae	<i>Chloris pectinata</i>	comb chloris
Poaceae	<i>Chrysopogon fallax</i>	
Poaceae	<i>Chrysopogon filipes</i>	
Poaceae	<i>Cleistochloa subjuncea</i>	
Poaceae	<i>Cymbopogon oblectus</i>	
Poaceae	<i>Cymbopogon refractus</i>	barbed-wire grass
Poaceae	<i>Cynodon dactylon</i>	

Poaceae	<i>Dactyloctenium radulans</i>	button grass
Poaceae	<i>Dichanthium annulatum</i>	sheda grass
Poaceae	<i>Dichanthium tenue</i>	small bluegrass
Poaceae	<i>Digitaria ammophila</i>	silky umbrella grass
Poaceae	<i>Digitaria bicornis</i>	
Poaceae	<i>Digitaria brownii</i>	
Poaceae	<i>Digitaria ciliaris</i>	summer grass
Poaceae	<i>Digitaria orbata</i>	
Poaceae	<i>Dinebra decipiens</i>	
Poaceae	<i>Dinebra ligulata</i>	
Poaceae	<i>Diplachne fusca</i> var. <i>fusca</i>	
Poaceae	<i>Echinochloa colona</i>	awnless barnyard grass
Poaceae	<i>Enneapogon lindleyanus</i>	
Poaceae	<i>Enneapogon polyphyllus</i>	leafy nineawn
Poaceae	<i>Enneapogon virens</i>	
Poaceae	<i>Enteropogon ramosus</i>	
Poaceae	<i>Entolasia stricta</i>	wiry panic
Poaceae	<i>Eragrostis exigua</i>	
Poaceae	<i>Eragrostis lacunaria</i>	purple lovegrass
Poaceae	<i>Eragrostis leptostachya</i>	
Poaceae	<i>Eragrostis parviflora</i>	weeping lovegrass
Poaceae	<i>Eragrostis sororia</i>	
Poaceae	<i>Eragrostis spartinoides</i>	
Poaceae	<i>Eragrostis tenellula</i>	delicate lovegrass
Poaceae	<i>Eremochloa bimaculata</i>	poverty grass
Poaceae	<i>Eriachne mucronata</i>	
Poaceae	<i>Eriachne mucronata</i>	
Poaceae	<i>Eriachne obtusa</i>	
Poaceae	<i>Eriochloa procera</i>	slender cupgrass
Poaceae	<i>Eriochloa pseudoacrotricha</i>	
Poaceae	<i>Eulalia aurea</i>	silky browntop
Poaceae	<i>Heteropogon contortus</i>	black speargrass
Poaceae	<i>Leptochloa digitata</i>	
Poaceae	<i>Megathyrsus maximus</i> var. <i>maximus</i>	
Poaceae	<i>Megathyrsus maximus</i> var. <i>pubiglumis</i>	
Poaceae	<i>Melinis repens</i>	red natal grass
Poaceae	<i>Mnesithea formosa</i>	
Poaceae	<i>Oxychloris scariosa</i>	winged chloris
Poaceae	<i>Panicum decompositum</i>	
Poaceae	<i>Panicum effusum</i>	
Poaceae	<i>Panicum larcomianum</i>	
Poaceae	<i>Paspalidium albobillosum</i>	
Poaceae	<i>Paspalidium caespitosum</i>	brigalow grass

Poaceae	<i>Paspalidium distans</i>	shotgrass
Poaceae	<i>Paspalidium flavidum</i>	
Poaceae	<i>Paspalidium gracile</i>	slender panic
Poaceae	<i>Paspalum dilatatum</i>	paspalum
Poaceae	<i>Pseudoraphis spinescens</i>	spiny mudgrass
Poaceae	<i>Sporobolus actinocladus</i>	katoora grass
Poaceae	<i>Sporobolus australasicus</i>	
Poaceae	<i>Sporobolus caroli</i>	fairy grass
Poaceae	<i>Sporobolus contiguus</i>	
Poaceae	<i>Sporobolus coromandelianus</i>	
Poaceae	<i>Sporobolus natalensis</i>	
Poaceae	<i>Thellungia advena</i>	coolibah grass
Poaceae	<i>Themeda triandra</i>	kangaroo grass
Poaceae	<i>Tragus australianus</i>	small burr grass
Poaceae	<i>Triodia mitchellii</i>	buck spinifex
Poaceae	<i>Triodia pungens</i>	
Poaceae	<i>Tripogon loliiformis</i>	five minute grass
Poaceae	<i>Urochloa holosericea</i>	
Poaceae	<i>Urochloa mosambicensis</i>	sabi grass
Poaceae	<i>Urochloa panicoides</i>	
Poaceae	<i>Urochloa piligera</i>	
Polygalaceae	<i>Polygala triflora</i>	
Pontederiaceae	<i>Monochoria cyanea</i>	
Portulacaceae	<i>Portulaca oleracea</i>	pigweed
Portulacaceae	<i>Portulaca pilosa</i>	
Pteridaceae	<i>Cheilanthes nudiuscula</i>	
Pteridaceae	<i>Cheilanthes sieberi</i>	
Revegetation species	<i>Vegetation Layer</i>	Species number
Rhamnaceae	<i>Alphitonia excelsa</i>	soap tree
Rhamnaceae	<i>Ventilago viminalis</i>	supplejack
Rubiaceae	<i>Larsenaikia ochreatea</i>	
Rubiaceae	<i>Oldenlandia corymbosa</i>	
Rubiaceae	<i>Psydrax johnsonii</i>	
Rubiaceae	<i>Spermacoce brachystema</i>	
Rutaceae	<i>Flindersia dissosperma</i>	
Rutaceae	<i>Flindersia maculosa</i>	leopardwood
Rutaceae	<i>Geijera parviflora</i>	wilga
Rutaceae	<i>Geijera salicifolia</i>	brush wilga
Rutaceae	<i>Phebalium glandulosum</i>	
Santalaceae	<i>Exocarpos latifolius</i>	
Sapindaceae	<i>Alectryon diversifolius</i>	scrub boonaree
Sapindaceae	<i>Atalaya hemiglauca</i>	
Sapindaceae	<i>Dodonaea triangularis</i>	

Sapindaceae	<i>Dodonaea viscosa subsp. spatulata</i>	
Scrophulariaceae	<i>Eremophila mitchellii</i>	
Solanaceae	<i>Solanum ellipticum</i>	potato bush
Solanaceae	<i>Solanum galbinum</i>	
Solanaceae	<i>Solanum nigrum</i>	
Sparrmanniaceae	<i>Corchorus trilocularis</i>	
Sparrmanniaceae	<i>Grewia latifolia</i>	dysentery plant
Sparrmanniaceae	<i>Triumfetta pentandra</i>	
Ulmaceae	<i>Trema tomentosa var. aspera</i>	
Verbenaceae	<i>Lantana camara</i>	lantana
Verbenaceae	<i>Stachytarpheta jamaicensis</i>	Jamaica snakeweed

Appendix F: Wirralie TSF Rehabilitation Strategy

Wirralie Gold Mine

TSF Rehabilitation Strategy

March 2014

prepared for Solomons Gold
by Northern Resource Consultants



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Limitations of this Report

Client: Solomons Gold (Solomons)

Prepared by Northern Resource Consultants (NRC)

This disclaimer brings the limitations of the investigations to the attention of the reader.

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This report has been formulated in the context of published guidelines, field observations, discussions with site personnel, and results of laboratory analyses.

NRC's opinions in this document are subject to modification if additional information is obtained through further investigation, observations or analysis. They relate solely and exclusively to environmental management matters, and are based on the technical and practical experience of environmental scientists.

They are not presented as legal advice, nor do they represent decisions from the regulatory agencies charged with the administration of the relevant Acts.

Any advice, opinions or recommendations contained in this document should be read and relied upon only in the context of the document as a whole and are considered current as of the date of this document.

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Introduction

1. Scope of the Rehabilitation Strategy

The Wirralie Tailings Storage Facility (TSF) rehabilitation strategy has been developed as an addendum to the Wirralie Gold Project Plan of Operations 2014 – 2019 (the PoO) to address the rehabilitation of the Wirralie TSF. The TSF is approximately 72ha and therefore represents the greatest potential closure liability for the site. This rehabilitation strategy aids in quantifying this potential liability, as well as addressing the following aspects:

- Detail proposed rehabilitation activities for the TSF
- Describe monitoring methods for the TSF rehabilitation
- Propose acceptance criteria for the TSF rehabilitation
- Describe water management aspects for the TSF

2. Description of the TSF Operation

The current tailings dam has a surface area of 72ha and this is expected to remain constant throughout the new operation. The facility was formed by the construction of an earth and rock fill embankment across a broad, shallow valley on Sugarbag Creek. The downstream embankment is approximately 900m, with the Wirralie waste dumps constructed adjacent to the embankment to create an integrated landform. The waste dump has been previously rehabilitated, though it is anticipated that some minor remedial works are required to the dump. These are described in detail in the Plan of Operations.

The profile of the tailings surface is gently sloping across the entire surface, with water shedding across the surface to a permanent water dam forming over approximately 25ha at the eastern end of the dam. A further 5ha surrounding the permanent storage is inundated on a semi-permanent basis. A heap leach circuit will be established on the north-western end of the TSF and is projected to cover an area of 5ha. A 3.5ha rehabilitation trial area will be established within the southern end of the tailings dam to inform the rehabilitation strategy described below. Figure 1 shows the location of the semi-permanent wetland and rehabilitation trial area.

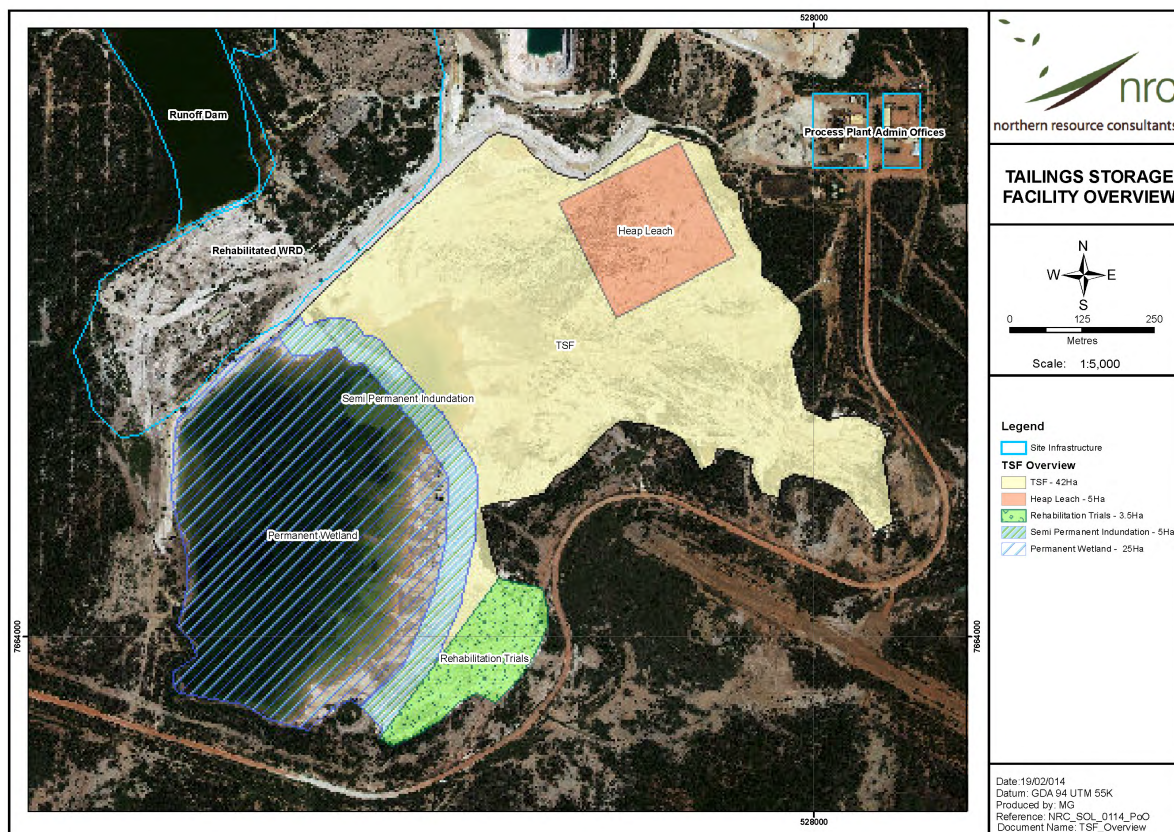


Figure 1: Tailings Storage Facility Overview including Wetland and Rehabilitation Trial Area

3. Closure Objectives

The mine closure objectives of the Wirralie Gold Mine are to:

- Protect the environment and public health through the use of responsible rehabilitation practices.
- Ensure any landforms constructed as part of site rehabilitation will be geochemically stable – resistant to weathering and oxidation and not generating seepage or leaching contaminants to surface water or groundwater.
- Reduce or eliminate potential impacts to the surrounding environment.
- Establish conditions that are consistent with the pre-determined end land use where practicable.
- Reduce the need for long-term monitoring and maintenance by establishing effective physical and chemical stability of disturbed areas.
- Facilitate lease relinquishment.

Performance of rehabilitation activities undertaken will be gauged against specific closure criteria, which will include:

- Quality of water leaving the rehabilitated landforms will meet acceptable standards and pose no adverse impact to off-lease water resources. Water will demonstrate stable or improving water quality over a number of wet and dry cycles.
- Achieving agreed post-mining and use objectives nominated in the Environmental Authority that are compatible with the climate, soils and topography of the final landforms.
- Final rehabilitated landforms that show trends toward long-term stability.

The specific post mine land use description for the TSF is contained in the Environmental Authority for the site. The TSF post mine land use is **Class VII – land not suitable for cultivation and only careful pastoral use** (DME 1995).

TSF Rehabilitation Strategy

1. Proposed Landforms

The final landform type for the TSF is proposed as a mixed landform made up of an ephemeral wetland and native habitat containing some pasture species. This design is based on maintaining water storage within a portion of the facility. Approximately one third of the tailings surface area is inundated following an average wet season. This water is confined to the western corner of the dam adjacent to the spillway. A further 5ha is inundated on a semi permanent basis and is also suitable as a wetland. The remainder, approximately 42ha, will require active rehabilitation through the development of a suitable capping. The cover method will be determined through rehabilitation trials that are proposed to start in the first year of the recommencement of operations (detailed below). Stock will be excluded from the area through the construction of a perimeter fence to limit access to water and enable native vegetation to establish.

2. Water Management

2.1 Water Quality

The water storage within the Wirralie TSF is approximately 25ha, and anecdotal evidence from local landholders indicates that the storage is permanent, having not dried out since the site was put on care and maintenance ten years ago. Water quality within the storage was assessed in January 2014 and meets the ANZECC Livestock Drinking Water Guideline for most analytes assessed. A summary of the current water quality assessment for the TSF is included in Table 1, showing that sulfate and TDS exceed the guideline values. However, the concentration of arsenic and all metals assessed are within the ANZECC guideline. The elevated TDS and sulfate levels at this stage do not represent a risk to the environment, livestock will be excluded from the permanent water storage through the installation of an exclusion fence around the perimeter. Elevated TDS and sulfate can cause health problems in livestock following long term or chronic exposure. Cattle and other livestock will be excluded from the mine site by a perimeter fence, which is to remain post closure, so it is not anticipated that the opportunity for chronic exposure will eventuate (ANZECC, 2000)

Table 1: Water Quality Wirralie TSF Spillway January 2014

Parameter	Unit	TSF Spillway	Livestock Drinking Water Guideline (ANZECC)
pH	pH Units	7.1	-
Total Dissolved Solids Dried at 175-185°C	mg/L	9100	5000
Zinc, Zn	mg/L	<0.01	20
Sulfur as Sulfate, SO ₄	mg/L	4300	1000

Parameter	Unit	TSF Spillway	Livestock Drinking Water Guideline (ANZECC)
Sulfur, S	mg/L	1400	-
Molybdenum, Mo	mg/L	0.014	0.15
Arsenic, As	mg/L	0.80	0.5-5
Copper, Cu	mg/L	<0.003	1 (Cattle)
Cadmium, Cd	mg/L	0.0065	0.01
Lead, Pb	mg/L	<0.003	0.1
Selenium, Se	mg/L	0.014	0.02
Total Zinc	mg/L	<0.01	-
Total Molybdenum	mg/L	0.014	-
Total Arsenic, As	mg/L	0.81	-
Total Cadmium, Cd	mg/L	0.0069	-
Total Copper, Cu	mg/L	<0.003	-
Total Lead, Pb	mg/L	<0.003	-
Total Selenium, Se	mg/L	0.014	-
Mercury	mg/L	<0.00005	0.002
Total Mercury	mg/L	<0.00005	-
Weak Acid Dissociable Cyanide	mg/L	<0.004	-

3. Geochemical Nature of Tails

The deposited tailings are consolidated and considered suitable for earthworks, including the heap leach and rehabilitation works. Characterisation of the tailings for rehabilitation purposes was completed by EGI (2004) and determined that the acid potential risk of the tailings was low. The geochemical investigation was undertaken on the tailings to:

- Assess the acid-forming potential of the tailings.
- Identify any elements that are enriched and/or soluble in the tailings that may present an environmental concern for water quality, soil contamination or dusting.
- Provide recommendations for rehabilitation.

The results of the test work indicated that the tailings are relatively barren in terms of acid generation, and the acid rock drainage risk from the tailings storage is considered to be low. However, the material is saline and contains relatively soluble arsenic at concentrations that may be of concern for closure and rehabilitation.

Arsenic is present in both the surface and at depth in the profile samples of the tailings, with a recommendation in the EGI report that a surface layer be installed over the tailings to isolate this risk. However, arsenic seems contained within the tailings, as recent water quality results from the TSF indicate that arsenic is within the ANZECC Livestock Drinking Water Guideline (Table 1).

4. Water Storage Landform

Construction of the permanent wetland will commence during the closure phase once the heap leach and active tailings deposition have ceased. Surrounding the permanent water storage, there is an area of semi-permanent inundation. Some minor earthworks may be required in order to return the batter on the dam to a natural slope, as well as some minor stabilisation works. A number of water plant species (*Cyprus* sp., *Enchylaena tomentosa*, and *Typha* sp.) have already begun to colonise the perimeter of the dam. These will continue to be monitored during the next phase of the operation and if necessary these will be propagated for either seeding or direct planting as part of the rehabilitation of the wetland. Figure 2 below shows the existing water storage at the Wirralie TSF and some of the vegetation that has colonised around the perimeter of the storage. Figure 2: Wirralie TSF Semi-Permanent Water Storage (Photo taken February 2014). Water quality monitoring of the TSF will continue during the operational phase of mining and processing at Wirralie as required in the EA. Water quality objectives for the semi-permanent wetland will be developed prior to rehabilitation commencing. It is anticipated that ongoing monitoring of the water quality will continue during post closure until it can be demonstrated that these water quality objectives have been met and will continue to be met into the future.



Figure 2: Wirralie TSF Semi-Permanent Water Storage (Photo taken February 2014).

5. Native Habitat and Grazing Pasture Landform

5.1 Summary of Previous Trials

Detailed experiments and trials have been conducted previously using the tailings from the Wirralie TSF. The outcomes of these experiments have been used to inform this rehabilitation strategy and are summarised below.

Freak (1993) conducted several experiments using tailings in pot trials to determine seed germination ability and seedling growth under various treatments of topsoil and fertiliser. From this study, it was determined that tailings from the Wirralie TSF inhibited seed germination and initial seedling establishment of most species examined. High germination percentages were however recorded for *Cenchrus ciliaris*, *Chloris gayana*, *Acacia holosericea*, *Lysiphyllum hookeri* and species of *Atriplex*, *Dysphania*, *Enchylaena* and *Eucalyptus* when germinated in tailings with added topsoil. Additionally, seedling survival of these species was enhanced with additions of fertiliser (Freak, 1993).

Freak (1993) also reported that *Acacia harpophylla* exhibited moderate growth rates in treatments with and without topsoil (direct sowing in dried tails). The growth of *A. shirleyi* in tailings could not be accurately determined as external factors, such as sensitivity to shading and transplanting, interfered with the effect of tailings on growth. It was suggested that *A. shirleyi* may be a potentially useful species for revegetating the tailings dam, as field trials indicated that this species grows well with added topsoil and fertiliser. *Eucalyptus camaldulensis* and *E. trachyphloia* exhibited rapid growth rates and high tolerance to both tailing types, but only under treatments with added topsoil (Freak, 1993).

Freak (1993) also examined the species used in tailings pot trials under field conditions within the Wirralie TSF. On a small-scale tailings dam plot, seed germination and vegetation cover were monitored over one year. Greater vegetation cover was recorded in areas with added topsoil and fertiliser compared to areas with added topsoil but no fertiliser, which supported the results from the pot trials. Additionally, there was evidence that compaction of the placed soil by heavy earthmoving machinery occurred at the plot, and that this appeared to severely restrict seed germination over most of the plot (Freak, 1993).

5.2 Proposed Trials

A cover trial for the existing TSF is proposed, with a focus on examining different rehabilitation methods through scientific trials, demonstrating their effectiveness and determining the most suitable methodology for rehabilitation of the TSF. The rehabilitation trials proposed will build on the previous work conducted by Freak (1993). The proposed trials are considered to be commensurate with current best practice and regulatory requirements for equivalent sites and climatic conditions.

5.3 Existing Material Available

As noted previously, the tailings are relatively benign with studies to date determining that they represent a low acid forming risk, and whilst arsenic concentrations are above desired levels this is relatively immobile and is below ANZECC guidelines in the water storage area.

An area of approximately 3.5ha is immediately available within the existing TSF to commence rehabilitation trials and monitoring upon the recommencement of operations. This area is representative of the whole tailings storage facility and will therefore provide a suitable rehabilitation trial area. Figure 3 to Figure 5 below are recent photographs of the proposed tailings trial area and are indicative of the whole tailings storage facility.

A topsoil balance of approximate 60,000m³ remains in stockpiles around the tailings dam and process areas. This topsoil will be used for revegetation of the tailings dam.



Figure 3: Wirralie TSF Rehabilitation Trial Area (Photo taken February 2014).



Figure 4: Wirralie TSF Rehabilitation Trial Area (Photo taken February 2014).



Figure 5: Wirralie TSF Rehabilitation Trial Area (Photo taken February 2014).

5.4 Site Preparation and Revegetation Method

The deposited tailings materials within the trial area are consolidated and considered suitable for earthworks, having been undisturbed for approximately 10 years. Further compaction of the tailings surface is not recommended for the trial area.

The surface of the whole trial area will be graded if necessary to ensure that water drains to the water pond area. A small fence or other suitable marker will delineate the trial areas. In

addition, a small nib wall will be constructed on the lower end of the trial area to minimise the potential for water inundation. This will be slotted to allow drainage, and formed so that it has no impact on the DSA of the TSF.

The following is an overview of the proposed trial methods:

OPTION 1 TRIAL – CAPILLARY BREAK

- A capillary break layer (0.5m deep) made up of screened coarse material from the proposed heap leach pad will be constructed over the area. This material will be readily available following the heap leach process and represents a potential beneficial reuse of the material. The layer will be track rolled with a dozer for the trial prior to placement of topsoil.
- Topsoil from the existing topsoil stockpiles surrounding the TSF will be spread directly over the trial area to a depth of approximately 0.2m. Topsoil will be placed in alternate strips nominally 5m in width to enable the full area to be covered and maximise the available topsoil resource. This will be shallow ripped using a grader to minimise potential compaction from machinery, prior to seeding.
- Topsoiled sections will be seeded using acacia tree species, a mix of groundcover/pasture species and a single dose of fertiliser. Given the relatively benign nature of the tailings, it is not considered necessary to limit species selection for rehabilitation to shallow rooting species.

OPTION 2 TRIAL - MOONSCAPE

- Oxide mine waste transported from the pit will be paddock dumped on the tailings to form islands. These shall be pushed over to form mounds approximately 0.8m high.
- Topsoil from the adjacent stockpiles will be selectively spread on each of the islands to a depth of approximately 0.2m.
- Topsoiled sections will be seeded using acacia tree species, a mix of groundcover/pasture species and a single dose of fertiliser. Given the relatively benign nature of the tailings, it is not considered necessary to limit species selection for rehabilitation to shallow rooting species.
- An engineered low permeability drainage system shall be installed to collect surface runoff and direct surface flows directly to the wetland area.

OPTION 3 TRIAL – TOPSOIL STRIPS DIRECT ON TAILS

- Topsoil will be directly spread over the trial area to a depth of approximately 0.2m in alternate strips approximately 5m wide. Spread topsoil will then be shallow ripped to incorporate the topsoil tailings media and minimise the impact from compaction of the surface by earthmoving equipment.
- Topsoiled sections will be seeded using acacia tree species, a mix of groundcover/pasture species and a single dose of fertiliser.

OPTION 4 TRIAL – DIRECT SEEDING

- The surface of the trial area will be shallow ripped along the contour to promote infiltration and limit erosion potential.
- A seed mix will be directly sown into the TSF using acacia tree species, a mix of groundcover/pasture species and a single dose of fertiliser.
- Trial 4 option is a control and will be used to benchmark the overall rehabilitation performance of each trial.

All four options will be trialled over the 3.5ha area. It is anticipated that options 3 and 4 will be able to commence in year one of the operation. Options 1 and 2 require the generation of suitable by product through mining and processing activities and so will not be able to commence until at least year two of the operation.

The following sections describe common elements within the trial, including:

- Topsoil treatment
- Timing
- Species selection
- Seed and fertiliser application rates

These proposed trials build on previous trials conducted on the TSF at both Wirralie and the nearby Yandan operations between 1990 and 1992 (Freak, 1993).

5.5 Topsoil Treatment

An existing topsoil stockpile from the previous operations will be accessed to provide topsoil for the trial. Each of the trials will have topsoil from the same stockpile area. Following placement, the topsoil will be lightly ripped to an approximate depth of 5 - 10mm. This is to minimize the potential effects of compaction during transport and placement. In addition, this will aid in the rainfall infiltration and seed germination. Ripping will occur across the surface contour to minimize the erosion potential.

5.6 Timing

Rehabilitation of the full tailings will not be able to commence until processing ceases on the site. Opportunities for the progressive rehabilitation of the TSF are limited. The rehabilitation trial area is likely to be the only area available within the TSF for rehabilitation prior to mine closure.

The rehabilitation trial is proposed to commence within the first year of operation under the current Plan of Operations. This will enable the trial to run over the full term of the Plan of Operations and allow a decision on the preferred cover strategy to occur prior to the next Plan.

Site preparation is proposed to occur in June/ July with the site fully prepared, including topsoiled ahead of the wet season.

Previous studies carried out during the operation of the TSF have recommended that the site be prepared and revegetation postponed for a full 12 months to enable surface salts to leach away (Freak, 1993). As the facility has been inactive for over a decade, at this stage there is no recognised benefit in postponing revegetation for the trials.

5.7 Plant Species Selection

Topsoil used on the tailings dam will likely have a degraded natural seed bank. This, coupled with the nature of the tailings necessitates extra seeding to ensure successful revegetation. In order to ensure high diversity, a wide range of pasture grasses, native shrub and tree species will be necessary. This diverse species mix will also improve the the chance of successful establishment of at least some species.

The following species are recommended for the tailings dam rehabilitation based on seeding trials conducted by Freak (1993): *Cenchrus ciliaris*, *Chloris gayana*, *Triodia pungens*, *Acacia holosericea*, *A. shirleyi*, *Lysiphyllum hookeri*, *Eucalyptus camaldulensis*, *E. melanophloia*, *Atriplex nummularia*, *Dysphania glomulifera* and *Enchylaena tomentosa*. These species have shown high potential for growth in tailings in field trials and glasshouse experiments carried out by Freak (1993). These species are also locally occurring and suited to the climatic conditions at Wirralie. Although many other chenopod species are available for revegetation purposes, the family is not predominant in the Wirralie region and the family is likely better suited to arid climates (Freak, 1993).

5.8 Seed and Fertiliser Application Rates

Seeding rates will need to be moderate to high due to the nature of the tailings and the uncertain viability of the seed bank in the topsoil stockpiles. A recommend seeding rate of 4 kg ha⁻¹ for most low-toxic tailings dams will be utilised across topsoil areas within the TSF (Ward and Warren 1989, taken from Freak 1993 thesis).

Seed can be used economically by sowing the areas of grass, herb, and saltbush species together, and alternating these areas with rows of tree and shrub species. This method of sowing will reduce competition between ground cover species and trees, and the rows of trees will provide a series of windbreaks across the dam. Freak (1993) recommended a design of 5 m wide strips of tree species, alternating with 10 m wide strips of grass and herb species. These rows of vegetation should be established across the contours of the dam to minimise soil erosion. This approach is considered appropriate for the trial plots proposed in this strategy. Minor amendments to the methodology may be required once the dimensions of the trial plots are taken into account.

Nutrient analyses of the tailings completed by Freak indicated extremely low levels of plant-available nitrogen, phosphorus and potassium. Therefore applications of N.P.K. compound fertiliser are recommended for the trial. A rate of 300 kg of fertiliser per hectare is considered adequate to successfully establish vegetation. A second application of fertiliser at the same rate will be applied prior to the second wet season to further assist vegetation establishment and further balance the nutrient deficit (Freak, 1993).

For the trial one option, the strips between the windrows without topsoil will be planted with a selection of tree seedlings to trial whether they can be directly planted into the tailings media. In addition, if successful this will form a windbreak across the tailings dam surface and reduce the risk of wind blown tailings. A range of tree species will be trialled at different densities.

6. Proposed Monitoring Methods

A regular monitoring program will be established to determine the success rate of the rehabilitation methods as well as act as an early warning system should rehabilitation fail. Monitoring will typically occur quarterly for the first 2 years, and then bi-annually during the remaining trial period. Quarterly monitoring provides a quantifiable measure of progression of rehabilitation (or lack thereof) and will provide an indication of whether the system is successful following the two year period. Future bi-annual monitoring will measure the stability of the system as well as aim to detect potential changes occurring at the rehabilitated sites.

A rehabilitation monitoring program has previously been undertaken on the site, although this was suspended under the previous operators during the care-and-maintenance period. Wirralie will look at actively re-establishing this program to improve the available understanding of the success of previous rehabilitation programs and to inform future programs.

The rehabilitation assessment will utilise contemporary monitoring techniques, including monitoring of suitable analogue sites to develop site-specific rehabilitation success criteria. Wirralie will use the principles of Landscape Function Analysis to obtain information on the success of rehabilitation by drawing comparisons to control/analogue sites for a variety of target values.

LANDSCAPE FUNCTION ANALYSIS

The primary goal of rehabilitation is to restore or replace missing or ineffective processes in the landscape in order to improve the soil habitat quality for desired biota. To gauge the progression of rehabilitation at Wirralie, annual monitoring using landscape functional analysis (LFA) methodology is recommended. LFA is a cost-effective monitoring procedure that uses simple indicators to provide a broad scale assessment relating to how well the rehabilitated ecosystem works as a biogeochemical system. This type of analysis allows a landscape to be categorised into a highly functional or highly dysfunctional system.

LFA is often used on rehabilitated mine sites to assess the biophysical functioning of the ecosystem in terms of soil habitat present. These assessments determine how sustainable the landscape is when presented with possible disturbance, high rainfall events or various climatic conditions. The LFA process provides a snapshot of how rehabilitation is performing and whether vegetation will be sustainable over a long period of time.

Tongway and Hindley's (2004) *Landscape Function Analysis: Procedures for monitoring and assessing landscapes* with special reference to mine sites and rangelands is considered a

best practice guide for LFA that will be consulted for future monitoring events. Monitoring will entail seven fundamental processes, the details of which are provided below:

1. Establishing a series of analogue (reference) and test (rehabilitated) sites where 50m vegetation transects can be established to monitor the progress of rehabilitation over time. Sites are to be established within the initial monitoring event.
2. Identifying features of the landscape such as length and width of patches and interpatches while walking along the transect. Patches accumulate resources by trapping litter, nutrients and water. These patches create an environment that is ideal for the establishment and germination of plant species, positively contributing to the rehabilitation process. Interpatches are the spaces between patches where nutrients are quickly transported over an area (e.g. areas of bare soil). Generally, a healthier landscape could be considered one with a high patch to interpatch ratio as little organic material and topsoils are lost to the system.
3. Measuring patch and interpatch distances to gauge the potential energy that could be caused during a high rainfall event. The larger the distance between the patches and inter-patches the more risk of erosion (hill-slope assessment).
4. Characterising the soil surface properties (soil surface assessment of the patches and interpatches). Characteristics include: rain-splash protection (vegetative or other protection of the bare soil), perennial vegetation cover, litter cover, cryptogam cover, crust brokenness, erosion type and severity, amount of deposited materials, surface roughness, surface resistance to disturbance, stability following rapid wetting and soil texture.
5. Using quadrats within transects to quantify vegetation cover.
6. Scoring habitat complexity for faunal habitat potential by assessing the habitat features of a given area to identify the development of environmental niches provided for vertebrate fauna. Habitat as well as vegetation descriptions and condition notes are to be recorded. These assessments determine how sustainable the landscape is when presented with possible disturbance, high rainfall events or various climatic conditions.
7. Repeat LFA processes annually and compare the aforementioned characteristics over time.

Annual monitoring of the analogue sites will determine the response of native grasses, herbs, shrubs and tree species to the natural fluctuations in the environment, and after a sufficient amount of data has been obtained, final rehabilitation success criteria will be determined for the rehabilitation sites.

7. Proposed Rehabilitation Acceptance Criteria

Measuring revegetated sites against control/analogue sites provides a comparative basis for assessing the success of rehabilitated areas. The success of rehabilitation is determined by the continued progression, stability and self-sustainability of the revegetated system. It is expected that rehabilitated sites eventually reach the same level of landscape functionality as a given control/analogue site.

Monitoring using LFA methodology assists in determining whether resources are being lost or gained at the rehabilitated site. Loss of landscape function indicates that the site is losing

resources (such as nutrients due to lack of groundcover) and an increase in function gain indicates that the site is maintaining resources, which is a step toward self-sustainability and therefore successful rehabilitation (Tongway and Hindley 2005).

Conclusion and Recommendations

The Wirralie TSF covers an area of 72ha, with 3.5ha available to trial a number of rehabilitation options. By initiating a large scale trial within the early operational and processing phase of the project, sufficient timescale should be available to examine a number of rehabilitation techniques. By trialling a number of different rehabilitation methodologies and through quantitative analysis of these methods, an appropriate large scale cover method should be indicated within the two year period. Additionally, rehabilitation acceptance criteria will then be developed for application to the TSF.

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EGI (Environmental Geochemistry International), (2002) *Environmental Geochemical Assessment of the Wirralie Tailings Storage* prepared for Wirralie Mines Pty Ltd.

Appendices

Appendix G: Wirralie Gold Mine Waste Rock Characterisation (C & R Consulting, 2021)



C&R CONSULTING

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WIRRALIE GOLD MINE

Waste Rock Characterisation

Report Prepared for:



Date:
February 2022

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A handwritten signature in black ink that reads 'Christopher Cuff'.

Dr Chris Cuff
Director

24/02/2022

Date

A handwritten signature in black ink that reads 'Cecily Rasmussen'.

Dr Cecily Rasmussen
Director

24/02/2022

Date

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7. The report reflects both the information provided to C&R Consulting in documents made available for review and the results of observations and consultations by C&R Consulting staff.

SUMMARY OF RELEVANT INFORMATION

Project Title	Wirralie Gold Mine – Waste Rock Characterisation
Property Location	Wirralie Gold Mine
Property Description	Open-cut gold mine
Project Purpose	Conduct a geochemical waste rock characterisation study to support the progressive rehabilitation and closure plan for the Wirralie Gold Mine.
Project Number	21078
Client's Details	
Nominated Representative	Scott Hayes-Stanley
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EXECUTIVE SUMMARY

C&R Consulting Pty Ltd (C&R) were commissioned by Wulguru Technical Services (WTS) to undertake a geochemical waste rock characterisation study of the Wirralie Gold Mine (Wirralie). This study will form part of the progressive rehabilitation and closure plan (PRCP) and associated estimated rehabilitation cost (ERC) that WTS are currently preparing on behalf of Wirralie's current owners, Solomons Gold Pty Ltd.

In accordance with the Queensland Department of Environment and Science (DES) *Guideline – Progressive rehabilitation and closure plans (PRC plans)* (DES, 2021), this waste rock characterisation study has been undertaken to:

“Characterise mine wastes in a report that describes the likely physical behaviour and chemical reactivity of the waste materials under the conditions in which they would be stored. The report must address the constituent elements present, and their likely future speciation and mobility.”

To achieve this, 155 rock/sediment samples were collected from 82 sampling locations, including the Wirralie waste rock dumps (WRDs), heap leach pad (HLP), former run-of-mine (ROM), haul road and tailings surface facility (TSF). These samples were tested in a National Association of Testing Authorities (NATA) accredited laboratory for a range of static and kinetic geochemical properties, including acid generation, salinity and metal/metalloid concentrations.

The undertaken geochemical testwork identifies that all of the Wirralie waste rock samples have similar physical and geochemical characteristics, apart from those obtained from the TSF. This is to be expected given that most waste rock areas are constructed of the same lithology (volcaniclastic sediment), whereas the TSF waste consists of processed (mineralised) ore.

The static geochemical results indicate that:

- All waste rock areas, including the TSF, are overwhelmingly (98%) non-acid forming;
- All waste rock areas, excluding the TSF, are not particularly saline (mean of 137 $\mu\text{S}/\text{cm}$), whereas the TSF has a much higher salinity (mean of 1,592 $\mu\text{S}/\text{cm}$) and may present salinity issues;
- All waste rock areas, including the TSF, have significant arsenic enrichment. However, all of the levels are still below the National Environment Protection Measure (NEPM) health-based investigation level (HIL) for 'Recreational C' (public open space scenario) of 300 mg/kg (National Environment Protection Council [NEPC], 2013); and
- All waste rock areas, excluding the TSF, are not particularly enriched with respect to any of the other metals/metalloids analysed.

Further to this, when comparing the TSF static testwork to the other waste rock areas:

- The arsenic enrichment in the TSF is more frequent and occurring at higher mean concentration of 114 mg/kg;
- The arsenic enrichment in the TSF is accompanied by mercury enrichment, although these mercury levels are still below NEPM HIL 'Residential A' (residential garden scenario) of 10 mg/kg (NEPC, 2013); and
- Historical static geochemical samples undertaken on the TSF were also significantly enriched with respect to arsenic, mercury, antimony and selenium (Environmental Geochemistry International [EGI], 2002).



The kinetic geochemical results demonstrate that:

- The kinetic results from waste rock areas – excluding the TSF – compare well with the static results, indicating a level chemical stability.

However, the TSF kinetic geochemical results are quite different and indicate that:

- The pH levels of the TSF are attributed to minor levels of developing or residual acidity;
- The electrical conductivity of TSF leachate does increase over time. Therefore, the static results are underestimating salinity levels;
- The high arsenic and mercury concentrations – as detected in the TSF static testwork – are relatively immobile; and
- The TSF is significantly enriched with respect to selenium – and most likely cadmium.

1. INTRODUCTION

1.1 BACKGROUND INFORMATION

C&R Consulting Pty Ltd (C&R) have been asked to undertake a geochemical waste rock characterisation study of the Wirralie Gold Mine (Wirralie), on behalf of Wulguru Technical Services (WTS). This study will form part of the progressive rehabilitation and closure plan (PRCP) and associated estimated rehabilitation cost (ERC) that WTS are currently preparing on behalf of Wirralie's current owners, Solomons Gold Pty Ltd.

Wirralie is located in north Queensland, approximately 210 km (280 km by road) south of Townsville and 40 km north of the historical gold mining township of Mt Coolon. Surface gold mineralisation was discovered at Wirralie by Australian Consolidated Minerals Limited in March 1986, with mining commencing in November 1987 (Fellows and Hammond, 1990).

Following the initial commencement of mining, a number of different owners acquired and mined the ore body between 1987 and 1993 – and between 1999 and 2001. During this time, all mined ore was treated by an on-site, conventional carbon-in-leach (CIL) mill. The Wirralie site was placed into care and maintenance in January 2002. Subsequently, much of the site infrastructure was sold and removed from the site (Northern Resource Consultants [NRC], 2016).

The latest sale of Wirralie occurred in December 2013, when Solomons Gold Pty Ltd acquired the mining lease (ML1079) and facilities, with a view to recommence mining and processing operations. The current plan is to process the Wirralie ore by utilising converging CIL and heap-leach circuits supplying strip columns (NRC, 2016). These activities will be undertaken under the current environmental authority (EA) EPML00772413 (dated 28 October 2016).

In accordance with the Queensland Department of Environment and Science (DES, 2021), a waste characterisation assessment should be undertaken at Wirralie. This assessment will be a contributing factor when choosing appropriate rehabilitation strategies and suitable post-mining land uses.

1.2 SCOPE OF WORK

The PRCP guideline (DES, 2021) outlines the waste characterisation reporting requirement:

“Characterise mine wastes in a report that describes the likely physical behaviour and chemical reactivity of the waste materials under the conditions in which they would be stored. The report must address the constituent elements present, and their likely future speciation and mobility.”

In order to characterise the mine waste as per the PRCP guideline, this investigation employed the following scope of works:

- Design a sampling programme to allow for correct spatial representation of all waste rock;
- Collate, validate and statistically analyse geochemical test results from a National Association of Testing Authorities (NATA) accredited laboratory;
- Compile a waste rock characterisation dataset to consider the estimated mining waste streams and the environmental risk they may pose; and
- Conduct a waste rock characterisation study to provide supporting evidence for the rehabilitation requirements to support the submission of the Wirralie ERC.

2. SITE DESCRIPTION

Wirralie is an open-cut gold mining operation located within the Whitsunday Regional Shire in north Queensland, approximately 40 km north of Mt Coolon (Figure 1). Mining commenced in 1987 and continued on a periodic basis until January 2002, when the mine was placed on care and maintenance. All mining activities undertaken at Wirralie are permitted under the EA EPML00772413 (dated 28 October 2016).

2.1 CLIMATE

Wirralie is located within the seasonally arid tropics, with the area dominated by intense rainfall events throughout the summer months. These rainfall events are often highly variable in their spatial and temporal distribution, with the majority of the rain falling in distinct, spatially separated cells across the landscape. Rainfall throughout the remainder of the year is generally limited to an occasional shower in June or July and evaporation tends to exceed rainfall for almost all days of the year, with the exception of periods with intense rainfall events. The Wirralie operations are exposed to this seasonal rainfall, where it is expected that more than 90% of the rainfall will eventuate as either surface runoff or waste dump seepage.

2.2 GEOLOGY

The Wirralie deposit is located in the northeastern portion of the Drummond Basin, within the Late Devonian Mount Wyatt Formation (Olgers, 1972). Olgers (1972) recognised that the Mount Wyatt Formation is connected to the earliest Drummond Basin depositional cycle, associated with marine and continental sedimentation followed by widespread volcanism. Locally at Wirralie, the Mount Wyatt Formation comprises volcanoclastic sediments, with subordinate, interbedded lapilli and crystal tuffs (Fellows and Hammond, 1990).

Gold-silver mineralisation at Wirralie is hosted by a low sulphidation, epithermal quartz vein complex, associated with the Mt Wyatt Formation. Host rock lithology is predominantly volcanoclastic sediments (with minor tuff), containing a network of quartz-chalcedony veins and quartz matrix breccia veins (Fellows and Hammond, 1990). The host rock lithology is principally volcanoclastic in origin. Therefore, for the purpose of this waste rock characterisation study, the waste rock is inferred to be entirely composed of the same unit: volcanoclastic sediments with silicified veins and/or breccia.

A series of stratified hydrothermal alteration assemblages surround the Wirralie ore body. Argillic alteration comprised of illite (with interstitial smectite), kaolinite and minor limonite occurs in the oxide zone rocks, whereas phyllic alteration composed of quartz, sericite, pyrite (or iron oxide) and clay is present within the ore body itself (Fellows and Hammond, 1990). Propylitic alteration – including quartz, siderite and calcite – is constrained below the base of oxidation and Wirralie ore body (Fellows and Hammond, 1990), and has yet to be intersected by mining. Most of the hydrothermal alteration in the Wirralie mining area is clay +/- quartz and/or pyrite (or iron oxide). Alteration was therefore not considered a significant factor in this waste rock characterisation study.

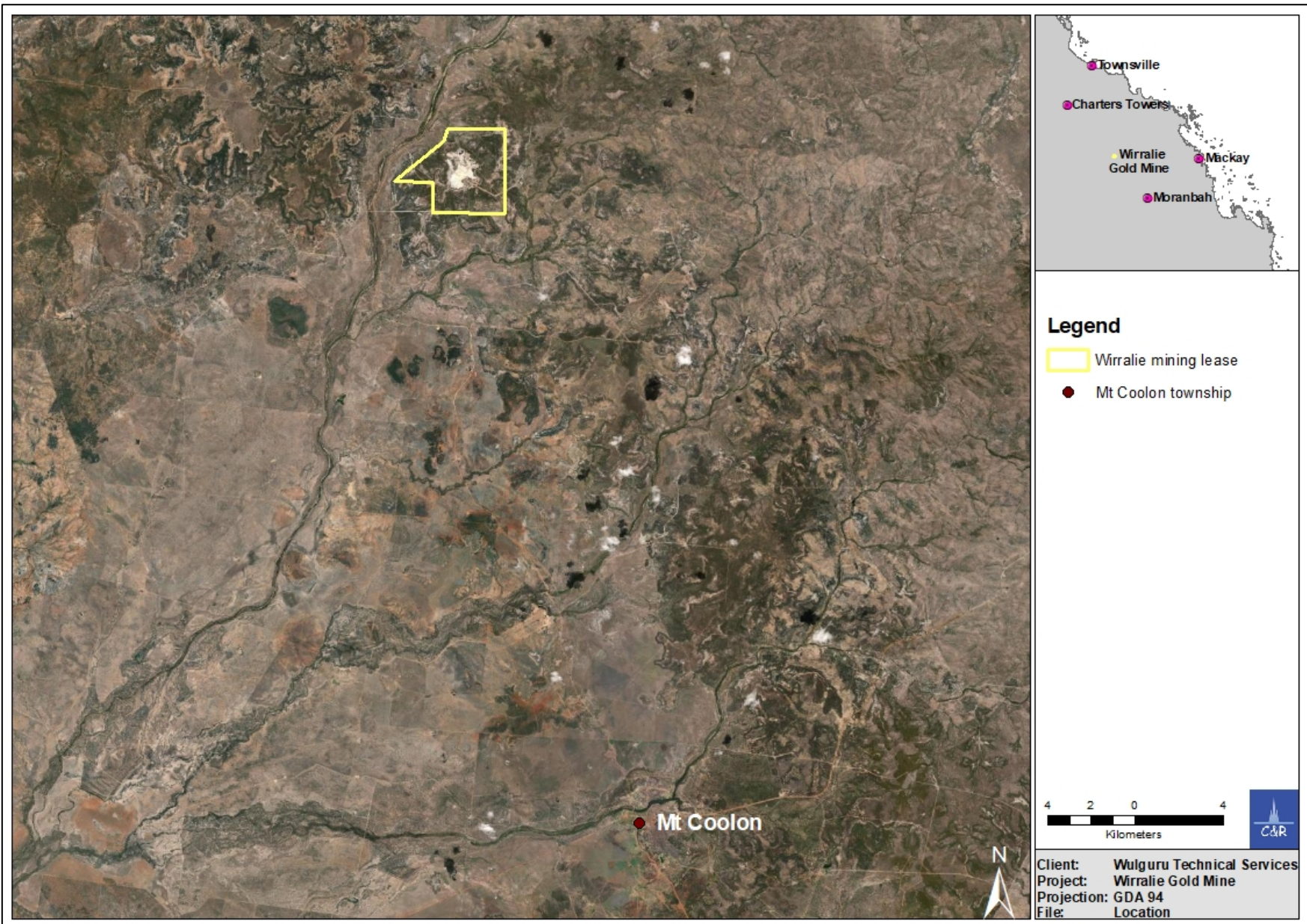


Figure 1: Location of Wirralie operations.

2.3 WASTE AREAS

2.3.1 DESKTOP REVIEW

The relevant waste areas for this investigation were identified as the waste rock dumps (WRDs), heap leach pad (HLP) and tailings surface facility (TSF; Figure 2).

Note: The runoff dam and open-cut pits are not assessed in this waste characterisation study. This is because both are categorised in the Wirralie EA (Schedule F – Table 1) as post-mine land classification *Class VIII - Land not suitable for agricultural or grazing uses* (Department of Mines and Energy [DME], 1995) and should be rehabilitated accordingly.

2.3.2 WASTE CHARACTERISATION SAMPLING STRATEGY

The waste characterisation sampling programme for Wirralie was guided by Australian technical guidelines for the geochemical assessment of mining wastes (DME, 1995; Department of Environment and Heritage Protection [DEHP], 2013; Commonwealth of Australia [COA], 2016). The DME (1995) guideline recommends that the tonnage of mined material determine the sampling interval, whereas the more recent guidelines favour a risk-based approach.

The waste characterisation sampling strategy for Wirralie incorporated the collection of samples from regular intervals in drill holes on the WRDs and HLP – in order to reach to the estimated depth of these piles. The TSF waste was sampled differently: A trowel was used to sample the surface crust and a push-tube was used to sample the tailings to depth.

Standards Australia (2005) was used to validate the Wirralie sampling methodology. This standard corroborated that the Wirralie sampling methodology would provide a good statistical and spatial representation of the potentially contaminated waste material across the Wirralie site.

The proposed Wirralie waste characterisation sampling locations are presented in Figure 3.

2.3.3 FIELD SAMPLING LOCATIONS

The proposed Wirralie waste characterisation sampling locations were not the final field sampling sites. The original, proposed locations were chosen based on the desktop review (section 2.3.1) which did not take into account accessibility issues or ground-truth the extent of the WRDs. Therefore, when the site was accessed for field sampling in July 2021, it became evident that not all of the designated rehabilitated WRD was waste and some intended sampling areas (including portions of the HLP, rehabilitated WRD and TSF) were inaccessible due to surface constraints. As a result, these areas were not sampled (Figure 4).

During the fieldwork, it was also determined that additional areas required sampling, including the former run-of-mine (ROM) pad that was built out of waste rock material, and parts of the haul road that were sheeted with waste material. Therefore, additional sampling was undertaken in these areas (Figure 4).

A comparison between the proposed and actual sampling programme is presented in Table 1.

Table 1: Summary of Wirralie waste characterisation samples.

Waste Area	Proposed Sampling Programme					Actual Sampling Programme				
	Area (hectares)	Estimated Depth* (metres)	Estimated Tonnage# (tonnes)	Proposed Number of Locations	Proposed Number of Samples	Area (hectares)	Estimated Tonnage (tonnes)	Actual Number of Locations	Actual Number of Samples	Comment
WRD01	1.7	10	340,000	5	13	1.7	340,000	5	11	-
WRD02	3.2	10	640,000	9	23	3.2	640,000	8	13	-
WRD03	6.1	5	610,000	13	24	6.1	610,000	12	29	-
Rehabilitated WRD	14.3	10	2,860,000	32	86	8.3	1,660,000	16	31	6.0 ha of rehabilitated WRD identified as natural landform (non-WRD), and 2.2 ha of rehabilitated WRD was inaccessible
Heap leach pad (HLP)	9.6	10	1,920,000	21	57	9.6	1,920,000	7	7	Most of the HLP pad (9.5 ha) was inaccessible
Tailings surface facility (TSF)	72.2	2	2,599,200	37	67	72.2	2,599,200	27	50	20.5 ha of saturated part of TSF (in the southwest) was inaccessible
Former run-of-mine (ROM) pad	2.3	10	460,000	-	-	2.3	460,000	5	12	Former ROM identified as waste rock
Haul road	-	-	-	-	-	-	-	2	2	Parts of the haul road were sheeted with waste material
TOTAL	109.4	-	9,429,200	117	270	103.4	8,229,200	82	155	6.0 ha identified as non-WRD and 32.2 ha was inaccessible^

* Estimated depths based on desktop review of artificial landform high-points versus surrounding natural topography (tiering of dumps, pads and tailings have not been considered).

Estimated tonnage based on area, estimated (high-point) depth and estimated density of the waste material (2.0 t/m³ for waste rock and 1.8 t/m³ for tailings).

^ Refer to Figure 4 for overview of non-WRD and inaccessible areas.

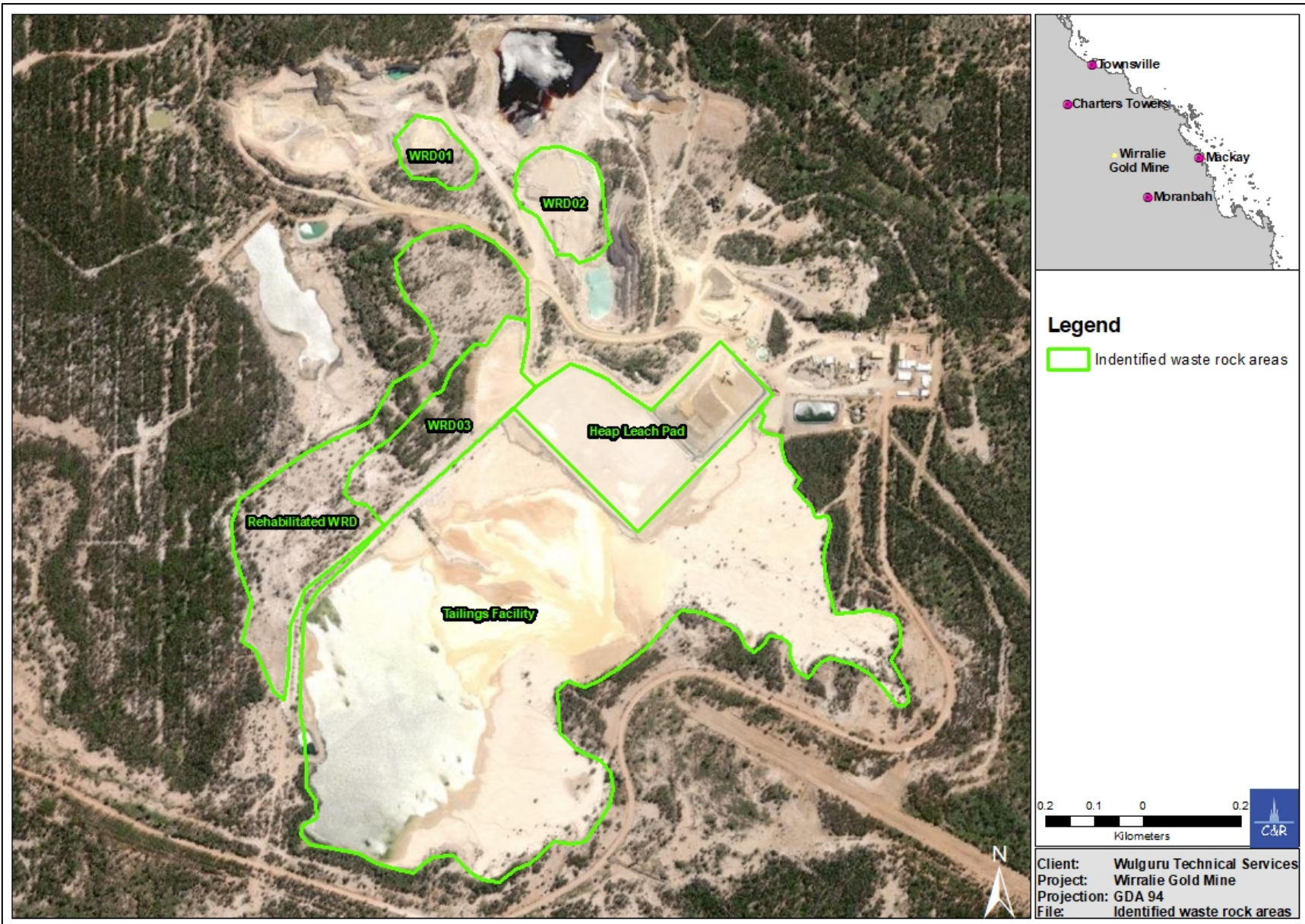


Figure 2: Waste rock areas identified by the desktop review.

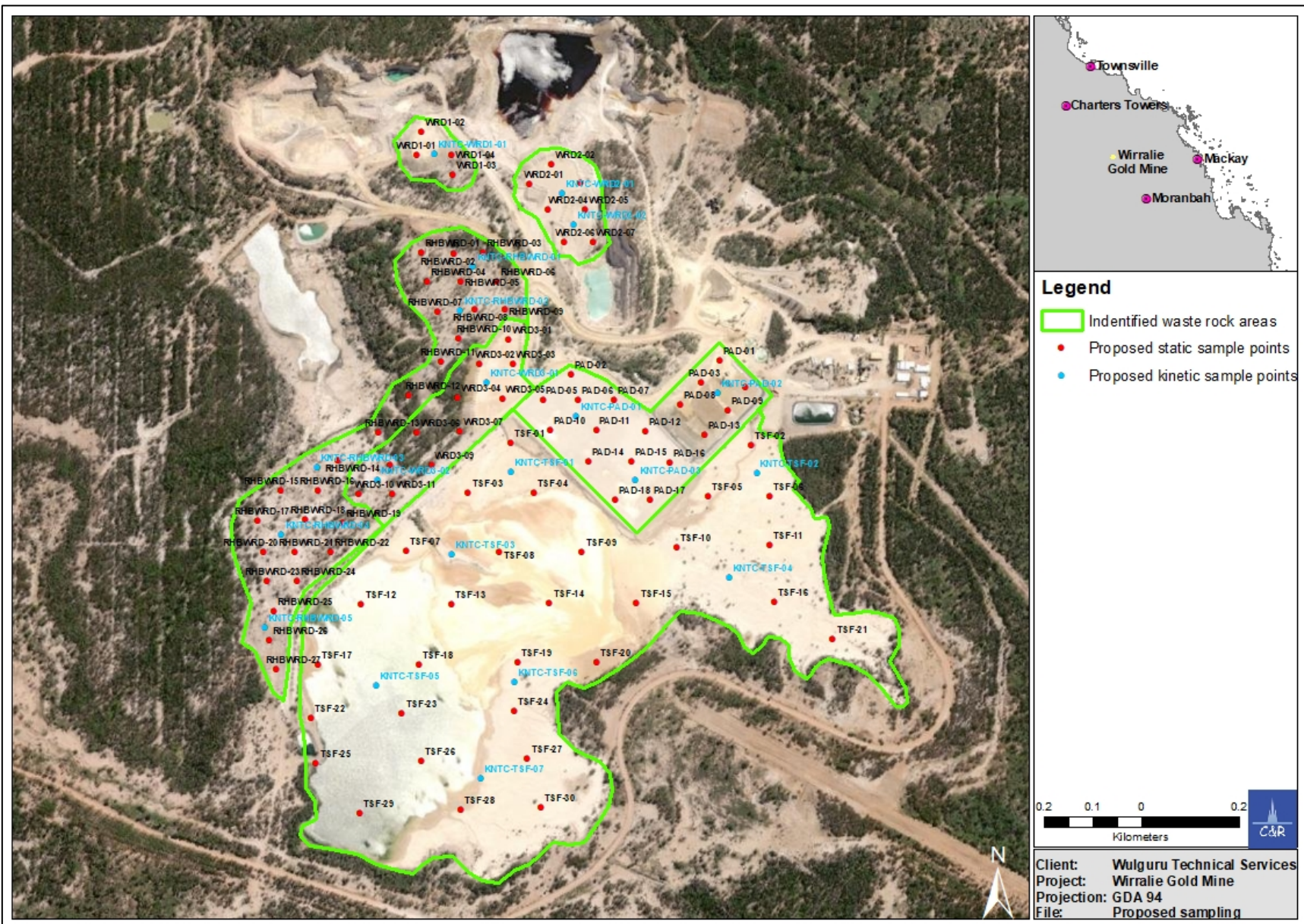


Figure 3: Proposed sampling locations.

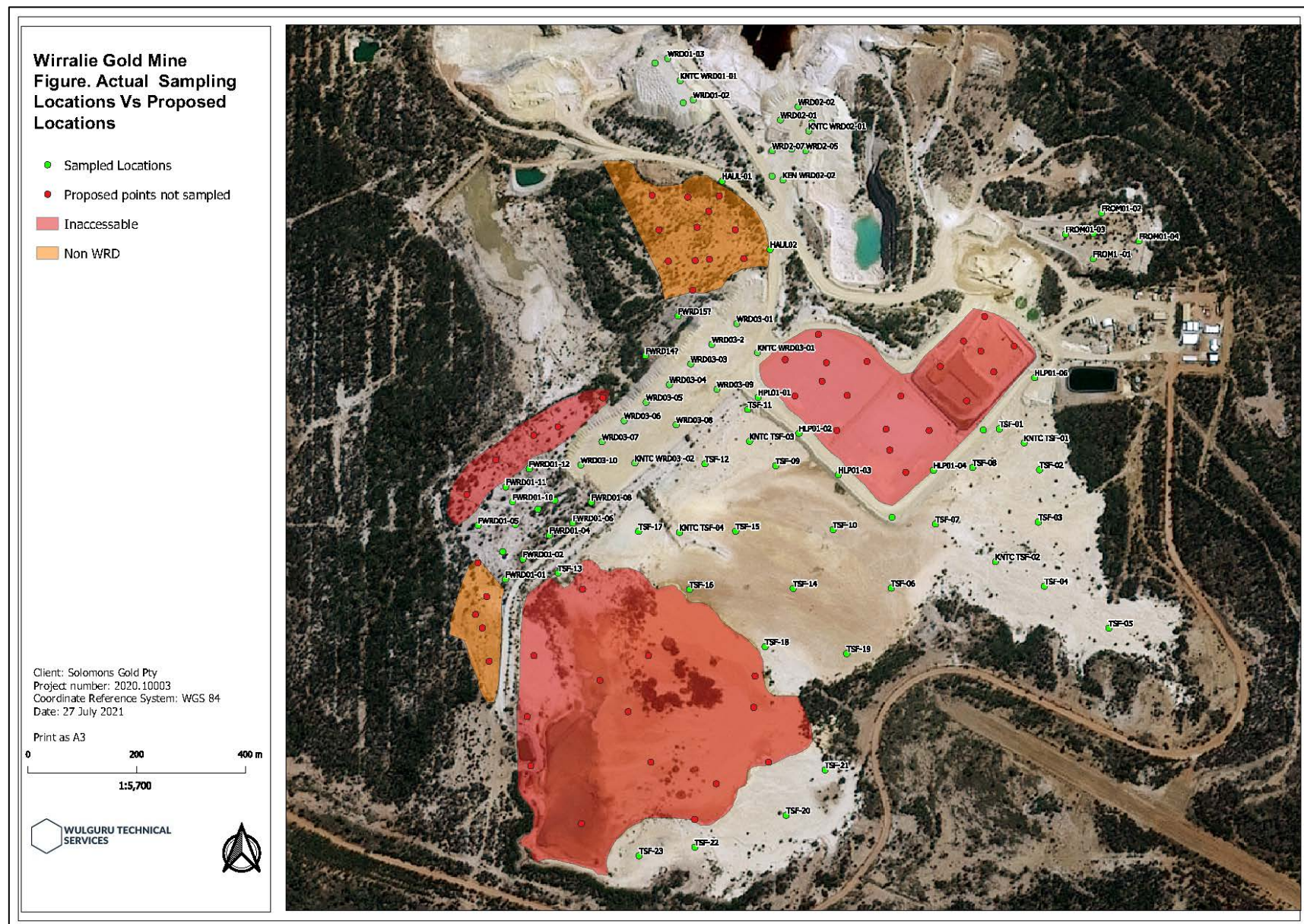


Figure 4: Actual sampling locations vs proposed locations. Figure sourced from Wulguru Technical Services (who undertook actual sampling programme).

3. METHODS

3.1 SAMPLING PROGRAMME

A total of 155 rock/sediment samples were collected from 82 sampling locations at Wirralie (Figure 4). These samples provide a good overall representation of the Wirralie waste material (waste rock and mine tailings), whilst maintaining a suitable site distribution.

Each sample consisted of either drillhole rock cuttings, (trowel) scoops of crust or push-tube sediments. The drillhole cuttings were obtained from the WRD, HLP, former ROM and haul road, whereas the crustal scoops and push-tube sediments were taken from the TSF (Table 2).

Table 2: Summary of Wirralie waste material sample types.

Sample Type	Area	Number of Samples Taken
Drillhole cuttings	WRD01	11 (from 5 holes)
	WRD02	13 (from 8 holes)
	WRD03	29 (from 12 holes)
	Rehabilitated WRD	31 (from 16 holes)
	Former run-of-mine (ROM) pad	12 (from 5 holes)
	Heap leach pad (HLP)	7 (from 7 holes)
	Haul road	2 (from 2 holes)
Trowel scoops	Tailings surface facility (TSF)	23
Push-tube sediments	TSF	27

All waste material samples were collected by WTS personnel during July 2021. The minimum amount of sample collected was 500 g, with up to 10 kg obtained for kinetic testwork. All samples were dispatched to the ALS Environmental Townsville laboratory for geochemical analysis.

3.2 GEOCHEMICAL CHARACTERISATION

The geochemical testwork was based on industry-recognised procedures for the geochemical characterisation and assessment on mine waste (AMIRA, 2002; The International Network for Acid Prevention [INAP], 2014; COA, 2016).

3.2.1 STATIC TESTWORK

Static geochemical tests provide information on the bulk geochemical characteristics of samples at a single point in time. They do not provide information on rates of chemical processes – or the release rates due to weathering processes.

All 155 samples dispatched to the ALS laboratory underwent static geochemical testing to evaluate the risk associated with the potential oxidation of sulphides, acid generation, and the presence of metals/metalloids and salts.

Each sample underwent static geochemical testing for:

- pH;
- Electrical conductivity;
- Moisture;
- Total sulphur;
- Acid neutralising capacity;
- Net acid generation capacity;
- Net acid producing potential; and
- Total metals/metalloids for Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Se, V and Zn.

All static geochemical results are provided in Appendix A.

3.2.2 KINETIC LEACH COLUMN TESTWORK

Kinetic leach column (KLC) tests accelerate the weathering of samples, and provide information on the magnitude and/or effects of dynamic processes that result from weathering. Unlike static tests, KLC tests measure the varying geochemical characteristics of sample effluent over a prolonged period of time.

Of the 155 samples dispatched to the ALS laboratory, 11 samples were selected for kinetic geochemical testwork to evaluate the risk associated with dissolution and mobility of metals/metalloids and salts (Table 3).

Table 3: Summary of Wirralie KLC testwork.

Area	Number of undertaken KLC tests	Samples
WRD01	1 (from 1 hole)	WRD01 -01
WRD02	1 (from 1 hole)	WRD02 -01
WRD03	2 (from 2 holes)	WRD03 -01 and WRD03 -02
Rehabilitated WRD	1 (from 1 hole)	WRD03 -02
Former run-of-mine (ROM) pad	1 (from 1 hole)	FROM01 -01
Heap leach pad (HLP)	1 (from 1 hole)	HLP01 -01
Haul road	0	-
Tailings surface facility (TSF)	4 (from 4 holes)	TSF -01, TSF -02, TSF -03 and TSF -04
TOTAL	11	11

Individual leach columns were set up for each of the 11 samples, with leachate-testwork cycles undertaken on a fortnightly basis.

Each kinetic leachate column underwent kinetic geochemical testing for:

- pH;
- Electrical conductivity;
- Total dissolved solids (calculated);
- Total hardness;
- Acidity
- Alkalinity;



- Major cations (Ca, Mg, Na and K);
- Major anions (F, Cl and SO₄); and
- Dissolved metals/metalloids for Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, Th, U, V and Zn.

All kinetic geochemical results are provided in Appendix B.

4. GEOCHEMICAL RESULTS

4.1 ACID BASE ACCOUNT

4.1.1 PH VALUE

The pH value of the 155 Wirralie waste rock samples ranges from strongly acidic (3.6) to slightly basic (9.7), with a slightly acidic median pH value of 4.9. The standard deviation (SD) of the dataset is 1.9 and the data are negatively skewed. In general, most Wirralie samples are in the slightly acidic range (Figure 5), indicative of the waste rock lithology (volcaniclastic sediments). Apart from a few waste rock dump samples, the majority of the strongly acidic samples occur in the sediments below the surface of the tailings dam.

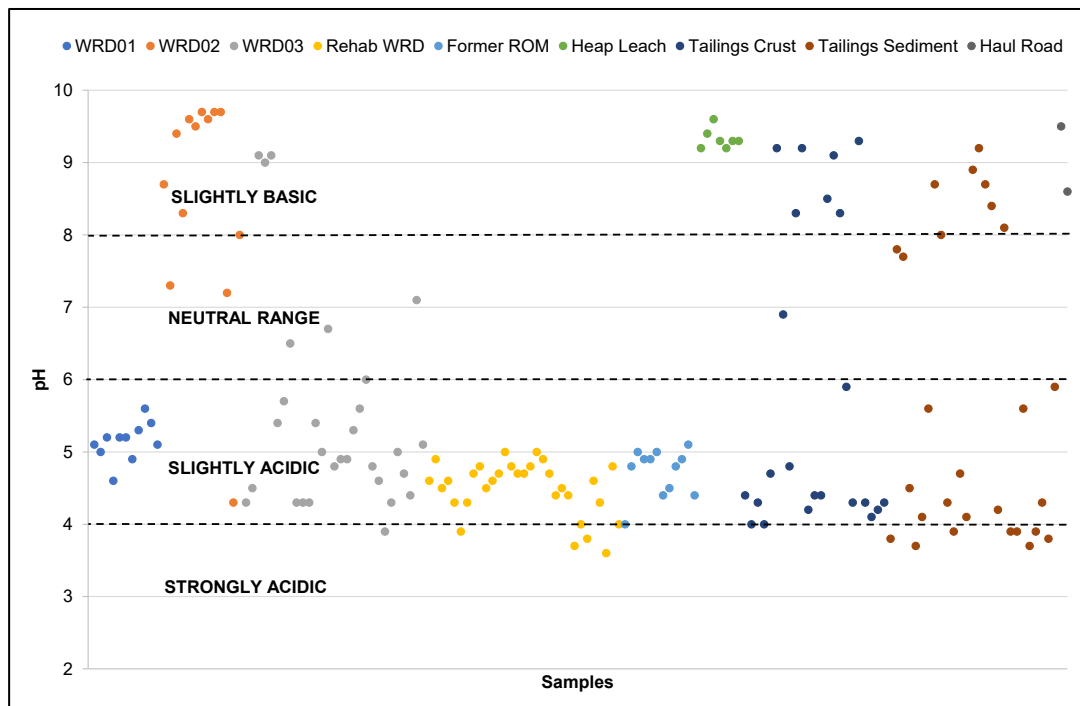


Figure 5: pH values for Wirralie waste rock samples.

Because of the method of testwork (i.e. fluid extract from crushed samples, with a very high surface area to solution ratio), it is expected that both the low and high pH results in the waste rock are a worst-case scenario. Therefore, it is envisaged that the pH of runoff from the Wirralie operations will not be as low or high as that reflected in the waste rock sample test results. Also, in order for significant runoff to occur at Wirralie, the rainfall dilution factor should be greater than the 1:5 (soil:water ratio) used in the extract solutions. This, in turn, would counteract the resulting acidity or alkalinity.

4.1.2 ELECTRICAL CONDUCTIVITY

The electrical conductivity (EC) of the 155 Wirralie waste rock samples ranges from 8 $\mu\text{S}/\text{cm}$ to 4,860 $\mu\text{S}/\text{cm}$ and has a low median value of 204 $\mu\text{S}/\text{cm}$. Most Wirralie waste rock samples have low EC values (<300 $\mu\text{S}/\text{cm}$) and, apart from the tailings dam samples, all waste rock has ECs below 1000 $\mu\text{S}/\text{cm}$ (Figure 6).

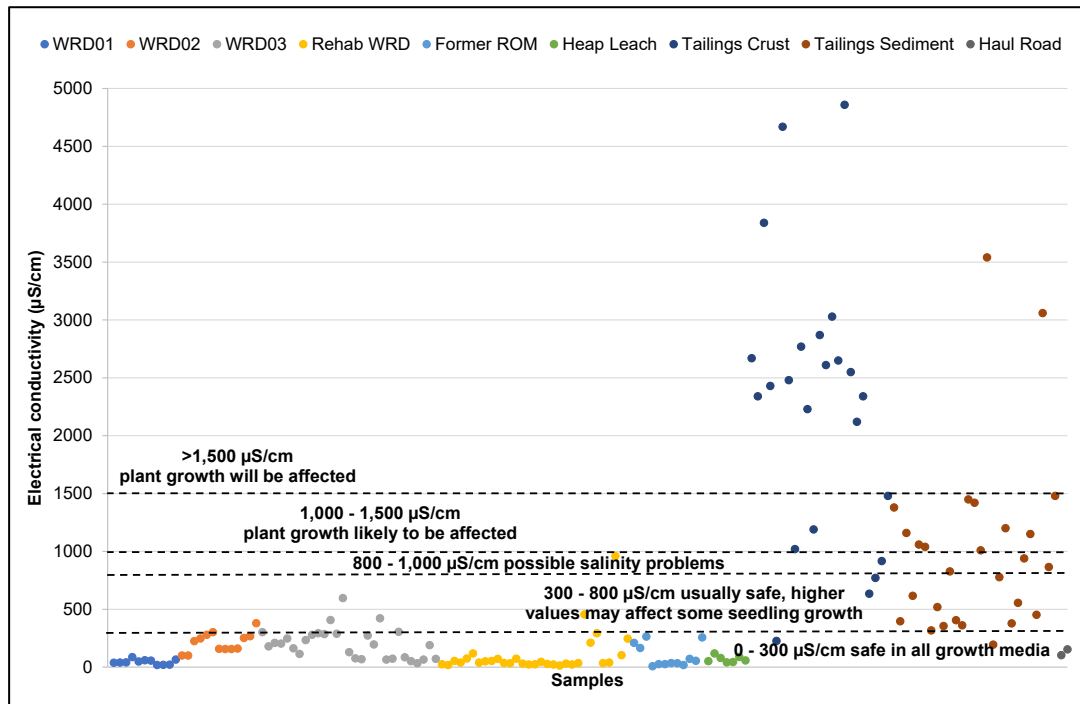


Figure 6: Electrical conductivity for Wirralie waste rock samples.

The Wirralie tailings dam samples have overall higher ECs than the rest of the waste rock samples (Figure 6). In particular, the salinity of the surface crust of the tailings dam is much higher than the rest of the waste rock, including the tailings sediment contained below the crust.

4.1.3 TOTAL SULPHUR

The total sulphur concentrations (measured by LECO method) of the 155 Wirralie waste rock samples range from 0.01% to 0.60% and have an extremely low median of 0.07%.

Figure 7 demonstrates that most of the Wirralie waste rock is barren (<0.1%) with respect to total sulphur concentrations. Both WRD03 and the TSF have higher sulphur levels than the rest of the waste rock. However, most of these elevated sulphur concentrations are still classified as very low (<0.55%).

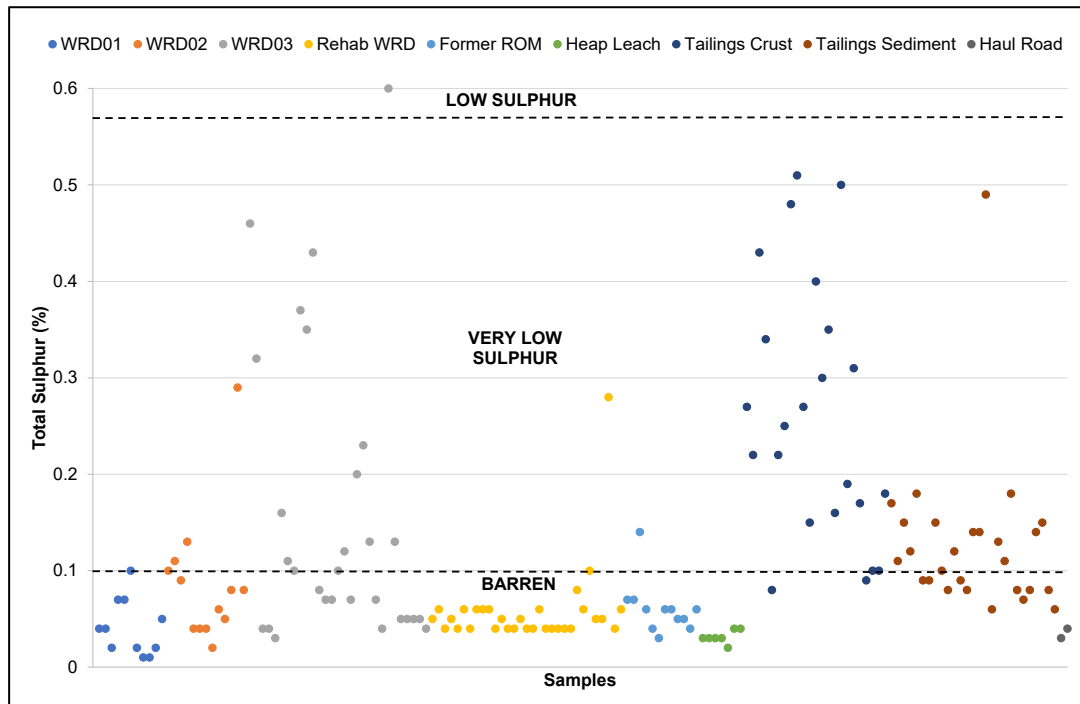


Figure 7: Total sulphur concentration for Wirralie waste rock samples.

4.1.4 MAXIMUM POTENTIAL ACIDITY

Maximum potential acidity (MPA) is the maximum amount of acid that can be produced by the oxidation of sulphur-bearing minerals in the waste rock material. MPA is calculated from the total sulphur content. The MPA – that could be generated by the 155 Wirralie waste rock samples – ranges from 0.3 to 18.4 kg H₂SO₄/t and has a low median value of 2.1 kg H₂SO₄/t.

4.1.5 ACID NEUTRALISING CAPACITY

Acid neutralising capacity (ANC) is related to the amount of acid neutraliser (usually carbonate minerals) in the waste rock sample. ANC is determined experimentally by reacting a standardised acid mixture with a known amount of waste rock sample – and is reported as kg H₂SO₄/t eq. (equivalent). The ANC of the 155 Wirralie waste rock samples ranges from 0.6 to 9.6 kg H₂SO₄/t eq., with a low median of 2.0 kg H₂SO₄/t eq.

4.1.6 ANC:MPA RATIO

The ANC:MPA ratio can assist in classifying the potential for waste rock samples to generate acid.

Generally speaking – and depending on the mineralogy – a sample with an ANC:MPA ratio below 1 is likely to be acid forming because it contains more acid-generating than acid-neutralising minerals. Samples with an ANC:MPA ratio of ≥ 1 but ≤ 2 have degree of uncertainty, whereas samples with an ANC:MPA ratio of > 2 are generally low risk. However there are exceptions because samples with an MPA of < 3.1 kg H₂SO₄/t are considered to contain insufficient acid forming potential (i.e. they are barren), and samples with an MPA of > 3.1 but < 10 kg H₂SO₄/t would, at worst, be classified as low capacity, potentially acid forming (PAF) material.

Wirralie waste rock samples have an ANC:MPA ratio ranging from 0 to 3.9, with a median value of 0.8. According to these ANC:MPA ratios, more than half of the Wirralie waste

samples could be considered to be potentially acid forming. However, given the low MPA values, most of these samples are considered either barren or of low capacity with respect to acid forming potential (Figure 8). Additionally, most of the PAF material, identified using the ANC:MPA ratio, is associated with either WRD03 or the TSF.

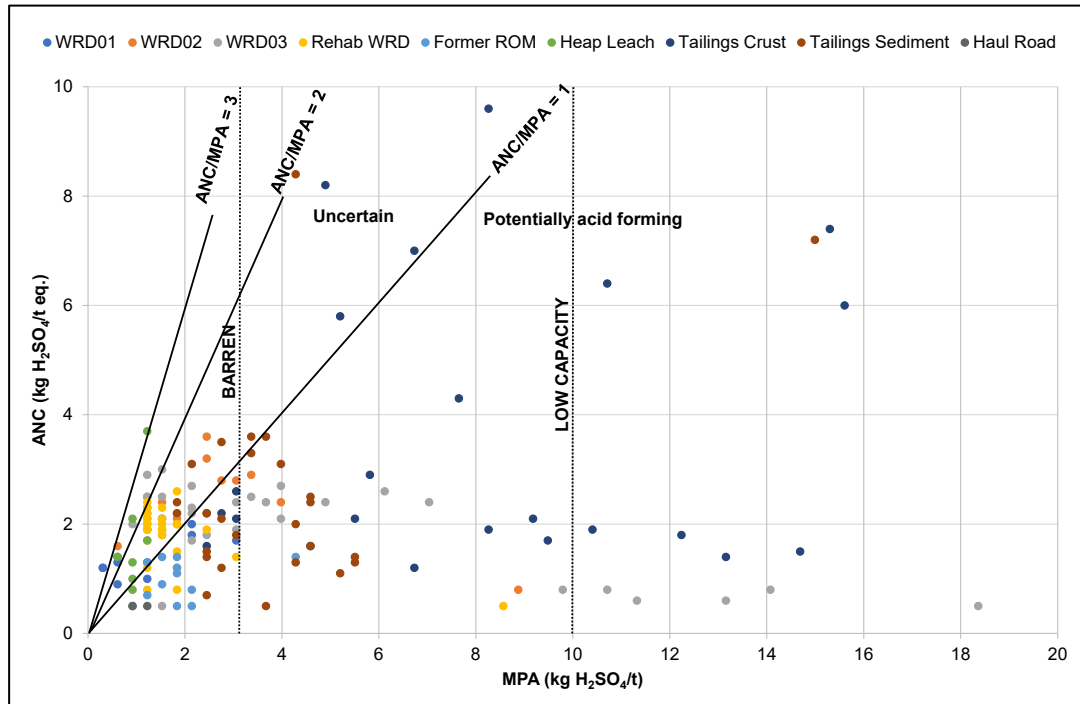


Figure 8: MPA versus ANC for Wirralie waste rock samples.

4.1.7 NET ACID PRODUCING POTENTIAL

Net acid producing potential (NAPP) is a theoretical calculation of the net acid producing (or consuming) value of a waste rock sample.

Generally speaking, waste rock samples with a negative NAPP value are non-acid forming (NAF), and those with a positive NAPP value are PAF. Miller (1997) provides further categorisation of waste rock material based on the magnitude of the NAPP value (Table 4).

Table 4: NAPP classification categories.

ARD Classification	NAPP Value (kg H ₂ SO ₄ /t)
Potentially Acid Forming (PAF)	> 10
Uncertain	0 to 10
Non-Acid Forming (NAF)	-50 to 0
Acid Consuming Material	< -50

Eight-five Wirralie waste rock samples have positive NAPP values. However, most of these positive samples are in the uncertain range, with only seven samples having values greater than 10. These are associated with either WRD03 or the TSF.

4.2 NET ACID GENERATION TEST

The net acid generation (NAG) test is used to directly measure the net amount of acid produced by a waste rock sample.

Generally speaking, samples with a $NAG_{(pH)}$ below 4.5 may be acid generating and samples with a $NAG_{(pH)}$ equal or greater than 4.5 (≥ 4.5) are unlikely to be acid generating. However, the NAG test does not estimate acid neutralisation potential. Therefore, AMIRA (2002) recommends the combined use of the NAPP values and the NAG results for a more detailed classification of acid generation.

Figure 9 demonstrates that most Wirralie waste rock samples have a $NAG_{(pH)}$ greater than 4.5 and are unlikely to be acid generating. There are still numerous uncertain samples (according to the NAPP). However, all of these uncertain samples can be confirmed as NAF based on their corresponding $NAG_{(pH)}$ and total sulphur values (Figure 10).

A summary of the $NAG_{(pH)}$ versus total sulphur geochemical classification criteria for the waste rock samples is presented in Table 5.

Table 5: Geochemical classification criteria for Wirralie waste rock samples (Sed. = sediment).

Geochemical Classification	Total Sulphur (%)	$NAG_{(pH)}$	WRD01	WRD02	WRD03	Rehab WRD	Former ROM	Heap leach	TSF Crust	TSF Sed.	Haul road
NAF (barren)	≤ 0.1	-	11	10	15	30	11	7	4	12	2
NAF (very low sulphur)	>0.1 to ≤ 0.55	≥ 4.5	0	3	11	0	1	0	19	15	0
NAF (low sulphur)	0.55 to 1.5	≥ 4.5	0	0	0	0	0	0	0	0	0
PAF (very low sulphur)	0.1 to ≤ 0.55	< 4.5	0	0	1	1	0	0	0	0	0
PAF (low sulphur)	0.55 to 1.5	< 4.5	0	0	1	0	0	0	0	0	0
Percentage of NAF samples			100%	100%	93%	97%	100%	100%	100%	100%	100%
Percentage of very low sulphur PAF samples			0%	0%	3.5%	3%	0%	0%	0%	0%	0%
Percentage of low sulphur PAF samples			0%	0%	3.5%	0%	0%	0%	0%	0%	0%

Applying the $NAG_{(pH)}$ and total sulphur geochemical classification criteria (Table 5), it can be shown that most waste characterisation samples (including that of the TSF) are NAF (Figure 10).

Of the 155 Wirralie waste rock samples, there are only three samples that could be categorised as PAF when the $NAG_{(pH)}$ and total sulphur values are considered:

- Two samples on WRD03, both of which occur in the same hole; and
- One sample on the rehabilitated WRD.

These samples make up less than 4% of the total sample size for their respective areas – and their sulphur values are still very low to low. It is therefore expected that these three samples will not present an acid drainage issue because:

- The amount of produced acid will be negligible; and
- Any acid produced by the samples will be buffered by the surrounding NAF rock that makes up more than 90% of the waste rock.

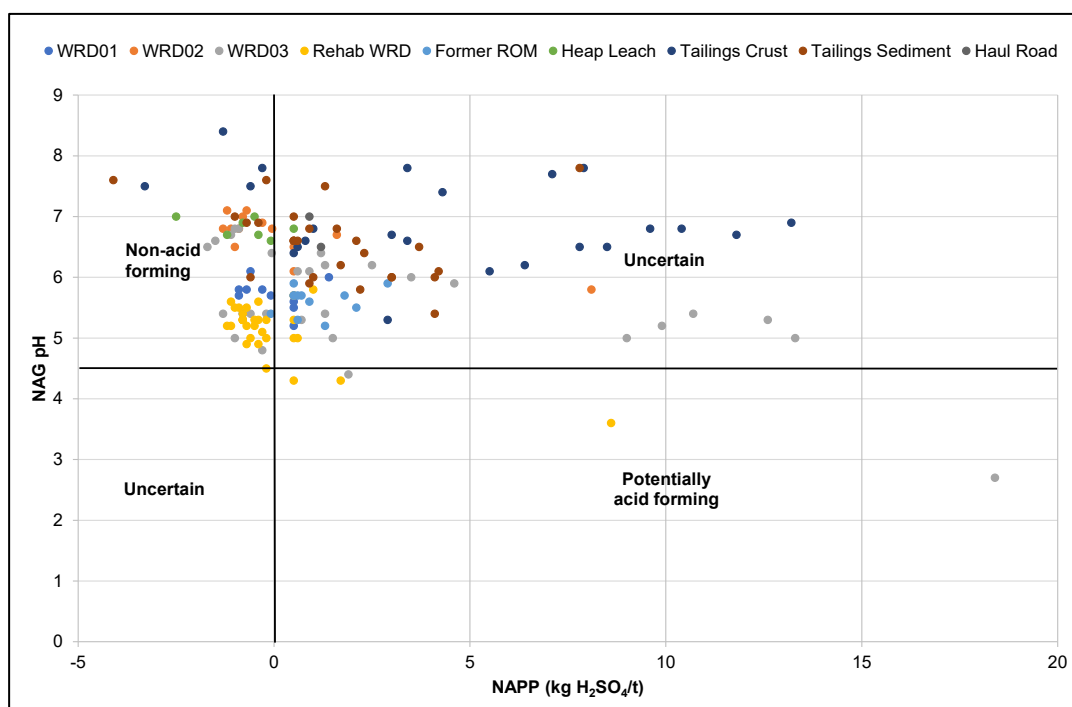


Figure 9: NAG_(pH) versus NAPP for Wirralie waste rock samples.

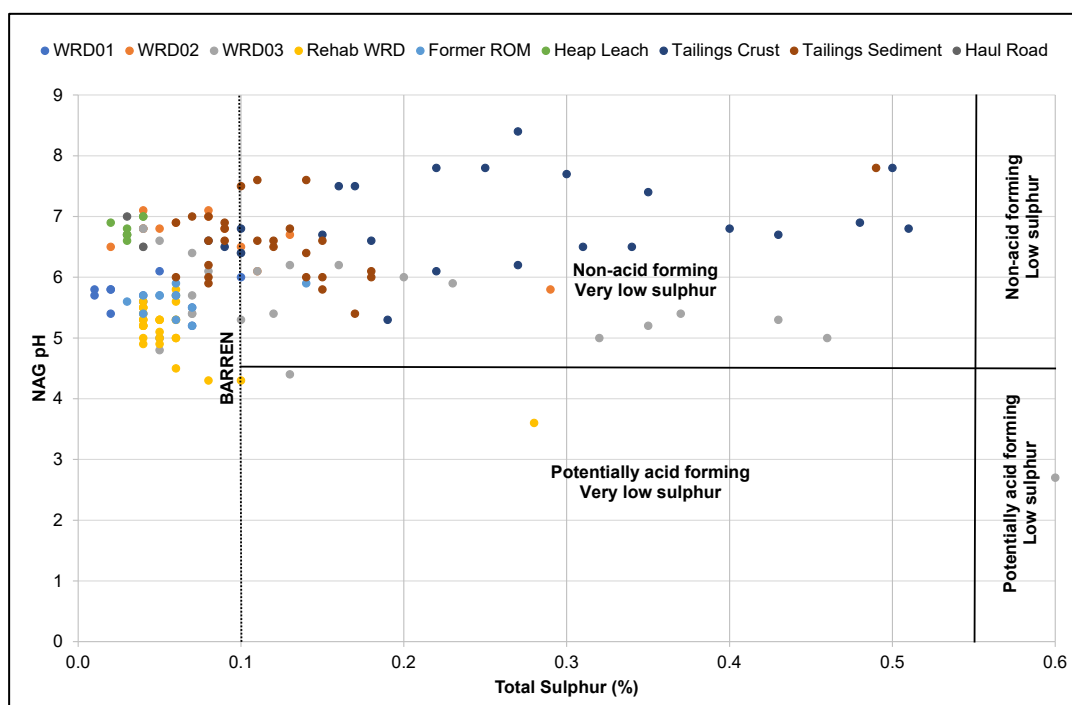


Figure 10: NAG_(pH) versus sulphur for Wirralie waste rock samples.

4.3 METAL/METALLOID ANALYSES

Static multi-element scans were undertaken on the 155 Wirralie waste rock samples. This testwork was carried out to assess natural background elemental levels, and to identify if any elements (particularly metals and metalloids) are present in the waste rock at concentrations that may be of environmental concern with respect to revegetation and water quality.

4.3.1 GEOCHEMICAL ABUNDANCE INDEX

The total metal and metalloid concentrations in the waste rock can be compared to the average crustal abundance of unmineralised soils (INAP, 2014). In this process, the geochemical abundance index (GAI) is used to report on the extent of elemental enrichment, by relating the actual concentration in a sample with the average crustal abundance on a log₂ scale (Table 6).

Table 6: Geochemical abundance index classification categories.

GAI	Enrichment Factor	Classification
<1	Less than 3-fold enrichment	Not enriched
1	3 – 6 fold enrichment	Not Enriched
2	6 – 12 fold enrichment	Slightly Enriched
3	12 – 24 fold enrichment	Significantly Enriched
4	24 – 48 fold enrichment	Significantly Enriched
5	48 – 96 fold enrichment	Highly Enriched
6	Greater than 96 fold enrichment	Highly Enriched

As a general guide, samples with a GAI of 3 or greater indicate enrichment that may warrant further investigation. However, elements identified as enriched may not necessarily be a reason for concern regarding revegetation and/or water quality because:

- The average crustal abundance varies between different literature sources;
- Some elements are more environmentally important than others;
(i.e. As, Al, Cr, Cd, Cu, Pb, Se and Zn are more important than Ca, Fe, Mg and Na);
- If a sample is shown to be enriched in a particular element, there is no direct correlation that the sample will leach the element at elevated concentrations; and
- The nature of an ore deposit means that the background levels for some elements are expected to be elevated.

Similarly, because an element is not enriched does not mean that it will never be a concern because – under certain conditions (e.g. low pH) – the solubility of some common, environmentally important elements (such as Al, Cu, Cd, Fe and Zn) will increase significantly.

Summaries of the multi-element scans and GAIs for the Wirralie waste rock samples are presented in Table 7. Beryllium, boron, cadmium and selenium were intentionally left out of these tables because all of the test results were below the limit of reporting (BLOR). Cobalt and lead were also intentionally left out because all but three cobalt results and one lead result were BLOR – and these four measurements were not enriched (as they all had a GAIs <1). Furthermore, any laboratory analyses that were reported as BLOR were not included in the statistical analysis (e.g. the Wirralie copper statistics were based on only 29 samples because the other 125 samples were BLOR). The BLOR data were purposely omitted to minimise bias in the GAI calculation and resulting statistics.

Table 7: Summary of multi-element analyses, results and geochemical abundance indices for Wirralie waste rock samples.

Element	Unit	Limit of Reporting	ACA*	n#	Concentration Statistics			NEPM Guideline HIL~ Recreational C	GAI Statistics			
					Min.	Median	Max.		Min. GAI	Median GAI	Max. GAI	Number of GAIs ≥3
Aluminium	mg/kg	50	82,000	155	180	1,060	2,450	-	0	0	0	0
Arsenic	mg/kg	5	1.5	129	BLOR^	72	214	300	1	5	6	120
Barium	mg/kg	10	500	137	BLOR	30	280	-	0	0	0	0
Chromium	mg/kg	2	100	92	BLOR	6	19	300	0	0	0	0
Copper	mg/kg	5	50	29	BLOR	6	25	17,000	0	0	0	0
Iron	mg/kg	50	41,000	155	140	3,400	18,700	-	0	0	0	0
Manganese	mg/kg	50	950	67	BLOR	9	65	19,000	0	0	0	0
Mercury	mg/kg	0.1	0.05	64	BLOR	0.5	2.1	80	0	2	4	26
Nickel	mg/kg	2	80	53	BLOR	4	15	1,200	0	0	0	0
Vanadium	mg/kg	0.1	2.4	79	BLOR	8	38	-	0	0	0	0
Zinc	mg/kg	5	75	9	BLOR	7	36	30,000	0	0	0	0

* Average crustal abundance (Bowen, 1979).

Number of reported measurements that were not below the limit of reporting.

~ National Environment Protection (Assessment of Site Contamination) Measure 1999 – Health-based investigation levels (NEPC, 2013).

^ Below limit of reporting.

Based on the GAI assessment of the Wirralie waste rock samples, it can be demonstrated that the waste rock at Wirralie is enriched with respect to arsenic – and to some extent mercury (Table 7). This is because 77% of the samples (including the BLOR samples) have an arsenic GAI ≥ 3 and 17% of samples have a mercury GAI ≥ 3 .

Figure 11 demonstrates that – apart from the tailings facility – there is no direct correlation between arsenic and mercury enrichment in the waste rock samples. Almost all of the tailings facility samples are enriched with respect to both arsenic and mercury. Apart from the tailings facility, mercury is only significantly enriched (GAI ≥ 3) in one WRD01 sample, whereas significant arsenic enrichments (GAI ≥ 3) frequently occur in all waste rock domains.

Arsenic enrichment is present in all of the waste rock samples at Wirralie. However, there is a substantial decrease of arsenic levels in the rehabilitated waste rock dump (Figure 11). The rehabilitated waste rock dump has been capped with Tertiary clay and most (80%) surface samples (<3 metres deep) obtained from the rehabilitated dump are registering arsenic values BLOR.

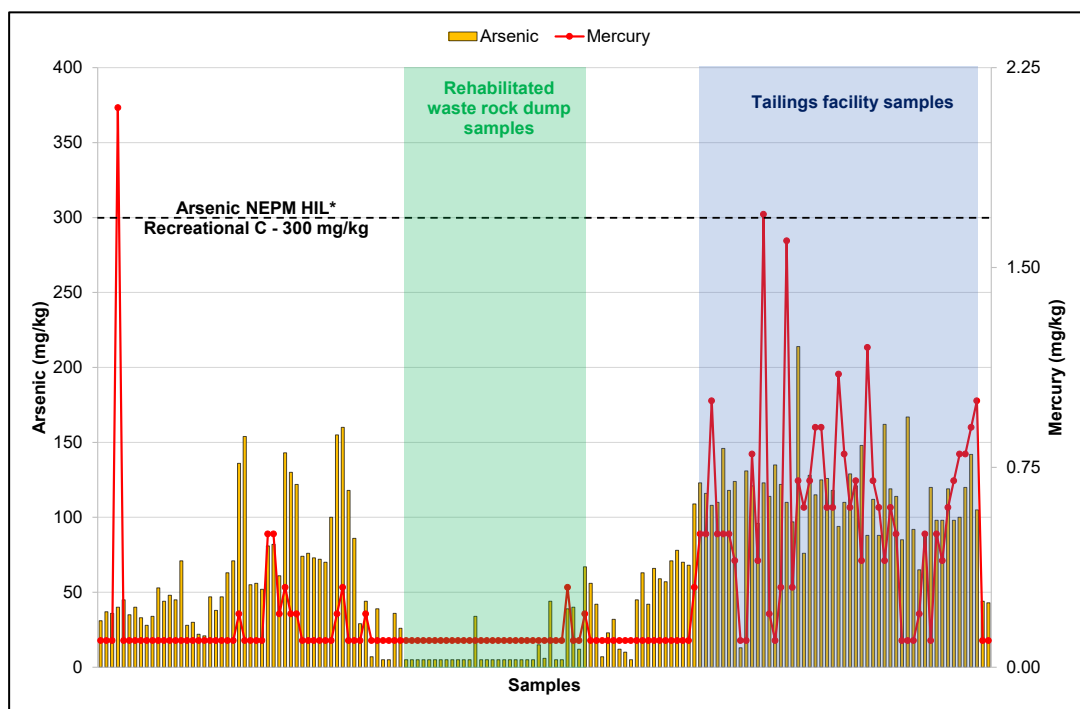


Figure 11: Total arsenic and mercury values for Wirralie waste rock samples (*NEPC, 2013).

The high arsenic values in the Wirralie waste rock are not a particular concern because they remain below the NEPM HIL for 'Recreational C' (public open space scenario) of 300 mg/kg (NEPC, 2013). The mercury enrichments are not a concern either because all mercury concentrations remain well below the HIL 'Residential A' (residential garden scenario) threshold of 10 mg/kg. For these aforementioned enrichments to be of environmental concern with respect to revegetation and water quality, a significant portion of the elements would need to be leached from the waste rock in order to enter the soil, surface water or groundwater, which is highly unlikely given the KLC results (Table 8).

4.4 KINETIC LEACH COLUMN WATER QUALITY ANALYSES

In order to understand the potential for the Wirralie waste rock to leach environmental contaminants into the surrounding environment, KLC testwork was undertaken on 11 samples (Table 3). Unlike static tests, KLC tests measure the varying geochemical characteristics of sample effluent over a prolonged period of time, providing a better indication of chemical reactivity of waste materials under the storage conditions.

The Wirralie KLC testwork has been compared with the receiving water contaminant limits (RWCLs) as listed in the Wirralie EA EPML00772413 (Table 8). It must be noted, however, that the EA metal/metalloid contaminant limits are for unfiltered samples, whereas the kinetic leach metal/metalloid results have been filtered to 0.45 µm.

4.4.1 pH VALUE

The KLC testwork results (Table 8) demonstrate that the majority of the pH values for the waste rock are outside of the EA RWCLs. This is because most of the Wirralie waste rock is slightly acidic (refer to section 4.1.1).

Figure 12 demonstrates that even though a lot of the waste dump KLC samples are below the lower pH limit, they are actually reacting with the leachate solution and increasing in pH. Therefore, it is possible that – as the reaction continues – the solutions may actually reach (and comply with) the EA lower limit. This phenomenon is further justified by the fact that most of the waste dump static samples were NAF (refer to section 4.2).

Figure 12 demonstrates that the TSF KLC samples are reacting with the leachate solution and either decreasing in pH or sustaining a relatively low pH (<4.5). This phenomenon is attributed to acid-forming reactions that are occurring in the TSF KLC samples. Therefore, although most TSF static samples were overwhelmingly NAF (refer to section 4.2), there may be a minor PAF component associated with weathering of the TSF.

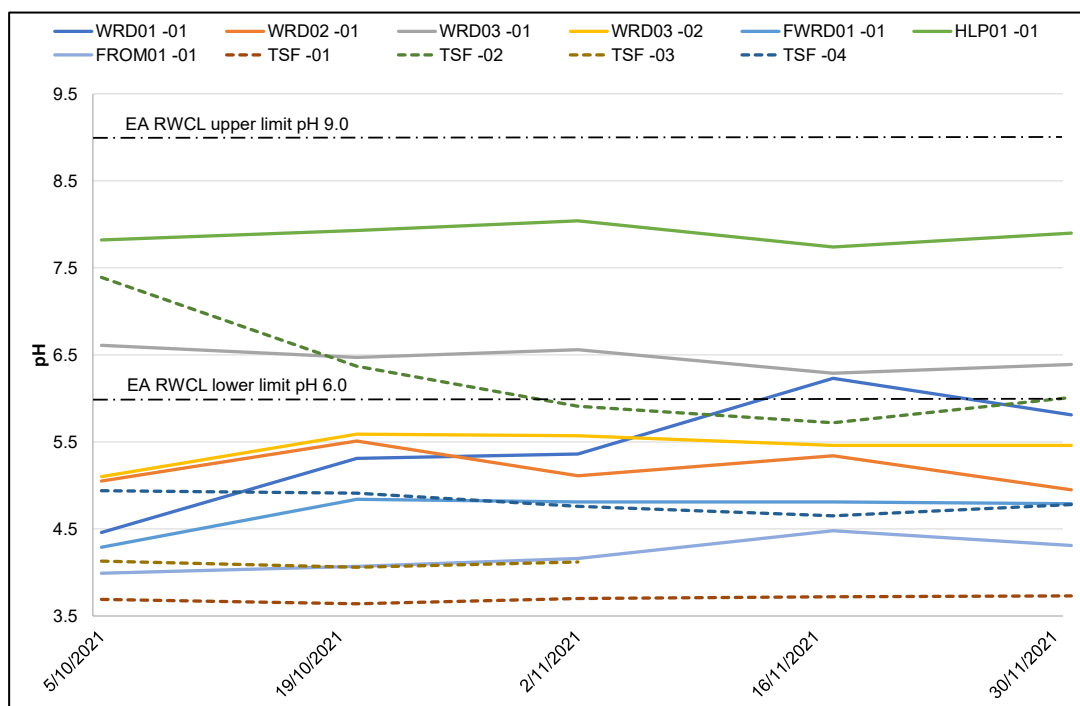


Figure 12: Kinetic leach column pH values for Wirralie waste rock samples.

Table 8: Summary of kinetic leach multi-element analyses and results.

	Sample	Contaminant Limit #	Cumulative Results				
			Leach 0	Leach 1	Leach 2	Leach 3	Leach 4
pH*	WRD01 -01	6.0 – 9.0	4.46	5.31	5.36	6.23	5.81
	WRD02 -01		5.05	5.51	5.11	5.34	4.95
	WRD03 -01		6.61	6.47	6.56	6.29	6.39
	WRD03 -02		5.10	5.59	5.57	5.46	5.46
	FWRD01 -01		4.29	4.84	4.81	4.81	4.79
	HLP01 -01		7.82	7.93	8.04	7.74	7.90
	FROM01 -01		3.99	4.07	4.16	4.48	4.31
	TSF -01		3.69	3.64	3.70	3.72	3.73
	TSF -02		7.39	6.37	5.91	5.72	6.01
	TSF -03		4.13	4.06	4.12	-	-
	TSF -04		4.94	4.91	4.76	4.65	4.78
Total Dissolved Solids (mg/l)	WRD01 -01	4,000	670	722	760	787	809
	WRD02 -01		910	957	987	1,014	1,039
	WRD03 -01		1,220	1,355	1,411	1,453	1,489
	WRD03 -02		949	1,033	1,089	1,123	1,152
	FWRD01 -01		606	640	656	673	688
	HLP01 -01		133	247	324	394	463
	FROM01 -01		819	1,196	1,388	1,510	1,609
	TSF -01		1,830	3,190	4,074	4,744	5,218
	TSF -02		5,970	6,341	6,413	6,589	6,788
	TSF -03		5,940	10,520	-	-	-
	TSF -04		1,160	1,684	2,145	2,603	2,938
Sulphate (mg/l)	WRD01 -01	1,000	9	26	39	49	58
	WRD02 -01		176	195	206	216	226
	WRD03 -01		432	496	524	542	557
	WRD03 -02		279	311	332	344	355
	FWRD01 -01		227	243	249	255	261
	HLP01 -01		38	64	75	81	87
	FROM01 -01		556	774	878	943	994
	TSF -01		1,540	2,570	3,290	3,786	4,124
	TSF -02		2,480	2,602	2,621	2,672	2,728
	TSF -03		3,070	5,850	-	-	-
	TSF -04		349	539	715	887	1,023

	Sample	Contaminant Limit #	Cumulative Results				
			Leach 0	Leach 1	Leach 2	Leach 3	Leach 4
Arsenic (mg/l)	WRD01 -01	0.5	0.0005	0.0025	0.0035	0.0075	0.0095
	WRD02 -01		0.0180	0.0220	0.0240	0.0260	0.0270
	WRD03 -01		0.0060	0.0080	0.0100	0.0140	0.0160
	WRD03 -02		0.0190	0.0200	0.0210	0.0230	0.0240
	FWRD01 -01		0.0040	0.0045	0.0050	0.0055	0.0060
	HLP01 -01		0.1220	0.2870	0.4500	0.6210	0.7840
	FROM01 -01		0.0050	0.0060	0.0070	0.0080	0.0100
	TSF -01		0.0130	0.0160	0.0170	0.0190	0.0200
	TSF -02		0.0040	0.0050	0.0060	0.0080	0.0090
	TSF -03		0.0190	0.0360	0.0420	-	-
	TSF -04		0.0040	0.0050	0.0055	0.0075	0.0095
Cadmium (mg/l)	WRD01 -01	0.01	0.00050	0.00055	0.00060	0.00065	0.00070
	WRD02 -01		0.00040	0.00045	0.00050	0.00055	0.00060
	WRD03 -01		0.00030	0.00035	0.00040	0.00045	0.00050
	WRD03 -02		0.00050	0.00055	0.00060	0.00065	0.00070
	FWRD01 -01		0.00080	0.00085	0.00090	0.00095	0.00100
	HLP01 -01		BLOR^	BLOR	BLOR	BLOR	BLOR
	FROM01 -01		0.00460	0.00640	0.00700	0.00750	0.00790
	TSF -01		0.00690	0.01100	0.01280	0.01410	0.01490
	TSF -02		0.00140	0.00145	0.00150	0.00155	0.00160
	TSF -03		0.03430	0.06410	0.07490	-	-
	TSF -04		0.00210	0.00290	0.00330	0.00390	0.00430
Copper (mg/l)	WRD01 -01	0.5	0.0110	0.0115	0.0120	0.0125	0.0130
	WRD02 -01		0.0020	0.0025	0.0030	0.0035	0.0040
	WRD03 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	WRD03 -02		0.0040	0.0045	0.0050	0.0055	0.0060
	FWRD01 -01		0.0160	0.0165	0.0170	0.0175	0.0180
	HLP01 -01		0.0005	0.0035	0.0040	0.0045	0.0050
	FROM01 -01		0.0030	0.0035	0.0040	0.0045	0.0050
	TSF -01		0.0900	0.1520	0.1880	0.2140	0.2320
	TSF -02		0.0020	0.0025	0.0030	0.0035	0.0040
	TSF -03		0.0980	0.2050	0.2540	-	-
	TSF -04		0.0050	0.0080	0.0110	0.0150	0.0180

	Sample	Contaminant Limit #	Cumulative Results				
			Leach 0	Leach 1	Leach 2	Leach 3	Leach 4
Lead (mg/l)	WRD01 -01	0.1	BLOR	BLOR	BLOR	BLOR	BLOR
	WRD02 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	WRD03 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	WRD03 -02		BLOR	BLOR	BLOR	BLOR	BLOR
	FWRD01 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	HLP01 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	FROM01 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	TSF -01		BLOR	BLOR	BLOR	BLOR	BLOR
	TSF -02		BLOR	BLOR	BLOR	BLOR	BLOR
	TSF -03		BLOR	BLOR	BLOR	BLOR	BLOR
	TSF -04		BLOR	BLOR	BLOR	BLOR	BLOR
Mercury (mg/l)	WRD01 -01	0.002	BLOR	BLOR	BLOR	BLOR	BLOR
	WRD02 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	WRD03 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	WRD03 -02		BLOR	BLOR	BLOR	BLOR	BLOR
	FWRD01 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	HLP01 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	FROM01 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	TSF -01		BLOR	BLOR	BLOR	BLOR	BLOR
	TSF -02		0.00020	0.00025	0.00030	0.00035	0.00040
	TSF -03		0.00010	0.00015	0.00020	-	-
	TSF -04		BLOR	BLOR	BLOR	BLOR	BLOR
Molybdenum (mg/l)	WRD01 -01	0.05	BLOR	BLOR	BLOR	BLOR	BLOR
	WRD02 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	WRD03 -01		0.0005	0.0025	0.0055	0.0075	0.0095
	WRD03 -02		BLOR	BLOR	BLOR	BLOR	BLOR
	FWRD01 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	HLP01 -01		0.0100	0.0230	0.0310	0.0370	0.0420
	FROM01 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	TSF -01		BLOR	BLOR	BLOR	BLOR	BLOR
	TSF -02		BLOR	BLOR	BLOR	BLOR	BLOR
	TSF -03		BLOR	BLOR	BLOR	BLOR	BLOR
	TSF -04		BLOR	BLOR	BLOR	BLOR	BLOR

	Sample	Contaminant Limit #	Cumulative Results				
			Leach 0	Leach 1	Leach 2	Leach 3	Leach 4
Selenium (mg/l)	WRD01 -01	0.02	BLOR	BLOR	BLOR	BLOR	BLOR
	WRD02 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	WRD03 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	WRD03 -02		BLOR	BLOR	BLOR	BLOR	BLOR
	FWRD01 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	HLP01 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	FROM01 -01		BLOR	BLOR	BLOR	BLOR	BLOR
	TSF -01		BLOR	BLOR	BLOR	BLOR	BLOR
	TSF -02		0.020	0.025	0.030	0.0350	0.040
	TSF -03		0.030	0.060	0.070	-	-
	TSF -04		BLOR	BLOR	BLOR	BLOR	BLOR
Zinc (mg/l)	WRD01 -01	20	1.8000	1.8920	1.9580	1.9880	2.0180
	WRD02 -01		1.3400	1.3990	1.4260	1.4400	1.4570
	WRD03 -01		1.1400	1.1880	1.2100	1.2240	1.2430
	WRD03 -02		1.4400	1.5580	1.63700	1.6660	1.6950
	FWRD01 -01		1.7200	1.8490	1.8750	1.8940	1.9120
	HLP01 -01		0.0025	0.01350	0.01600	0.01850	0.0210
	FROM01 -01		2.2900	3.8500	4.8400	5.4550	6.0110
	TSF -01		2.0000	3.7200	4.8700	5.8260	6.5610
	TSF -02		1.2400	1.2425	1.2450	1.2475	1.2500
	TSF -03		4.5700	9.9800	11.9400	-	-
	TSF -04		0.7150	1.1810	1.6690	2.1500	2.5180

Receiving water contaminant limits as per EA EPML00772413 (Schedule C – Table 2).

* pH results are not cumulative.

^ BLOR = Below limit of reporting.

4.4.2 SALINITY

The KLC testwork results (Table 8) demonstrate that – apart from the TSF samples – all of the total dissolved solids (TDS) values for the waste rock are below the EA TDS RWCL of 4,000 mg/l (Figure 13).

Figure 13 demonstrates that the KLC results for three of the TSF samples exceed the EA TDS RWCL. These exceedances are attributed to the high EC of the three TSF KLC solutions (Figure 14) and it can be shown that these three samples would also exceed a corresponding EC RWCL (calculated from the TDS RWCL using a multiplying factor of 1.493). These results indicate that salinity is an issue in the TSF samples, with the EC (hence salinity) of three samples, dramatically increasing as time and/or weathering progresses (Figure 14).

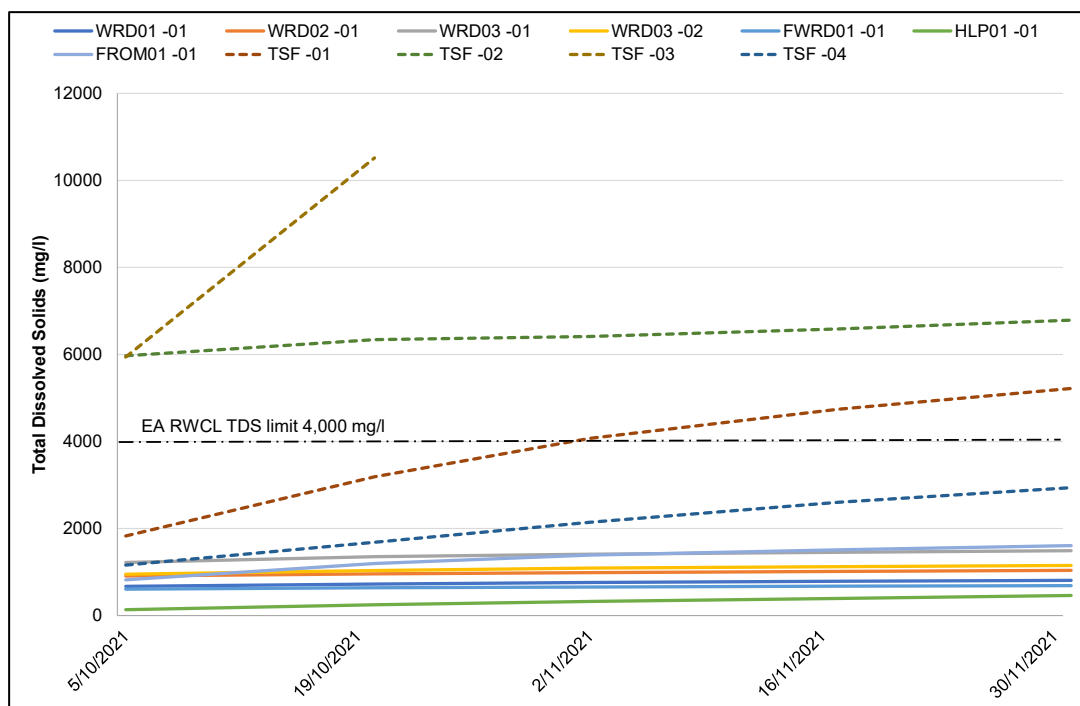


Figure 13: Kinetic leach column total dissolved solids values for Wirralie waste rock samples.

The salinity of the other KLC samples (WRD, HLP and former ROM) are different to the TSF results. This is because – after the initial EC is reported (in Leach 0) – the EC levels of subsequent leaches are not radically increasing (Table 8). Also, none of the samples exceed the EA TDS RWCL (or calculated EC RWCL). Therefore, the salinity of these samples is stabilising after the initial leach – preventing EA RWCL exceedances – and is not of environmental concern.

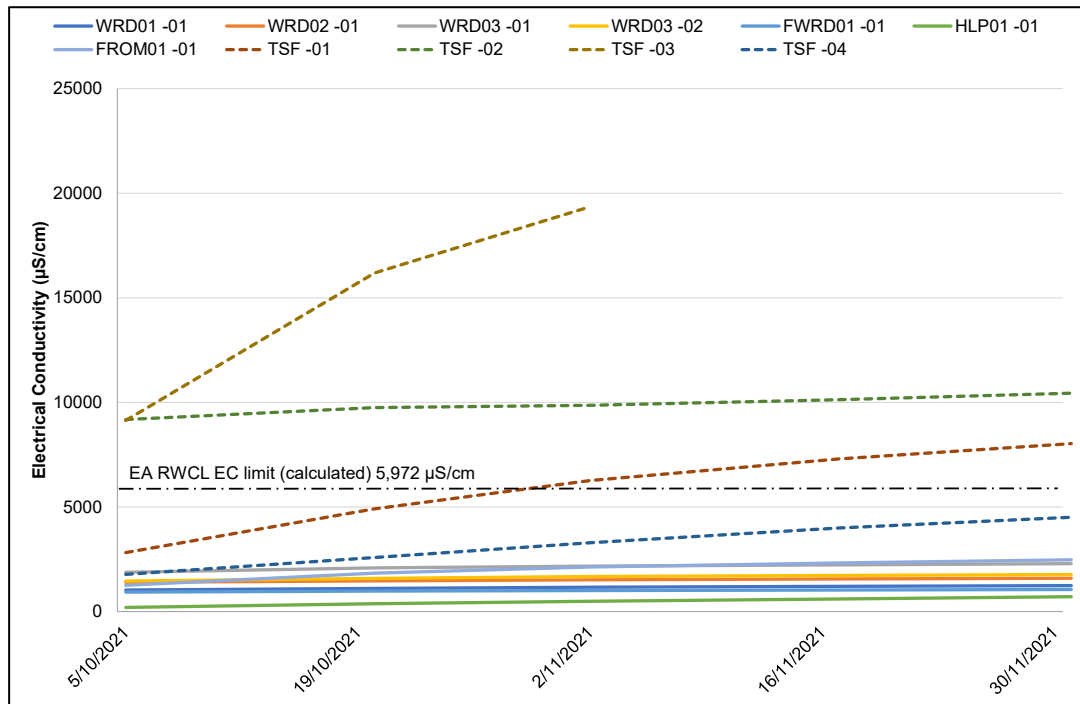


Figure 14: Kinetic leach column electrical conductivities for Wirralie waste rock samples.

4.4.3 METALS/METALLOIDS

The results from the KLC metals/metalloids analyses (Table 8) report:

- an arsenic exceedance in the HLP sample (HLP01 -01);
- cadmium exceedances in two TSF samples (TSF -01 and TSF -03); and
- selenium exceedances in two TSF samples (TSF -02 and TSF -03).

In contrast, all of the other elements – including copper, lead, mercury, molybdenum and zinc – are well below their respective EA RWCLs.

The arsenic exceedance in the HLP KLC test is not of environmental concern because it is most likely attributable to natural background arsenic levels (refer to section 4.3.1). Also, the KLC arsenic results show that – although the waste rock is significantly enriched with respect to arsenic – this arsenic is relatively immobile.

The cadmium and/or selenium exceedances that occur in a couple of the TSF KLC samples are of environmental concern because the RWCL values for both of these elements are exceeded by a minimum of 49% (Table 8). Also, the KLC values reported in Table 8 are dissolved constituents, so it is possible that the total cadmium and selenium values are actually a lot higher than their respective EA RWCLs (that are total limits). Neither of these elements were detected in the waste rock static results (refer to section 4.3.1). However, EGI (2002) previously reported that the TSF was significantly enriched with respect to selenium.

5. CONCLUSION AND RECOMMENDATIONS

Most Wirralie waste rock samples demonstrate similar physical and geochemical characteristics. This is to be expected given that most sample sources have the same lithology. There is, however, a distinct difference between waste rock that occurs in the WRDs, HLP, former ROM, haul road and the waste rock contained in the TSF. The TSF contains processed (mineralised ore) waste and not just mined waste material, explaining the difference.

5.1 ACID MINE DRAINAGE

The acid base account results demonstrate that – although most pH values of the waste rock samples are slightly acidic – these results tend to be misleading due to the nature of the testwork (refer to section 4.1.1). It is expected that – under normal conditions (i.e. dissolution and erosion of the waste rock) – the pH of the surface runoff would not be as acidic as that represented by the 1:5 (pulverised soil:water) extracts.

The ANC:MPA ratio of the waste rock samples is generally low and it could be perceived that a lot of the Wirralie waste rock is PAF. However, both the MPA and ANC values of the waste rock samples are low ($< 20\text{kg H}_2\text{SO}_4/\text{t}$ or eq.). Therefore, the ANC:MPA ratios are only really demonstrating that the ANC of the waste rock is often much lower than the corresponding MPA.

Total sulphur concentrations in all waste areas – apart from the TSF – are mostly $< 0.1\%$ and therefore considered barren. However, there are some slightly elevated measurements (very low to low concentrations), particularly in WRD03 and the TSF (Figure 7). It can be shown that – although the TSF sample results are all NAF – there is a higher median concentration of sulphur in the TSF (0.15%) when compared with the rest of the waste rock areas (0.05%).

In order to adequately assess the potential acid forming properties of the waste rock, consideration has to be given to both the total sulphur concentration and $\text{NAG}_{(\text{pH})}$ of the waste rock samples. Total sulphur concentrations of all waste rock samples are either barren ($< 0.1\%$) or low ($< 0.55\%$), with only one slightly higher (0.6%) measurement recorded. Also, the $\text{NAG}_{(\text{pH})}$ of most waste rock samples is generally ≥ 4.5 . Thus, when assessed with the corresponding total sulphur concentrations, most (98%) of the Wirralie waste rock is considered NAF (refer to section 4.2). Of the 155 Wirralie waste rock samples, only 2% are classified as very low to low sulphur PAF (this amounts to 3 samples, as the other 152 are NAF). These PAF instances are considered rare – with a low acid generating potential – and are not representative of the dataset.

The overwhelming majority (98%) of waste rock static samples at Wirralie are considered NAF (refer to Table 5). These samples represent material with a very low to low risk of acid generation and a high safety factor with respect to potential acid mine drainage (AMD). Although AMD is unlikely to occur in the TSF, it must be noted that the KLC results indicate that there is minor (developing or residual) acidity associated with the TSF.

5.2 SALINITY

The majority of EC measurements for the Wirralie waste rock static samples – apart from the TSF – are generally low ($< 300\ \mu\text{S}/\text{cm}$). In contrast, the TSF waste rock static samples tend to have much higher ECs, ranging from $195\ \mu\text{S}/\text{cm}$ to $4,860\ \mu\text{S}/\text{cm}$, with a median value of $1,175\ \mu\text{S}/\text{cm}$. Therefore, it is considered that there is a very low risk of salinity issues in all waste rock areas, apart from the TSF.

The TSF has the potential for salinity issues because a lot of the EC values are greater than 1,000 $\mu\text{S}/\text{cm}$. This is particularly evident with the TSF surface crust (Figure 6), which will have a higher potential for surface dissolution, erosion and transportability. Furthermore, the TSF KLC results demonstrate that the weathering of the TSF material has the potential to form moderately/highly saline waters up to around 20,000 $\mu\text{S}/\text{cm}$ (Figure 14).

5.3 ELEMENTS

The Wirralie waste rock static samples were assessed against the GAls for each individual analysed element. This assessment demonstrates that – although the waste rock is not significantly enriched with respect to the majority of the elements analysed (refer to section 4.3.1) – there is a definite enrichment of arsenic in all waste rock areas – and both arsenic and mercury in the TSF.

The significant arsenic enrichment in the Wirralie waste rock is most likely geological because it occurs in most of the volcanoclastic waste, but not the Tertiary clay (that has been used to cap the rehabilitated WRD). Although arsenic enrichment is common to the waste rock, it can be established – using the KLC results – that the arsenic contained in the waste rock is relatively immobile (refer to section 4.4.3).

The significant mercury enrichments only occur in the TSF, apart from one sample taken from WRD01. Therefore, it is assumed that the mercury enrichment is associated with the ore rather than the mined waste, which is why it is almost entirely constrained to the TSF. Regardless, it can be demonstrated – using the KLC results – that the mercury contained in the waste rock, including the TSF, is relatively immobile (refer to section 4.4.3).

The high arsenic values in the Wirralie waste rock are not a particular concern because they remain below the NEPM HIL for 'Recreational C' (public open space scenario) of 300 mg/kg (NEPC, 2013). The mercury enrichments are not a concern either because all mercury concentrations remain well below the HIL 'Residential A' (residential garden scenario) threshold of 10 mg/kg. Also, the KLC results indicate that both of these elements as they occur in the waste rock are relatively immobile.

The results of this study demonstrate that the Wirralie TSF is enriched with respect to arsenic, mercury, cadmium and selenium. EGI (2002) also indicate that the TSF is enriched with respect to antimony. Therefore, it is assessed that metal/metalloid enrichment in the TSF is at a much higher concentration and potential risk than that of the rest of the waste rock areas.

5.4 RECOMMENDATIONS

This geochemical investigation recognises that – apart from the TSF – all of the waste rock areas sampled for this report have similar physical and geochemical characteristics. As such, the risk profile for all areas (TSF excluded) are very similar. Based on both the static and KLC test results conducted as part of this study, the anticipated risk with the storage of this type of waste material is considered to be very low to low.

The TSF has a different risk profile to the rest of the waste rock areas. When compared with the rest of the waste rock, the TSF has the following characteristics:

- Even though the waste rock samples are NAF, they contain more sulphur and it can be shown that during weathering there is minor developing or residual acidity;
- Samples have elevated salinities (particularly on the crust of the TSF);
- Most samples have elevated arsenic and mercury concentrations;
- The KLC testwork indicates that some samples have elevated selenium and/or cadmium concentrations;



- Previously sampling events (EGI, 2002) have identified antimony enrichments;
- The surface crust will be more prone to dissolution, erosion and transportability; and
- Due to the nature of the TSF waste (chemically processed material), the availability and mobility of metals/metalloids is further enhanced.

It is recommended that – with respect to the TSF risk – further analysis is undertaken of the surface waters contained in the 20.5 ha of ponding in the southwest of the TSF. This analysis should be undertaken in order to understand the pH, salinity, future speciation and mobility of metals/metalloids in runoff and/or seepage from the TSF. Although the KLC tests assist with this type of analysis, examination of the saturated section of the TSF would be more representative of the physical behaviour and chemical reactivity of the TSF waste under the Wirralie storage conditions.

6. REFERENCES

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CLIENT: WULGURU TECHNICAL SERVICES
PROJECT: WIRRALIE GOLD MINE
REPORT: WASTE ROCK CHARACTERISATION
DATE: FEBRUARY 2022



Appendix A – Static Results

CERTIFICATE OF ANALYSIS

Work Order : **EB2121644**
Client : **C & R CONSULTING PTY LTD**
Contact : MR MATT KNOTT
Address : 188 ROSS RIVER ROAD
AITKENVALE QUEENSLAND 4812
Telephone : +61 07 47253751
Project : 2020.10003 - Solomons Gold Geochemistry
Order number : ----
C-O-C number : ----
Sampler : MATTHEW AYRE
Site : ----
Quote number : TV/110/21 v2
No. of samples received : 78
No. of samples analysed : 78

Page : 1 of 34
Laboratory : Environmental Division Brisbane
Contact : Princess Marcelo
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61-7-3243 7222
Date Samples Received : 02-Aug-2021 11:25
Date Analysis Commenced : 06-Aug-2021
Issue Date : 18-Aug-2021 15:11



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
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	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 Contact 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.

- **SPLIT WORK ORDER:** It should be noted that ALS has split this work order over the following work orders (EB2121644, EB2121646) due to the size of the sample numbers. For any further information regarding this processing of samples please contact ALS client services division on ALSEnviro.Brisbane@alsglobal.com
- EG005T (Total Metals by ICP-AES): Sample 'WRD02-01 3-6m' (EB2121644-002) shows poor matrix spike recovery due to sample heterogeneity. Confirmed by visual inspection.
- 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	WRD02-01 0-3m	WRD02-01 3-6m	WRD02-02 0-3m	WRD02-02 3-6m	WRD02-03 0-3m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-001	EB2121644-002	EB2121644-003	EB2121644-004	EB2121644-005
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		8.7	7.3	9.4	8.3	9.6
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		<0.5	<0.5	-0.05	1.6	-1.1
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		101	101	225	247	279
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		6.5	6.1	6.8	6.7	6.8
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		1.9	1.8	1.0	0.6	0.6
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		2.8	2.9	2.8	2.4	2.3
ANC as CaCO3	----	0.1	% CaCO3		0.3	0.3	0.3	0.2	0.2
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		3.6	3.8	5.1	4.2	2.8
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.10	0.11	0.09	0.13	0.04
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		710	870	520	650	460
Arsenic	7440-38-2	5	mg/kg		44	48	45	71	28
Barium	7440-39-3	10	mg/kg		20	20	30	60	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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		4	3	<2	<2	7
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		2890	3720	1680	3600	1680
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		6	<5	6	<5	7
Nickel	7440-02-0	2	mg/kg		3	3	<2	<2	4
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		<5	<5	<5	<5	<5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD02-01 0-3m	WRD02-01 3-6m	WRD02-02 0-3m	WRD02-02 3-6m	WRD02-03 0-3m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-001	EB2121644-002	EB2121644-003	EB2121644-004	EB2121644-005
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<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



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD02-03 3-6m	WRD02-04 0-3m	WRD02-04 3-6m	WRD02-05 0-3m	WRD02-05 3-6m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-006	EB2121644-007	EB2121644-008	EB2121644-009	EB2121644-010
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		9.5	9.7	9.6	9.7	9.7
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		-0.7	-1.3	-1.0	-0.3	-0.9
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		303	158	157	156	161
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		7.1	6.8	6.5	6.9	6.8
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	0.4	0.7	0.2	0.4
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		1.9	2.5	1.6	2.1	2.4
ANC as CaCO3	----	0.1	% CaCO3		0.2	0.2	0.2	0.2	0.2
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		2.8	3.2	1.2	4.0	2.5
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.04	0.04	0.02	0.06	0.05
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		520	400	600	490	460
Arsenic	7440-38-2	5	mg/kg		30	22	21	47	38
Barium	7440-39-3	10	mg/kg		20	20	20	30	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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		7	3	5	5	8
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		1820	1080	1340	2140	2170
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		7	<5	6	7	8
Nickel	7440-02-0	2	mg/kg		5	2	4	3	5
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		<5	<5	<5	<5	<5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD02-03 3-6m	WRD02-04 0-3m	WRD02-04 3-6m	WRD02-05 0-3m	WRD02-05 3-6m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-006	EB2121644-007	EB2121644-008	EB2121644-009	EB2121644-010
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<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



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD02-06 0-3m	WRD02-07 0-3m	WRD01-01 0-3m	WRD01-01 3-6m	WRD01-01 6-9m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-011	EB2121644-012	EB2121644-013	EB2121644-014	EB2121644-015
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		7.2	4.3	5.1	5.0	5.2
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		-0.8	8.1	-0.08	<0.5	-0.3
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		253	268	39	40	42
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		7.0	5.8	5.7	5.6	5.8
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	1.0	1.5	1.5	1.1
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		3.2	0.8	1.3	1.0	0.9
ANC as CaCO3	----	0.1	% CaCO3		0.3	<0.1	0.1	0.1	<0.1
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		5.3	5.2	3.1	3.7	2.1
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.08	0.29	0.04	0.04	0.02
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		1460	650	560	580	580
Arsenic	7440-38-2	5	mg/kg		47	63	31	37	36
Barium	7440-39-3	10	mg/kg		50	50	<10	<10	<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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		4	<2	4	<2	7
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		4490	2500	1450	1620	2000
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		<5	7	<5	<5	<5
Nickel	7440-02-0	2	mg/kg		<2	<2	2	<2	4
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		26	5	<5	<5	<5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD02-06 0-3m	WRD02-07 0-3m	WRD01-01 0-3m	WRD01-01 3-6m	WRD01-01 6-9m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-011	EB2121644-012	EB2121644-013	EB2121644-014	EB2121644-015
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<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



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD01-02 0-3m	WRD01-03 0-3m	WRD01-03 3-6m	WRD01-03 6-9m	WRD01-04 0-3m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-016	EB2121644-019	EB2121644-020	EB2121644-021	EB2121644-022
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		4.6	5.2	5.2	4.9	5.3
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		<0.5	<0.5	1.4	-0.8	-0.9
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		87	49	59	57	19
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		5.2	5.5	6.0	5.4	5.8
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		1.9	2.1	1.2	2.1	1.2
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		2.0	1.8	1.7	1.4	1.2
ANC as CaCO3	----	0.1	% CaCO3		0.2	0.2	0.2	0.1	0.1
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		1.4	1.9	2.1	3.7	2.4
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.07	0.07	0.10	0.02	0.01
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		880	600	590	560	480
Arsenic	7440-38-2	5	mg/kg		40	45	35	40	33
Barium	7440-39-3	10	mg/kg		100	10	<10	<10	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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		15	9	8	<2	2
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		25	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		3300	2320	2070	1690	1340
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		10	6	5	<5	<5
Nickel	7440-02-0	2	mg/kg		10	7	5	<2	<2
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		<5	<5	<5	<5	<5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD01-02 0-3m	WRD01-03 0-3m	WRD01-03 3-6m	WRD01-03 6-9m	WRD01-04 0-3m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-016	EB2121644-019	EB2121644-020	EB2121644-021	EB2121644-022
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		2.1	<0.1	<0.1	<0.1	<0.1



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD01-04 3-6m	WRD01-04 6-9m	WRD03-01 0-3m	WRD03-01 3-6m	WRD03-02 0-3m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-023	EB2121644-024	EB2121644-025	EB2121644-026	EB2121644-027
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		5.6	5.4	4.3	4.5	9.1
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		-0.9	-0.7	13.3	9.0	-1.7
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		20	21	303	179	210
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		5.7	5.8	5.0	5.0	6.5
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		1.8	1.4	1.5	2.1	1.0
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		1.2	1.3	0.8	0.8	2.9
ANC as CaCO3	----	0.1	% CaCO3		0.1	0.1	<0.1	<0.1	0.3
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		1.0	1.4	4.5	3.4	1.9
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.01	0.02	0.46	0.32	0.04
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		480	560	1450	2450	510
Arsenic	7440-38-2	5	mg/kg		28	34	136	154	55
Barium	7440-39-3	10	mg/kg		10	20	130	280	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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		14	8	2	5	6
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		2330	1900	8870	14000	2590
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		10	<5	<5	<5	7
Nickel	7440-02-0	2	mg/kg		8	5	<2	4	4
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		<5	<5	6	11	<5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD01-04 3-6m	WRD01-04 6-9m	WRD03-01 0-3m	WRD03-01 3-6m	WRD03-02 0-3m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-023	EB2121644-024	EB2121644-025	EB2121644-026	EB2121644-027
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	0.2	<0.1	<0.1



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD03-02 3-6m	WRD03-02 6-9m	WRD03-03 0-3m	WRD03-03 3-6m	WRD03-03 6-9m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-028	EB2121644-029	EB2121644-030	EB2121644-031	EB2121644-032
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		9.0	9.1	5.4	5.7	6.5
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		-0.9	-1.1	2.5	0.9	1.2
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		204	248	162	114	234
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		6.8	6.7	6.2	6.1	6.4
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		0.3	0.7	0.7	1.2	0.7
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		2.1	2.0	2.4	2.5	1.9
ANC as CaCO3	----	0.1	% CaCO3		0.2	0.2	0.2	0.2	0.2
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		<1.0	2.0	3.2	2.2	1.6
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.04	0.03	0.16	0.11	0.10
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		550	480	720	700	510
Arsenic	7440-38-2	5	mg/kg		56	52	81	82	61
Barium	7440-39-3	10	mg/kg		60	60	80	80	70
Beryllium	7440-41-7	1	mg/kg		<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		10	5	<2	<2	<2
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		2930	2420	4560	4320	3430
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		10	6	<5	<5	<5
Nickel	7440-02-0	2	mg/kg		7	3	<2	<2	<2
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		<5	<5	<5	<5	<5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD03-02 3-6m	WRD03-02 6-9m	WRD03-03 0-3m	WRD03-03 3-6m	WRD03-03 6-9m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-028	EB2121644-029	EB2121644-030	EB2121644-031	EB2121644-032
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	0.5	0.5	0.2



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD03-04 0-3m	WRD03-04 3-6m	WRD03-04 6-9m	WRD03-05 0-3m	WRD03-05 3-6m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-033	EB2121644-034	EB2121644-035	EB2121644-036	EB2121644-037
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		4.3	4.3	4.3	5.4	5.0
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		10.7	9.9	12.6	0.6	<0.5
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		279	293	285	407	288
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		5.4	5.2	5.3	6.1	5.7
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		1.6	1.8	2.1	0.9	0.7
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		0.6	0.8	0.6	1.8	1.7
ANC as CaCO3	----	0.1	% CaCO3		<0.1	<0.1	<0.1	0.2	0.2
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		4.7	4.7	2.2	3.0	2.2
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.37	0.35	0.43	0.08	0.07
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		1020	870	1000	620	670
Arsenic	7440-38-2	5	mg/kg		143	130	122	74	76
Barium	7440-39-3	10	mg/kg		100	100	80	70	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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		<2	<2	<2	<2	<2
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		9660	9520	7480	2930	2900
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		<5	<5	<5	<5	<5
Nickel	7440-02-0	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		<5	<5	<5	<5	<5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD03-04 0-3m	WRD03-04 3-6m	WRD03-04 6-9m	WRD03-05 0-3m	WRD03-05 3-6m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-033	EB2121644-034	EB2121644-035	EB2121644-036	EB2121644-037
				Result	Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		0.3	0.2	0.2	<0.1	<0.1



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD03-05 6-9m	WRD03-06 0-3m	WRD03-06 3-6m	WRD03-06 6-9m	WRD03-07 0-3m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-038	EB2121644-039	EB2121644-040	EB2121644-041	EB2121644-042
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		6.7	4.8	4.9	4.9	5.3
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		-0.06	0.7	1.3	-0.2	3.5
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		597	129	77	69	274
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		6.4	5.3	5.4	5.4	6.0
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		0.5	0.8	0.7	1.2	0.7
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		2.2	2.4	2.4	2.3	2.6
ANC as CaCO3	----	0.1	% CaCO3		0.2	0.2	0.2	0.2	0.3
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		1.1	3.9	3.4	3.8	1.9
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.07	0.10	0.12	0.07	0.20
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		670	780	790	880	730
Arsenic	7440-38-2	5	mg/kg		73	72	70	100	155
Barium	7440-39-3	10	mg/kg		80	40	30	40	80
Beryllium	7440-41-7	1	mg/kg		<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		<2	<2	<2	3	2
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		3140	2570	2480	3400	5610
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		<5	<5	<5	<5	<5
Nickel	7440-02-0	2	mg/kg		3	<2	3	5	4
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		<5	<5	<5	<5	<5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD03-05 6-9m	WRD03-06 0-3m	WRD03-06 3-6m	WRD03-06 6-9m	WRD03-07 0-3m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-038	EB2121644-039	EB2121644-040	EB2121644-041	EB2121644-042
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	0.2



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD03-07 3-6m	WRD03-07 6-9m	WRD03-08 0-3m	WRD03-08 3-6m	WRD03-09 0-3m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-043	EB2121644-044	EB2121644-045	EB2121644-046	EB2121644-047
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		5.6	6.0	4.8	4.6	3.9
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		4.6	1.3	-0.6	-1.3	18.4
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		196	422	66	73	306
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		5.9	6.2	5.4	5.4	2.7
NAG (pH 4.5)	----	0.1	kg H2SO4/t		<0.1	<0.1	<0.1	<0.1	12.3
NAG (pH 7.0)	----	0.1	kg H2SO4/t		1.2	0.9	2.1	1.7	16.3
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		2.4	2.7	2.7	2.5	<0.5
ANC as CaCO3	----	0.1	% CaCO3		0.2	0.3	0.3	0.2	<0.1
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		2.4	1.0	2.6	2.6	4.5
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.23	0.13	0.07	0.04	0.60
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		810	720	1160	1470	1450
Arsenic	7440-38-2	5	mg/kg		160	118	86	29	44
Barium	7440-39-3	10	mg/kg		70	80	30	20	30
Beryllium	7440-41-7	1	mg/kg		<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		3	2	2	5	3
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		6790	4500	4820	4760	3360
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		<5	<5	<5	<5	<5
Nickel	7440-02-0	2	mg/kg		<2	5	<2	3	<2
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		<5	<5	11	31	19



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD03-07 3-6m	WRD03-07 6-9m	WRD03-08 0-3m	WRD03-08 3-6m	WRD03-09 0-3m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-043	EB2121644-044	EB2121644-045	EB2121644-046	EB2121644-047
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		0.3	0.1	<0.1	<0.1	0.2



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD03-09 3-6m	WRD03-10 0-3m	WRD03-10 3-6m	FWRD01-01 0-3m	FWRD01-01 3-6m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-048	EB2121644-049	EB2121644-050	EB2121644-051	EB2121644-052
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		4.3	5.0	4.7	4.6	4.9
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		1.9	-0.3	-1.0	-0.8	0.6
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		86	52	33	24	18
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		4.4	4.8	5.0	5.3	5.0
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		1.2	2.4	2.1	1.4	1.8
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		2.1	1.8	2.5	2.3	1.2
ANC as CaCO3	----	0.1	% CaCO3		0.2	0.2	0.2	0.2	0.1
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		1.0	5.8	5.0	3.5	3.8
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.13	0.05	0.05	0.05	0.06
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		450	1090	1050	960	890
Arsenic	7440-38-2	5	mg/kg		7	39	5	<5	<5
Barium	7440-39-3	10	mg/kg		20	20	10	<10	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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		<2	<2	<2	<2	<2
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		1030	2230	610	270	440
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		<5	<5	<5	<5	<5
Nickel	7440-02-0	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		7	6	<5	<5	<5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	WRD03-09 3-6m	WRD03-10 0-3m	WRD03-10 3-6m	FWRD01-01 0-3m	FWRD01-01 3-6m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-048	EB2121644-049	EB2121644-050	EB2121644-051	EB2121644-052
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<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



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	FWRD01-02 0-3m	FWRD01-02 3-6m	FWRD01-03 0-3m	FWRD01-03 3-6m	FWRD01-04 0-3m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-053	EB2121644-054	EB2121644-055	EB2121644-056	EB2121644-057
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		4.5	4.6	4.3	3.9	4.3
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		<0.5	-0.5	-1.1	-0.2	-0.7
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		53	40	74	118	40
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		5.3	5.3	5.2	5.0	4.9
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		1.9	1.3	1.6	1.2	2.6
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		1.2	2.0	2.3	2.0	1.9
ANC as CaCO3	----	0.1	% CaCO3		0.1	0.2	0.2	0.2	0.2
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		3.4	3.3	5.6	4.8	4.2
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.04	0.05	0.04	0.06	0.04
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		1130	880	1240	1050	1240
Arsenic	7440-38-2	5	mg/kg		<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg		20	30	<10	10	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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		<2	<2	<2	<2	<2
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		440	330	360	240	360
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		<5	<5	<5	<5	<5
Nickel	7440-02-0	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		<5	<5	<5	<5	<5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	FWRD01-02 0-3m	FWRD01-02 3-6m	FWRD01-03 0-3m	FWRD01-03 3-6m	FWRD01-04 0-3m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-053	EB2121644-054	EB2121644-055	EB2121644-056	EB2121644-057
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<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



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	FWRD01-04 3-6m	FWRD01-05 0-3m	FWRD01-05 3-6m	FWRD01-06 0-3m	FWRD01-06 3-6m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-058	EB2121644-059	EB2121644-060	EB2121644-061	EB2121644-062
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		4.7	4.8	4.5	4.6	4.7
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		<0.5	-0.4	-0.8	<0.5	-0.3
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		50	54	71	37	34
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		5.7	5.6	5.3	5.0	5.1
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		0.7	0.8	1.2	2.3	2.0
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		1.5	2.2	2.6	0.8	1.8
ANC as CaCO3	----	0.1	% CaCO3		0.2	0.2	0.3	<0.1	0.2
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		3.9	3.4	2.4	4.0	3.3
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.06	0.06	0.06	0.04	0.05
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		830	850	780	1040	850
Arsenic	7440-38-2	5	mg/kg		<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg		20	20	20	10	<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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		<2	<2	<2	<2	<2
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		480	350	470	360	1160
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		<5	<5	<5	<5	<5
Nickel	7440-02-0	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		6	<5	6	<5	9



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	FWRD01-04 3-6m	FWRD01-05 0-3m	FWRD01-05 3-6m	FWRD01-06 0-3m	FWRD01-06 3-6m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-058	EB2121644-059	EB2121644-060	EB2121644-061	EB2121644-062
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<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



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	FWRD01-06 6-9m	FWRD01-07 0-3m	FWRD01-07 3-6m	FWRD01-07 6-9m	FWRD01-08 0-3m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-063	EB2121644-064	EB2121644-065	EB2121644-066	EB2121644-067
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		5.0	4.8	4.7	4.7	4.8
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		-0.9	-0.8	-0.4	-0.8	-1.0
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		73	30	23	25	46
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		5.5	5.3	5.3	5.3	5.5
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		1.1	1.8	1.1	1.2	1.2
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		2.1	2.0	1.9	2.0	2.2
ANC as CaCO3	----	0.1	% CaCO3		0.2	0.2	0.2	0.2	0.2
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		2.7	4.0	4.1	4.2	3.5
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.04	0.04	0.05	0.04	0.04
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		1090	1060	920	990	1120
Arsenic	7440-38-2	5	mg/kg		34	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg		10	10	20	10	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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		4	<2	<2	<2	<2
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		2430	490	430	450	650
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		<5	<5	<5	<5	<5
Nickel	7440-02-0	2	mg/kg		7	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		<5	<5	<5	<5	6



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	FWRD01-06 6-9m	FWRD01-07 0-3m	FWRD01-07 3-6m	FWRD01-07 6-9m	FWRD01-08 0-3m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-063	EB2121644-064	EB2121644-065	EB2121644-066	EB2121644-067
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<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



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	FWRD01-08 3-6m	FWRD01-09 0-3m	FWRD01-09 3-6m	FWRD01-10 0-3m	FWRD01-10 3-6m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-068	EB2121644-069	EB2121644-070	EB2121644-071	EB2121644-072
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		5.0	4.9	4.7	4.4	4.5
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		-0.2	-0.7	-1.2	-0.7	-0.8
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		27	23	14	30	23
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		5.3	5.5	5.2	5.2	5.4
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		1.1	1.2	1.5	1.3	1.0
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		2.0	1.9	2.4	1.9	2.0
ANC as CaCO3	----	0.1	% CaCO3		0.2	0.2	0.2	0.2	0.2
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		2.9	4.8	4.6	4.4	3.6
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.06	0.04	0.04	0.04	0.04
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		690	1040	1060	1150	830
Arsenic	7440-38-2	5	mg/kg		<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg		10	20	20	<10	<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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		<2	<2	<2	<2	<2
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		680	340	350	240	140
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		<5	<5	<5	<5	<5
Nickel	7440-02-0	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		6	<5	<5	<5	<5



Analytical Results

Sub-Matrix: SOIL
 (Matrix: SOIL)

Sample ID

				FWRD01-08 3-6m	FWRD01-09 0-3m	FWRD01-09 3-6m	FWRD01-10 0-3m	FWRD01-10 3-6m
Sampling date / time				29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit	EB2121644-068	EB2121644-069	EB2121644-070	EB2121644-071	EB2121644-072
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Zinc	7440-66-6	5	mg/kg	<5	<5	<5	<5	<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



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	FWRD01-11 0-3m	FWRD01-11 3-6m	FWRD01-12 0-3m	FWRD01-12 3-6m	FWRD01-13 0-3m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121644-073	EB2121644-074	EB2121644-075	EB2121644-076	EB2121644-077
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		4.4	3.7	4.0	3.8	4.6
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		-0.5	0.5	-0.2	1.7	-0.4
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		36	456	212	293	36
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		5.2	4.3	4.5	4.3	4.9
NAG (pH 4.5)	----	0.1	kg H2SO4/t		<0.1	0.1	<0.1	0.2	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t		1.6	1.6	2.8	2.8	2.1
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		1.7	1.9	2.0	1.4	1.9
ANC as CaCO3	----	0.1	% CaCO3		0.2	0.2	0.2	0.1	0.2
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		3.8	4.0	4.1	2.6	4.6
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.04	0.08	0.06	0.10	0.05
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		1160	1070	1410	1160	1040
Arsenic	7440-38-2	5	mg/kg		<5	15	6	44	<5
Barium	7440-39-3	10	mg/kg		20	20	<10	<10	<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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		<2	<2	3	3	<2
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		400	910	3480	3840	210
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		<5	<5	<5	<5	<5
Nickel	7440-02-0	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		<5	<5	27	20	<5



Analytical Results

Sub-Matrix: SOIL
 (Matrix: SOIL)

Sample ID

				FWRD01-11 0-3m	FWRD01-11 3-6m	FWRD01-12 0-3m	FWRD01-12 3-6m	FWRD01-13 0-3m
Sampling date / time				29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit	EB2121644-073	EB2121644-074	EB2121644-075	EB2121644-076	EB2121644-077
Result				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Zinc	7440-66-6	5	mg/kg	<5	<5	<5	<5	<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



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	FWRD01-13 3-6m	FWRD01-14 0-3m	FWRD01-15 0-3m	----	----
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	----	----
Compound	CAS Number	LOR	Unit		EB2121644-078	EB2121644-079	EB2121644-080	-----	-----
				Result	Result	Result	Result	----	----
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		4.3	3.6	4.8	----	----
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		-0.6	8.6	-1.1	----	----
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		40	961	103	----	----
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		5.0	3.6	5.6	----	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t		<0.1	1.8	<0.1	----	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t		1.5	5.4	2.5	----	----
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		2.1	<0.5	2.3	----	----
ANC as CaCO3	----	0.1	% CaCO3		0.2	<0.1	0.2	----	----
Fizz Rating	----	0	Fizz Unit		0	0	0	----	----
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		5.2	1.6	2.8	----	----
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.05	0.28	0.04	----	----
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		1090	2410	1030	----	----
Arsenic	7440-38-2	5	mg/kg		<5	39	40	----	----
Barium	7440-39-3	10	mg/kg		10	<10	10	----	----
Beryllium	7440-41-7	1	mg/kg		<1	<1	<1	----	----
Boron	7440-42-8	50	mg/kg		<50	<50	<50	----	----
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	----	----
Chromium	7440-47-3	2	mg/kg		<2	11	2	----	----
Cobalt	7440-48-4	2	mg/kg		<2	3	<2	----	----
Copper	7440-50-8	5	mg/kg		<5	14	<5	----	----
Iron	7439-89-6	50	mg/kg		340	5070	2270	----	----
Lead	7439-92-1	5	mg/kg		<5	<5	<5	----	----
Manganese	7439-96-5	5	mg/kg		<5	6	<5	----	----
Nickel	7440-02-0	2	mg/kg		<2	7	<2	----	----
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	----	----
Vanadium	7440-62-2	5	mg/kg		<5	19	7	----	----



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	FWRD01-13 3-6m	FWRD01-14 0-3m	FWRD01-15 0-3m	----	----
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	----	----
Compound	CAS Number	LOR	Unit		EB2121644-078	EB2121644-079	EB2121644-080	-----	-----
					Result	Result	Result	----	----
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	0.3	<0.1	----	----

CERTIFICATE OF ANALYSIS

Work Order : **EB2121646**
Client : **C & R CONSULTING PTY LTD**
Contact : MR MATT KNOTT
Address : 188 ROSS RIVER ROAD
AITKENVALE QUEENSLAND 4812
Telephone : +61 07 47253751
Project : 2020.10003 - Solomons Gold Geochemistry
Order number : ----
C-O-C number : ----
Sampler : MATTHEW AYRE
Site : ----
Quote number : TV/110/21 v2
No. of samples received : 77
No. of samples analysed : 74

Page : 1 of 32
Laboratory : Environmental Division Brisbane
Contact : Princess Marcelo
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61-7-3243 7222
Date Samples Received : 02-Aug-2021 11:25
Date Analysis Commenced : 06-Aug-2021
Issue Date : 17-Aug-2021 16:47



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
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	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 Contact 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.

- **SPLIT WORK ORDER:** It should be noted that ALS has split this work order over the following work orders (EB2121644, EB2121646) due to the size of the sample numbers. For any further information regarding this processing of samples please contact ALS client services division on ALSEnviro.Brisbane@alsglobal.com
- EG035T (Total Mercury): Sample TSF-03 0m and TSF-13 0m(EB2121646-023 and 043) shows poor matrix spike recovery due to sample heterogeneity. Confirmed by visual inspection.
- 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	HLP-01 0-2m	HLP-02 0-2m	HLP-03 0-2m	HLP-04 0-2m	HLP-05 0-2m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-001	EB2121646-002	EB2121646-003	EB2121646-004	EB2121646-005
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		9.2	9.4	9.6	9.3	9.2
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		-0.08	<0.5	-1.2	-0.4	-0.8
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		52	119	79	42	45
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		6.6	6.8	6.7	6.7	6.9
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		1.5	1.2	1.1	1.0	0.2
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		1.0	0.8	2.1	1.3	1.4
ANC as CaCO3	----	0.1	% CaCO3		0.1	<0.1	0.2	0.1	0.1
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		5.6	5.7	4.9	5.8	6.3
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.03	0.03	0.03	0.03	0.02
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		520	570	580	600	580
Arsenic	7440-38-2	5	mg/kg		66	59	57	71	78
Barium	7440-39-3	10	mg/kg		50	60	50	60	60
Beryllium	7440-41-7	1	mg/kg		<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		<2	<2	<2	<2	<2
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		2160	2540	2680	2660	2730
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		<5	<5	<5	<5	<5
Nickel	7440-02-0	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		<5	<5	<5	<5	<5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	HLP-01 0-2m	HLP-02 0-2m	HLP-03 0-2m	HLP-04 0-2m	HLP-05 0-2m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-001	EB2121646-002	EB2121646-003	EB2121646-004	EB2121646-005
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<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



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	HLP-06 0-2m	FROM01-01 0-3m	FROM01-01 3-6m	FROM01-01 6-9m	FROM01-02 0-3m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-006	EB2121646-007	EB2121646-008	EB2121646-009	EB2121646-010
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		9.3	4.0	4.8	5.0	4.9
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		-0.5	1.3	2.1	2.9	<0.5
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		88	210	166	265	8
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		7.0	5.2	5.5	5.9	5.9
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	1.8	2.0	1.4	1.3
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		1.7	0.8	<0.5	1.4	1.4
ANC as CaCO3	----	0.1	% CaCO3		0.2	<0.1	<0.1	0.1	0.1
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		5.5	3.2	1.3	3.3	1.9
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.04	0.07	0.07	0.14	0.06
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		650	1790	1750	2070	1110
Arsenic	7440-38-2	5	mg/kg		70	67	56	42	7
Barium	7440-39-3	10	mg/kg		40	20	150	100	<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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		<2	7	14	19	3
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		2720	4940	9520	18700	2610
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		<5	<5	23	47	<5
Nickel	7440-02-0	2	mg/kg		<2	3	12	15	<2
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		<5	24	22	18	19



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	HLP-06 0-2m	FROM01-01 0-3m	FROM01-01 3-6m	FROM01-01 6-9m	FROM01-02 0-3m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-006	EB2121646-007	EB2121646-008	EB2121646-009	EB2121646-010
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	7	11	<5
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	0.2	<0.1	<0.1	<0.1



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	FROM01-02 3-6m	FROM01-02 6-9m	FROM01-03 0-3m	FROM01-03 3-6m	FROM01-04 0-3m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-011	EB2121646-012	EB2121646-013	EB2121646-014	EB2121646-016
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		4.9	5.0	4.4	4.5	4.8
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		0.5	0.9	1.8	0.7	0.6
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		26	26	35	34	18
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		5.7	5.6	5.7	5.7	5.7
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		2.0	2.3	1.2	1.1	1.3
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		0.7	<0.5	<0.5	1.1	0.9
ANC as CaCO3	----	0.1	% CaCO3		<0.1	<0.1	<0.1	0.1	<0.1
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		1.3	2.1	4.7	3.8	5.2
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.04	0.03	0.06	0.06	0.05
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		1610	1520	1290	1190	1080
Arsenic	7440-38-2	5	mg/kg		23	32	12	10	<5
Barium	7440-39-3	10	mg/kg		30	50	10	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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		13	12	6	5	<2
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		3290	3540	5440	3800	1320
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		9	8	<5	<5	<5
Nickel	7440-02-0	2	mg/kg		10	9	<2	<2	<2
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		13	15	38	28	12



Analytical Results

Sub-Matrix: SOIL
 (Matrix: SOIL)

Sample ID

				FROM01-02 3-6m	FROM01-02 6-9m	FROM01-03 0-3m	FROM01-03 3-6m	FROM01-04 0-3m
Sampling date / time				29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit	EB2121646-011	EB2121646-012	EB2121646-013	EB2121646-014	EB2121646-016
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Zinc	7440-66-6	5	mg/kg	<5	<5	<5	<5	<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



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	FROM01-04 3-6m	FROM01-04 6-9m	TSF-01 0m	TSF-01 0-2m	TSF-02 0m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-017	EB2121646-018	EB2121646-019	EB2121646-020	EB2121646-021
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		4.9	5.1	4.4	3.8	4.0
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		<0.5	-0.08	6.4	4.1	5.5
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		71	55	2670	1380	2340
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		5.7	5.4	6.2	5.4	6.1
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		2.6	2.2	0.7	1.0	0.7
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		1.4	1.3	1.9	1.1	1.2
ANC as CaCO3	----	0.1	% CaCO3		0.1	0.1	0.2	0.1	0.1
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		3.2	2.3	3.6	9.3	3.7
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.05	0.04	0.27	0.17	0.22
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		1420	1370	1140	1260	1360
Arsenic	7440-38-2	5	mg/kg		45	63	109	126	123
Barium	7440-39-3	10	mg/kg		30	50	30	20	30
Beryllium	7440-41-7	1	mg/kg		<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		5	9	6	6	7
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	5	5	8
Iron	7439-89-6	50	mg/kg		3890	4850	6290	6990	6360
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		<5	5	17	8	14
Nickel	7440-02-0	2	mg/kg		4	7	<2	<2	<2
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		16	28	10	9	10



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	FROM01-04 3-6m	FROM01-04 6-9m	TSF-01 0m	TSF-01 0-2m	TSF-02 0m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-017	EB2121646-018	EB2121646-019	EB2121646-020	EB2121646-021
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	6
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	0.3	0.6	0.5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	TSF-02 0-2m	TSF-03 0m	TSF-03 0-2m	TSF-04 0m	TSF-04 0-2m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-022	EB2121646-023	EB2121646-024	EB2121646-025	EB2121646-026
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		7.8	4.3	7.7	4.0	4.5
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		<0.5	11.8	2.1	8.5	<0.5
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		396	3840	1160	2430	617
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		6.6	6.7	6.6	6.5	6.6
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		0.4	0.6	0.7	0.7	1.1
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		3.3	1.4	2.5	1.9	3.6
ANC as CaCO3	----	0.1	% CaCO3		0.3	0.1	0.2	0.2	0.4
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		15.3	6.6	14.0	5.3	12.4
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.11	0.43	0.15	0.34	0.12
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		1110	970	1070	1220	1170
Arsenic	7440-38-2	5	mg/kg		118	116	94	108	110
Barium	7440-39-3	10	mg/kg		40	20	50	30	30
Beryllium	7440-41-7	1	mg/kg		<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		6	7	7	8	8
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		7	<5	6	6	6
Iron	7439-89-6	50	mg/kg		5580	5730	5390	6250	6830
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		28	19	23	25	65
Nickel	7440-02-0	2	mg/kg		2	2	2	3	4
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		6	6	5	7	9



Analytical Results

Sub-Matrix: **SOIL**
 (Matrix: **SOIL**)

Sample ID

				TSF-02 0-2m	TSF-03 0m	TSF-03 0-2m	TSF-04 0m	TSF-04 0-2m
Sampling date / time				29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit	EB2121646-022	EB2121646-023	EB2121646-024	EB2121646-025	EB2121646-026
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Zinc	7440-66-6	5	mg/kg	<5	7	<5	5	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	0.6	0.5	1.1	1.0	0.8



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	TSF-05 0m	TSF-05 0-2m	TSF-06 0m	TSF-06 0-2m	TSF-07 0m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-027	EB2121646-028	EB2121646-029	EB2121646-030	EB2121646-031
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		4.7	3.7	9.2	4.1	6.9
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		0.8	4.1	-0.3	-0.7	3.4
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		227	1060	4670	1040	2480
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		6.6	6.0	7.8	6.9	7.8
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		0.8	0.8	<0.1	0.2	<0.1
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		1.6	1.4	7.0	3.5	4.3
ANC as CaCO3	----	0.1	% CaCO3		0.2	0.1	0.7	0.4	0.4
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		2.2	14.5	4.1	13.0	6.1
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.08	0.18	0.22	0.09	0.25
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		710	1270	1500	1220	1500
Arsenic	7440-38-2	5	mg/kg		110	129	146	121	118
Barium	7440-39-3	10	mg/kg		30	20	110	20	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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		9	6	2	6	8
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		5	6	<5	5	7
Iron	7439-89-6	50	mg/kg		6720	6290	6350	6210	6290
Lead	7439-92-1	5	mg/kg		26	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		8	10	7	6	8
Nickel	7440-02-0	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		6	8	8	7	8



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	TSF-05 0m	TSF-05 0-2m	TSF-06 0m	TSF-06 0-2m	TSF-07 0m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-027	EB2121646-028	EB2121646-029	EB2121646-030	EB2121646-031
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		0.5	0.6	0.5	0.7	0.5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	TSF-07 0-2m	TSF-08 0m	TSF-08 0-2m	TSF-09 0m	TSF-09 0-2m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-032	EB2121646-033	EB2121646-034	EB2121646-035	EB2121646-036
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		5.6	4.8	8.7	8.3	8.0
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		1.6	13.2	2.2	9.6	1.3
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		317	1020	520	2770	356
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		6.8	6.9	5.8	6.8	7.5
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		0.4	0.4	1.7	2.8	<0.1
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		1.2	1.5	2.4	6.0	1.8
ANC as CaCO3	----	0.1	% CaCO3		0.1	0.2	0.2	0.6	0.2
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		9.4	6.4	16.4	14.0	16.2
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.09	0.48	0.15	0.51	0.10
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		1210	1350	1260	180	1100
Arsenic	7440-38-2	5	mg/kg		148	124	88	13	112
Barium	7440-39-3	10	mg/kg		20	40	20	<10	30
Beryllium	7440-41-7	1	mg/kg		<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		6	8	8	<2	7
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	6	6	<5	<5
Iron	7439-89-6	50	mg/kg		6250	6670	6250	520	5620
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		<5	10	9	<5	16
Nickel	7440-02-0	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		7	8	8	<5	7



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	TSF-07 0-2m	TSF-08 0m	TSF-08 0-2m	TSF-09 0m	TSF-09 0-2m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-032	EB2121646-033	EB2121646-034	EB2121646-035	EB2121646-036
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		0.4	0.4	1.2	<0.1	0.7



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	TSF-10 0m	TSF-10 0-2m	TSF-11 0m	TSF-11 0-2m	TSF-12 0m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-037	EB2121646-038	EB2121646-039	EB2121646-040	EB2121646-041
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		9.2	4.3	4.2	3.9	4.4
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		-1.3	<0.5	3.0	3.7	10.4
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		2230	828	1190	405	2870
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		8.4	7.0	6.7	6.5	6.8
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	0.2	1.1	1.2	1.0
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		9.6	2.2	1.6	<0.5	1.8
ANC as CaCO3	----	0.1	% CaCO3		1.0	0.2	0.2	<0.1	0.2
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		3.0	15.5	8.7	13.4	12.1
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.27	0.08	0.15	0.12	0.40
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		1280	1080	1450	1320	1920
Arsenic	7440-38-2	5	mg/kg		131	88	121	162	96
Barium	7440-39-3	10	mg/kg		240	40	40	30	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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		<2	6	7	15	7
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	8	6
Iron	7439-89-6	50	mg/kg		6180	5440	7460	10300	5040
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		6	19	8	14	7
Nickel	7440-02-0	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		5	7	14	8	10



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	TSF-10 0m	TSF-10 0-2m	TSF-11 0m	TSF-11 0-2m	TSF-12 0m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-037	EB2121646-038	EB2121646-039	EB2121646-040	EB2121646-041
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		0.1	0.6	0.8	0.4	0.4



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	TSF-12 0-2m	TSF-13 0m	TSF-13 0-2m	TSF-14 0m	TSF-14 0-2m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-042	EB2121646-043	EB2121646-044	EB2121646-045	EB2121646-046
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		4.7	4.4	4.1	8.5	8.9
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		0.6	7.1	1.7	4.3	-4.1
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		362	2610	1450	3030	1420
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		6.6	7.7	6.2	7.4	7.6
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		0.6	<0.1	1.0	<0.1	<0.1
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		2.1	2.1	0.7	6.4	8.4
ANC as CaCO3	----	0.1	% CaCO3		0.2	0.2	<0.1	0.6	0.8
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		15.4	7.6	8.8	20.4	22.5
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.09	0.30	0.08	0.35	0.14
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		1380	1710	1170	1580	1720
Arsenic	7440-38-2	5	mg/kg		119	123	114	114	85
Barium	7440-39-3	10	mg/kg		30	20	30	110	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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		8	9	8	<2	<2
Cobalt	7440-48-4	2	mg/kg		<2	8	<2	<2	<2
Copper	7440-50-8	5	mg/kg		9	20	<5	<5	<5
Iron	7439-89-6	50	mg/kg		6660	6970	6170	4310	3080
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		15	41	<5	7	15
Nickel	7440-02-0	2	mg/kg		2	10	<2	<2	<2
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		9	7	10	<5	<5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	TSF-12 0-2m	TSF-13 0m	TSF-13 0-2m	TSF-14 0m	TSF-14 0-2m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-042	EB2121646-043	EB2121646-044	EB2121646-045	EB2121646-046
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	36	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		0.6	1.7	0.5	0.2	<0.1



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	TSF-15 0m	TSF-15 0-2m	TSF-16 0m	TSF-16 0-2m	TSF-17 0m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-047	EB2121646-048	EB2121646-049	EB2121646-050	EB2121646-051
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		9.1	9.2	8.3	8.7	5.9
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		-3.3	2.3	7.9	7.8	2.9
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		2650	1010	4860	3540	2550
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		7.5	6.4	7.8	7.8	5.3
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	0.9	<0.1	<0.1	1.7
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		8.2	2.0	7.4	7.2	2.9
ANC as CaCO3	----	0.1	% CaCO3		0.8	0.2	0.8	0.7	0.3
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		19.8	22.6	21.8	23.6	4.7
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.16	0.14	0.50	0.49	0.19
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		1800	1890	1870	1640	1190
Arsenic	7440-38-2	5	mg/kg		135	167	122	92	110
Barium	7440-39-3	10	mg/kg		100	100	140	210	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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		<2	2	<2	<2	9
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	8
Iron	7439-89-6	50	mg/kg		5510	6130	4860	3940	5840
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		6	6	7	6	12
Nickel	7440-02-0	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		5	7	5	<5	5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	TSF-15 0m	TSF-15 0-2m	TSF-16 0m	TSF-16 0-2m	TSF-17 0m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-047	EB2121646-048	EB2121646-049	EB2121646-050	EB2121646-051
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		0.1	0.1	0.3	0.1	1.6



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	TSF-17 0-2m	TSF-18 0m	TSF-18 0-2m	TSF-19 0m	TSF-19 0-2m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-052	EB2121646-053	EB2121646-054	EB2121646-055	EB2121646-056
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		8.4	4.3	4.2	9.3	8.1
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		-0.4	7.8	0.9	-0.6	-0.2
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		195	2120	778	2340	1200
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		6.9	6.5	6.8	7.5	7.6
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		0.2	1.0	0.6	<0.1	<0.1
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		2.2	1.7	3.1	5.8	3.6
ANC as CaCO3	----	0.1	% CaCO3		0.2	0.2	0.3	0.6	0.4
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		8.3	3.6	18.4	11.2	13.3
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.06	0.31	0.13	0.17	0.11
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		540	1000	1360	2190	1350
Arsenic	7440-38-2	5	mg/kg		65	97	90	214	120
Barium	7440-39-3	10	mg/kg		30	<10	30	50	110
Beryllium	7440-41-7	1	mg/kg		<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		10	6	7	2	<2
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	6	<5	<5	<5
Iron	7439-89-6	50	mg/kg		5710	4960	7840	10200	4470
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		18	13	11	<5	6
Nickel	7440-02-0	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		8	6	13	10	5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	TSF-17 0-2m	TSF-18 0m	TSF-18 0-2m	TSF-19 0m	TSF-19 0-2m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-052	EB2121646-053	EB2121646-054	EB2121646-055	EB2121646-056
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		0.2	0.3	0.5	0.7	<0.1



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	TSF-20 0m	TSF-20 0-2m	TSF-21 0m	TSF-21 0-2m	TSF-22 0m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-057	EB2121646-058	EB2121646-059	EB2121646-060	EB2121646-061
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		4.3	3.9	4.1	3.9	4.2
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		0.6	4.2	<0.5	0.9	1.0
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		634	378	772	556	917
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		6.5	6.1	6.4	5.9	6.8
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		1.1	0.3	0.4	0.4	<0.1
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		2.2	1.3	2.6	1.5	2.1
ANC as CaCO3	----	0.1	% CaCO3		0.2	0.1	0.3	0.1	0.2
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		2.0	8.8	3.0	9.2	4.4
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.09	0.18	0.10	0.08	0.10
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		590	800	1040	1070	980
Arsenic	7440-38-2	5	mg/kg		76	98	128	98	115
Barium	7440-39-3	10	mg/kg		<10	30	10	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
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		5	5	7	5	15
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	6	<5	9
Iron	7439-89-6	50	mg/kg		4180	5490	6900	5140	6450
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		9	8	20	6	13
Nickel	7440-02-0	2	mg/kg		<2	<2	3	<2	<2
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		<5	7	6	6	6



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	TSF-20 0m	TSF-20 0-2m	TSF-21 0m	TSF-21 0-2m	TSF-22 0m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-057	EB2121646-058	EB2121646-059	EB2121646-060	EB2121646-061
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		0.6	0.5	0.7	0.4	0.9



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	TSF-22 0-2m	TSF-23 0m	TSF-23 0-2m	KNTC WRD01 -01 0-3m	KNTC WRD02 -01 0-6m
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit		EB2121646-062	EB2121646-063	EB2121646-064	EB2121646-065	EB2121646-066
				Result	Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		5.6	4.3	3.7	5.1	8.0
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		-1.0	3.4	1.0	-0.6	-1.2
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		940	1480	1150	65	380
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		7.0	6.6	6.0	6.1	7.1
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	0.3	0.3	1.3	<0.1
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		3.1	2.1	1.4	2.1	3.6
ANC as CaCO3	----	0.1	% CaCO3		0.3	0.2	0.1	0.2	0.4
Fizz Rating	----	0	Fizz Unit		0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		9.4	5.9	8.2	1.8	3.4
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.07	0.18	0.08	0.05	0.08
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		1200	1320	1190	830	840
Arsenic	7440-38-2	5	mg/kg		119	125	98	53	71
Barium	7440-39-3	10	mg/kg		30	20	30	30	30
Beryllium	7440-41-7	1	mg/kg		<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		8	9	7	4	4
Cobalt	7440-48-4	2	mg/kg		<2	2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		6	7	5	<5	<5
Iron	7439-89-6	50	mg/kg		6570	6400	5840	2630	2930
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		15	36	6	<5	<5
Nickel	7440-02-0	2	mg/kg		<2	4	<2	2	4
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		8	6	8	<5	<5



Analytical Results

Sub-Matrix: SOIL
 (Matrix: SOIL)

Sample ID

				TSF-22 0-2m	TSF-23 0m	TSF-23 0-2m	KNTC WRD01 -01 0-3m	KNTC WRD02 -01 0-6m
Sampling date / time				29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit	EB2121646-062	EB2121646-063	EB2121646-064	EB2121646-065	EB2121646-066
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Zinc	7440-66-6	5	mg/kg	<5	7	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	0.6	0.9	0.7	<0.1	<0.1



Analytical Results

Sub-Matrix: SOIL
 (Matrix: SOIL)

Sample ID

				KNTC WRD03 -01 0-4m	KNTC WRD03 -02 0-3m	KNTC FWRD01 -01 0-9m	KNTC HLP01 -01 0-2m	KNTC FROM01-01 0-9m
Sampling date / time				29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit	EB2121646-067	EB2121646-068	EB2121646-069	EB2121646-070	EB2121646-071
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	7.1	5.1	4.0	9.3	4.4
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-1.5	-1.0	1.0	-2.5	0.6
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	190	71	246	58	257
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	6.6	6.8	5.8	7.0	5.3
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	0.4	0.3	0.5	<0.1	1.2
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	3.0	2.2	0.8	3.7	1.2
ANC as CaCO3	----	0.1	% CaCO3	0.3	0.2	<0.1	0.4	0.1
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	3.5	4.2	1.7	5.3	1.3
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.05	0.04	0.06	0.04	0.06
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	1520	1420	1230	490	1880
Arsenic	7440-38-2	5	mg/kg	36	26	12	68	42
Barium	7440-39-3	10	mg/kg	40	70	20	40	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
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	4	3	4	<2	12
Cobalt	7440-48-4	2	mg/kg	<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg	<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg	5630	2160	1960	2610	4990
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg	<5	<5	<5	<5	10
Nickel	7440-02-0	2	mg/kg	<2	2	10	<2	8
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	27	10	7	<5	23



Analytical Results

Sub-Matrix: SOIL
 (Matrix: SOIL)

Sample ID

				KNTC WRD03 -01 0-4m	KNTC WRD03 -02 0-3m	KNTC FWRD01 -01 0-9m	KNTC HLP01 -01 0-2m	KNTC FROM01-01 0-9m
Sampling date / time				29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00
Compound	CAS Number	LOR	Unit	EB2121646-067	EB2121646-068	EB2121646-069	EB2121646-070	EB2121646-071
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Zinc	7440-66-6	5	mg/kg	<5	<5	<5	<5	<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



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	KNTC TSF - 01 0-2m	KNTC TSF - 02 0-2m	KNTC TSF - 03 0-2m	KNTC TSF - 04 0-2m	----
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	----
Compound	CAS Number	LOR	Unit		EB2121646-072	EB2121646-073	EB2121646-074	EB2121646-075	-----
				Result	Result	Result	Result	Result	----
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		3.9	4.3	3.8	5.9	----
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		3.0	3.0	<0.5	-0.6	----
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		453	3060	865	1480	----
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		6.0	6.0	6.6	6.0	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t		<0.1	<0.1	<0.1	<0.1	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t		0.5	0.5	0.2	0.6	----
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		1.3	1.6	2.2	2.4	----
ANC as CaCO3	----	0.1	% CaCO3		0.1	0.2	0.2	0.2	----
Fizz Rating	----	0	Fizz Unit		0	0	0	0	----
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		16.8	6.8	15.9	2.2	----
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.14	0.15	0.08	0.06	----
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		1140	1420	1220	1360	----
Arsenic	7440-38-2	5	mg/kg		100	120	142	105	----
Barium	7440-39-3	10	mg/kg		20	20	30	30	----
Beryllium	7440-41-7	1	mg/kg		<1	<1	<1	<1	----
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	----
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	----
Chromium	7440-47-3	2	mg/kg		4	9	10	10	----
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	----
Copper	7440-50-8	5	mg/kg		<5	11	8	10	----
Iron	7439-89-6	50	mg/kg		5210	7080	7110	7070	----
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	----
Manganese	7439-96-5	5	mg/kg		6	18	<5	11	----
Nickel	7440-02-0	2	mg/kg		<2	2	<2	2	----
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	----
Vanadium	7440-62-2	5	mg/kg		6	7	8	12	----



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	KNTC TSF - 01 0-2m	KNTC TSF - 02 0-2m	KNTC TSF - 03 0-2m	KNTC TSF - 04 0-2m	----
Sampling date / time					29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	29-Jul-2021 00:00	----
Compound	CAS Number	LOR	Unit		EB2121646-072	EB2121646-073	EB2121646-074	EB2121646-075	-----
					Result	Result	Result	Result	----
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	6	<5	7	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		0.8	0.8	0.9	1.0	----

CERTIFICATE OF ANALYSIS

Work Order : **EB2125703**
Client : **C & R CONSULTING PTY LTD**
Contact : MR MATT KNOTT
Address : 188 ROSS RIVER ROAD
AITKENVALE QUEENSLAND 4812
Telephone : +61 07 47253751
Project : 2020.10003 - Solomons Gold Geochemistry
Order number : ----
C-O-C number : ----
Sampler : MATTHEW AYRE
Site : ----
Quote number : TV/110/21 v2
No. of samples received : 3
No. of samples analysed : 3

Page : 1 of 4
Laboratory : Environmental Division Brisbane
Contact : Princess Marcelo
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61-7-3243 7222
Date Samples Received : 09-Sep-2021 11:56
Date Analysis Commenced : 10-Sep-2021
Issue Date : 17-Sep-2021 12:28



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
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Inorganics, Stafford, QLD
Mark Hallas	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 Contact 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.

- EG005T (Total Metals by ICP-AES): Sample (EB2125627_041) shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- 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	Haul-01 0-2m	Haul-02 0-1m	WRD03-10 6-9m	----	----
Sampling date / time					25-Jul-2021 00:00	25-Jul-2021 00:00	25-Jul-2021 00:00	----	----
Compound	CAS Number	LOR	Unit		EB2125703-001	EB2125703-002	EB2125703-003	-----	-----
				Result	Result	Result	Result	----	----
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		9.5	8.6	4.4	----	----
EA009: Net Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		0.9	1.2	1.5	----	----
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		103	154	66	----	----
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		7.0	6.5	5.0	----	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t		<0.1	<0.1	<0.1	----	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t		<0.1	0.7	1.2	----	----
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		<0.5	<0.5	<0.5	----	----
ANC as CaCO3	----	0.1	% CaCO3		<0.1	<0.1	<0.1	----	----
Fizz Rating	----	0	Fizz Unit		0	0	0	----	----
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		3.6	3.3	3.7	----	----
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.03	0.04	0.05	----	----
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		370	530	1060	----	----
Arsenic	7440-38-2	5	mg/kg		44	43	<5	----	----
Barium	7440-39-3	10	mg/kg		40	40	20	----	----
Beryllium	7440-41-7	1	mg/kg		<1	<1	<1	----	----
Boron	7440-42-8	50	mg/kg		<50	<50	<50	----	----
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	----	----
Chromium	7440-47-3	2	mg/kg		<2	<2	<2	----	----
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	----	----
Copper	7440-50-8	5	mg/kg		<5	<5	<5	----	----
Iron	7439-89-6	50	mg/kg		1220	1730	770	----	----
Lead	7439-92-1	5	mg/kg		<5	<5	<5	----	----
Manganese	7439-96-5	5	mg/kg		<5	<5	<5	----	----
Nickel	7440-02-0	2	mg/kg		<2	<2	<2	----	----
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	----	----
Vanadium	7440-62-2	5	mg/kg		<5	<5	6	----	----



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	Haul-01 0-2m	Haul-02 0-1m	WRD03-10 6-9m	----	----
Sampling date / time					25-Jul-2021 00:00	25-Jul-2021 00:00	25-Jul-2021 00:00	----	----
Compound	CAS Number	LOR	Unit		EB2125703-001	EB2125703-002	EB2125703-003	-----	-----
					Result	Result	Result	----	----
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	<0.1	----	----

CLIENT: WULGURU TECHNICAL SERVICES
PROJECT: WIRRALIE GOLD MINE
REPORT: WASTE ROCK CHARACTERISATION
DATE: FEBRUARY 2022



Appendix B – Kinetic Results

CERTIFICATE OF ANALYSIS

Work Order : **EB2128027**
Client : **C & R CONSULTING PTY LTD**
Contact : ALEXANDER BARNES
Address : 188 ROSS RIVER ROAD
AITKENVALE QUEENSLAND 4812
Telephone : ----
Project : Wirralie KLC - Leach 0
Order number : ----
C-O-C number : ----
Sampler : ----
Site : ----
Quote number : TV/110/21 v2
No. of samples received : 11
No. of samples analysed : 11

Page : 1 of 11
Laboratory : Environmental Division Brisbane
Contact : Princess Marcelo
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61-7-3243 7222
Date Samples Received : 05-Oct-2021 11:21
Date Analysis Commenced : 07-Oct-2021
Issue Date : 12-Oct-2021 14:38



Accreditation No. 825
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ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Kim McCabe	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.

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 Contact 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.

- EG035F (Dissolved Mercury): Positive mercury results have been confirmed by re-extraction and re-analysis.
- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- 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: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC WRD01-01 0-3m	KNTC WRD02-01 0-6m	KNTC WRD03-01 0-4m	KNTC WRD03-02 0-3m	KNTC FWRD01-01 0-9m
Sampling date / time				05-Oct-2021 00:00	05-Oct-2021 00:00	05-Oct-2021 00:00	05-Oct-2021 00:00	05-Oct-2021 00:00
Compound	CAS Number	LOR	Unit	EB2128027-001	EB2128027-002	EB2128027-003	EB2128027-004	EB2128027-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	4.46	5.05	6.61	5.10	4.29
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	1030	1400	1880	1460	933
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	670	910	1220	949	606
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	47	180	322	95	134
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	111	100	9	<1
Total Alkalinity as CaCO3	----	1	mg/L	<1	111	100	9	<1
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	68	13	11	20	58
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	9	176	432	279	227
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	68	292	228	235	118
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	4	59	96	28	11
Magnesium	7439-95-4	1	mg/L	9	8	20	6	26
Sodium	7440-23-5	1	mg/L	48	193	234	242	97
Potassium	7440-09-7	1	mg/L	67	8	18	13	19
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	1.16	0.63	0.05	0.36	5.67
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	<0.001	0.018	0.006	0.019	0.004
Boron	7440-42-8	0.05	mg/L	1.22	0.81	0.81	0.86	1.27
Barium	7440-39-3	0.001	mg/L	2.12	0.274	0.128	0.172	0.338
Beryllium	7440-41-7	0.001	mg/L	0.001	<0.001	<0.001	<0.001	0.003
Cadmium	7440-43-9	0.0001	mg/L	0.0005	0.0004	0.0003	0.0005	0.0008
Cobalt	7440-48-4	0.001	mg/L	0.023	0.013	0.011	0.018	0.050
Chromium	7440-47-3	0.001	mg/L	<0.001	0.001	<0.001	<0.001	0.002



Analytical Results

Sub-Matrix: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC WRD01-01 0-3m	KNTC WRD02-01 0-6m	KNTC WRD03-01 0-4m	KNTC WRD03-02 0-3m	KNTC FWRD01-01 0-9m
Sampling date / time				05-Oct-2021 00:00	05-Oct-2021 00:00	05-Oct-2021 00:00	05-Oct-2021 00:00	05-Oct-2021 00:00
Compound	CAS Number	LOR	Unit	EB2128027-001	EB2128027-002	EB2128027-003	EB2128027-004	EB2128027-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Copper	7440-50-8	0.001	mg/L	0.011	0.002	<0.001	0.004	0.016
Manganese	7439-96-5	0.001	mg/L	0.695	0.165	0.466	0.537	0.438
Nickel	7440-02-0	0.001	mg/L	0.445	0.050	0.306	0.536	0.508
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	1.80	1.34	1.14	1.44	1.72
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	7439-89-6	0.05	mg/L	11.2	0.35	0.19	3.38	4.10
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	0.4	0.4	0.5	0.3	1.8



Analytical Results

Sub-Matrix: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC HLP01-01 0-2m	KNTC FROM01-01 0-9m	KNTC TSF-01 0-2m	KNTC TSF-02 0-2m	KNTC TSF-03 0-2m
Sampling date / time				05-Oct-2021 00:00	05-Oct-2021 00:00	05-Oct-2021 00:00	05-Oct-2021 00:00	05-Oct-2021 00:00
Compound	CAS Number	LOR	Unit	EB2128027-006	EB2128027-007	EB2128027-008	EB2128027-009	EB2128027-010
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.82	3.99	3.69	7.39	4.13
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	205	1260	2820	9180	9140
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	133	819	1830	5970	5940
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	25	381	918	1450	1630
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	152	<1	<1	157	<1
Total Alkalinity as CaCO3	----	1	mg/L	152	<1	<1	157	<1
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	198	204	10	189
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	38	556	1540	2480	3070
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	15	38	56	1640	1390
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	10	85	323	529	456
Magnesium	7439-95-4	1	mg/L	<1	41	27	31	119
Sodium	7440-23-5	1	mg/L	31	40	256	1600	1460
Potassium	7440-09-7	1	mg/L	2	10	24	30	55
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.03	28.6	28.9	0.02	23.4
Antimony	7440-36-0	0.001	mg/L	0.002	<0.001	<0.001	0.003	<0.001
Arsenic	7440-38-2	0.001	mg/L	0.122	0.005	0.013	0.004	0.019
Boron	7440-42-8	0.05	mg/L	0.09	0.79	1.12	1.44	2.94
Barium	7440-39-3	0.001	mg/L	0.085	0.332	0.153	0.058	0.072
Beryllium	7440-41-7	0.001	mg/L	<0.001	0.002	0.006	<0.001	0.005
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.0046	0.0069	0.0014	0.0343
Cobalt	7440-48-4	0.001	mg/L	<0.001	0.240	0.184	0.125	0.244
Chromium	7440-47-3	0.001	mg/L	<0.001	0.009	0.018	<0.001	0.012



Analytical Results

Sub-Matrix: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC HLP01-01 0-2m	KNTC FROM01-01 0-9m	KNTC TSF-01 0-2m	KNTC TSF-02 0-2m	KNTC TSF-03 0-2m
Sampling date / time				05-Oct-2021 00:00	05-Oct-2021 00:00	05-Oct-2021 00:00	05-Oct-2021 00:00	05-Oct-2021 00:00
Compound	CAS Number	LOR	Unit	EB2128027-006	EB2128027-007	EB2128027-008	EB2128027-009	EB2128027-010
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Copper	7440-50-8	0.001	mg/L	<0.001	0.003	0.090	0.002	0.098
Manganese	7439-96-5	0.001	mg/L	<0.001	2.80	3.40	1.18	9.45
Nickel	7440-02-0	0.001	mg/L	<0.001	0.775	0.448	0.055	1.54
Lead	7439-92-1	0.001	mg/L	<0.001	0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	0.02	0.03
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	<0.005	2.29	2.00	1.24	4.57
Molybdenum	7439-98-7	0.001	mg/L	0.010	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.015	0.003	0.010
Iron	7439-89-6	0.05	mg/L	<0.05	1.43	0.16	<0.05	0.15
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	0.0002	0.0001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	0.4	1.1	0.7	0.3	0.5



Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)		Sample ID		KNTC TSF-04 0-2m	----	----	----	----
		Sampling date / time		05-Oct-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2128027-011	-----	-----	-----	-----
Result				----	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	4.94	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	1780	----	----	----	----
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	1160	----	----	----	----
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	105	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	<1	----	----	----	----
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	9	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	349	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	341	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	32	----	----	----	----
Magnesium	7439-95-4	1	mg/L	6	----	----	----	----
Sodium	7440-23-5	1	mg/L	304	----	----	----	----
Potassium	7440-09-7	1	mg/L	6	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.22	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	0.004	----	----	----	----
Boron	7440-42-8	0.05	mg/L	0.42	----	----	----	----
Barium	7440-39-3	0.001	mg/L	0.158	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	0.0021	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	0.024	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	0.005	----	----	----	----



Analytical Results

Sub-Matrix: **LEACHATE**
 (Matrix: **WATER**)

Sample ID

				KNTC TSF-04 0-2m	----	----	----	----
Sampling date / time				05-Oct-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2128027-011	-----	-----	-----	-----
Result				----	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Manganese	7439-96-5	0.001	mg/L	0.336	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	0.046	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	0.715	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	----	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	----	----	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	----	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	0.3	----	----	----	----



Analytical Results

Sub-Matrix: SOIL
 (Matrix: SOIL)

Sample ID

				KNTC WRD01-01 0-3m	KNTC WRD02-01 0-6m	KNTC WRD03-01 0-4m	KNTC WRD03-02 0-3m	KNTC FWRD01-01 0-9m
Sampling date / time				05-Oct-2021 00:00	05-Oct-2021 00:00	05-Oct-2021 00:00	05-Oct-2021 00:00	05-Oct-2021 00:00
Compound	CAS Number	LOR	Unit	EB2128027-001	EB2128027-002	EB2128027-003	EB2128027-004	EB2128027-005
				Result	Result	Result	Result	Result
EA047 Free Draining Leach Column								
∅ Initial weight of sample	----	0.001	g	2000	2000	2000	2000	2000
∅ Leachate added	----	0.01	mL	800	800	900	800	900
∅ Leachate collected	----	0.01	mL	350	340	380	360	280
∅ Initial pH	----	0.01	pH Unit	4.57	5.17	6.60	5.20	4.30
∅ Initial Electrical Conductivity	----	1	µS/cm	1070	1420	1890	1480	953



Analytical Results

Sub-Matrix: SOIL
 (Matrix: SOIL)

Sample ID

				KNTC HLP01-01 0-2m	KNTC FROM01-01 0-9m	KNTC TSF-01 0-2m	KNTC TSF-02 0-2m	KNTC TSF-03 0-2m
Sampling date / time				05-Oct-2021 00:00	05-Oct-2021 00:00	05-Oct-2021 00:00	05-Oct-2021 00:00	05-Oct-2021 00:00
Compound	CAS Number	LOR	Unit	EB2128027-006	EB2128027-007	EB2128027-008	EB2128027-009	EB2128027-010
				Result	Result	Result	Result	Result
EA047 Free Draining Leach Column								
∅ Initial weight of sample	----	0.001	g	2000	2000	2000	2000	2000
∅ Leachate added	----	0.01	mL	800	800	800	900	900
∅ Leachate collected	----	0.01	mL	380	410	300	250	350
∅ Initial pH	----	0.01	pH Unit	8.73	3.98	3.62	7.55	4.03
∅ Initial Electrical Conductivity	----	1	µS/cm	215	1280	2870	9410	9330



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	KNTC TSF-04 0-2m	----	----	----	----
			Sampling date / time	05-Oct-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2128027-011	-----	-----	-----	-----
				Result	----	----	----	----
EA047 Free Draining Leach Column								
ø Initial weight of sample	----	0.001	g	2000	----	----	----	----
ø Leachate added	----	0.01	mL	800	----	----	----	----
ø Leachate collected	----	0.01	mL	410	----	----	----	----
ø Initial pH	----	0.01	pH Unit	4.89	----	----	----	----
ø Initial Electrical Conductivity	----	1	µS/cm	1800	----	----	----	----

CERTIFICATE OF ANALYSIS

Work Order : **EB2129795**
Client : **C & R CONSULTING PTY LTD**
Contact : ALEXANDER BARNES
Address : 188 ROSS RIVER ROAD
AITKENVALE QUEENSLAND 4812
Telephone : ----
Project : Wirralie KLC - Leach 1
Order number : ----
C-O-C number : ----
Sampler : ----
Site : ----
Quote number : TV/110/21 v2
No. of samples received : 11
No. of samples analysed : 11

Page : 1 of 11
Laboratory : Environmental Division Brisbane
Contact : Princess Marcelo
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61-7-3243 7222
Date Samples Received : 20-Oct-2021 11:33
Date Analysis Commenced : 20-Oct-2021
Issue Date : 27-Oct-2021 18:54



Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Mark Hallas	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Mark Hallas	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 Contact 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.

- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- 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: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC WRD01-01 0-3m	KNTC WRD02-01 0-6m	KNTC WRD03-01 0-4m	KNTC WRD03-02 0-3m	KNTC FWRD01-01 0-9m
Sampling date / time				20-Oct-2021 00:00	20-Oct-2021 00:00	20-Oct-2021 00:00	20-Oct-2021 00:00	20-Oct-2021 00:00
Compound	CAS Number	LOR	Unit	EB2129795-001	EB2129795-002	EB2129795-003	EB2129795-004	EB2129795-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	5.31	5.51	6.47	5.59	4.84
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	80	72	208	129	52
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	52	47	135	84	34
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	<1	5	19	2	<1
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	4	1	3	1	<1
Total Alkalinity as CaCO3	----	1	mg/L	4	1	3	1	<1
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	6	4	4	4	6
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	17	19	64	32	16
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	2	5	4	10	<1
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	2	6	1	<1
Magnesium	7439-95-4	1	mg/L	<1	<1	1	<1	<1
Sodium	7440-23-5	1	mg/L	6	11	28	21	4
Potassium	7440-09-7	1	mg/L	6	<1	4	2	4
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.02	0.48	<0.01	0.28	0.29
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	0.002	0.004	0.002	0.001	<0.001
Boron	7440-42-8	0.05	mg/L	1.06	0.37	0.56	0.99	0.81
Barium	7440-39-3	0.001	mg/L	0.050	0.030	0.072	0.023	0.047
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	0.002
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001



Analytical Results

Sub-Matrix: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC WRD01-01 0-3m	KNTC WRD02-01 0-6m	KNTC WRD03-01 0-4m	KNTC WRD03-02 0-3m	KNTC FWRD01-01 0-9m
Sampling date / time				20-Oct-2021 00:00	20-Oct-2021 00:00	20-Oct-2021 00:00	20-Oct-2021 00:00	20-Oct-2021 00:00
Compound	CAS Number	LOR	Unit	EB2129795-001	EB2129795-002	EB2129795-003	EB2129795-004	EB2129795-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	0.019	0.008	0.022	0.024	0.021
Nickel	7440-02-0	0.001	mg/L	0.010	0.002	0.013	0.025	0.019
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	0.092	0.059	0.048	0.118	0.129
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.002	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	7439-89-6	0.05	mg/L	0.19	<0.05	<0.05	0.13	0.10
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<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	<0.1	<0.1



Analytical Results

Sub-Matrix: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC HLP01-01 0-2m	KNTC FROM01-01 0-9m	KNTC TSF-01 0-2m	KNTC TSF-02 0-2m	KNTC TSF-03 0-2m
Sampling date / time				20-Oct-2021 00:00	20-Oct-2021 00:00	20-Oct-2021 00:00	20-Oct-2021 00:00	20-Oct-2021 00:00
Compound	CAS Number	LOR	Unit	EB2129795-006	EB2129795-007	EB2129795-008	EB2129795-009	EB2129795-010
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.93	4.07	3.64	6.37	4.06
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	175	580	2090	571	7050
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	114	377	1360	371	4580
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	32	158	808	92	1600
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	46	<1	<1	4	<1
Total Alkalinity as CaCO3	----	1	mg/L	46	<1	<1	4	<1
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	59	147	4	131
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	26	218	1030	122	2780
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	8	9	22	76	855
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	13	37	299	35	476
Magnesium	7439-95-4	1	mg/L	<1	16	15	1	100
Sodium	7440-23-5	1	mg/L	25	18	124	74	1030
Potassium	7440-09-7	1	mg/L	2	6	14	2	46
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	6.64	17.1	<0.01	15.0
Antimony	7440-36-0	0.001	mg/L	0.002	<0.001	<0.001	<0.001	0.002
Arsenic	7440-38-2	0.001	mg/L	0.165	0.001	0.003	0.001	0.017
Boron	7440-42-8	0.05	mg/L	0.34	0.96	1.37	<0.05	4.32
Barium	7440-39-3	0.001	mg/L	0.062	0.056	0.024	0.003	0.043
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.003	<0.001	0.004
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.0018	0.0041	<0.0001	0.0298
Cobalt	7440-48-4	0.001	mg/L	<0.001	0.106	0.122	0.004	0.236
Chromium	7440-47-3	0.001	mg/L	<0.001	0.004	0.008	<0.001	0.007



Analytical Results

Sub-Matrix: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC HLP01-01 0-2m	KNTC FROM01-01 0-9m	KNTC TSF-01 0-2m	KNTC TSF-02 0-2m	KNTC TSF-03 0-2m
Sampling date / time				20-Oct-2021 00:00	20-Oct-2021 00:00	20-Oct-2021 00:00	20-Oct-2021 00:00	20-Oct-2021 00:00
Compound	CAS Number	LOR	Unit	EB2129795-006	EB2129795-007	EB2129795-008	EB2129795-009	EB2129795-010
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Copper	7440-50-8	0.001	mg/L	0.003	<0.001	0.062	<0.001	0.107
Manganese	7439-96-5	0.001	mg/L	0.001	1.35	1.85	0.010	9.17
Nickel	7440-02-0	0.001	mg/L	<0.001	0.494	0.266	<0.001	1.71
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	0.03
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	0.011	1.56	1.72	<0.005	5.41
Molybdenum	7439-98-7	0.001	mg/L	0.013	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	0.002
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.008	<0.001	0.007
Iron	7439-89-6	0.05	mg/L	<0.05	0.07	0.06	<0.05	0.23
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	0.3	0.6	0.6	<0.1	0.5



Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)		Sample ID		KNTC TSF-04 0-2m	----	----	----	----
Sampling date / time		20-Oct-2021 00:00		----	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2129795-011	-----	-----	-----	-----
Result				----	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	4.91	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	806	----	----	----	----
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	524	----	----	----	----
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	70	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	<1	----	----	----	----
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	8	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	190	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	104	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	23	----	----	----	----
Magnesium	7439-95-4	1	mg/L	3	----	----	----	----
Sodium	7440-23-5	1	mg/L	126	----	----	----	----
Potassium	7440-09-7	1	mg/L	3	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.10	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	0.001	----	----	----	----
Boron	7440-42-8	0.05	mg/L	1.06	----	----	----	----
Barium	7440-39-3	0.001	mg/L	0.015	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	0.0008	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	0.015	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	0.003	----	----	----	----



Analytical Results

Sub-Matrix: **LEACHATE**
 (Matrix: **WATER**)

Sample ID

				KNTC TSF-04 0-2m	----	----	----	----
Sampling date / time				20-Oct-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2129795-011	-----	-----	-----	-----
Result				----	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Manganese	7439-96-5	0.001	mg/L	0.149	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	0.023	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	0.466	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	----	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	----	----	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	----	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	----	----	----	----



Analytical Results

Sub-Matrix: SOIL
 (Matrix: SOIL)

Sample ID

				KNTC WRD01-01 0-3m	KNTC WRD02-01 0-6m	KNTC WRD03-01 0-4m	KNTC WRD03-02 0-3m	KNTC FWRD01-01 0-9m
Sampling date / time				20-Oct-2021 00:00	20-Oct-2021 00:00	20-Oct-2021 00:00	20-Oct-2021 00:00	20-Oct-2021 00:00
Compound	CAS Number	LOR	Unit	EB2129795-001	EB2129795-002	EB2129795-003	EB2129795-004	EB2129795-005
				Result	Result	Result	Result	Result
EA047 Free Draining Leach Column								
∅ Leachate added	----	0.01	mL	800	800	800	800	800
∅ Leachate collected	----	0.01	mL	650	680	620	670	670
∅ Initial pH	----	0.01	pH Unit	5.34	5.21	6.41	5.38	4.65
∅ Initial Electrical Conductivity	----	1	µS/cm	82	73	211	129	52



Analytical Results

Sub-Matrix: SOIL
 (Matrix: SOIL)

Sample ID

				KNTC HLP01-01 0-2m	KNTC FROM01-01 0-9m	KNTC TSF-01 0-2m	KNTC TSF-02 0-2m	KNTC TSF-03 0-2m
Sampling date / time				20-Oct-2021 00:00	20-Oct-2021 00:00	20-Oct-2021 00:00	20-Oct-2021 00:00	20-Oct-2021 00:00
Compound	CAS Number	LOR	Unit	EB2129795-006	EB2129795-007	EB2129795-008	EB2129795-009	EB2129795-010
				Result	Result	Result	Result	Result
EA047 Free Draining Leach Column								
∅ Leachate added	----	0.01	mL	800	800	800	800	800
∅ Leachate collected	----	0.01	mL	660	700	700	730	320
∅ Initial pH	----	0.01	pH Unit	8.31	3.98	3.59	6.51	4.04
∅ Initial Electrical Conductivity	----	1	µS/cm	176	578	2070	566	7120



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	KNTC TSF-04 0-2m	----	----	----	----
				Sampling date / time	20-Oct-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EB2129795-011	-----	-----	-----	-----
					Result	----	----	----	----
EA047 Free Draining Leach Column									
ø Leachate added	----	0.01	mL		800	----	----	----	----
ø Leachate collected	----	0.01	mL		650	----	----	----	----
ø Initial pH	----	0.01	pH Unit		4.68	----	----	----	----
ø Initial Electrical Conductivity	----	1	µS/cm		800	----	----	----	----

CERTIFICATE OF ANALYSIS

Work Order : **EB2131161**
Client : **C & R CONSULTING PTY LTD**
Contact : ALEXANDER BARNES
Address : 188 ROSS RIVER ROAD
AITKENVALE QUEENSLAND 4812
Telephone : ----
Project : Wirralie KLC - Leach 2
Order number : ----
C-O-C number : ----
Sampler : ----
Site : ----
Quote number : TV/110/21 v2
No. of samples received : 11
No. of samples analysed : 11

Page : 1 of 11
Laboratory : Environmental Division Brisbane
Contact : Princess Marcelo
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61-7-3243 7222
Date Samples Received : 02-Nov-2021 11:40
Date Analysis Commenced : 03-Nov-2021
Issue Date : 19-Nov-2021 14:55



Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
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.

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 Contact 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.

- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- 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: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC WRD01-01 0-3m	KNTC WRD02-01 0-6m	KNTC WRD03-01 0-4m	KNTC WRD03-02 0-3m	KNTC FWRD01-01 0-9m
Sampling date / time				02-Nov-2021 00:00	02-Nov-2021 00:00	02-Nov-2021 00:00	02-Nov-2021 00:00	02-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2131161-001	EB2131161-002	EB2131161-003	EB2131161-004	EB2131161-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	5.36	5.11	6.56	5.57	4.81
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	58	46	86	87	25
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	38	30	56	56	16
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	<1	2	5	<1	<1
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	3	<1	<1
Total Alkalinity as CaCO3	----	1	mg/L	<1	<1	3	<1	<1
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	6	4	4	4	4
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	13	11	28	21	6
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	2	3	1	7	<1
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	1	2	<1	<1
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	<1
Sodium	7440-23-5	1	mg/L	4	6	11	14	2
Potassium	7440-09-7	1	mg/L	4	<1	2	1	2
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.06	0.39	0.01	0.07	0.42
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	0.001	0.002	0.002	0.001	<0.001
Boron	7440-42-8	0.05	mg/L	1.35	0.24	0.40	0.85	0.22
Barium	7440-39-3	0.001	mg/L	0.043	0.024	0.077	0.026	0.027
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001



Analytical Results

Sub-Matrix: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC WRD01-01 0-3m	KNTC WRD02-01 0-6m	KNTC WRD03-01 0-4m	KNTC WRD03-02 0-3m	KNTC FWRD01-01 0-9m
Sampling date / time				02-Nov-2021 00:00	02-Nov-2021 00:00	02-Nov-2021 00:00	02-Nov-2021 00:00	02-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2131161-001	EB2131161-002	EB2131161-003	EB2131161-004	EB2131161-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	0.012	0.006	0.005	0.016	0.012
Nickel	7440-02-0	0.001	mg/L	0.006	0.002	0.005	0.016	0.010
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	0.066	0.027	0.022	0.079	0.026
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.003	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<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	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.2	<0.1	<0.1



Analytical Results

Sub-Matrix: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC HLP01-01 0-2m	KNTC FROM01-01 0-9m	KNTC TSF-01 0-2m	KNTC TSF-02 0-2m	KNTC TSF-03 0-2m
Sampling date / time				02-Nov-2021 00:00	02-Nov-2021 00:00	02-Nov-2021 00:00	02-Nov-2021 00:00	02-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2131161-006	EB2131161-007	EB2131161-008	EB2131161-009	EB2131161-010
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	8.04	4.16	3.70	5.91	4.12
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	119	295	1360	110	3160
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	77	192	884	72	----
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	30	73	572	10	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	38	<1	<1	1	----
Total Alkalinity as CaCO3	----	1	mg/L	38	<1	<1	1	----
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	2	25	77	4	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	11	104	720	19	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	3	2	6	15	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	12	16	216	4	----
Magnesium	7439-95-4	1	mg/L	<1	8	8	<1	----
Sodium	7440-23-5	1	mg/L	13	8	46	16	----
Potassium	7440-09-7	1	mg/L	1	4	8	<1	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	2.06	8.92	<0.01	4.99
Antimony	7440-36-0	0.001	mg/L	0.002	<0.001	<0.001	<0.001	0.002
Arsenic	7440-38-2	0.001	mg/L	0.163	0.001	0.001	0.001	0.006
Boron	7440-42-8	0.05	mg/L	0.50	1.04	1.29	<0.05	1.70
Barium	7440-39-3	0.001	mg/L	0.093	0.068	0.026	0.002	0.034
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.002	<0.001	0.002
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.0006	0.0018	<0.0001	0.0108
Cobalt	7440-48-4	0.001	mg/L	<0.001	0.046	0.056	<0.001	0.102
Chromium	7440-47-3	0.001	mg/L	<0.001	0.002	0.004	<0.001	0.003



Analytical Results

Sub-Matrix: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC HLP01-01 0-2m	KNTC FROM01-01 0-9m	KNTC TSF-01 0-2m	KNTC TSF-02 0-2m	KNTC TSF-03 0-2m
Sampling date / time				02-Nov-2021 00:00	02-Nov-2021 00:00	02-Nov-2021 00:00	02-Nov-2021 00:00	02-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2131161-006	EB2131161-007	EB2131161-008	EB2131161-009	EB2131161-010
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.036	<0.001	0.049
Manganese	7439-96-5	0.001	mg/L	<0.001	0.703	0.952	0.002	3.79
Nickel	7440-02-0	0.001	mg/L	<0.001	0.288	0.140	<0.001	0.860
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	0.01
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	<0.005	0.990	1.15	<0.005	1.96
Molybdenum	7439-98-7	0.001	mg/L	0.008	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.004	<0.001	0.003
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<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	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	0.3	0.2	0.4	<0.1	----



Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)		Sample ID		KNTC TSF-04 0-2m	----	----	----	----
		Sampling date / time		02-Nov-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2131161-011	-----	-----	-----	-----
				Result	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	4.76	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	709	----	----	----	----
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	461	----	----	----	----
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	67	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	<1	----	----	----	----
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	9	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	176	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	86	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	22	----	----	----	----
Magnesium	7439-95-4	1	mg/L	3	----	----	----	----
Sodium	7440-23-5	1	mg/L	109	----	----	----	----
Potassium	7440-09-7	1	mg/L	3	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.09	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	----	----	----	----
Boron	7440-42-8	0.05	mg/L	1.18	----	----	----	----
Barium	7440-39-3	0.001	mg/L	0.015	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	0.0004	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	0.013	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	0.003	----	----	----	----



Analytical Results

Sub-Matrix: **LEACHATE**
 (Matrix: **WATER**)

Sample ID

				KNTC TSF-04 0-2m	----	----	----	----
Sampling date / time				02-Nov-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2131161-011	-----	-----	-----	-----
Result				----	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Manganese	7439-96-5	0.001	mg/L	0.133	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	0.022	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	0.488	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	----	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	----	----	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	----	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	----	----	----	----



Analytical Results

Sub-Matrix: SOIL
 (Matrix: SOIL)

Sample ID

				KNTC WRD01-01 0-3m	KNTC WRD02-01 0-6m	KNTC WRD03-01 0-4m	KNTC WRD03-02 0-3m	KNTC FWRD01-01 0-9m
Sampling date / time				02-Nov-2021 00:00	02-Nov-2021 00:00	02-Nov-2021 00:00	02-Nov-2021 00:00	02-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2131161-001	EB2131161-002	EB2131161-003	EB2131161-004	EB2131161-005
				Result	Result	Result	Result	Result
EA047 Free Draining Leach Column								
∅ Leachate added	----	0.01	mL	800	800	800	800	800
∅ Leachate collected	----	0.01	mL	670	680	660	670	660
∅ Initial pH	----	0.01	pH Unit	5.73	5.21	6.40	5.37	4.60
∅ Initial Electrical Conductivity	----	1	µS/cm	61	46	86	84	25



Analytical Results

Sub-Matrix: SOIL
 (Matrix: SOIL)

Sample ID

				KNTC HLP01-01 0-2m	KNTC FROM01-01 0-9m	KNTC TSF-01 0-2m	KNTC TSF-02 0-2m	KNTC TSF-03 0-2m
Sampling date / time				02-Nov-2021 00:00	02-Nov-2021 00:00	02-Nov-2021 00:00	02-Nov-2021 00:00	02-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2131161-006	EB2131161-007	EB2131161-008	EB2131161-009	EB2131161-010
				Result	Result	Result	Result	Result
EA047 Free Draining Leach Column								
∅ Leachate added	----	0.01	mL	800	800	800	800	800
∅ Leachate collected	----	0.01	mL	670	690	680	750	380
∅ Initial pH	----	0.01	pH Unit	8.03	4.11	3.71	6.11	3.98
∅ Initial Electrical Conductivity	----	1	µS/cm	117	290	1320	110	3340



Analytical Results

Sub-Matrix: **SOIL**
 (Matrix: **SOIL**)

Sample ID

				KNTC TSF-04 0-2m	----	----	----	----
				Sampling date / time	02-Nov-2021 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EB2131161-011	-----	-----	-----	-----
				Result	----	----	----	----
EA047 Free Draining Leach Column								
ø Leachate added	----	0.01	mL	800	----	----	----	----
ø Leachate collected	----	0.01	mL	660	----	----	----	----
ø Initial pH	----	0.01	pH Unit	4.68	----	----	----	----
ø Initial Electrical Conductivity	----	1	µS/cm	697	----	----	----	----

CERTIFICATE OF ANALYSIS

Work Order : **EB2133060**
Client : **C & R CONSULTING PTY LTD**
Contact : ALEXANDER BARNES
Address : 188 ROSS RIVER ROAD
AITKENVALE QUEENSLAND 4812
Telephone : ----
Project : Wirralie KLC - Leach 3
Order number : ----
C-O-C number : ----
Sampler : ----
Site : ----
Quote number : TV/110/21 v2
No. of samples received : 10
No. of samples analysed : 10

Page : 1 of 7
Laboratory : Environmental Division Brisbane
Contact : Princess Marcelo
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61-7-3243 7222
Date Samples Received : 17-Nov-2021 11:50
Date Analysis Commenced : 18-Nov-2021
Issue Date : 24-Nov-2021 13:58



Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Kim McCabe	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.

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 Contact 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.

- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- 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: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC WRD01-01 0-3m	KNTC WRD02-01 0-6m	KNTC WRD03-01 0-4m	KNTC WRD03-02 0-3m	KNTC FWRD01-01 0-9m
Sampling date / time				17-Nov-2021 00:00	17-Nov-2021 00:00	17-Nov-2021 00:00	17-Nov-2021 00:00	17-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2133060-001	EB2133060-002	EB2133060-003	EB2133060-004	EB2133060-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	6.23	5.34	6.29	5.46	4.81
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	42	42	64	52	26
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	27	27	42	34	17
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	<1	2	2	<1	<1
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	4	<1	2	<1	<1
Total Alkalinity as CaCO3	----	1	mg/L	4	<1	2	<1	<1
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	4	3	3	3	4
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	10	10	18	12	6
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<1	2	<1	3	<1
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	1	1	<1	<1
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	<1
Sodium	7440-23-5	1	mg/L	3	6	8	8	2
Potassium	7440-09-7	1	mg/L	3	<1	2	1	2
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.22	<0.01	0.05	0.21	0.01
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	0.004	0.002	0.004	0.002	<0.001
Boron	7440-42-8	0.05	mg/L	0.83	0.18	0.33	0.42	0.21
Barium	7440-39-3	0.001	mg/L	0.026	0.019	0.051	0.021	0.019
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001



Analytical Results

Sub-Matrix: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC WRD01-01 0-3m	KNTC WRD02-01 0-6m	KNTC WRD03-01 0-4m	KNTC WRD03-02 0-3m	KNTC FWRD01-01 0-9m
Sampling date / time				17-Nov-2021 00:00	17-Nov-2021 00:00	17-Nov-2021 00:00	17-Nov-2021 00:00	17-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2133060-001	EB2133060-002	EB2133060-003	EB2133060-004	EB2133060-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	0.008	0.005	0.003	0.009	0.011
Nickel	7440-02-0	0.001	mg/L	0.004	0.001	0.003	0.008	0.009
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	0.030	0.014	0.014	0.029	0.019
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.002	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<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	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.1	<0.1	<0.1



Analytical Results

Sub-Matrix: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC HLP01-01 0-2m	KNTC FROM01-01 0-9m	KNTC TSF-01 0-2m	KNTC TSF-02 0-2m	KNTC TSF-04 0-2m
Sampling date / time				17-Nov-2021 00:00	17-Nov-2021 00:00	17-Nov-2021 00:00	17-Nov-2021 00:00	17-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2133060-006	EB2133060-007	EB2133060-008	EB2133060-009	EB2133060-011
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.74	4.48	3.72	5.72	4.65
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	107	188	1030	270	704
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	70	122	670	176	458
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	30	39	430	27	65
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	36	<1	<1	1	<1
Total Alkalinity as CaCO3	----	1	mg/L	36	<1	<1	1	<1
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	2	13	43	3	8
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	6	65	496	51	172
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	1	<1	3	38	69
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	12	9	164	11	21
Magnesium	7439-95-4	1	mg/L	<1	4	5	<1	3
Sodium	7440-23-5	1	mg/L	8	5	24	36	105
Potassium	7440-09-7	1	mg/L	1	3	6	1	3
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	0.85	4.51	<0.01	0.44
Antimony	7440-36-0	0.001	mg/L	0.002	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	0.171	0.001	0.002	0.002	0.002
Boron	7440-42-8	0.05	mg/L	0.67	0.71	1.11	0.06	1.22
Barium	7440-39-3	0.001	mg/L	0.151	0.079	0.028	0.007	0.021
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.0005	0.0013	<0.0001	0.0006
Cobalt	7440-48-4	0.001	mg/L	<0.001	0.025	0.035	0.002	0.012
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.002	<0.001	<0.001



Analytical Results

Sub-Matrix: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC HLP01-01 0-2m	KNTC FROM01-01 0-9m	KNTC TSF-01 0-2m	KNTC TSF-02 0-2m	KNTC TSF-04 0-2m
Sampling date / time				17-Nov-2021 00:00	17-Nov-2021 00:00	17-Nov-2021 00:00	17-Nov-2021 00:00	17-Nov-2021 00:00
Compound	CAS Number	LOR	Unit	EB2133060-006	EB2133060-007	EB2133060-008	EB2133060-009	EB2133060-011
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.026	<0.001	0.004
Manganese	7439-96-5	0.001	mg/L	<0.001	0.415	0.620	0.002	0.123
Nickel	7440-02-0	0.001	mg/L	<0.001	0.165	0.090	<0.001	0.020
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	<0.005	0.615	0.956	<0.005	0.481
Molybdenum	7439-98-7	0.001	mg/L	0.006	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.003	<0.001	<0.001
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	0.08
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	0.3	0.2	0.3	<0.1	<0.1



Analytical Results

Sub-Matrix: **SOIL**
 (Matrix: **SOIL**)

Sample ID

				KNTC TSF-01 0-2m	KNTC TSF-02 0-2m	KNTC TSF-04 0-2m	----	----
Sampling date / time				17-Nov-2021 00:00	17-Nov-2021 00:00	17-Nov-2021 00:00	----	----
Compound	CAS Number	LOR	Unit	EB2133060-008	EB2133060-009	EB2133060-011	-----	-----
				Result	Result	Result	----	----
EA047 Free Draining Leach Column								
ø Leachate added	----	0.01	mL	800	800	800	----	----
ø Leachate collected	----	0.01	mL	460	700	630	----	----
ø Initial pH	----	0.01	pH Unit	3.81	6.34	4.79	----	----
ø Initial Electrical Conductivity	----	1	µS/cm	1080	282	730	----	----

CERTIFICATE OF ANALYSIS

Work Order	: EB2134748	Page	: 1 of 8
Amendment	: 1		
Client	: C & R CONSULTING PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: ALEXANDER BARNES	Contact	: Princess Marcelo
Address	: 188 ROSS RIVER ROAD AITKENVALE QUEENSLAND 4812	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Wirralie KLC - Leach 4	Date Samples Received	: 01-Dec-2021 12:05
Order number	: ----	Date Analysis Commenced	: 01-Dec-2021
C-O-C number	: ----	Issue Date	: 24-Jan-2022 15:12
Sampler	: ----		
Site	: ----		
Quote number	: TV/110/21 v2		
No. of samples received	: 10		
No. of samples analysed	: 10		



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.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Mark Hallas	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Mark Hallas	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 Contact 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.

- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- 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: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC WRD01-01 0-3m	KNTC WRD02-01 0-6m	KNTC WRD03-01 0-4m	KNTC WRD03-02 0-3m	KNTC FWRD01-01 0-9m
Sampling date / time				01-Dec-2021 00:00	01-Dec-2021 00:00	01-Dec-2021 00:00	01-Dec-2021 00:00	01-Dec-2021 00:00
Compound	CAS Number	LOR	Unit	EB2134748-001	EB2134748-002	EB2134748-003	EB2134748-004	EB2134748-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	5.81	4.95	6.39	5.46	4.79
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	34	39	56	45	23
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	22	25	36	29	15
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	<1	2	<1	<1	<1
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	1	<1	3	1	1
Total Alkalinity as CaCO3	----	1	mg/L	1	<1	3	1	1
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	3	3	3	3	3
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	9	10	15	11	6
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<1	2	<1	3	<1
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	1	<1	<1	<1
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	<1
Sodium	7440-23-5	1	mg/L	2	5	7	7	1
Potassium	7440-09-7	1	mg/L	2	<1	1	<1	1
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.06	<0.01	0.03	0.10	0.18
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	0.002	0.001	0.002	0.001	<0.001
Boron	7440-42-8	0.05	mg/L	0.91	0.27	0.36	0.49	0.26
Barium	7440-39-3	0.001	mg/L	0.022	0.018	0.038	0.019	0.017
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001



Analytical Results

Sub-Matrix: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC WRD01-01 0-3m	KNTC WRD02-01 0-6m	KNTC WRD03-01 0-4m	KNTC WRD03-02 0-3m	KNTC FWRD01-01 0-9m
Sampling date / time				01-Dec-2021 00:00	01-Dec-2021 00:00	01-Dec-2021 00:00	01-Dec-2021 00:00	01-Dec-2021 00:00
Compound	CAS Number	LOR	Unit	EB2134748-001	EB2134748-002	EB2134748-003	EB2134748-004	EB2134748-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	0.006	0.005	0.002	0.008	0.009
Nickel	7440-02-0	0.001	mg/L	0.003	0.001	0.003	0.008	0.007
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	0.030	0.017	0.019	0.029	0.018
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.002	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<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	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1



Analytical Results

Sub-Matrix: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC HLP01-01 0-2m	KNTC FROM01-01 0-9m	KNTC TSF-01 0-2m	KNTC TSF-02 0-2m	KNTC TSF-04 0-2m
Sampling date / time				01-Dec-2021 00:00	01-Dec-2021 00:00	01-Dec-2021 00:00	01-Dec-2021 00:00	01-Dec-2021 00:00
Compound	CAS Number	LOR	Unit	EB2134748-006	EB2134748-007	EB2134748-008	EB2134748-009	EB2134748-010
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.90	4.31	3.73	6.01	4.78
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	106	153	729	306	515
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	69	99	474	199	335
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	32	30	300	37	51
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	48	<1	<1	2	<1
Total Alkalinity as CaCO3	----	1	mg/L	48	<1	<1	2	<1
ED038: Acidity								
Acidity as CaCO3	----	1	mg/L	2	10	27	3	5
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	6	51	338	56	136
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<1	<1	1	35	40
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	13	7	115	15	17
Magnesium	7439-95-4	1	mg/L	<1	3	3	<1	2
Sodium	7440-23-5	1	mg/L	7	4	14	40	75
Potassium	7440-09-7	1	mg/L	1	3	5	<1	2
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	1.03	2.90	<0.01	0.62
Antimony	7440-36-0	0.001	mg/L	0.002	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	0.163	0.002	0.001	0.001	0.002
Boron	7440-42-8	0.05	mg/L	0.87	0.77	1.00	<0.05	1.09
Barium	7440-39-3	0.001	mg/L	0.188	0.080	0.029	0.008	0.018
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.0004	0.0008	<0.0001	0.0004
Cobalt	7440-48-4	0.001	mg/L	<0.001	0.019	0.021	0.002	0.008
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.001	<0.001	<0.001



Analytical Results

Sub-Matrix: LEACHATE
 (Matrix: WATER)

Sample ID

				KNTC HLP01-01 0-2m	KNTC FROM01-01 0-9m	KNTC TSF-01 0-2m	KNTC TSF-02 0-2m	KNTC TSF-04 0-2m
Sampling date / time				01-Dec-2021 00:00	01-Dec-2021 00:00	01-Dec-2021 00:00	01-Dec-2021 00:00	01-Dec-2021 00:00
Compound	CAS Number	LOR	Unit	EB2134748-006	EB2134748-007	EB2134748-008	EB2134748-009	EB2134748-010
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.018	<0.001	0.003
Manganese	7439-96-5	0.001	mg/L	<0.001	0.333	0.378	0.001	0.086
Nickel	7440-02-0	0.001	mg/L	<0.001	0.144	0.056	<0.001	0.014
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	<0.005	0.556	0.735	<0.005	0.368
Molybdenum	7439-98-7	0.001	mg/L	0.005	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.002	<0.001	<0.001
Iron	7439-89-6	0.05	mg/L	<0.05	0.06	<0.05	<0.05	0.09
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	0.2	0.1	0.2	<0.1	<0.1



Analytical Results

Sub-Matrix: SOIL
 (Matrix: SOIL)

Sample ID

				KNTC WRD01-01 0-3m	KNTC WRD02-01 0-6m	KNTC WRD03-01 0-4m	KNTC WRD03-02 0-3m	KNTC FWRD01-01 0-9m
Sampling date / time				01-Dec-2021 00:00	01-Dec-2021 00:00	01-Dec-2021 00:00	01-Dec-2021 00:00	01-Dec-2021 00:00
Compound	CAS Number	LOR	Unit	EB2134748-001	EB2134748-002	EB2134748-003	EB2134748-004	EB2134748-005
				Result	Result	Result	Result	Result
EA047 Free Draining Leach Column								
∅ Leachate added	----	0.01	mL	800	800	800	800	800
∅ Leachate collected	----	0.01	mL	680	710	690	680	660
∅ Initial pH	----	0.01	pH Unit	5.42	4.97	6.21	5.49	4.78
∅ Initial Electrical Conductivity	----	1	µS/cm	35	38	53	44	22



Analytical Results

Sub-Matrix: SOIL
 (Matrix: SOIL)

Sample ID

				KNTC HLP01-01 0-2m	KNTC FROM01-01 0-9m	KNTC TSF-01 0-2m	KNTC TSF-02 0-2m	KNTC TSF-04 0-2m
Sampling date / time				01-Dec-2021 00:00	01-Dec-2021 00:00	01-Dec-2021 00:00	01-Dec-2021 00:00	01-Dec-2021 00:00
Compound	CAS Number	LOR	Unit	EB2134748-006	EB2134748-007	EB2134748-008	EB2134748-009	EB2134748-010
				Result	Result	Result	Result	Result
EA047 Free Draining Leach Column								
∅ Leachate added	----	0.01	mL	800	800	800	800	800
∅ Leachate collected	----	0.01	mL	660	660	690	670	710
∅ Initial pH	----	0.01	pH Unit	7.79	4.31	3.82	6.16	4.84
∅ Initial Electrical Conductivity	----	1	µS/cm	104	150	710	292	498

Appendix H: AGE (2023) Hydrogeology Report



Australasian
Groundwater
& Environmental
Consultants

Report on

Wirralie Gold Mine Progressive Rehabilitation and Closure Plan Hydrogeological Report

Prepared for
Wulguru Technical Services

Project No. WIR5000.001
December 2023

ageconsultants.com.au

ABN 64 080 238 642

Document details and history



Document details

Project number	WIR5000.001
Document title	Wirralie Gold Mine Progressive Rehabilitation and Closure Plan Hydrogeological Report.
Site address	Mount Coolon, Queensland.
File name	WIR5000.001_PRCP_hydrogeology_report_v01.02.docx

Document status and review

Edition	Comments	Author	Authorised by	Date
v01.01	Draft for internal review	CP/LC	CP	27/11/2023
v01.02	Draft for release to client	CP/LC	CP	13/12/2023

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Wirralie Gold Mine Progressive Rehabilitation and Closure Plan Hydrogeological Report

1 Introduction

Solomons Mine Pty Ltd (Solomons) is the owner of Wirralie Gold Mine (Wirralie), located approximately 200 km west of Mackay in North Queensland. The operation consists of four small open cut pits and an ore processing facility that uses a cyanide heap leach circuit. Wirralie operates on mining lease ML1079, subject to conditions set out under Environmental Authority (EA) number EPML00772413.

The Environmental Protection Act 1994 was amended in November 2019 to require new and existing mining operations, such as Wirralie, to actively commit to and implement a Progressive Rehabilitation and Closure Plan (PRCP). The PRCP guidelines (DES, 2023) sets out the types of information needed to fulfil this requirement. A key scope item of the PRCP guidelines is a hydrogeological report.

Wulguru Technical Services (WTS) on behalf of Solomons have asked Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) to prepare this report to conform to the hydrogeology assessment components of the PRCP guidelines (DES, 2023).

2 PRCP guidelines for hydrogeology

The following is an excerpt from the PRCP guidelines (DES, 2023) that outlines the expectations regarding rehabilitation items for groundwater. These guidelines inform the content and structure of this report, which is described further in Section 3.

This section [of the guideline] outlines the range of information that the administering authority considers is necessary to underpin the development of the rehabilitation or management methodologies applicable to new and existing mines for most domains. [...]

The hydrogeology assessment should: *Assess the hydrogeology of the site and all connected strata, and develop a conceptual model of the mine site's groundwater systems. This information must be integrated into the designing of rehabilitation strategies and choice of PMLU (post -mining land use) or NUMA (non-use management area).*

The hydrogeological assessment should include the following steps:

- *determining the groundwater occurrence including the existence of, and depth to, aquifers and aquitards;*
- *locating groundwater recharge and discharge locations locally and regionally;*
- *groundwater quality within each of the aquifers and from surface expressions (i.e. seeps and springs);*
- *current and potential future uses of groundwater including existing groundwater extraction bores;*
- *groundwater flow direction and velocity, including field tests to determine hydraulic conductivity;*
- *the development of potentiometric mapping and hydro stratigraphic cross sections; and*
- *groundwater modelling to determine contaminant transport and potential changes to groundwater level from dewatering or waste storage.*

The prediction of water quality impacts from mining activities is necessary to determine appropriate measures for the containment and management of contaminants and the potential impacts on environmental values should they be released.

The PRCP guidelines (DES, 2023) also require the following regarding Water Management:

- *source, pathway and fate of contaminants that have the potential to impact environmental values.*

Further modelling for mine voids, including open-cut pits, is specified as follows:

- *void hydrology, addressing the long-term water balance and water level in the voids, stratification, connections to groundwater resources and potential for overflow; and*
- *groundwater modelling to determine whether the void is acting as a sink or a source for groundwater.*

Therefore, the PRCP guidelines (DES, 2023) state that groundwater modelling is necessary to: “determine contaminant transport and potential changes to groundwater level from dewatering or waste storage” and “determine whether the void is acting as a sink or a source for groundwater”. The industry definition of modelling in groundwater studies is very broad, and it is not constrained by the glossary of the guideline. As such, a range of numerical, analytical, and geochemical models could fulfil the PRCP requirements, so long as the work provides sound predictions of groundwater and contaminant behaviour to inform management decision making.

3 Objectives and report structure

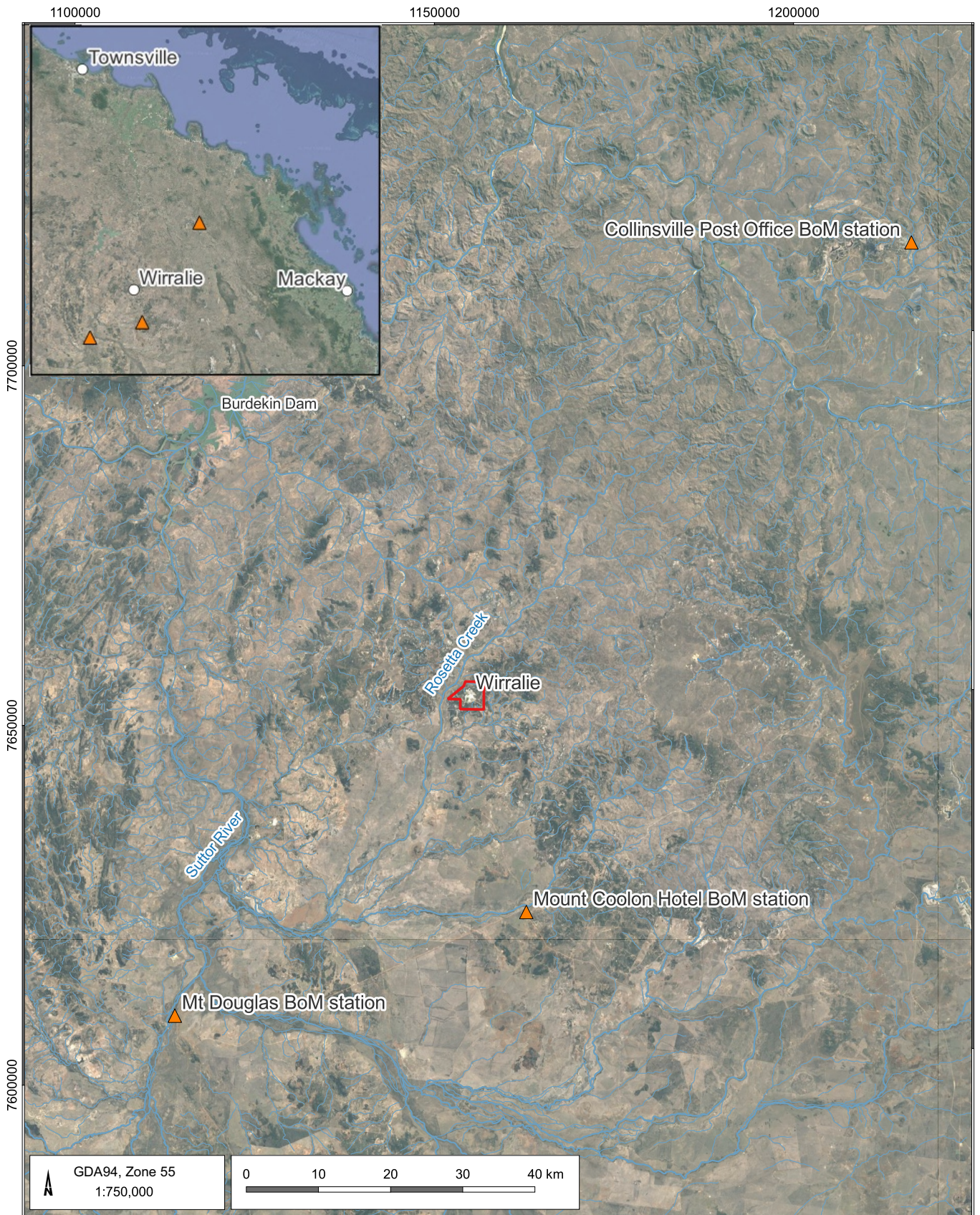
The objective of this report is to deliver a hydrogeological assessment that provides confidence to Solomons and DES that the proposed rehabilitation strategies for ML1079 are appropriate for achieving the closure criteria outlined in Section 2. This report fulfils requirements of the PRCP guidelines (DES, 2023) to the degree to which the data allow; the key information for each of the requirements is summarised at the end of this report.

The structure of this report is as follows:

- introduction – An overview of the Project and a summary of information;
- PRCP guidelines for hydrogeology – An overview of the guidelines, which inform the report structure;
- objectives and report structure;
- project setting – An overview of the climate and topography of the Project;
- site infrastructure and potential sources of impacts;
- geology;
- hydrogeological cross-sections;
- hydrostratigraphic units (aquifers and aquitards), including a summary of hydraulic properties;
- groundwater levels (with potentiometric mapping);
- groundwater recharge and discharge;
- groundwater quality;
- groundwater flow and velocity;
- void groundwater status and modelling;
- groundwater Environmental Values (groundwater users);
- conceptual hydrogeological model (cross section) in closure;
- impact assessment (source, pathway and fate analysis); and
- summary – a summary of the key information against the PRCP requirements (DES, 2023).

4 Project Setting

Wirralie is located approximately 30 km north of Mount Coolon, within the Whitsunday Regional Council Local Government Area (Figure 4.1). The Project area sits west of the Great Dividing Range, is classified as a hot semi-arid climate under the Köppen climate classification; it has distinct wet and dry seasons. The Wirralie mine is located on a generally flat ridge between the southeastern side of Rosetta Creek and the north side of Bungobine Creek. It lies within the Burdekin drainage basin and the Suttor River sub-basin.



LEGEND

- Mining Lease
- ▲ Bureau of Meteorology (BoM) station
- Drainage**
 - Major drainage
 - Minor drainage

Wirralie Permeability Testing and Progressive Rehabilitation and Closure Plan (WIR5000.001)

Project Location



AGE

DATE
20/10/2023

FIGURE No:
4.1

4.1 Climate

The climate of the area is hot, seasonally arid, and tropical; it is dominated by intense rainfall events during the summer months, with average annual pan evaporation significantly exceeding annual rainfall. Evaporation is primarily temperature dependent, peaking in summer months. The dry season is typically from April to November, with the wettest months generally being January and February.

The closest operational Bureau of Meteorology (BoM) climate station is located approximately 85km northeast of Wirralie at the Collinsville Post Office (Station 33013) (Figure 4.1). Rainfall data collection begun in 1939 (99% complete) and temperature recording begun in 1955 (85.4% complete). The mean annual rainfall is 701.9 mm and is observed to be highest in January and February (>135mm) and lowest in September (mean 11.4mm). Coinciding with summer wet season, the mean maximum temperature peaks in December (34.2°C) and is lowest in June and July (25.3°C and 25.1°C). The mean minimum monthly temperature is 21.7°C for the December to February period, and 10.1°C for June through to August.

Closer to the Project area (approximately 50 km southwest), and with the longest continuous historical rainfall records, is the Mount Douglas rainfall station (Station 34022) (Figure 4.1). Mount Douglas Station has recorded monthly rainfall over most of the period from 1912 to 2020 (94% complete) and has notable data gaps between January 1925 to December 1928 and from February 2017. The average annual rainfall for Mount Douglas is 586 mm/yr, with rainfall typically highest in January and February (>100 mm) and lowest in September (<15 mm).

Rainfall was also measured approximately 30km south of Wirralie at the Mount Coolon Hotel (Station 34006) (Figure 4.1), from 1925 to 2004 (87% complete), with large data gaps from June 1988 to November 1989 and July 1994 to Mar 2003. At Mount Coolon, the mean annual rainfall is 577 mm/yr.

The Mount Douglas and Mount Coolon stations receive considerably (>100 mm) less rainfall during the wet season than Collinsville (Figure 4.2). Thus, although Collinsville has the most comprehensive and complete climate data for the last 20 years, it is furthest away from the Project area and has lower average rainfall than the more proximal sites.

Additional rainfall and evapotranspiration data were sourced from the Scientific Information for Land Owners (SILO) database. SILO is operated by DES, with data contributions from BOM. The SILO database provides a weather record dataset that utilises neighbouring stations to infill missing data and accumulated days, spatially interpolated for specific locations between stations. Due to the discrepancies between sites and data gaps noted above for adjacent BOM site, the SILO data set is likely the most representative climate record for the Project area. The SILO dataset extracted for the Project was for latitude -21.10 and longitude: 147.25. The mean annual precipitation in the SILO dataset is 584.7 mm/yr.

The SILO data provides additional climate information (Table 4.1) and mean annual pan (potential) evaporation is estimated to be 2,397 mm, whereas Morton's mean actual annual evapotranspiration is 1,098.2 mm). The potential evaporation values greatly exceed the annual average rainfall recorded in the region, creating an annual rainfall deficit that limits groundwater recharge. However, recharge can occur seasonally during constrained periods of rainfall surplus. Rainfall surplus only occurs in months where the rainfall total exceeds Morton's mean actual evapotranspiration (Based on the SILO data, there are no months where the rainfall surplus exceeds 10 mm, though the balance Table 4.1) is close in January and February. There is potential for recharge when rainfall exceeds the long-term average in the region, albeit this recharge is typically limited (1-5% of rainfall) under these conditions.

Cumulative rainfall departure (CRD) is a method of analysing long-term rainfall trends to understand water-balance variations. The CRD is a summation of the monthly departure of rainfall from the long-term average monthly rainfall. A rising trend in the CRD indicates periods of above average rainfall, whereas a negative slope indicates below average rainfall periods. Diffuse infiltration of rainwater is the primary source of groundwater in most landscape settings. As such, the CRD is a climate analysis tool for groundwater assessments, whereby positive CRD trends occur over progressive periods of above average rainfall, with greater rainfall likely resulting in greater groundwater recharge volumes and elevated or increasing groundwater levels. Conversely, negative CRD trends occur during prolonged periods of below average rainfall and may correspond to lower groundwater levels or declines in water level.

The CRD from the SILO data steeply increased from 1916 to 1918, corresponding to a significant rainfall event (640mm in Jan 1918), before gradually decreasing until 1940 (Figure 4.3). Between 1940 and 1955 the CRD exhibited an oscillatory trend. It increased steeply until 1959, then decreased until 1973 before once again steeply increasing in 1974 in response to a large rainfall event. From 1991 to 2023 the CRD showed an oscillatory but decreasing trend.

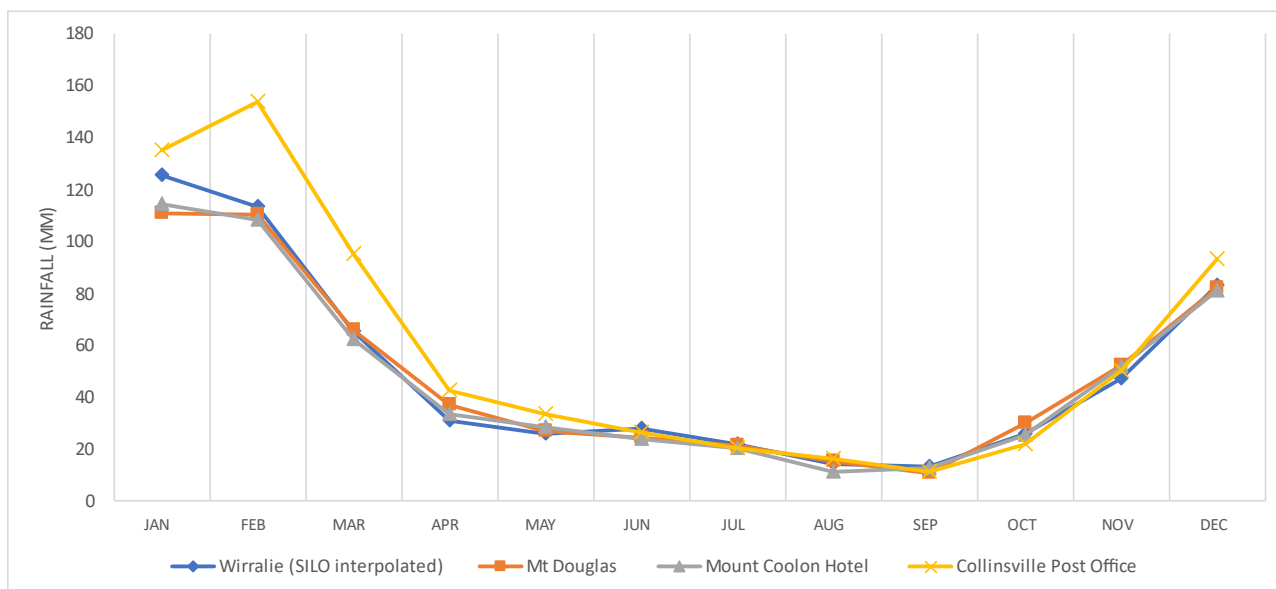


Figure 4.2 Mean monthly rainfall comparison between BoM stations

Table 4.1 SILO climate averages for the Project (January 1912 – July 2023)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max Temp (°C)	33.9	32.9	32.0	30.0	26.9	24.4	24.3	26.4	29.5	32.3	34.0	34.5	361.0
Mean Rainfall (mm)	116.9	117.3	61.0	31.4	26.3	26.8	22.4	13.7	10.8	26.1	48.7	83.3	584.7
Mean Pan (Potential) Evaporation (mm)	242.3	205.3	207.2	175.9	146.8	123.6	136.9	170.9	208.0	253.6	261.7	265.4	2397.7
Morton's Mean Actual Evapotranspiration (mm)	128.6	120.6	117.4	85.9	58.6	42.1	48.3	66.4	86.0	104.7	113.3	126.4	1098.2

Notes: 1. Evapotranspiration values derived from Morton's areal actual evapotranspiration.
2. Evaporation values synthetic estimate pre-1970, class A pan 1970 onwards.

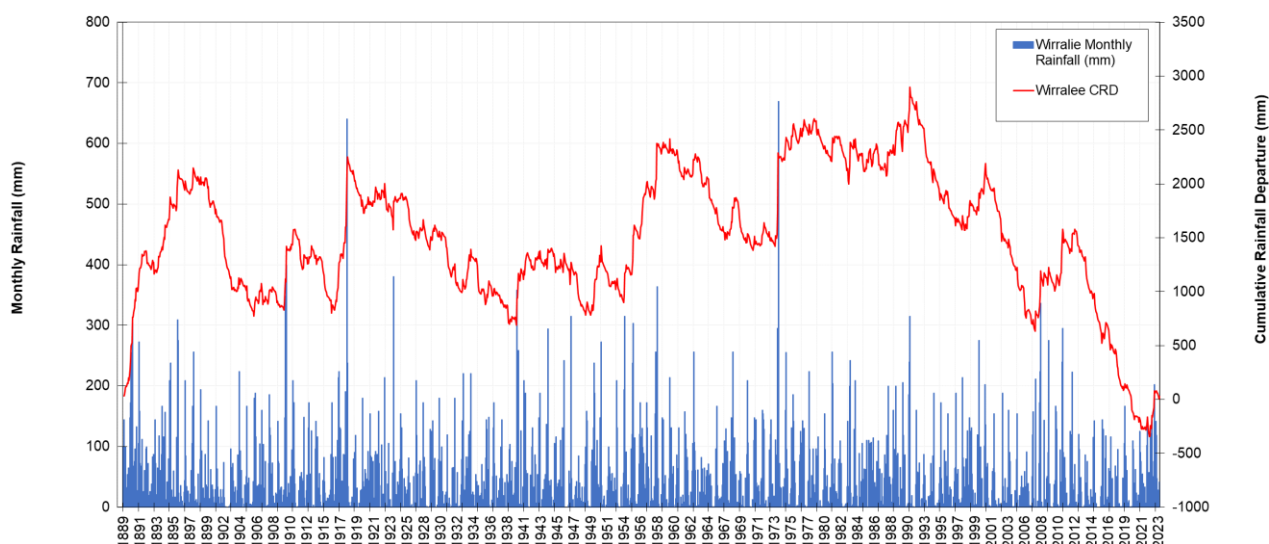


Figure 4.3 Monthly rainfall at Wirralie with cumulative rainfall departure from 1889 to 2023 (SILO)

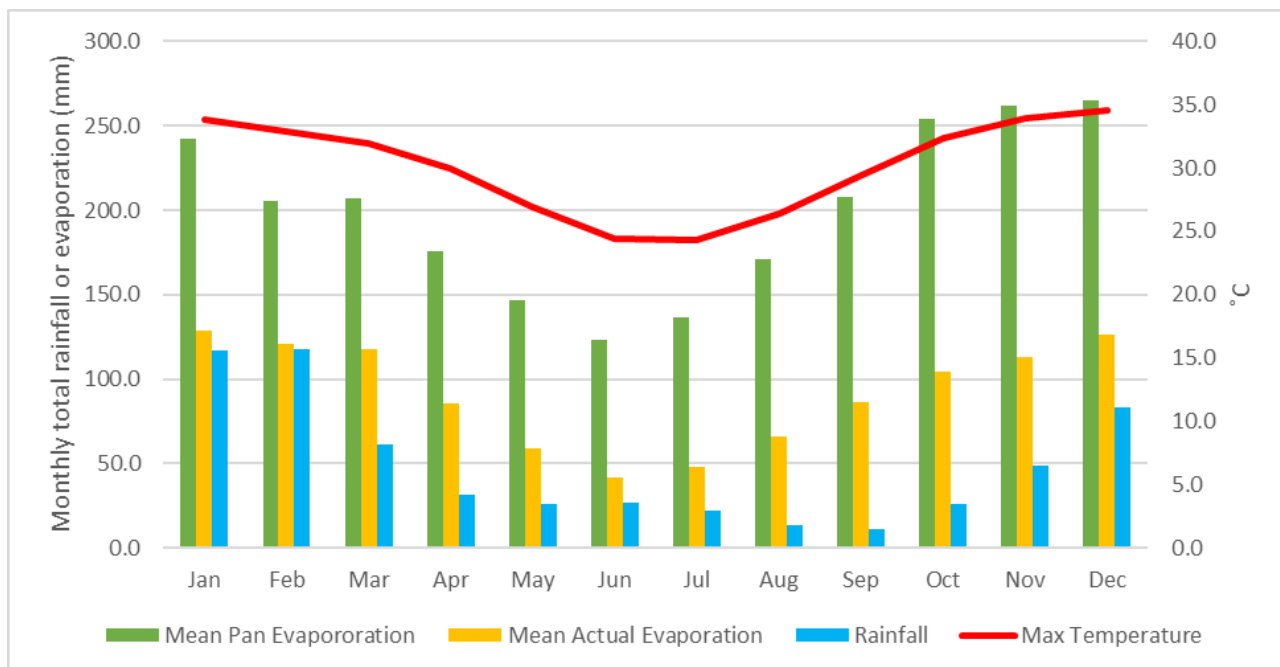


Figure 4.4 Long term average monthly pan evaporation, actual evapotranspiration (Morton's areal actual), total rainfall, and maximum temperature

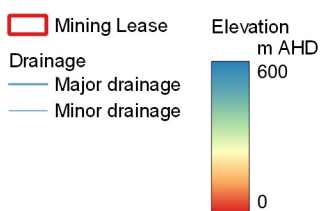
4.2 Topography and surface drainage

Wirralie gold mine lies to the west of the Leichhardt Range (part of the Great Dividing Range) and is located on the ridge between the southeast bank of Rosetta Creek and the north bank of Bungobine Creek (Figure 4.5). Locally, the topography consists of gentle rolling rises and plains, with the elevation ranging from approximately 250 m AHD near Rosetta Creek to 300 m AHD on the east side of the mining lease (Figure 4.6).

Wirralie sits within the Burdekin River drainage basin, the Suttor River sub-drainage basin, and the Rosetta Creek Sub-catchment (Figure 4.7). Surface water from the site drains north via several minor ephemeral drainage lines, including Sugarbag Creek, to Rosetta Creek. These ephemeral drainage lines typically flow for short durations immediately following rainfall and remain dry for the rest of the year. Some pools may persist along Sugarbag creek, although none are permanent. Clean water diversions were constructed around existing infrastructure, including the TSF, to divert water around the site and into Sugarbag Creek. Rosetta Creek flows north to south and drains to the Suttor River approximately 44 km southwest of the site. The Suttor River flows north before discharging into the Burdekin Dam.



LEGEND



Wirralie Permeability Testing and Progressive Rehabilitation and Closure Plan (WIR5000.001)

Project topography and natural drainage

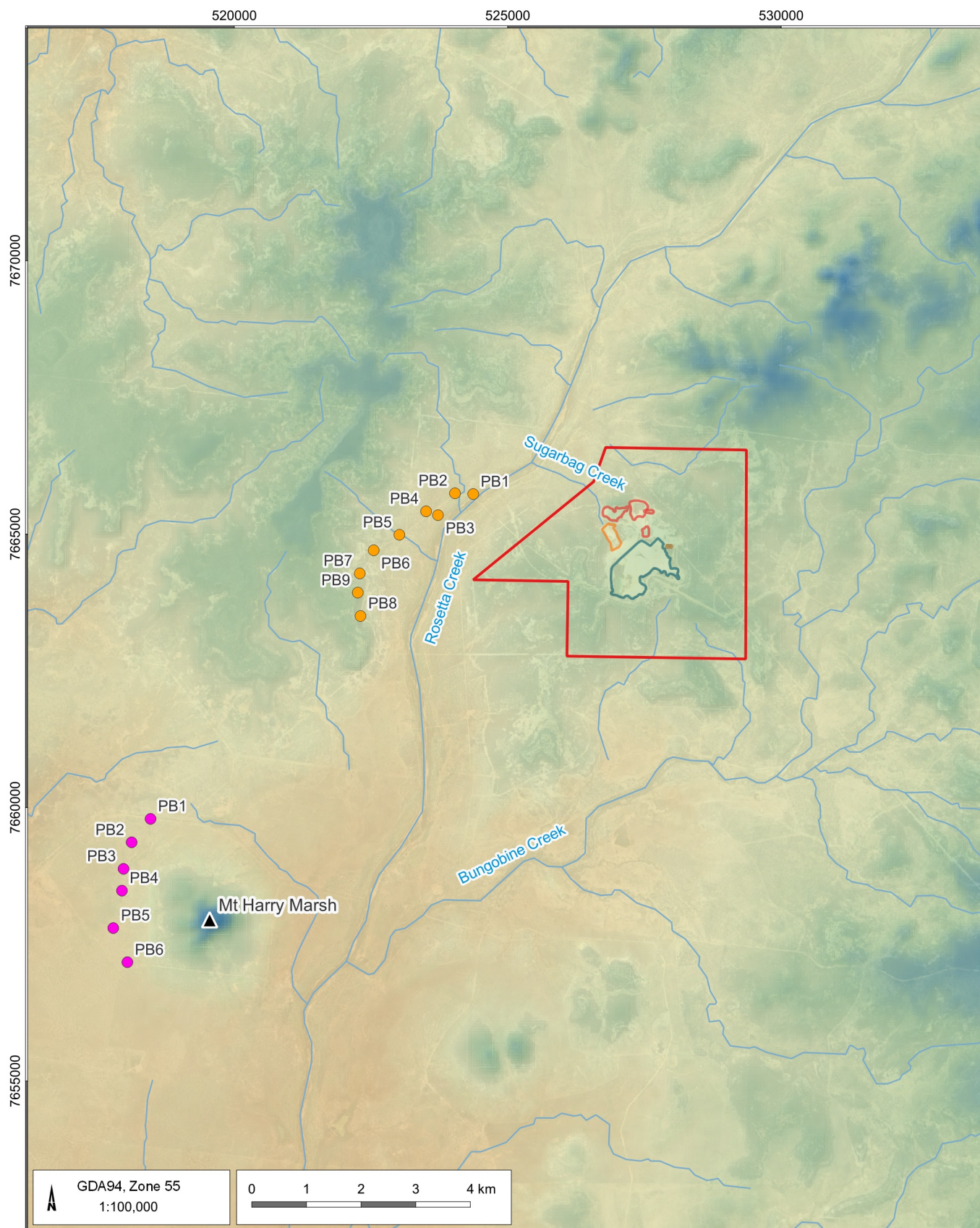


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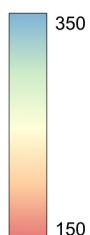
4.5



LEGEND

- ▭ Mining Lease
- Drainage
- Rosetta Borefield
- Harry Marsh Borefield
- Mine Features**
 - ▭ Pit
 - ▭ Raw water pond
 - ▭ Runoff dam
 - ▭ TSF

Elevation
m AHD



Wirralie Permeability Testing and Progressive Rehabilitation and Closure Plan (WIR5000.001)

Site drainage



AGE

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30/11/2023

FIGURE No:

4.6

4.2.1 Water Plans

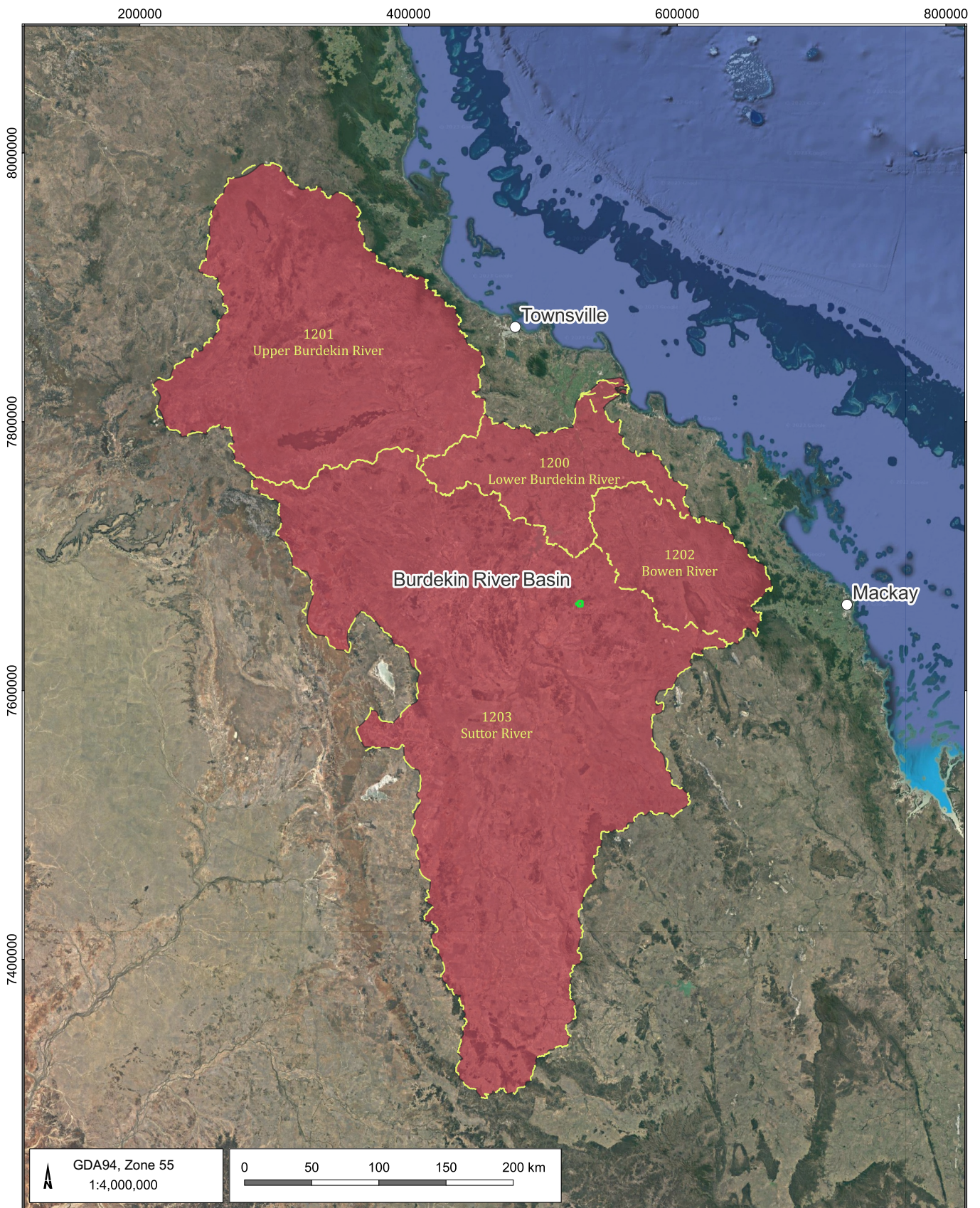
Wirralie sits within the management area of the Water Plan (Burdekin Basin) 2007 (hereafter referred to as the Water Plan) (Figure 4.7). There are no groundwater management areas overlapping the Project. The Bowen, Whitsunday, Pioneer Valley and Isaac Connors Groundwater Management areas are located east of the Project and the Burdekin and Giru Benefited Groundwater Management Areas are to the north.

4.2.2 Site water supply

The raw water dam is a source of potable water supply and water for gold processing. The runoff dam (situated directly west of the runoff dam) supplies raw water for processing and general use around the site. The water is transferred from the dam to the process plant area via an existing pipeline. At the process area, water is stored in a water tank with an attached standpipe (fill point). The site has a 20kL water cart which loads water for dust suppression and other operational uses. Make-up water for processing is available from the tailings decant water and abandoned mining pits. A floating pump has been installed in the TSF to transport this water back to the processing facility.

Wirralie currently extracts water from bores in the Rosetta Creek Borefield (location on Figure 4.6) during the dry season if there is no water available on site. The water is pumped to the raw water dam. No information is available on extraction rates or volumes.

The Rosetta borefield (also called Olderfleet borefield, established in 1987) and the Harry Marsh borefield (southwest of the Rosetta borefield, established in 1999) were used to supply potable and process water to the previous Wirralie operation, which stopped operations in 2001 (Figure 4.6). Bore 2 in the Rosetta borefield primarily provided Wirralie with potable water until November 2001, when it became too saline (Water Studies, 2004). Thereafter, Bore 8 supplied potable water to the site, with water classified as marginally potable by NHMRC (1996) guideline values (Water Studies, 2004). In addition to groundwater, the previous operation also sourced process water from the tailings return water and surface runoff dam (Water Studies, 2004). Groundwater levels in Rosetta Borefield had not recovered two years after the cessation of pumping, and it was advised that no future contribution to process water demand is likely from this borefield (Water Studies, 2004). The aquifer at Bore 8 remained fully saturated and it was recommended that it be reserved for potable water supply only (Water Studies, 2004). Additionally, groundwater levels in the Harry Marsh Borefield recovered strongly and could be a future source of process water with careful management of future pumping (Water Studies, 2004).



LEGEND

- Mining Lease
- Burdekin River Basin - Water Plan area

Wirralie Permeability Testing and Progressive Rehabilitation and Closure Plan (WIR5000.001)

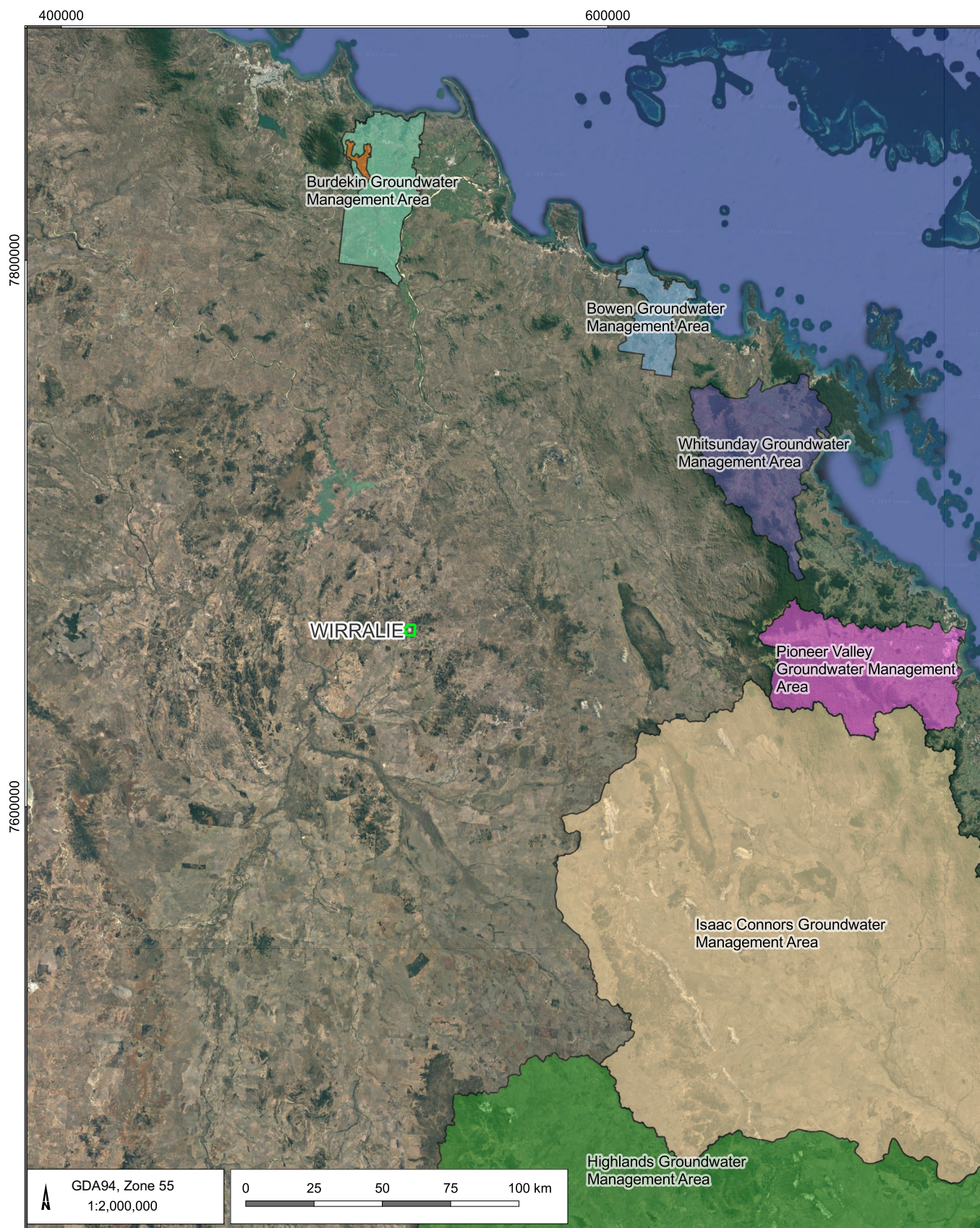
Water Plan (Burdekin Basin) 2007 area



AGE

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30/11/2023

FIGURE No:
4.7



LEGEND

 Mining Lease

Groundwater management areas

- Bowen Groundwater Management Area
- Burdekin Groundwater Management Area
- Giru Benefited Groundwater Area
- Highlands Groundwater Management Area
- Isaac Connors Groundwater Management Area
- Pioneer Valley Groundwater Management Area
- Whitsunday Groundwater Management Area

Wirralie Permeability Testing and Progressive Rehabilitation and Closure Plan (WIR5000.001)

Nearby Groundwater Management Areas



AGE

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30/11/2023

FIGURE No:
4.8

5 Site infrastructure and potential sources

5.1 Site history and project duration

The Wirralie deposit was discovered in 1986 and is located in the northeastern section of the Drummond Basin, within the Late Devonian Mount Wyatt Formation (Olgers, 1972). It is a low-grade, low-sulfidation, epithermal gold deposit. The initial phase of mining began in 1987 and continued until 1993, under various owners, and involved the extraction of ore from four open-cut pits, subsequent carbon-in-leach (CIL) processing using cyanide, and tailings and waste rock management. During this period of peak operation, there was on-site accommodation, including sewage treatment, and use of on-site workshops. Following this phase of mining, rehabilitation efforts were completed, and, in 1998, the processing plant was relocated 30km west to the Yandan mine site, which was owned by a related entity.

A second period of operation occurred from 1999 to 2001, with the installation of an upgraded 1.5 million tonne per annum treatment plant to treat low-grade oxide and mineralisation from the Deep Lead Pit (Section 5.2.4).

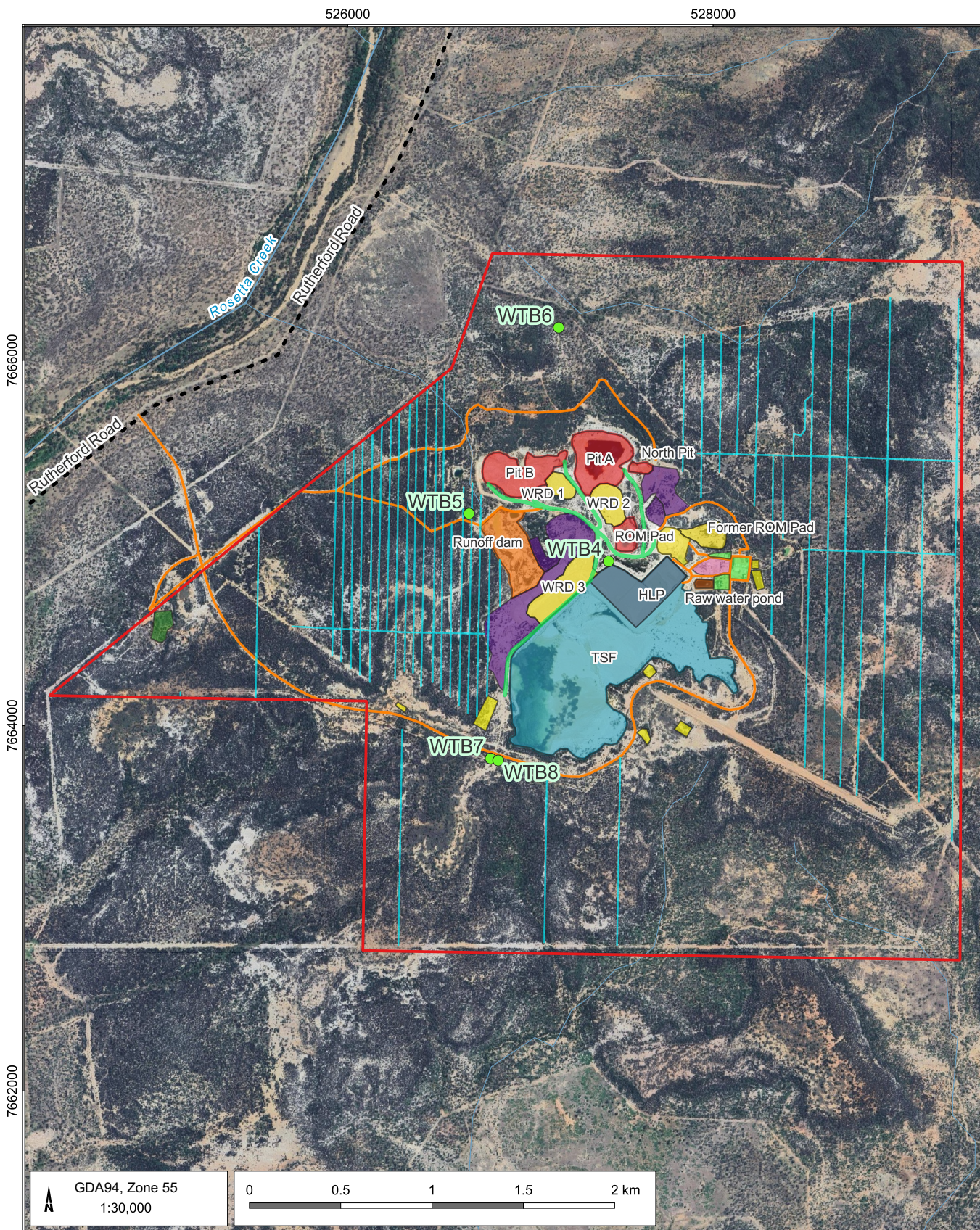
Rehabilitation efforts were completed following the breaks in operations in 1993 and 2001. Areas where rehabilitation occurred included:

- waste rock dumps, backfilled voids and stockpile areas
- final voids
- tailings dam (rehabilitation trials commenced)
- process areas
- ancillary areas (including the Run of Mine (ROM), exploration facilities, landfill, airstrip, and accommodation village).

In January 2002, the process plant was decommissioned, and the site was placed on care and maintenance. Total production from Wirralie from 1987 – 2001 was 7.93Mt at an average mined grade of 1.97 grams per tonne of gold, with a total of 477,000 ounces of gold recovered (NRC, 2016). Annual production to the end of 2001 totalled 1.280Mt, grading 1.16g/t for 41,898oz of gold (NRC, 2016). As of February 1, 2004, Wirralie had a measured, indicated and inferred oxide resource of 7.67Mt grading 0.82g/t at a 0.5g/t cut-off for 203,000oz of contained gold (WTS, 2023).

Solomons Gold acquired the Project in December 2013 and recommenced mining and processing operations. The operation is of significantly smaller scale than was conducted by previous owners, with up to 400,000 tonnes of ore mined and processed per year. Current operations focus on Pit B (Section 5.2.2) and a cyanide heap leach circuit is operated within the existing tailings dam footprint. Mining is expected to continue until the oxide resource is depleted (approximately 3 years) (WTS, 2023). Future activities are planned to occur within previously disturbed areas. Any new disturbance will be designed and conducted in a way that supports future rehabilitation efforts (WTS, 2023).

The site layout of the current operation is depicted in Figure 5.1. Descriptions of each site feature are provided below, including their post mine land descriptions and uses as currently prescribed in Schedule F Table F1 (Final Land Use and Rehabilitation Approval Schedule) of the Wirralie EA.



LEGEND

- | | |
|--|--|
| Mining Lease | Former camp/administration |
| ● Monitoring bores | Heap leach pads (HLP) |
| Drainage | — Mine haul roads |
| — Major drainage | Open mining pits |
| — Minor drainage | Processing plant |
| Mine Features | Raw water pond |
| — Access roads and tracks | Rehabilitation repair areas |
| Camp/administration and Laydown yards | Overburden dump and piles |
| — Exploration | Runoff dam |
| | Tailings storage facility (TSF) |

Wirralie Permeability Testing and Progressive Rehabilitation and Closure Plan (WIR5000.001)

Wirralie Site Infrastructure



AGE

DATE
04/12/2023

FIGURE No:
5.1

5.2 Pit voids

The Wirralie project is comprised of four open-cut voids: Pit A, Pit B, North Pit, and the Deep Lead pit (Figure 5.1). Development and rehabilitation by previous owners are considered complete at Pit A and North Pit; however, Pit B will continue to be mined to a maximum depth of approximately 50m (~195 m AHD). The surface area of Pit B will remain the same as it is currently. The Deep Lead Pit will be backfilled with waste rock from Pit B and, upon conclusion of mining and rehabilitation of the site, no void will remain and the PMLU will be low intensity grazing on native pasture. The final rehabilitation plan is for residual voids to remain at Pit A, Pit B and North Pit, and these pits are designated NUMAs in closure. The other final landforms of the site will be stabilised via mechanical reshaping and will drain away from the residual NUMA voids. Fencing will be erected around all pits to prevent ingress. A summary of the pit void geometry and water quality is provided below.

5.2.1 Pit A

Pit A was mined from 1987 to 1993. The existing pit void is triangular in shape, with two 'arms', one pointing south and the other east. It has a surface area of approximately 8.32 ha (WTS, 2023). The surrounding topography is 270 m AHD, extending up to 290 m AHD on the western side. The pit lake level is approximately 243.6 m AHD; however, the pit's total depth is unknown. For void modelling (Section 13), the depth of the pit is assumed to be 5m in the southern arm and 10m in the northern section, placing the base of the pit at 234 m AHD. The catchment area of the pit is relatively small (approximately 112,000 m²); however, if the pit lake level reaches 251 m AHD, water in Pit A and North Pit will mix, and if the water level reaches 258 m AHD, it will flow south towards the Deep Lead Pit.

Six water quality samples were collected from Pit A over a twelve-month period across 2000 and 2001 (Table 5.1). Water in Pit A is characterised by a low pH (2.1-2.3), high salinity, and high concentrations of sulfate, aluminium, arsenic, cadmium, copper, nickel and zinc (Table 5.1). It is dark in colour and has a reddish hue, which can be observed in satellite imagery.

Table 5.1 Pit A water quality

Location	Date	pH	TDS	SO4	Al	As	Cd	Cu	Mo	Ni	Pb	Zn	Total CN
		pH Unit	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Pit A (SW3)	26/08/2000	2.2	11200	7900	582	42.5	0.018	4.73	0.005	1.2	0.0005	11.2	
Pit A (SW3)	19/11/2000	2.2	12400	7420	544	40	0.095	4.3	0.21	1.18	0.0005	10.8	
Pit A (SW3)	31/01/2001	2.22	4680	8300	626	44.7	0.102	4.73	0.23	1.25	0.0005	11.4	
Pit A (SW3)	21/02/2001	2.2	12600	8370	581	42.7	0.105	4.64	0.16	1.18	0.001	10.9	0.005
Pit A (SW3)	11/05/2001	2.17	13300	7790	664	45.1	0.109	5.66	0.19	1.27	0.0005	11.1	0.0025
Pit A (SW3)	8/08/2001	2.13	12800	9580	707	48.6	0.108	4.98	0.22	1.39	0.0005	12.7	0.0025

Source: 2002-3 Environmental monitoring report, Wirralie Gold Mine (Landline Consulting, 2003)

5.2.2 Pit B

Pit B was first mined from 1987 to 1993. Solomons will continue to mine Pit B to a maximum depth of approximately 50m (to 195 m AHD), with the same surface area as current (7.27 ha). Mining to date has reached 255 mAHd. Pit progression will consist of an east and west migration of the pit void from its current location. The surrounding topography ranges from 280 to 290 m AHD on the north side of the pit and 250 to 258 mAHd West of the pit. At 253 mAHd, the current pit would overflow on the west boundary and the water would flow north and south down the nearby ephemeral drainage line.

There is a small (550 m²), potentially ephemeral pit lake on the northern boundary of the pit that is turquoise in colour. The only available water sample for Pit B was collected in October 2001 (Table 5.2). The water had a low pH (2.84), was moderately saline (2200 µS/cm), and had relatively low, but measurable concentrations of metals (Table 5.2).

Table 5.2 Pit B water quality

Location	Date	pH	EC	TDS	SO ₄	Al	As	Cd	Cu	Mo	Ni	Pb	Zn	Hg
		pH Unit	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Pit B	Oct-01	2.84	2200	1100	516	61.4	0.008	0.001	0.443	0.005	0.06	0.0005	0.6	0.00005

Source: 2002-3 Environmental monitoring report, Wirralie Gold Mine (Landline Consulting, 2003)

5.2.3 North Pit

The North Pit was developed from 1999 to 2001 and has a surface area of 0.67 ha. The shape of the pit pinches in the middle, with a greenish-blue pit lake (0.062 ha) present on the northwest side of the void. The pit extends 100m east to west and 65m north to south at its widest point. Five water quality samples have been collected at the North Pit, one in 2002, one in 2021 and three in 2023 (Table 5.3). The water in the pit is characterised by low pH (2.29), high salinity (EC = 5625 µS/cm) and elevated concentrations of manganese and zinc (Table 5.3).

Table 5.3 North Pit water quality

Location	Date	pH	EC	TDS	SO ₄	Cl	Ca	Mg	Na	K	CN
		pH Unit - lab	µS/cm - field	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Pit North	1/07/2002	2.7	4490	5090	3590	*	*	*	*	*	*
North Pit	17/11/2021	2.23	8052	10600	8760	173	141	135	114	3	<0.004
N PIT	23/03/2023	2.45	5010	4960	4040	93	86	69	62	2	<0.004
North Pit	29/05/2023	2.28	5625	7340	4520	114	96	88	77	2	<0.004
North Pit	2/08/2023	2.29	*	7020	5200	124	*	93	85	2	<0.004

Location	Date	Al	As	Cd	Cu	Mn	Mo	Ni	Pb	Se	Zn	Hg
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Pit North	10/07/2002	339	0.021	0.028	1.89	*	<0.01	0.55	<0.001	0.01	4.07	0.0001
North Pit	17/11/2021	*	*	*	*	*	*	*	*	*	*	*
N PIT	23/03/2023	*	5.23	0.0399	1.61	1.58	0.008	*	<0.001	0.03	5.78	<0.0001
North Pit	29/05/2023	*	*	231	*	2.05	*	*	*	*	*	*
North Pit	2/08/2023	*	*	*	*	2	*	*	*	*	*	*

Sources: 2002-3 Environmental monitoring report, Wirralie Gold Mine (Landline Consulting, 2003) and Wirralie water quality database (WTS, 2023)

5.2.4 Deep Lead Pit

The Deep Lead pit, oblong in shape and covering 1.83 ha, was developed from 1999 to 2001. It has a turquoise pit lake standing at 229 to 230 mAHd. The only available water quality data for the Deep Lead pit lake was

collected in May 2001 (Table 5.4); the pit water was circum-neutral (pH 7.84), and fresh (TDS 526 mg/L), with relatively low dissolved metal concentrations.

Table 5.4 Deep Lead Pit water quality

Location	Date	pH	TDS	SO ₄	Al	As	Cd	Cu	Mo	Ni	Pb	Zn	Total CN
		pH Unit	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Pit - Deep Lead	May-01	7.84	526	106	0.36	0.006	0.002	0.002	0.005	0.005	0.0005	0.022	0.0025

Source: 2002-3 Environmental monitoring report, Wirralie Gold Mine (Landline Consulting, 2003)

5.3 Waste Rock Dumps (WRD)

There are three operational waste rock dumps at Wirralie: WRD1 (1.7 ha, 340,000 tonnes), WRD2 (3.2 ha, 640,000 tonnes), and WRD3 (6.1ha, 610,000 tonnes) (C&R, 2022). The WRDs are not expected to increase in size during the current mining phase, with the Wirralie operation intending to fill the Deep Lead Pit with waste rock from Pit B. A rehabilitated WRD (14.3 ha, 2,860,000 tonnes) exists adjacent to WRD3, having previously been rehabilitated with varying success by previous mine operators (WTS, 2023). Water from rehabilitated WRDs is directed to the site runoff dam via natural overland flow.

The PMLU for the WRDs is to be low intensity grazing on native pasture. To achieve such, the dumps will be re-shaped as a low-profile structure, topsoiled and revegetated.

5.3.1 Waste rock characterisation

Waste rock characterisation was completed by C&R Consulting in July 2021. In total, 155 samples were collected from WRDs, tailings storage facilities (TSFs) and the heap leach pad (HLP) and underwent tests to evaluate the risk associated with dissolution and mobility of metals/metalloids and salts (C&R, 2022). Eleven samples were collected from WRD1 (5 drillholes), 13 samples from WRD2 (8 drillholes) and 29 samples from WRD3 (12 drillholes). Additionally, 31 samples from 16 boreholes were taken from the rehabilitated WRD. All samples underwent static geochemical testing and 5 samples (2 at WRD3 and 1 each at WRD1, WRD2 and the rehabilitated WRD) and kinetic leach column (KLC) tests.

The pH of the fluid extract from crushed waste rock samples ranges from acidic (3.6) to basic (9.7), but with low EC (<300 μ S/cm). Rock samples from WRD2 were basic (pH > 8) whereas samples from other WRDs were typically slightly acidic (pH 4-6). The total sulphur concentrations were measured by LECO method and the results indicate that most of the waste rock is barren (<0.1% total sulfur) with low sulfur (0.6% total sulfur) detected at WRD3. Three of the 66 WRD samples were classified as PAF (very low or low sulfur); these PAF samples were from WRD3 and the rehabilitated WRD. Therefore, the WRDs are considered either barren or of low acid generating capacity (C&R, 2022).

5.4 Tailings Storage Facility (TSF)

The tailings dam covers 72 ha and consists of an earth and rock fill embankment approximately 900m across the broad, shallow valley of a natural watercourse flowing generally northwest. It was built in 1987 and has undergone several lifts, the most recent in 2000 (NRC, 2016b). The downstream wall is fortified by placement of the waste rock dump extending from the top of the wall and out approximately 100m, at a 3:1 slope. It has an emergency spillway at 277.3 mAHD and the design crest height for the northern embankment is 278.0 mAHD (NRC, 2016b).

The dam stores left-over materials from the processing of mined ore and receives surface runoff from the catchment during the wet season. Water ponding occurs in the western end and the saturated area covers approximately 20.5 ha (C&R, 2022).

Post-closure, the TSF surface will be capped and graded to achieve free-draining fall to the downstream environment. Rehabilitation works will be carried out in two stages (eastern catchment and western catchment), with precautions taken to capture runoff from the disturbed areas. The PMLU will be native pasture.

5.4.1 Tailings characterisation

Characterisation studies indicate that the tailings have no, or low acid forming potential and are enriched in arsenic, mercury, antimony, cadmium, selenium and silver (EGI, 2002; C&R, 2022).

A surface salts and depth profile investigation on deposited tailings was completed in 2002 by Environmental Geochemistry International (EGI) as part of a previous rehabilitation investigation; it indicated that the tailings had a low acid forming potential. Multi-elemental analyses indicated significant concentrations of arsenic, mercury, antimony, and selenium (EGI, 2002). Silver was enriched in some samples. The net acid producing potential (NAPP) for surface salts ranged from 17 to 95 kg H₂SO₄/t, with NAGpH values ranging 7.2 to 8.4, although most of the sulfur in the samples occurred as non-reactive salts and are therefore non-acid forming (NAF). The NAPP for depth profiled tailings samples ranged from 0 to 8 kg H₂SO₄/t, with NAGpH values ranging 6.1 to 6.7 (EGI, 2002).

The C&R (2022) waste rock characterisation was comprised of TSF surface crust and push-tube sampling to depths of 2 m. Fifty samples (23 surface crust, 27 push tube) were collected across 27 locations and submitted for geochemical testing; four of these samples underwent KLC tests. All TSF samples were classified as non-acid forming (NAF) (barren or very low sulfur). Additionally, the pH of the fluid extract from crushed rock samples ranged from acidic (3.6) to basic (9.3) and kinetic geochemical results indicate that pH values of TSF leachates are attributed to minor levels of developing or residual acidity. The salinity of the surface crust of the tailings (EC mostly 2000-3000 µS/cm, up to 4,860 µS/cm) is much higher than that of the tailing's sediment below the crust (EC mostly 300-1500 µS/cm, up to 3500 µS/cm). These static testing results underestimate salinity, as the kinetic testing indicated that the EC of TSF leachate increases over time. The median concentration of sulfur in the TSF is 0.15%, which is higher than other waste rock areas at Wirralie. The TSF is enriched in arsenic (mean concentration of 114 mg/kg), mercury, cadmium and selenium; however, kinetic tests indicated that arsenic and mercury are relatively immobile.

5.4.1.1 TSF surface pondage characterisation

Surface water sample from the large, persistent pondage present on the TSF (Figure 5.1) has been collected periodically (Table 5.5). This water is generally circum-neutral to alkaline, with moderate to high salinity. The salinity appears to have decreased after 2002, but this could be dependent on the area of the TSF sampled. The water is generally enriched in arsenic, copper, molybdenum, and zinc (Table 5.5). Samples are variably enriched in sulfate and detectable concentration of cyanide are occasionally present. Some samples (e.g. September 2002) have very high (14,900 mg/L) concentrations of sulfate but an alkaline pH; this, combined with the presence of detectable cyanide, suggest that the pH has likely been increased by alkaline cyanide leachate solutions.

Table 5.5 TSF pondage water quality

Location		Tails Dam	Tails Dam	Tails Dam	Tails Dam	Tails Dam	TSF	TSF	TSF	TSF	TSF	TSF	TSF
Date		Dec-01	Apr-02	Jul-02	Sep-02	Dec-02	17/11/2021	31/05/2022	11/08/2022	08/11/2022	22/03/2023	30/05/2023	2/08/2023
Easting (#Latitude)		*	*	*	*	*	526872.96	526827.47	526878.36	526905.38	-21.123771#	-21.123364#	*
Northing (#Longitude)		*	*	*	*	*	7664045.32	7665173.41	7664146.8	7663896.63	147.259189#	147.258994#	*
pH (field)	pH Unit	7.98	7.7	7.65	7.75	6.93	8.45	7.86	8.17	7.15	8.5	6.04	7.93 (lab)
EC (field)	µS/cm	6230	11000	20200	33800	13600	12210	306	2722	4065	2574	2813	*
TDS (lab)	mg/L	*	*	16800	24100	6900	8230	265	1610	2700	1460	1920	2780
SO4	mg/L	2360	5260	7830	14900	7040	3050	38	586	59	570	748	866
Cl	mg/L	*	*	*	*	*	2200	*	*	*	402	546	631
Ca	mg/L	*	*	*	*	*	396	*	*	*	101	140	*
Mg	mg/L	*	*	*	*	*	32	*	*	*	5	7	6
Na	mg/L	*	*	*	*	*	2150	*	*	*	372	530	610
K	mg/L	*	*	*	*	*	68	*	*	*	14	20	26
Bicarbonate Alkalinity as HCO3	mg/L	*	*	*	*	*	110	*	*	*	22	65	68
Al (dissolved)	mg/L	0.18	0.33	<0.1	<0.01	0.05	*	*	*	*	*	*	*
As (dissolved)	mg/L	0.021	0.045	0.032	0.055	0.023	*	*	*	*	0.234	*	*
Cd (dissolved)	mg/L	0.0005	0.001	<0.001	<0.001	<0.001	*	*	*	*	<0.0001	109	<1
Cu (dissolved)	mg/L	0.563	0.022	0.05	0.071	0.255	*	*	*	*	0.002	*	*
Fe (dissolved)	mg/L	*	*	*	*	*	*	*	*	*	<0.05	<0.05	<0.05
Pb (dissolved)	mg/L	0.0005	0.0005	<0.001	<0.001	<0.001	*	*	*	*	<0.001	*	*
Mn (dissolved)	mg/L	*	*	*	*	*	*	*	*	*	0.001	0.003	0.002
Hg (dissolved)	mg/L	*	0.00005	<0.0001	0.0001	<0.0001	*	*	*	*	<0.0001	*	*
Mo (dissolved)	mg/L	0.38	0.8	1.4	2.4	0.67	*	*	*	*	0.026	*	*
Ni (dissolved)	mg/L	0.09	0.05	<0.1	<0.1	0.02	*	*	*	*	*	*	*
Se (dissolved)	mg/L	*	0.05	<0.1	<0.1	0.04	*	*	*	*	<0.01	*	*

Location		Tails Dam	Tails Dam	Tails Dam	Tails Dam	Tails Dam	TSF	TSF	TSF	TSF	TSF	TSF	TSF
Date		Dec-01	Apr-02	Jul-02	Sep-02	Dec-02	17/11/2021	31/05/2022	11/08/2022	08/11/2022	22/03/2023	30/05/2023	2/08/2023
Zn (dissolved)	mg/L	0.002	0.007	0.002	0.001	0.004	*	*	*	*	0.013	*	*
CN (total)	mg/L	4.3	0.323	0.705	0.347	13.7	*	*	*	*	*	*	*
CN (WAD)	mg/L	*	*	*	*	*	0.012	<0.004	0.006	<0.004	<0.004	<0.004	<0.004

Sources: 2002-3 Environmental monitoring report, Wirralie Gold Mine (Landline Consulting, 2003) and Wirralie water quality database (WTS, 2023)

5.5 Heap Leach Pad (HLP)

Heap leach processing occurs within the north-eastern cell of the TSF. The heap leach pad was constructed over the top of the existing tailings storage with a HDPE plastic layer first installed over the tailings. Other features within the HLP include two HDPE lined ponds (a pregnant and a barren pond), and pipework and infrastructure associated with cyanide delivery to the heaps. The HLP has a total surface area of 9.5 ha (within the 72 ha TSF footprint).

Mined ore is selected by grade and blended prior to entering the crushing circuit. The HLP receives screened material that has undergone primary crushing within the crushing circuit. Depending on the size fraction, crushed material may enter the Carbon in Leach (CIL) circuit instead (WTS, 2023).

During rehabilitation, the heap material will either be sold for beneficial reuse offsite for base-course in road works or used as a capping on the remainder of the TSF (WTS, 2023). It will then be rehabilitated with the TSF to meet requirements for the proposed PMLU of open pasture.

5.5.1 Waste characterisation

The C&R (2022) waste characterisation study found that most of the HLP pad was inaccessible; however, seven samples from seven drillholes (to depths of 2m) along the southwest and southeast boundaries collected. One of these samples underwent a KLC test. All seven samples had a fluid extract that was slightly basic (pH9), low EC (<150 $\mu\text{S}/\text{cm}$) and NAF (barren).

5.6 Run of Mill (ROM) pad (former and existing)

The former ROM pad is located east of the existing ROM pad. The former ROM is comprised of approximately 460,000 tonnes of mine overburden (waste rock), covering an area of 2.3 ha and rising up to 15m above the natural ground level (C&R, 2022). From recent satellite imagery, it appears to have been revegetated. The existing ROM pad has a footprint of 3 ha and is operational.

During rehabilitation, the material contained in the ROM may be excavated and used to cap other areas of the site. The existing ROM pad area will then be contoured to minimise erosion; however, the landform will remain as a low hill blended to the surrounding environment. The face will be deep ripped, have topsoil applied (if available), fertilised and seeded with pasture species. The proposed PMLU is low intensity grazing on native vegetation.

5.6.1 Waste characterisation

The C&R (2022) waste characterisation included twelve samples from five holes (to depths of 9m) on the former ROM pad. One sample underwent a KLC test. Fluid extract from all twelve samples were slightly acidic, had low EC and were NAF. The majority were barren, but one was classified as NAF (very low sulphur) >0.1 to ≤ 0.55 .

5.7 Run-off dam

The Runoff Dam, located to the northwest of the site, consists of a large embankment (standing at 257 mAHD) built across a natural drainage line. The storage capacity of the dam is 319 ML and it has an approximate surface area of 8.54 ha.

The run-off dam captures potentially mine-affected site water, which is then used as raw water for processing and general use around the site. In the 2002-3 environmental monitoring report the run-off dam was reported to have good water quality, with the only exceedance (above the environmental investigation limit – ANZECC livestock limit = 0.5mg/L) for arsenic (0.13 mg/L) at the last sampling in December 2002 (Landline Consulting, 2003).

It will be used as a sink and sedimentation basin for runoff from the Project until landforms have been adequately rehabilitated and are stable and non-polluting (WTS, 2023). Once rehabilitation is complete, the

dam will be assessed, and any contaminated material will be removed. It will then be desilted, lined, and allowed to fill with clean run-off. The retained dam will function as a stock water supply for future landholders, in line with its intended PMLU of water storage.

5.8 Raw water dam

The raw water dam covers 0.45 ha and is situated directly east of the runoff dam. It stores water for potable use and gold processing. It receives and holds water pumped from the Rosetta Creek Borefield, when the additional volume of water is required at Wirralie.

The PMLU for the raw water dam will be low intensity grazing on native pasture. It will be required to provide water for the rehabilitation of other mining domains, before it can be decommissioned, and the landform established. The dam walls will be pushed in and shaped to drain similarly to the pre-mining landform. Topsoil, fertiliser and a pasture seed mix will be applied to re-establish vegetation.

5.9 Topsoil stockpiles

Numerous topsoil stockpiles remain on the site from previous mining operations and will be used during the Project's rehabilitation. Approximately 3 ha of topsoil from stockpiles has been removed as part of previous rehabilitation efforts, and an estimated 4 ha of stockpile remain on the site. During rehabilitation, topsoil will be removed using the mine excavator and transported in existing trucks to previously prepared areas around the site. The PMLU is low intensity grazing on native pasture.

5.10 Process Plant

The process plant installed at Wirralie is a mixture of mobile machinery and recommissioned components of the existing plant (from the previous operation). The infrastructure and disturbance associated with this domain includes:

- 9 disused steel process tanks,
- 0.47 ha of concrete slabs/ footings,
- 6.2 ha of cleared hardstand area,
- mobile crushing plant, and
- Carbon in leach (CIL) and elution tanks.

Potentially affected water from the process plant drains to the tailings storage facility and clean water is diverted around the process area into Sugarbag creek via a perimeter drain.

The rehabilitation strategy involves excavating areas beneath the process plant and re-fuelling tanks to 0.5 m deep. The contaminated material will then be disposed of in Pit A. Concrete footings will be left in situ where these are buried, or disposed of in Pit A. The footprint of the entire plant area (6.2 ha) may then be deep ripped to alleviate compaction, seeded and fertilised. The PMLU is low intensity grazing on native pasture.

5.11 Mine haul roads and access roads

The mine haul roads and access roads are constructed of compacted gravel, graded to direct surface water run-off and minimise erosion. Culverts have been installed in some areas to enable natural surface flows across the roads.

The mine haul roads are wide and allow for bulk transfer of materials by heavy mining equipment between the four pits, WRDs, HLP, TSF and ROM pad. WTS estimates the haul roads cover 6.4 ha (WTS, 2023). The C&R (2022) waste characterisation study examined two samples from two bore holes taken from sections of the haul road that were sheeted with waste material. Both samples were classified as non-acid forming.

The network of access roads and tracks cover 7.65 ha across the mining lease (WTS, 2023), allowing smaller vehicles to move around the site for operational, explorational and monitoring activities.

The PMLU will be low intensity grazing on native pasture.

5.12 Site offices and former mining camp

The former mining camp was located on the western mining lease boundary, southwest of the current site access road. Buildings and other major infrastructure associated with the previous operations' camp have been removed from the site. Low value items such as landscaping, concrete paths, and underground services remain; these will be reused by the site during operation, disposed of in a landfill or remain underground (underground services) during site remediation.

The current accommodation buildings, administration area and laydown yards are adjacent to the processing plant area and are accessible via the access road that curves south around the TSF. This is a smaller-scale camp, able to accommodate 10 people, with demountable dongas for both accommodation and messing. Once processing and operations have concluded at site, the portable buildings will be disconnected and removed from site using trucks. The footings will either be removed or remain in-situ and the underground services will be cut-off at ground level. The area will then be contoured, deep ripped, seeded and fertilised. The PMLU will be low intensity grazing on native pasture.

5.13 Sewage effluent ponds (location unknown)

A sewage treatment plant was utilised at Wirralie during previous operations, and it was removed from site prior to Solomons acquiring the Project. Sewage from the current operation is managed via evaporation from one of the existing sewage ponds. The sewage effluent is not suitable for dust suppression or irrigation and is monitored by Solomons to ensure that an unauthorised discharge does not occur (NRC, 2016).

5.14 Landfill (location unknown)

A small trench-system landfill existed on the site. It was used to support the previous operation and will be utilised when required by the current smaller-scale operation.

6 Geology

Regionally, Wirralie is situated within the northeastern section of the Drummond Basin (cycle one volcanics) and southeast of the Anakie Inlier (Uysal et al., 2011). The Drummond Basin sequence is from the Upper Devonian to Lower Carboniferous periods and crops out over an area of 25,000 km² in central Queensland (Olgers, 1972). The geologic units present at Wirralie are the Silver Hills Volcanics, Mount Wyatt Formation, Rosetta Creek Formation, Suttor Formation, and Tertiary to Holocene colluvium and alluvium (Table 6.1).

Gold-silver mineralisation at Wirralie is hosted by a low-grade, low-sulfidation, epithermal quartz vein complex, within the Mount Wyatt Formation. The Mount Wyatt Formation is associated with the earliest Drummond Basin depositional cycle (Olgers, 1972) and locally at Wirralie, it is comprised of volcanoclastic sediments, with subordinate, interbedded lapilli and crystal tuffs (Fellows and Hammond, 1990). Mineralisation primarily occurs with a network of fractures and veins, with the main zone of mineralisation occurring across about 400m of strike. The site has been mined to the base of oxide mineralisation (NRC, 2016). At greater depth mineralisation persists as a silicified zone, within quartz and quartz-matrix veining, and within fine grained pyrite disseminations and veins (Fellows and Hammond, 1990).

Queensland state geological surface mapping shows the Tertiary Suttor Formation outcropping across most of the mining lease, coinciding topographically with ridge between Rosetta creek and Bungobine creek (Figure 6.1). It unconformably overlies the Late Devonian – Early Carboniferous Rosetta Creek Formation, which outcrops at the base of the hills where surface drainage has eroded the Suttor Formation. Late tertiary colluvium is present at the base of hills to the west of the mining lease, where minor drainage from the site enters Rosetta Creek. Quaternary and Holocene alluvium have accumulated in the Rosetta creek (west of mining lease) and Bungobine creek (south of mining lease) flood plain and active channel areas.

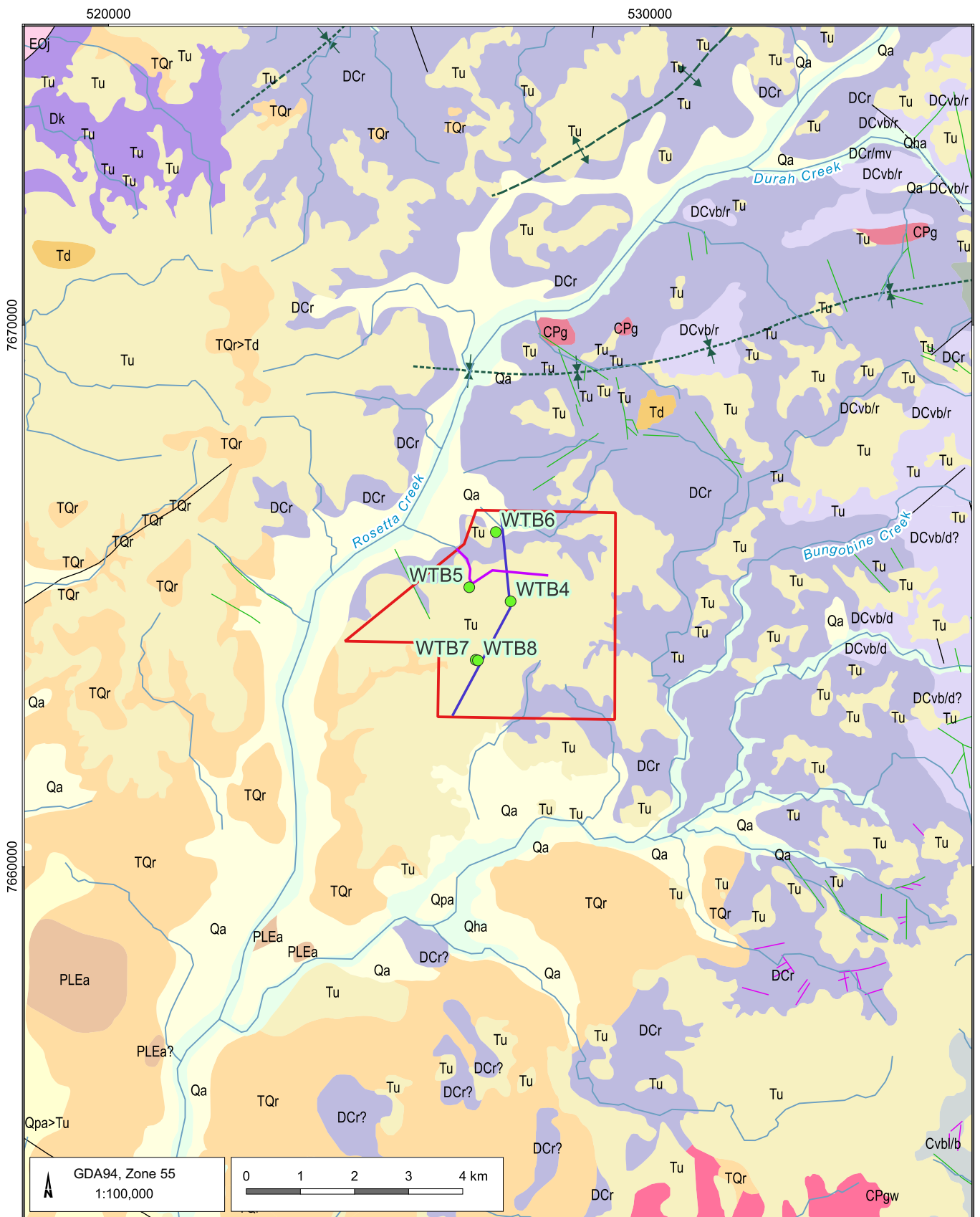
State bedrock mapping indicates that the Silver Hills Volcanics is the underlying basement rock at Wirralie, with the Anakie Metamorphic Group to the west and Bulgonunna Volcanic Group to the east (Figure 6.2). These units were not encountered during drilling of groundwater monitoring bores in 2021, which extend to 25-76 m bgl.

In addition to the state geologic maps, the subsurface geology of the site is further constrained by lithologic observations made during groundwater bore installation that occurred in 2021 (Appendix A). The Suttor Formation was encountered near the surface during drilling of all five groundwater monitoring bores in 2021, supporting the state surface geology mapped extent of this unit. The Mount Wyatt Formation was encountered below the Suttor Formation in the northern area of site, at WTB05 and WTB06, and lithological data suggests that it is also directly overlain by the Suttor Formation around the ore body (WTS, 2023). The Rosetta Creek Formation was only intersected at bore WTB-08 (south of the TSF) and this unit is, therefore, inferred to pinch out below the TSF (WTS, 2023). The inferred geology of the site is represented in the cross-sections of Section 7.

Table 6.1 Summary of geological units

Formation	General lithological description ¹	Age ¹
Alluvium - active channel (Qha-QLD)	Sand, gravel, silt and clay; active stream channels and low terraces	Holocene (<0.0117 Ma)
Alluvium - flood plain (Qa-QLD)	Clay, silt, sand, gravel; flood-plain alluvium	Quaternary (<2.58 Ma)
Colluvium (TQr-QLD)	Clay, silt, sand, gravel and soil; colluvial and residual deposits (generally on older land surfaces)	Late Tertiary – Quaternary (<66 Ma)
Suttor (Tu)	Quartz sandstone, clayey sandstone, mudstone and conglomerate; fluvial and lacustrine sediments; minor interbedded basalt	Tertiary (Paleogene and Neogene, 66 - 2.58 Ma)
Rosetta Creek (DCr)	Siltstone to pebbly sandstone with locally abundant plant fossils; numerous, relatively thin rhyolitic ignimbrite sheets. Coherent basalt to andesite lava; minor high-level mafic intrusives. Volcaniclastic sst; minor intermediate pyroclastic deposits.	Late Devonian - Early Carboniferous (375 - 358.9 +/-0.4 Ma)
Mount Wyatt Formation	Labile sandstone and siltstone, tuff, epiclastic sediments, algal limestone pods, minor rhyolite and oligomictic "quartz-pebble" conglomerate.	Late Devonian (Famennian, 372.2 +/-1.6 - 358.9 +/-0.4 Ma)
Silver Hills Volcanics	Rhyolite, dacite, rhyolitic ignimbrite, volcaniclastic sediments, sinter, minor sandstone and siltstone.	Late Devonian - Early Carboniferous (Visean) (371.2 +/-6 - 343.7 +/-5.3)

Notes: ¹Source: Australian Stratigraphic Units Database (Geoscience Australia, October 2023)



LEGEND

- | | | |
|--|--|---|
| Mining Lease | ● Monitoring bores | Bimurra Volcanics (DCvb) |
| Drainage | Transect lines | Rosetta Creek Formation (DCr) |
| — Major drainage | — E-W (Sugarbag Ck) | Ukalunda Formation (Dk) |
| — Minor drainage | — N-S | Locharwood Rhyolite/b (Cvbl/b) |
| QLD structural geology | Surface geology | Granitoid (CPg) |
| - - - Anticline | Quaternary alluvium (Qa) | Les Jumelles beds (EOj) |
| — Fault | Sutor Formation (Tu) | Wirralie Granodiorite (CPgw) |
| - - - Fault concealed | Late tertiary colluvium (TQr) | |
| — Joint pattern | Tertiary Ferricrete (Td) | |
| — Lineament | Anakie Metamorphic Group (PLEa) | |
| - - - Syncline | Holocene alluvium (Qha) | |

Wirralie Permeability Testing and Progressive Rehabilitation and Closure Plan (WIR5000.001)

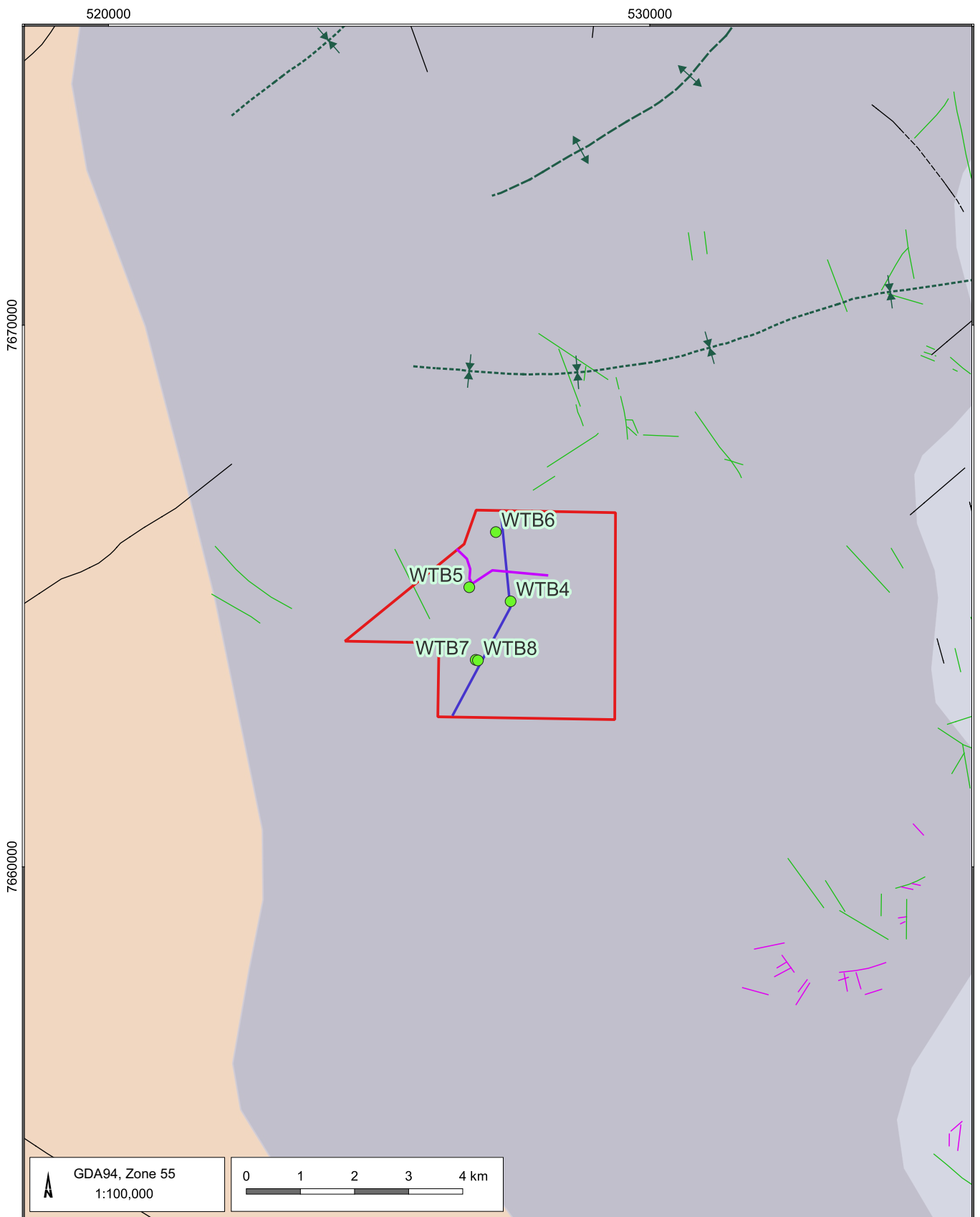
State geologic map



AGE

DATE
04/12/2023

FIGURE No:
6.1



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- | | |
|--|--|
| Mining Lease | ● Monitoring bores |
| QLD structural geology | Transect lines |
| --- Anticline | --- E-W (Sugarbag Ck) |
| --- Fault concealed | --- N-S |
| --- Joint pattern | Basement geology |
| --- Lineament | ■ Bulgonunna Volcanic Group (Cvb) |
| ... Syncline | ■ Silver Hills Volcanics (DCs) |
| | ■ Anakie Metamorphic Group (PLEa) |

Wirralie Permeability Testing and Progressive Rehabilitation and Closure Plan (WIR5000.001)

State geologic map - Basement geology



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04/12/2023

FIGURE No:
6.2

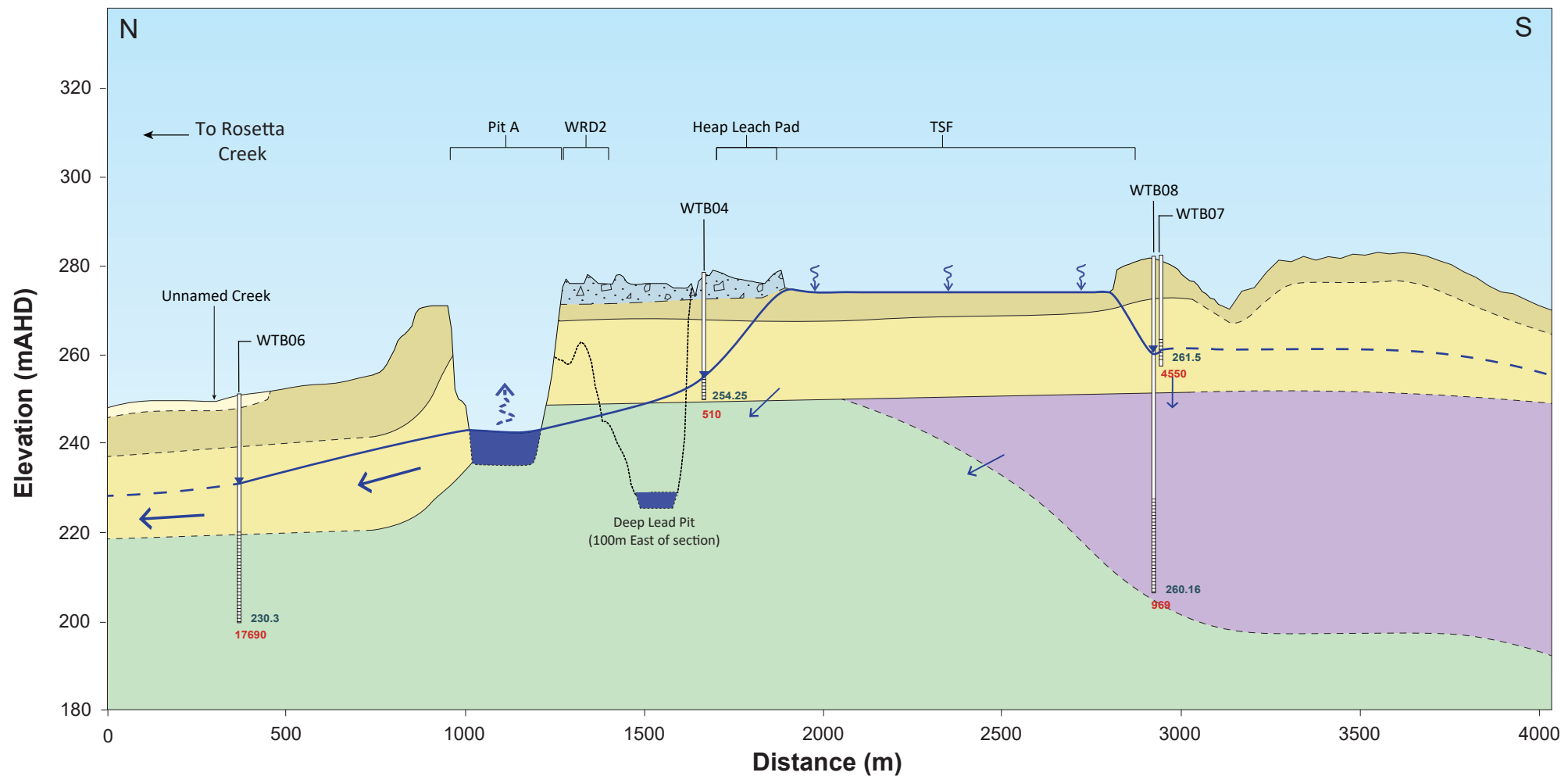
7 Conceptual hydrogeological model (cross sections)

To conceptualise the groundwater flow system in at Wirralie, existing data for ground elevation, infrastructure, geology, and water levels were collated to produce interpretative north to south (Figure 7.1) and east to west (Figure 7.2) hydrogeological cross sections.

The West to East section follows Sugarbag creek from the mining lease boundary to bore WTB05. The transect then travels northeast through Pit B before rotating east to intercept the pit lakes of Pit A and North Pit. The North to South section begins at the northern mining lease boundary and heads south past WTB06 (100m off section) and through Pit A, WRD2 and WTB04. From WTB04 it travels southwest through the HLP, TSF and past WTB07 and WTB08 before terminating at the southern mining lease boundary. The 2023 topography (1m LiDAR) is infilled with the inferred geology. Rock weathering is indicated by a grey overlay which results in the lithology appearing darker in colour than the legend indicates.

The conceptualisations are subject to uncertainty related to the spatial and temporal distribution of data; in particular, geology and water levels are limited by the spatial distribution of the data uncertainty. Where uncertainty exists, the inferred elevations and boundaries are presented as dotted lines.

There are no groundwater receptors directly indicated on the cross section, as no confirmed users exist in the area depicted by the cross-sections (refer to Section 14). Off lease potential receptors include the Rosetta Borefield and ecosystem use along Rosetta Creek; the general direction of these receptors is indicated on the cross-sections.

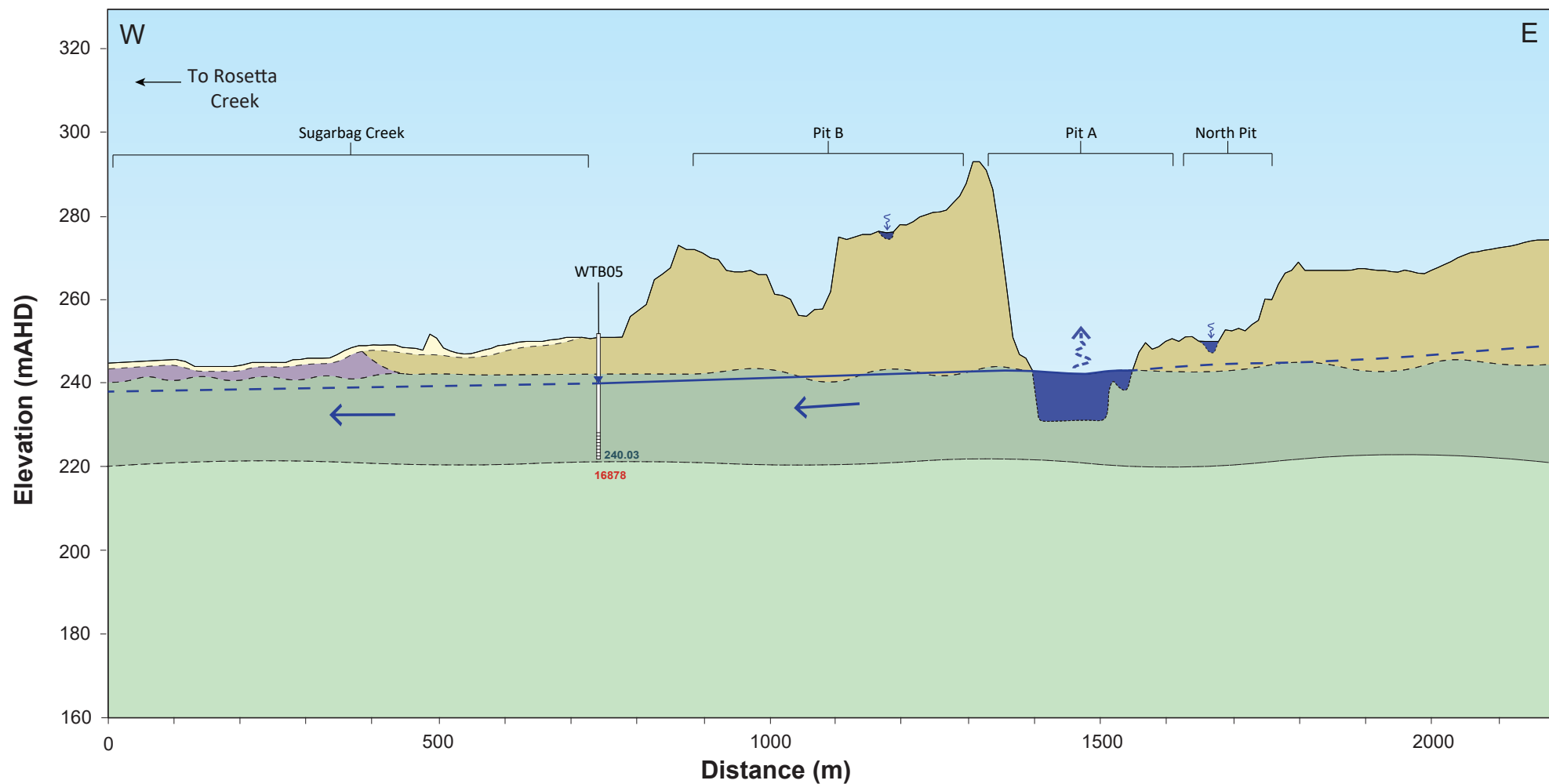


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- | | | | | | | | | | | | | |
|--|---|--|---|--|---|--|--|---|---|---|--|---|
| Alluvium | Waste rock | Suttor Formation | Rosetta Creek Formation | Mount Wyatt Formation | Weathering (grey overlay) | Inferred evaporation /
evapotranspiration processes | Inferred seepage | Inferred groundwater table (May 2023) | Inferred groundwater flow direction | Groundwater monitoring bore with May
2023 groundwater elevation (mAHD) | Inferred based on available data | 254.2 Electrical Conductivity (uS/cm) |
|--|---|--|---|--|---|--|--|---|---|---|--|---|

Vertical exaggeration: 1:15





Legend

- | | | |
|--|---|--|
| Alluvium | ▼ Groundwater table (May 2023) | 128.6 Groundwater monitoring bore with May 2023 groundwater elevation (mAHD) |
| Suttor Formation | → Inferred groundwater flow direction | Inferred based on available data |
| Rosetta Creek Formation | ↑ Inferred evaporation / evapotranspiration processes | 254.2 Electrical Conductivity (uS/cm) |
| Mount Wyatt Formation | ↓ Inferred seepage | |
| Weathering (grey overlay) | | |

Vertical exaggeration: 1:6

West to East conceptual cross-section

Figure 7.2

Wirralie Permeability Testing and Progressive Rehabilitation and Closure Plan (WIR5000.001)

8 Hydrostratigraphic units (aquifers and aquitards)

The hydrostratigraphic unit that host the target ore at Wirralie is the Mount Wyatt Formation, which is locally comprised of volcanics and would be considered a fractured rock aquifer. The younger, sedimentary lithologies of the Rosetta Creek and Suttor Formation unconformably overlie the Mount Wyatt Formation and host water in intergranular pore space. Another potential hydrostratigraphic unit near the Project is the younger cover units, although these are not saturated. These hydrostratigraphic units are discussed in more detail below.

8.1 Mount Wyatt Formation

Regionally, the Mount Wyatt Formation can consist of siltstone, sandstone and conglomerates, as well as volcanics. It was intercepted 7 and 8 m bgl during drilling at bores WTB05 and WTB06, respectively. These bore logs indicate that locally the formation is comprised of porphytic intermediate volcanics with a varying weathered zone (5 to 21 m) of high clay content. Quartz veining and intersecting dykes were identified in the fresh rock. Due to the crystalline nature of the fresh Mount Wyatt Formation, it is unlikely that these rocks have preserved primary porosity. Thus, groundwater flow and movement within this unit is controlled by secondary porosity from fracturing. The overlying, clay rich weathered zone may act as a partially confining unit.

8.2 Rosetta Creek Formation

The Rosetta Creek Formation can be composed of siltstone to pebbly sandstone or variable volcanic lithologies. At Wirralie, the Rosetta Creek Formation was intersected at 251.49 mAH (31 m bgl) in bore WTB08 and consisted of 23 m of clayey sandstone, 17 m of sandstone with conglomerate clasts, and 5 m of clay rich conglomerate. Given this lithology, the Rosetta Creek Formation is considered to have variable primary porosity, which is dependent on the size and properties of the comprising grains and the degree of cementation and compaction of the subunits; this porosity is likely to be inversely proportional to the clay content.

8.3 Suttor Formation

The Suttor Formation can be composed of quartz sandstone, clayey sandstone, mudstone and conglomerate, fluvial and lacustrine sediments, and minor interbedded basalt. At Wirralie, the Suttor Formation predominately consists of poorly sorted sandstone of varying colours (cream, white, grey, red, pink, brown, orange). It is highly weathered (ferruginised) near the surface. Given this lithology, the Suttor Formation is considered to have variable primary porosity, which is dependent on the size and properties of the comprising grains and the degree of cementation and compaction of the subunits. This porosity is likely to be inversely proportional to the clay content and the degree of weathering, with ferricrete weathering acting to decrease the initial porosity.

8.4 Other cover units

Late tertiary colluvium and quaternary alluvium are present on the outskirts of the Project. The characteristics of the younger cover units reflect the nature of the source rocks, weathering, transport, and depositional conditions. Poorly sorted clay, silt, sand, and gravel comprise the thin flood-plain alluvium. These units have variable primary porosity, which is dependent on the size and properties of the comprising grains and the degree of cementation and compaction of these units.

8.5 Hydraulic properties (including summary of hydraulic conductivity)

AGE conducted rising and falling head tests at Wirralie in August 2023. The falling head tests (FHT) were undertaken using a standard technique, where a solid slug (1.2 L volume) was inserted into the bore, resulting in a displaced/raised water level. The recovery of the water level over time was then recorded with a water level datalogger (pressure transducer). The rising head tests (RHT) were completed using a similar technique, where a solid slug was instead removed from the bore, resulting in the negative displacement of water, and

lowering of the water level. The water level was then recorded as it recovered for the RHT. Only bores WTB05 and WTB06 (both screened in the Mount Wyatt Formation) could successfully be fully tested for formation permeability; relative estimates of hydraulic conductivity are available for WTB07. In-situ permeability tests could not be performed on WTB04 due to the bore being dry and WTB08 due to a blockage at ~30m.

The FHT and RHT were performed three times WTB05 and the levellogger recording interval was reduced from 1 minute (1st test) to 0.125 seconds (2nd and 3rd tests), to best capture the recharge curve. The second and third tests best captured the recharge at WTB05, given the water level recovered within 5 minutes (Appendix B). Small oscillatory (underdamped) responses were measured at WTB05 during the FHTs and RHTs, which likely reflect the high permeability of the gravel pack around the bore casing and not the screened lithological unit (weathered intermediate volcanics). The underdamped response underwent a preliminary analysis with the Spring-Gelhar (1991) model within AQTESOLV software (considered suitable for use on underdamped test responses) and the modelled K value was compared to expected K value ranges for the screened lithology (Weathered intermediate volcanics). The K value modelled from the short, underdamped response was many orders of magnitude away from expected values for the lithology, and, therefore, is suspected of reflecting the permeability of the gravel pack around the bore casing. The data points representing this underdamped response were then ignored for WTB05, and the remaining data was analysed using Hvorslev (1951) and Bouwer and Rice (1976) mathematical models within AQTESOLV software. These models are considered appropriate for use on overdamped responses.

One FHT and one RHT were performed at WTB06. The levellogger recording interval was set to 1 minute, after WTS advised that, historically, the bore is slow to recover from purging. WTB06 was slower to recover than WTB05 (Appendix B). WTB06 intersects a 16m clay (with some coarse sand) layer, from 8 m bgl to 24 m bgl, and therefore it was run through the model as unconfined and confined and analysed using Hvorslev (1951) and Bouwer and Rice (1976) mathematical models within AQTESOLV software.

FHT and RHT were attempted in WTB07; however, due to its low hydraulic conductivity and purging during groundwater sampling two days prior, it appears that the water level hadn't yet fully recovered prior to commencement of the tests. The recorded head responses show a consistent rise across the test duration, far exceeding the initial head level by the end of the tests (Appendix B). There was inadequate time to repeat the tests for a second time. However, these results, combined with the very slow response time, indicate that the hydraulic conductivity of the screened interval at WTB07 is considerably less than that of WTB05 and WTB06.

The hydraulic conductivity estimates for each formation provided by the analysis are provided in Table 8.1. The graphical analytical reports for WTB05, WTB06, and WTB07 are presented in Appendix B. The range of published hydraulic property values of sandstone (Suttor Formation: weathered to fresh) and igneous rocks and metamorphic rocks (Mount Wyatt formation: intermediate volcanics, weathered to fresh) are also presented for comparison. The Rosetta Creek Formation, a potential combination of siltstone, sandstone, coherent basalt to andesite lava and volcanoclastics, will likely have a hydraulic conductivity (K) between that of sandstone and igneous rocks.

Table 8.1 Hydraulic properties

Hydrostratigraphic unit	Data type	Permeability (m/d)	Reference
Mount Wyatt Formation (WTB05 and WTB06)	Slug tests	0.008 to 1.1	Appendix B
Suttor Formation (WTB07)	Slug test (failed)	<<0.008	Appendix B
Sandstone	Published values	0.0000086 to 0.41	Freeze and Cherry (1979)
Fractured igneous rocks and metamorphic rocks	Published values	0.00041 to 41	Freeze and Cherry (1979)
Unfractured igneous rocks and metamorphic rocks	Published values	0.0000000041 to 0.000041	Freeze and Cherry (1979)
Sandstone	Published values	0.00001 to 1	Heath (1983)
Igneous and metamorphic rocks	Published values	0.0000001 to 10	Heath (1983)

9 Groundwater levels (with potentiometric mapping)

Groundwater levels have been monitored monthly to quarterly since their construction. Details of these bores are provided in Table 9.1 and their locations are shown on Figure 5.1. Groundwater levels in the Wirralie area, from 2021 to 2023, are characterised temporally in hydrographs (Figure 9.1 and Figure 9.2) and spatially in a potentiometric map (Figure 9.3).

The groundwater hydrographs for these bores are depicted in Figure 9.1 and indicate that groundwater is generally more than 20 m bgl, but it rises closer to the ground surface around WTB05 (~10 m bgl). Groundwater level fluctuations (excepting the August 2022 data from WTB06, which is potentially anomalous) of up to 5 m are observed in individual bores but there are generally no overall trends (excepting bore WTB06, which may have a gradually increasing trend) apparent in groundwater levels across the Project area. This absence of trends in hydrographs occurs despite a CRD that has generally been increasing since early 2022 (Figure 9.2). Additionally, there are no bores at Wirralie that display seasonal trends in groundwater levels. Groundwater levels with relatively flat hydrographs are typical of areas with limited and slow recharge; such observations are consistent with the climate (see Section 4.1) and/or low hydraulic conductivity (see Section 8.5) observed at Wirralie.

The elevation of the potentiometric surface in May 2023 was mapped and, where data allowed, contoured using the kriging interpolation method in the Golden Software program Surfer® version 16. The preliminary kriged contour maps were modified to reflect actual onsite conditions. Groundwater elevation dummy points were inserted at the lakes in Pit A (243 mAHD), Deep Lead Pit (230 mAHD) and the TSF (274 mAHD), where the water is present year-round and assumed to connect to groundwater. The groundwater elevation at these locations was estimated from the 1m LiDAR elevation data. The lake in North Pit has a surface elevation of 250 mAHD and is assumed to be no deeper than 5m; placing the base of the North Pit Lake approximately 2m above the surface of the Pit A lake (located 50m West). Therefore, it is assumed that the lake in North Pit is perched above the groundwater table. The small lake (550 m²) in the north section of Pit B has a surface elevation of 276 mAHD (1m LiDAR) and is also assumed to be perched above the water table. Two additional dummy points were inserted between the TSF and WTB05 (253 mAHD at 526921.4E,7664721N and 246 mAHD at 526890.6E,7664978N) to move the groundwater below the ground surface; these contours were smoothed. Contours were left open east and west of the TSF and near Deep Lead Pit, to represent the areas of uncertainty, and Pit A was treated as a flow-through feature. Arrows on the map indicate the inferred groundwater flow direction.

Table 9.1 Wirralie monitoring bore details

Bore	Easting	Northing	Ground Surface (m AHD)	Total Depth (m BGL)	Screened interval	Geology intersected	Screened lithology	SWL- May 2023 (m AHD)
WTB04	527427.1	7664899	277.88	28	22 - 28	Waste Rock, Suttor Formation	Sandstone	254.25
WTB05	526663.7	7665160	249.98	28	22 - 28	Suttor Formation, Mount Wyatt Formation	Weathered intermediate volcanics	240.03
WTB06	527154.5	7666179	249.5	50	29 - 50	Suttor Formation, Mount Wyatt Formation	Intermediate volcanics	230.30
WTB07	526781.9	7663820	282.62	25	19 - 24	Suttor Formation	Sandstone	261.50
WTB08	526823.4	7663809	282.49	76	55 - 76	Suttor Formation, Rosetta Creek Formation	Sandstone, conglomerate	260.16

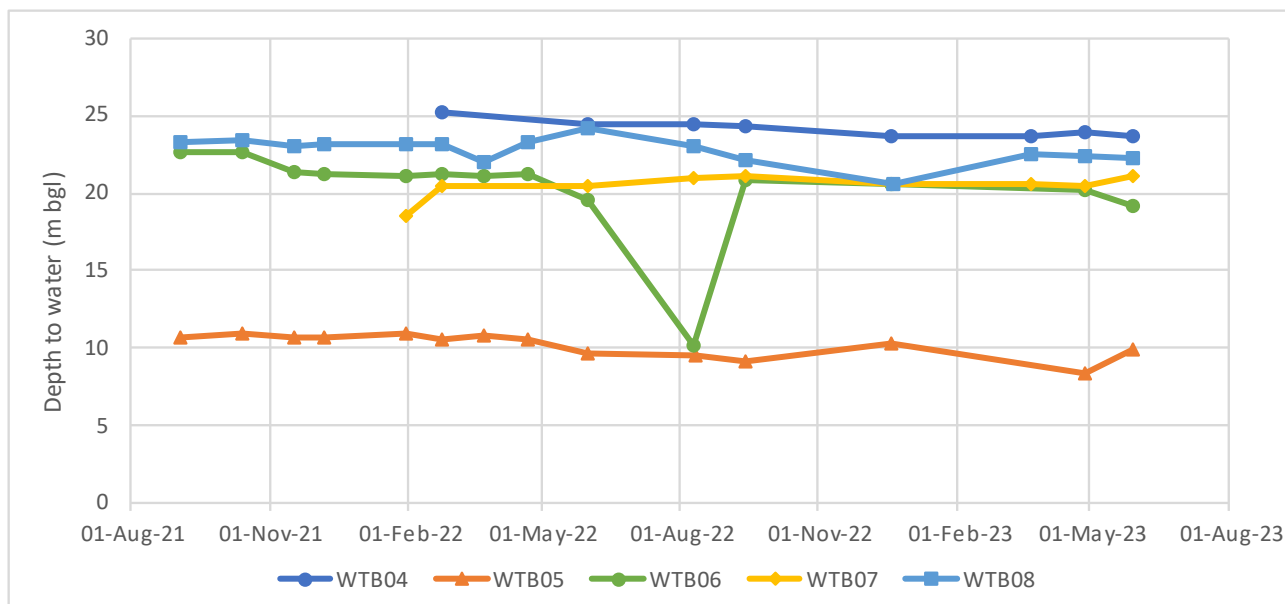


Figure 9.1 Hydrograph of depth to water (m bgl) at Wirralie

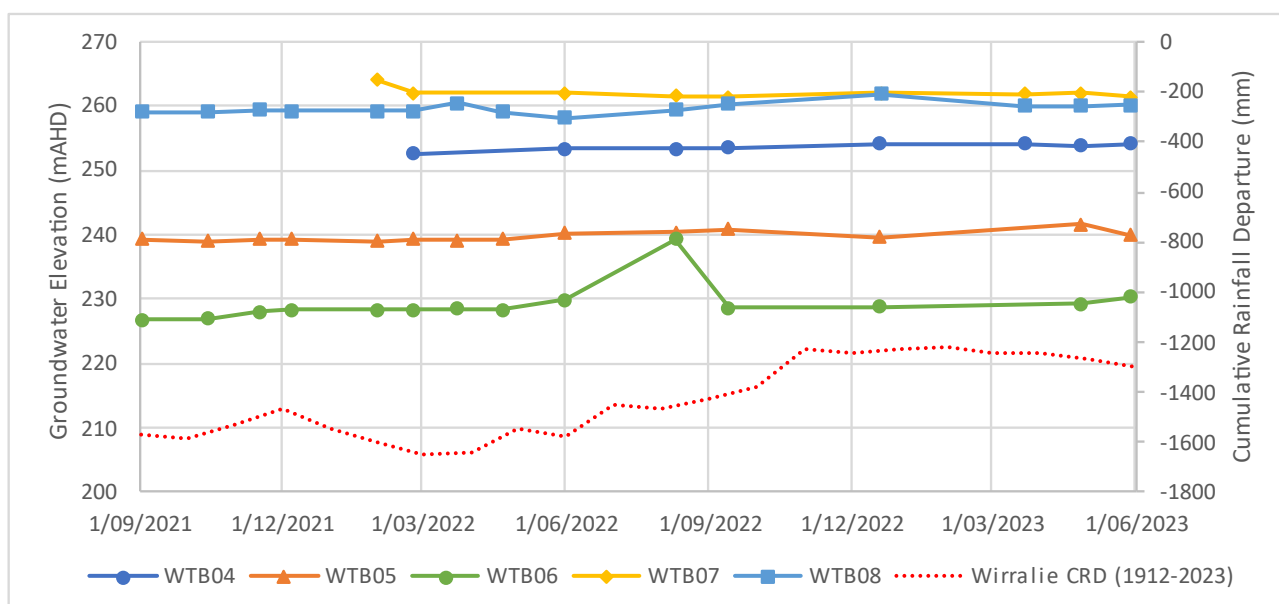


Figure 9.2 Hydrograph of groundwater elevation (mAHD) at Wirralie



LEGEND

- ▭ Mining Lease
- Monitoring bores
- Water table (2m contours)
- Drainage
 - Major drainage
 - Minor drainage
- ➔ Inferred groundwater flow direction

Wirralie Permeability Testing and Progressive Rehabilitation and Closure Plan (WIR5000.001)

Potentiometric map (May 2023 groundwater levels)



AGE

DATE
12/12/2023

FIGURE No:
9.3

10 Groundwater recharge and discharge

10.1 Recharge

It is estimated that the quaternary sediments (alluvium and colluvium) and the Suttor formation are recharged directly by heavy rainfall. This is due to the unconsolidated nature of alluvial and colluvial sediments and their proximity to Rosetta Creek. The Suttor formation outcrops across most of the site and is weathered to varying degrees, which may allow some rainfall infiltration during heavy rainfall periods. It is estimated that a significant portion of rainfall that hits the outcropping hills of the Suttor formation will become surface runoff and drain downgradient. The predominant recharge mechanism of the Mount Wyatt Formation, Rosetta Creek Formation and Suttor Formation is likely due to downward/sideways seepage from overlying/adjacent geology, infiltration from outcrops, and leakage through faults or other structures.

10.2 Discharge

In the quaternary alluvium and colluvium, groundwater discharge is thought to occur via evaporation and through-flow of the aquifer. In the Suttor Formation, groundwater likely discharges via seepage to the underlying Rosetta Creek/Mount Wyatt Formations, as well as through evaporation where it is near enough to the surface, and through-flow to other units. Groundwater in the Rosetta Creek Formation will enter underlying bedrock through seepage and preferential flow fault structures, and a portion of groundwater will be discharged as through-flow. Discharge of the Mount Wyatt Formation is likely to be dominated by faults.

10.3 Abstraction history

The Rosetta borefield (also called Olderfleet borefield, established in 1987) and the Harry Marsh borefield (southwest of the Rosetta borefield, established in 1999) were used to supply potable and process water to the previous Wirralie operation, which stopped mining operations in 2001. The present Wirralie operation extracts groundwater from bores in the Rosetta Creek Borefield, pumping water to the raw water dam when required during dry season (for use as potable water supply or in gold processing). No information is available on extraction rates or volumes. The five bores installed at Wirralie in 2012 are used for groundwater monitoring and not for water supply. All registered bores in the vicinity of Wirralie have been abandoned and destroyed, and, therefore, it is not anticipated that additional groundwater is being extracted near the site.

10.4 Groundwater – surface water interaction

Creeks in the site area, including Rosetta creek, are ephemeral. The groundwater at Wirralie is generally more than 20 m BGL but it rises closer to the ground surface around WTB05 (~10 m BGL, 240.03 m AHD) (Figure 9.1). WTB05 is the closest bore to Sugarbag creek and is located downgradient of the process and tailings storage areas. Rosetta creek has an approximate elevation 271.7 m AHD where it intersects with Sugarbag creek. Given the base of Rosetta Creek is approximately 1.7 m higher than the groundwater level recorded at WTB05, and all creeks near the project are ephemeral, it is inferred that no baseflow (groundwater discharge) is occurring to natural surface water features.

According to the Queensland Wetlands Database there are no springs in either in the mining lease area or surrounds (DSITI, 2015b). This observation matches the conceptual model described above of negligible groundwater discharge to natural surface water features]

11 Groundwater quality

Historical groundwater monitoring at Wirralie was sparse and infrequent (NRC, 2016b); however, routine (monthly to every second month) groundwater level monitoring has occurred for the bores listed in Table 9.1) since August 2021 (Table 11.1). The location of all of the groundwater monitoring bores is proximal (within 550 m) to mine infrastructure and the hydrogeochemical profile of groundwater in all bores has at least one characteristic that is potentially indicative of a mining impact. At a metalliferous mine site, such as Wirralie, generic water quality indicators of potential mining impacts include low pH values, high total dissolved solids (TDS), elevated sulfate concentrations, high metal concentrations, and elevated sulfate/chloride ratios. These are discussed further below by parameter and summarised for all bores in Table 11.2. In the absence of groundwater quality data from additional locations, it is not possible to definitively characterise the extent to which mining operations have impacted site water quality.

Table 11.1 Wirralie Groundwater Quality summary

Bore ID	Analyte Units LoR	pH pH units	TDS g/L	SO4 mg/L 1	Ar mg/L 0.001	Cd mg/L 0.0001	Cu mg/L 0.001	Fe mg/L 0.05	Pb mg/L 0.001	Mn mg/L 0.001	Mo mg/L 0.001	Se mg/L 0.01	Zn mg/L 0.005	Hg mg/L 0.0001	Cyanide mg/L 0.004
WTB04	Min	3.87	283	46	0.0005	0.00005	0.002	0.025	0.0005	0.641	0.0005	0.005	0.024	0.00005	0.002
	Median	4.62	416	72	0.0005	0.0001	0.007	0.025	0.0005	0.773	0.0005	0.005	0.121	0.00005	0.002
	Max	5.47	720	88	0.008	0.0003	0.027	0.2	0.0005	0.902	0.002	0.005	0.268	0.00005	0.002
	No. of samples	9	9	9	9	9	9	3	9	3	9	9	9	9	9
WTB05	Min	3.15	4810	1460	0.007	0.0043	0.015	0.26	0.002	6.76	0.0005	0.005	2.28	0.00005	0.002
	Median	3.65	11400	1660	0.01	0.0046	0.035	0.34	0.0065	6.86	0.0005	0.0075	3.105	0.00005	0.002
	Max	7.47	15500	1880	0.023	0.0054	0.651	0.5	0.036	7.27	0.0005	0.02	4.63	0.0101	0.002
	No. of samples	17	17	17	14	14	14	3	14	3	14	14	14	14	17
WTB06	Min	6.32	9860	1360	0.002	0.00005	0.0005	0.025	0.0005	2.18	0.002	0.005	0.0025	0.00005	0.002
	Median	6.76	13600	1950	0.003	0.0002	0.001	0.025	0.0005	4.14	0.004	0.005	0.00475	0.00005	0.002
	Max	7.9	15700	2130	0.005	0.0024	0.004	0.025	0.0005	8.42	0.013	0.005	0.192	0.00005	0.002
	No. of samples	17	17	17	14	14	14	3	14	3	14	14	14	14	17
WTB07	Min	6.37	2330	273	0.0005	0.00005	0.0005	0.025	0.0005	0.0005	0.003	0.005	0.0025	0.00005	0.002
	Median	6.725	2545	295.5	0.0005	0.00005	0.00075	0.025	0.0005	0.102	0.0035	0.005	0.0075	0.00005	0.002
	Max	7.46	2770	323	0.002	0.0003	0.001	0.025	0.0005	0.81	0.01	0.005	0.035	0.00005	0.002
	No. of samples	10	10	10	10	10	10	3	10	3	10	10	10	10	10
WTB08	Min	5.79	378	40	0.0005	0.00005	0.0005	0.025	0.0005	0.004	0.0005	0.005	0.0025	0.00005	0.002
	Median	6.77	594	43.5	0.0005	0.00005	0.0005	0.025	0.0005	0.015	0.001	0.005	0.0025	0.00005	0.002
	Max	7.45	676	62	0.0005	0.00005	0.017	0.025	0.0005	0.026	0.002	0.005	0.07	0.00005	0.002
	No. of samples	16	16	16	14	14	14	3	14	3	14	14	14	14	16

NOTES: Data from August 2021 to August 2023

LoR = limit of reporting

Non-detects were assigned the value of 0.5 x LoR (i.e. <0.01 was assigned 0.005)

Table 11.2 Summary of water quality indicators of potential impact

Bore	low pH (Y/N); comments	High EC/TDS (Y/N); comments	Elevated sulfate concentration (Y/N); comments	High copper concentration (Y/N); comments	Elevated sulfate/chloride (Y/N); comments
WTB04	Y	N	N	Y	Y
WTB05	Y	Y	Y	Y	Potentially
WTB06	N	Y	Y	Y	Potentially
WTB07	N	Y	Y	N	Potentially
WTB08	N	N	N	N (one sample)	Potentially

The groundwater pH in monitoring bores at Wirralie ranges from 3 to 8 pH values across the site (Figure 11.1). The pH values measure in groundwater from bores WTB06, WTB07, and WTB08 is generally circum-neutral to slightly acidic; these values are within the range expected for groundwater in the region. In contrast, groundwater in bores WTB05 and WTB04 are acid (WTB04) to very acidic (WTB05); these low groundwater pH values contrasts somewhat with the findings of the waste rock characterisation undertaken in 2021 (C&R, 2022, discussed in Section 5), which suggests that waste generally has a low potential to be acid forming.

This apparent contradiction may be to either due to surface material (i.e. the samples collected in 2021) that has already undergone oxidative leaching of sulphides or higher acid producing potential in the ore (not assessed in the C&R, 2022 study).

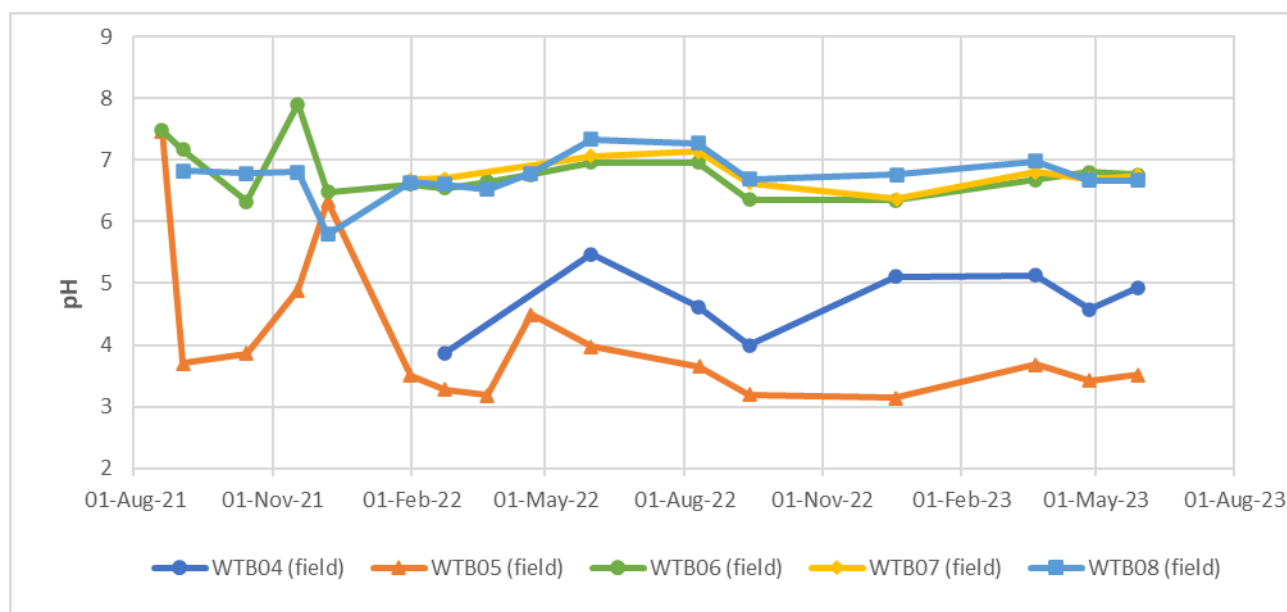


Figure 11.1 Field pH values from groundwater bores

The TDS in groundwater from the monitoring bores at Wirralie ranges from 283 to 15,700 mg/L (Figure 11.2). Saline water TDS >10,000 mg/L was detected at both WTB05 and WTB06. Relatively fresh water (TDS <1,000 mg/L) is generally present in groundwater from bores WTB04 and WTB08 and brackish water is generally present in groundwater from bore WTB07. Both the interbore concentrations of sulfate and intrabore trends in sulfate concentration (Figure 11.3) have patterns that are broadly consistent with the TDS of groundwater in these bores, indicating a generally correlation between salinity and sulfate concentration. High salinity is observed in bores with both circum-neutral (WTB06) and low pH (WTB05), with WTB04 having relatively fresh water, despite an acidic pH. As such, the hydrogeochemical evolution of groundwater at the Wirralie cannot be explained solely as result of sulfate oxidation (resulting in water with low pH and high solute load). Other

process must be occurring and might include saline, but neutral drainage; evapoconcentration of solutes; and slow, in situ weathering of natural sulfides.

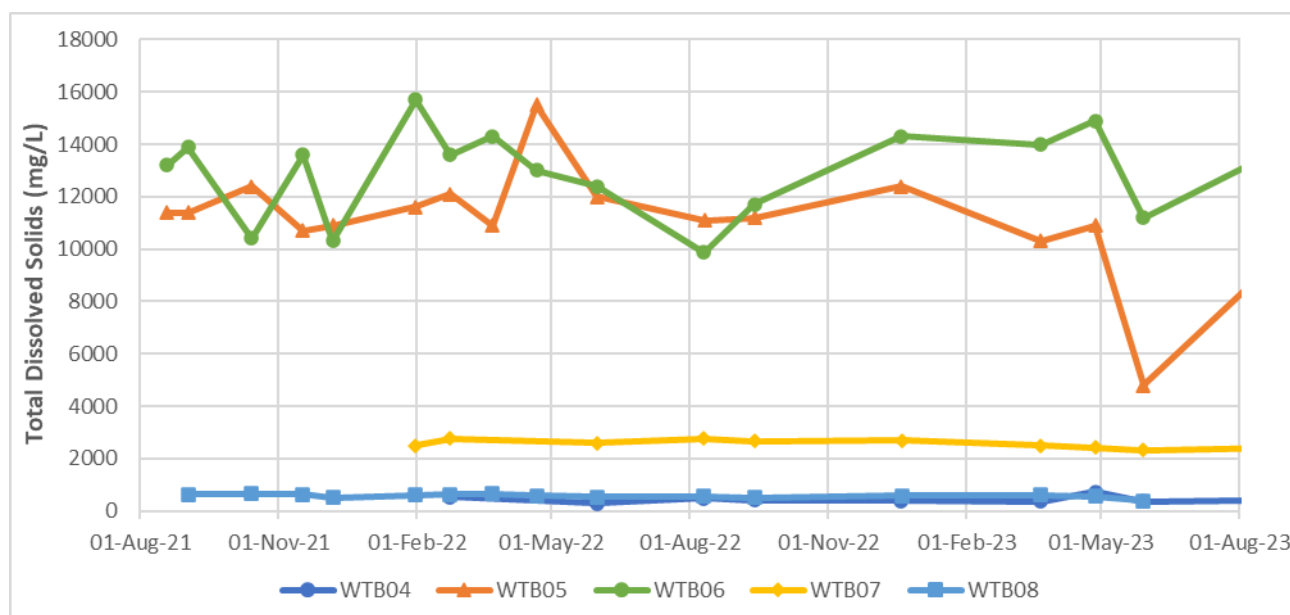


Figure 11.2 TDS from groundwater bores

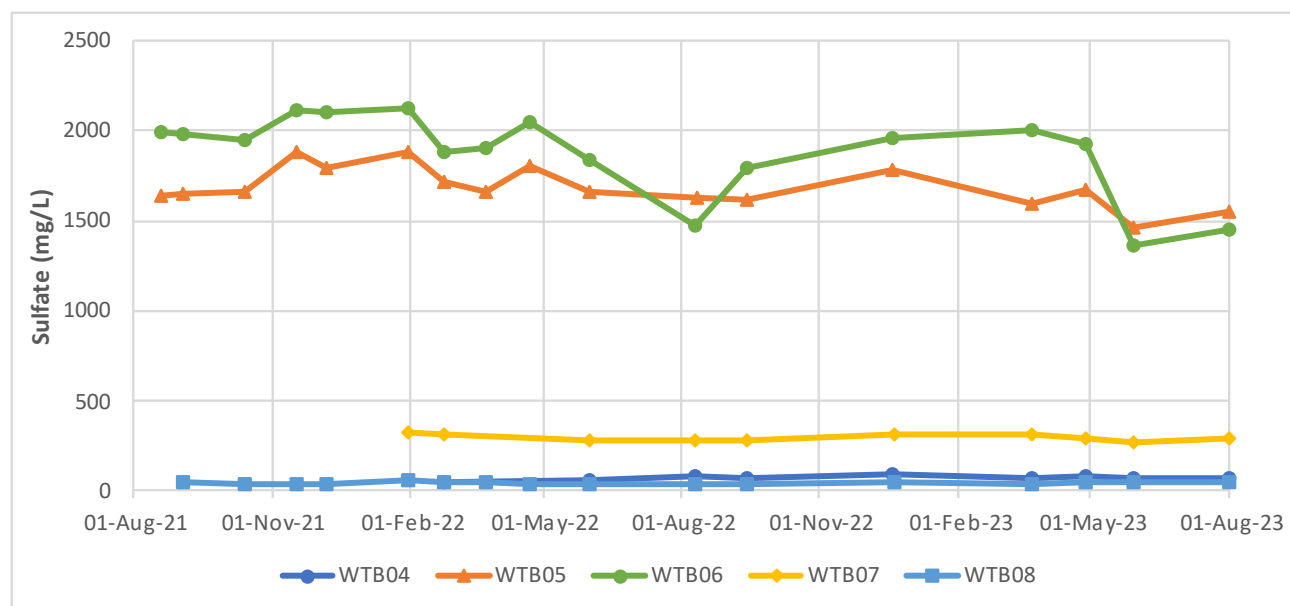
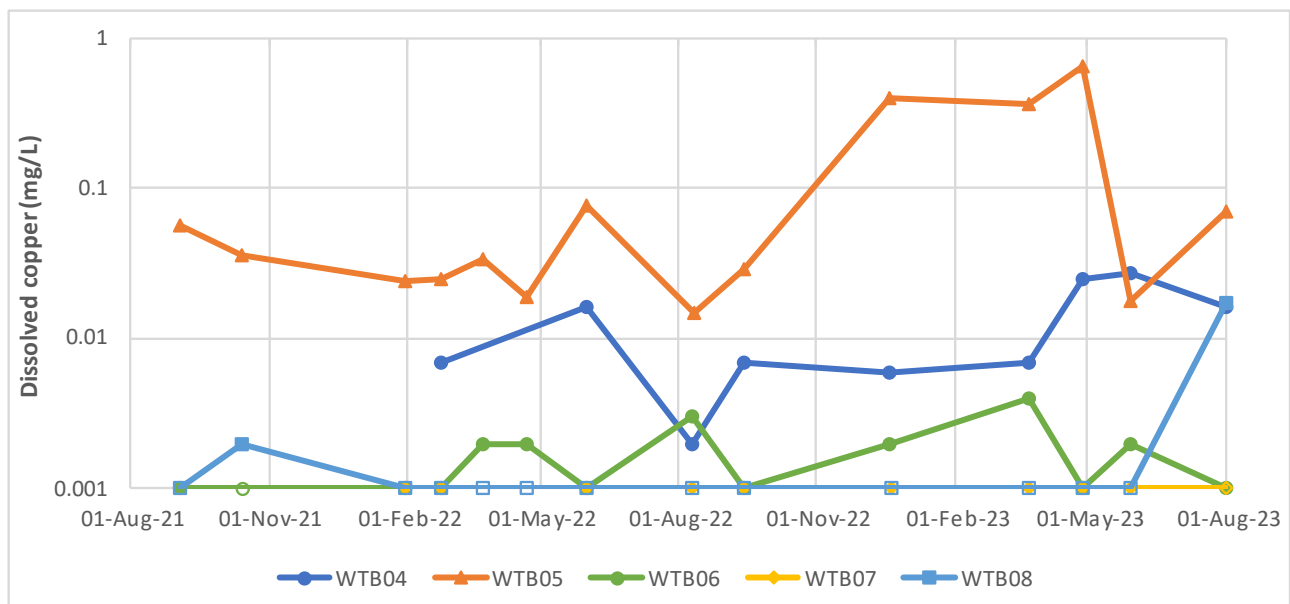


Figure 11.3 Concentrations of sulfate from groundwater bores

Concentrations of some metals, including cadmium, copper (Figure 11.4), lead, and zinc are above the limit of detection at Wirralie. The bores with the highest dissolved copper concentration are WTB05 (which has the highest TDS) and WTB04 (which has the lowest pH). As such, elevated metal concentration is potentially associated with acidic and/or saline mine drainage at Wirralie.



NOTES: Limit of reporting is 0.001 mg/L.
All WTB07 water samples tested for dissolved copper were below the limit of reporting (10 samples)

Figure 11.4 Concentrations of copper from groundwater bores on logarithmic scale

To further understand the processes controlling solute concentrations the ratio of sulfate to chloride (sulfate/chloride) and Piper diagrams were examined. Sulfate/chloride is useful because chloride exhibits chemically conservative behaviour and has few sources except for meteoric deposition. Thus, the sulfate/chloride allows examination of changes in sulfate contributions that are separate from changes in overall salinity (as a result of evaporation and/or transpiration). Piper diagrams represent the relative composition of major anions and cations in groundwaters and allow determination of water types. Changes in major ion composition are indicated by a change in the plotted location of water samples on the Piper diagram. If this change in composition is two-end member mixing, samples will plot in a linear array on the Piper diagram.

The sulfate/chloride ratio of groundwater from most bores (WTB05, WTB06, WTB07, and WTB08) at Wirralie is between 0.2 and 0.4, whereas bore WTB04 has a sulfate/chloride ratio >0.5 . The low pH and relatively higher sulfate/chloride for WTB04 is consistent with sulfide dissolution that results in acidic waters. However, at Wirralie, the sulfate/chloride ratio cannot exclude mine-sourced solutes because WTB05 (which also has a low pH together with a high TDS and elevated metal concentration, which collectively are indicative of potential impact from mining) has a sulfate/chloride that is indistinguishable from that of WTB06, WTB07 and WTB08.

Groundwater at Wirralie is sodium-potassium type in terms of cation composition and chloride or chloride/bicarbonate type in terms of anion composition (Figure 11.6). Relative to bores WTB05, WTB06, and WTB07, groundwater from WTB04 has a distinctly higher sulfate composition and groundwater from WTB08 has a distinctly higher bicarbonate composition. The differing composition of WTB08 is likely due to it being in a different, deeper hydrostratigraphic unit (the Rosetta Creek Formation) and/or it being less impacted by mine sourced solutes that contain relatively greater proportions of chloride and sulfate (representative surface water sources of solutes are shown on Figure 11.6 for reference).

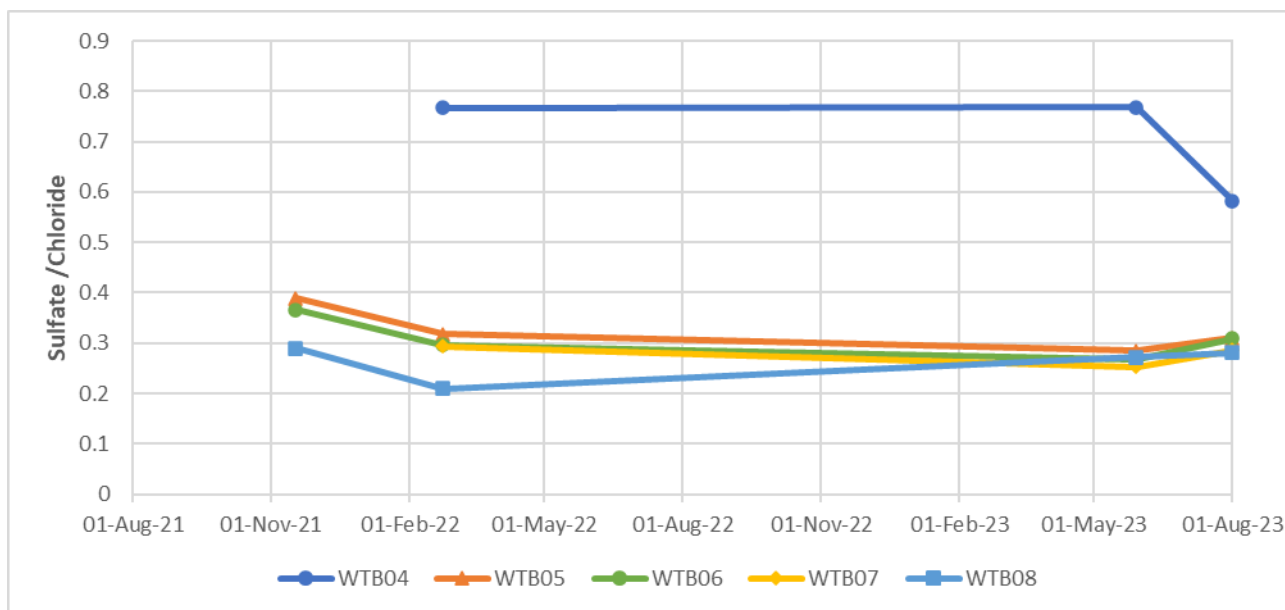


Figure 11.5 Sulfate/chloride from groundwater bores

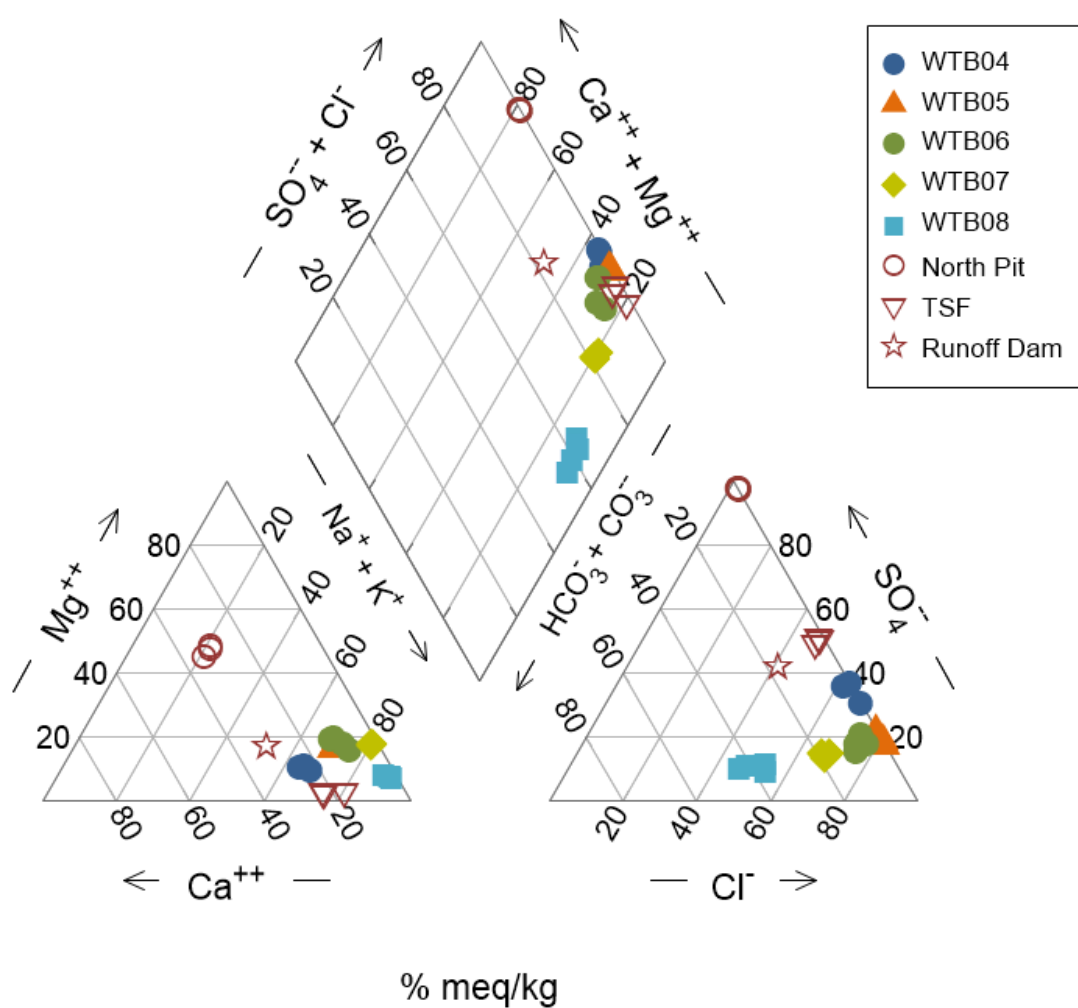


Figure 11.6 Piper diagram of Wirralie groundwater chemistry

12 Groundwater flow and velocity

Analyses of the groundwater level elevations (Section 9) provide understanding of how groundwater is controlled by the stratigraphic and structural framework, and how it may interact with surface water. The map of groundwater contours (Figure 9.2) can be used to understand the groundwater flow pattern, as groundwater flows from areas of high pressure to areas of low pressure.

Linear groundwater flow velocities can be calculated from pairs of bores that are aligned along groundwater flow paths. At Wirralie, the only two bore that are within the same hydrostratigraphic unit and also roughly aligned along a potential flow path are WTB05 and WTB06; these bores are screened in the Mount Wyatt Formation, which is the host unit for mineralisation and the pits. Hydraulic gradients between this bore pair were calculated and average linear velocities (v) were calculated according to Darcy's law:

$$v = K \cdot \frac{dh}{dl} \div n_e$$

were,

K = hydraulic conductivity

n_e = the effective porosity, and

$$\frac{dh}{dl} = \frac{head_2 - head_1}{distance\ between\ bores}$$

These calculations require assumptions about hydraulic conductivity (K) and effective porosity. A range of values for K was used based on the summary provided in Section 9.3, and the minimum and maximum effective porosity (n_e) values considered were: 0.05 (5%), and 0.15 (15%), respectively.

12.1 Flow directions

Groundwater flow broadly follows the topography at site, flowing south to north from the mining and process areas to Sugarbag creek and Rosetta creek. Conceptually, both the cross-section of Figure 7.1 and the contour map of Figure 9.2 have been created to show hydrologic connection between groundwater and water in Pit A, the Deep Lead pit, and the large pond on the TSF. The inferred connection between groundwater and the TSF pond results in apparent mounding under the TSF; however, it is possible that an unsaturated zone exists below the TSF and that the TSF pond is perched above the water table. Regardless of any actual continuously saturated zone between the TSF pond and groundwater, the groundwater quality of the site (Section 9) indicates that surface infrastructure has likely resulted in seepage into groundwater.

12.2 Velocity

The estimates of groundwater flow velocity (average linear velocity) calculated for the Mount Wyatt Formation from bores WTB05 and WTB06 range between 2.1 and 69 m/yr (Table 12.1). Broadly, this range of velocities places some constraints on the speed at which groundwater may potentially move offsite. However, it is only possible to calculate one range of velocities from the project area, and this singular estimate may not be representative of the site as a whole or even of the Mount Wyatt Formation.

Table 12.1 Average linear groundwater velocity estimates

Up-gradient bore	Up-gradient head (mAHD)	Down-gradient bore	Down-gradient head (mAHD)	dh/dl (m/m)	dh/dl as ratio (1 to m)	K (m/d)	(K) comment	V _{max} if n _e = 5% (m/yr)	V _{min} if n _e = 15% (m/yr)
WTB05	240.03	WTB06	230.30	0.009	116	0.008	Min (based on field tests)	2.1	6.3
WTB05	240.03	WTB06	230.30	0.009	116	1.1	Max (based on field tests)	23	69

Notes: * = Horizontal and vertical distance between bore screens used for calculation of dh/dl.

Head = groundwater level.

mAHD = metres Australian Height Datum.

m/d = metres per day.

K = hydraulic conductivity (Section **Error! Reference source not found.**).

dh/dl = hydraulic gradient.

n_e = effective porosity, assumed to be 5% to 15%.

v = average linear velocity (Darcy velocity).

13 Void groundwater status and modelling

Groundwater inflows and/or outflows at any given pit stage are dependent on the relationship between the elevation of the water level in the pit and the elevation of the surrounding groundwater table. Voids that intersect the groundwater table can be classified as sources, sinks, or flow-through systems (Figure 13.1).

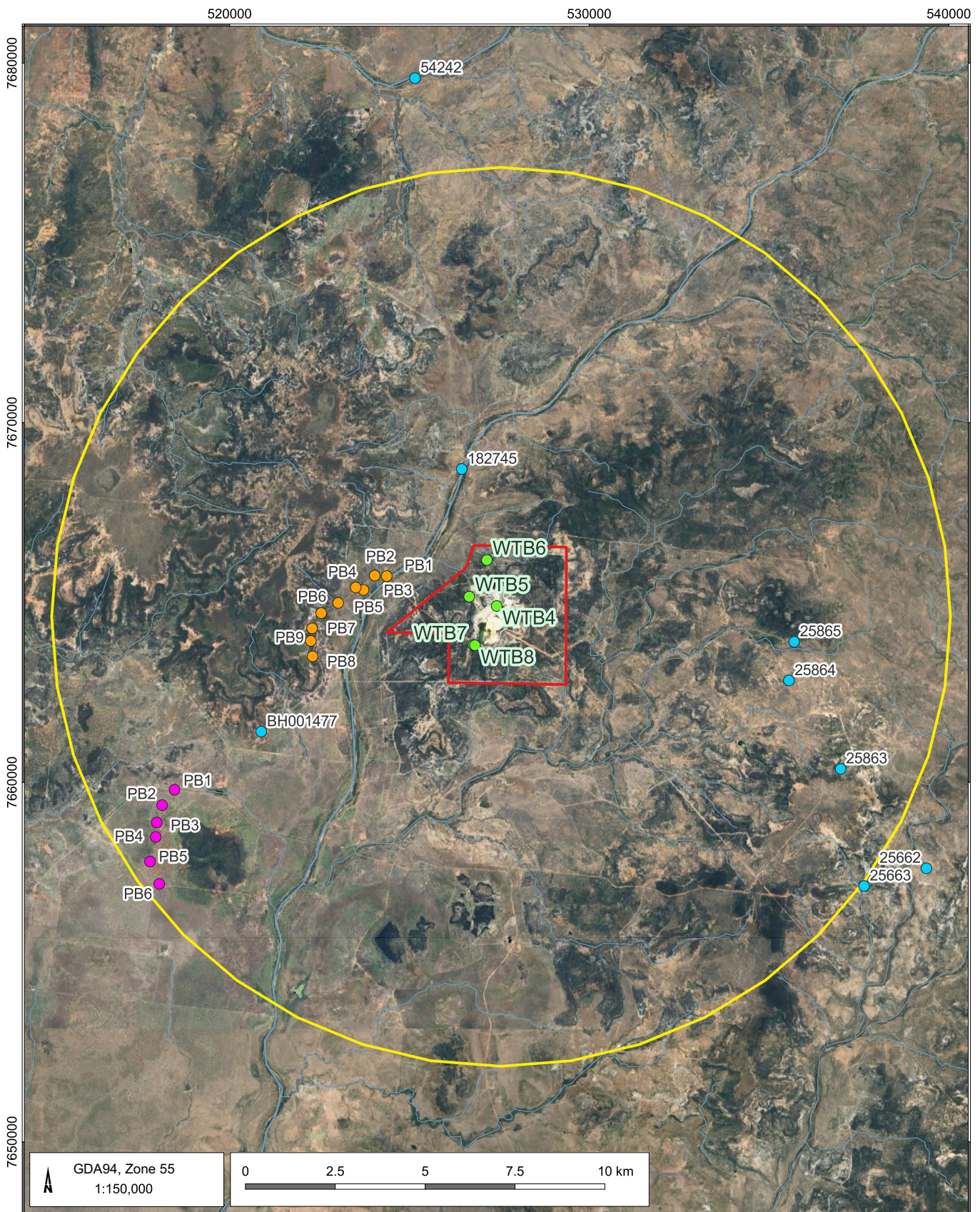
During development of a pit void below the water table, groundwater is expected to seep into the pit and this water is removed to create safe and dry working conditions. If the final void is below the regional water table a pit-ward hydraulic gradient will be present at the dry pit when mining (or pumping from the pit) ceases. The hydraulic gradient between the surrounding rock and the void is related to the elevational difference between the pit lake level and the regional groundwater table level, and the hydraulic properties of the host geologic unit. This pit-ward hydraulic gradient that is initially present upon closure results in inflows to the pit. As such, active voids or recently active voids that are well below the water table are typically groundwater sinks. However, post-closure pit conditions have a different groundwater balance than active mining conditions.

During the groundwater recovery stage, water levels in the pit typically increase due to inflows of both runoff and groundwater, coupled with the cessation of dewatering. The increasing pit lake levels cause the resultant hydraulic gradient towards the pit to weaken. Groundwater inflows are proportional to hydraulic properties (especially hydraulic conductivity), and the hydraulic gradient. As the hydraulic properties of the host geologic unit(s) remain constant in the post-closure phase, groundwater inflows are greatest when the pit lake is at its lowest elevation. As the pit fills, groundwater inflows diminish, and the level rises more slowly.

Eventually, the pit water balance reaches equilibrium or near equilibrium conditions. If the pit water balance reaches an equilibrium level that is below the regional water table, the pit will function as a terminal evaporative sink. In Queensland (where evaporation rates are generally high), voids that are groundwater sinks are typically characterised by small catchment areas (resulting in low surface water inflows to the void) and hydrostratigraphic units with low hydraulic conductivity (resulting in low groundwater inflow). Under such scenarios the pit typically remains a sink after closure.

Pits can also be groundwater sources; this occurs when equilibrium water levels in the pit are higher than the surrounding water table. The source-to-groundwater scenario typically occurs when surface inflow to the pit exceeds evaporation (i.e., when the surface water balance is strongly positive). Under these circumstances, the higher hydraulic head in the pit will cause movement of water from the pit into groundwater. The void will remain a source to groundwater if the pit water level does not recede below the water table. Therefore, the outflow to groundwater from the void must be counterbalanced by a greater runoff inflow to the void. The rate of outflow from the pit to the aquifer is proportional to hydraulic properties and hydraulic gradient. In Queensland, voids that are groundwater sources are typically characterised by large catchment areas or high rainfall zones (resulting in high surface water inputs), and / or deep geometry (which minimises evaporation).

The third scenario is a flow-through feature, whereby the relative levels of the pit lake and the groundwater table become similar to each other. This occurs when total surface water / evaporation fluxes are close to unity or where groundwater fluxes are potentially very large (due to high hydraulic conductivity). Under flow-through conditions, water may move between the void and groundwater (Figure 13.1). In parts of Queensland with very high seasonal and/or interannual variability in rainfall, pits that have relatively small (<10% of the total lake volume) positive or negative surface water fluxes have the potential to act as sources during wet conditions and sinks during dry conditions, which is best classified as flow-through conditions.



LEGEND

- ▭ Mining Lease
- ▭ 10km buffer
- Harry Marsh Borefield
- Rosetta Borefield
- Wirralie monitoring bores
- Registered bores

Drainage

- Major drainage
- Minor drainage

Wirralie Permeability Testing and Progressive Rehabilitation and Closure Plan (WIR5000.001)

Nearby registered bores



AGE

DATE
04/12/2023

FIGURE No:
13.1

13.1 Existing and future voids

There are four voids either currently existing or planned across the Project (Table 13.1), Pit A, Pit B, the North Pit, and the Deep Lead Pit. The North Pit and Pit B currently contain small lakes of variable size; conceptually (Section 7) these small lakes are inferred to be perched above the local water table; technically this classifies these features as potential sources, as seepage from these lakes may reach groundwater. However, because the conceptualisation of these lake is that they are not connected to groundwater by a continuous saturated surface, their interaction with groundwater is not modelled. Pit B will be deepened considerably and intersect the water table; as such, closure conditions for this pit are modelled below. Pit A and the Deep Lead Pit are currently best classified as flowthroughs, with seasonally fluctuating water levels that approximate the level of the water table (see Figure 9.2). The Deep Lead Pit will be backfilled in closure and is not further assessed by modelling.

Table 13.1 Summary of voids and void status at present and in closure

Void	Current status	Closure status	How status is addressed within this report
Pit A	Flow-through (seasonal changing between source and sink)	The pit will remain in its current state in closure, but will be disconnected from the Deep Lead pit	A water budget to address overflow in closure is presented; the equilibrium closure water level should remain similar to current conditions
North Pit	This is a small seasonal lake, conceptualised as perched above the water table	This pit will remain in its current state (a source) in closure.	This pit is considered part of the Pit A catchment area for overflow modelling
Deep Lead Pit	Conceptually, this pit is likely a flow-through	This pit will be backfilled in closure	The final void status of this pit is not modelled as it will be backfilled in closure.
Pit B	A small, mostly dry pit, with a small ephemeral perched pit lake. This pit is currently conceptualised as disconnected from the water table	This pit will deepen significantly before closure and will be a sink in closure.	The equilibrium water level and potential for overflow for this pit are modelled.

13.2 Water balance

This void modelling/water balance calculations aim to address the PRCP guideline requirements for Pit A and Pit B by providing an estimation of the long-term water level and water balance. The results from these models, in conjunction with site conceptual models, address the connections between the voids and groundwater, including whether a void is acting as a sink or source for groundwater and modelled probabilities of the potential for overflow under closure conditions. These void balances are intended to be an adaptive management tool for identifying and reducing risks. They are designed to inform high-level risk assessment and be adaptable to changes (e.g. changes to final landform design). As rehabilitation progresses, the void modelling tool can be updated and improved by the collection of further data.

A pit water balance was created to better understand the closure water levels and the relationship between the pit void and groundwater. The intent is to assess the water balance for the pit and compare this to proposed closure plans for Pit A and Pit B. The water balance was calculated on a monthly basis, but the void modelling allows calculation on either an annual or monthly basis; annual calculations are given in this report. The principal water balance components used herein are as follows:

Inputs:

- runoff (calculated as average rainfall over the catchment area, multiplied by a runoff coefficient);
- direct rainfall over the pit; and
- groundwater inflow (if applicable).

Outputs:

- evaporation (calculated as average pan evaporation multiplied by a coefficient) and
- groundwater outflow (if applicable).

As such, the water balance (in m³/month) for a void is as follows, with the variables described in Table 13.2, is given by:

$$W = [Rn \times C_{ro} \times (S_{ac} - S_{ap})] + [S_{ap} \times Rn] \pm [GW] - [C_E \times ET \times S_{al}]$$

Table 13.2 Parameters used in the void water balance

Parameter	Symbol	Units (secondary unit)
Monthly water balance	W	m ³
Rainfall	Rn	m/month (mm/month)
Surface area of catchment	S_{ac}	m ²
Surface area of pit	S_{ap}	m ²
Surface area of pit lake	S_{al}	m ²
Runoff coefficient	C_{ro}	fraction (%)
Mean pan evaporation	ET	m/month (mm/month)
Evaporation coefficient	C_E	fraction (%)
Groundwater Inflow or outflow	GW	m ³ /month (L/s)

13.3 Water balance inputs

13.3.1 Rainfall

Rainfall data was sourced from the Scientific Information for Land Owners (SILO) database as reviewed in Section 4.1. In addition to calculating monthly and annual averages, this dataset was used to calculate Annual Exceedance Probabilities (AEP) for rainfall. The formula for calculating AEP is:

$$P = 100 \times \frac{m}{n + 1}$$

Where:

P is the AEP expressed as a percentage;

m is the rank of the rainfall value with 1 being the largest possible value; and

n is the total number of events or data points on record.

The average monthly rainfall and AEP values for rainfall are presented in Table 13.3.

Table 13.3 Rainfall and AEP data

Rainfall (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
99% AEP	5.3	2.2	0	0	0	0	0	0	0	0	0.1	1.7	241.4
95% AEP	17.7	11.6	1.4	0	0	0	0	0	0	0	0.8	14.3	280.3
90% AEP	25.4	19.5	5.7	0	0	0	0	0	0	0.1	2.6	20.9	307.6
80% AEP	51.8	35.8	14.3	0.1	0.4	0.4	0	0	0	1.5	7.2	29	378.5

Rainfall (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
70% AEP	58.6	65.9	22.9	2.1	1.2	1.6	0.1	0	0.2	3.5	17.5	44.2	448.6
60% AEP	81.6	84.8	40	5.7	3.3	3.8	0.9	0.3	0.9	8.5	28.4	56.5	501.3
50% AEP	109.3	95.3	47.1	14.5	12	13.9	4.8	1.5	1.5	13.4	37.3	70.7	554.7
40% AEP	119.7	118.3	54.7	28.5	18.9	20.6	10.9	6.7	4.1	27.4	47.5	86.9	618
30% AEP	142.1	143.9	72.1	33	31.1	35.5	20	14.3	10	36.8	59.2	105.1	680.7
20% AEP	166.7	172.4	115.8	42.9	51.8	51.1	41.6	25.8	16.4	47.9	86.3	147.7	778.6
10% AEP	223.4	255.9	142.3	75.1	79.2	80.6	88.9	41.4	41.8	75.2	119.2	172.3	942.9
5% AEP	255.6	314.9	188.3	199.9	113.9	104.8	110.3	86.8	64.1	100.8	157.6	213.7	1049.3
1% AEP	640	357.9	241.9	258.4	129.9	148.6	143	126	110.9	131	239.2	294.8	1149.9

13.3.2 Runoff coefficients

The proportion of rainfall that exits a catchment as surface drainage is the runoff coefficient. Broadly, the runoff coefficient increases with steeper slope, decreased vegetation, lower hillside roughness, and lower rates of water infiltration into the soil. In detail, runoff produced during a specific rainfall event varies depending on the conditions of the catchment; for example, rainfall events that fall on soil that is already saturated with water produce larger runoff volumes than those falling on dry soil. For this reason and a number of additional factors, the runoff coefficient is higher for higher magnitude rainfall events.

Rainfall runoff values for the one-year annual recurrence interval (ARI) rainfall events in a sparsely vegetated north Queensland landscape are presented in Table 13.4. A default runoff coefficient of 0.35 was used in the void models presented here; this corresponds to the runoff coefficient for a 1-year ARI rainfall event on a rolling land slope with high permeability soils (Table 13.4).

Table 13.4 Runoff coefficients in north Queensland (from Soil Conservation Guidelines for Queensland, 2015)

Land slope	1-year ARI runoff coefficients		
	soil permeability		
	high	medium	low
Rolling (2–10%)	0.3	0.5	0.6
Hilly (10–30%)	0.4	0.6	0.7

13.3.3 Evaporation

Average pan evaporation data is also available from SILO. These values are indicative of the amount of water evaporating from open water; however, actual evaporation values from a void are generally less than the pan evaporation and it is necessary to apply a correction factor that adjusts the evaporation rate to be more representative of the actual evaporation. For deep voids, which are shaded by the pit walls and protected from surface wind currents, a correction factor of 0.7 is commonly applied (DES, 2023) and was used in this model. The average monthly pan evaporation values from SILO are presented in Table 13.5.

Table 13.5 Average monthly pan evaporation data

Month	Pan Evaporation (mm)
January	218.0
February	179.5
March	184.9
April	152.9
May	125.1
June	101.2
July	109.2
August	144.5
September	184.0
October	226.8
November	235.3
December	242.4
Annual value	2103.8

13.3.4 Void lake surface areas and volumes

For Pit A, lake surface areas and volumes as a function of lake height were calculated using the existing DEM for lake levels about the current lake and using an assumed geometry for the currently submerged area. For Pit B, the surface area and volume curves were derived from the pit shells for the proposed void. The model inputs are from the curves derived in Figure 13.2 and Figure 13.3.

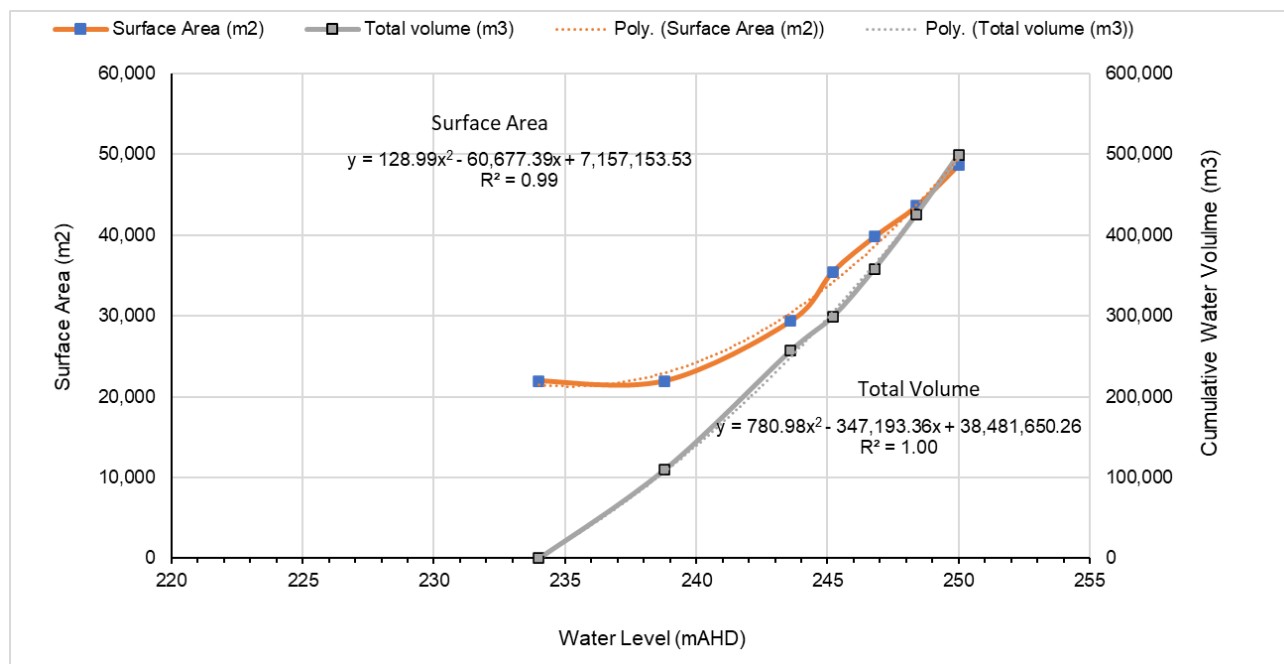


Figure 13.2 Pit lake surface area and volume verses lake elevation for Pit A

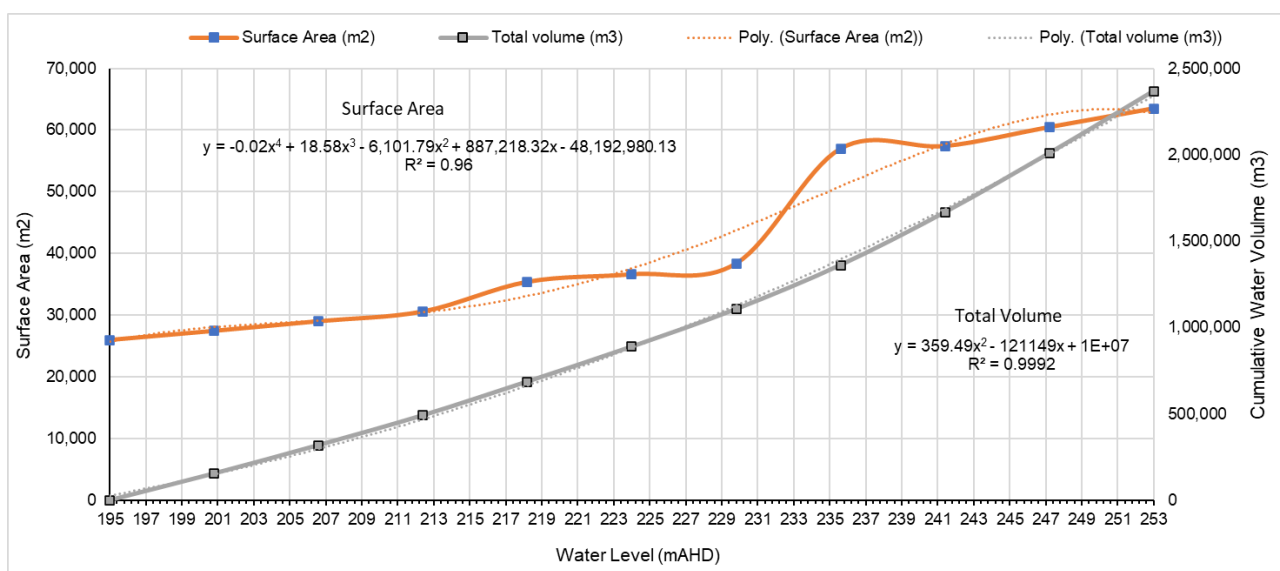


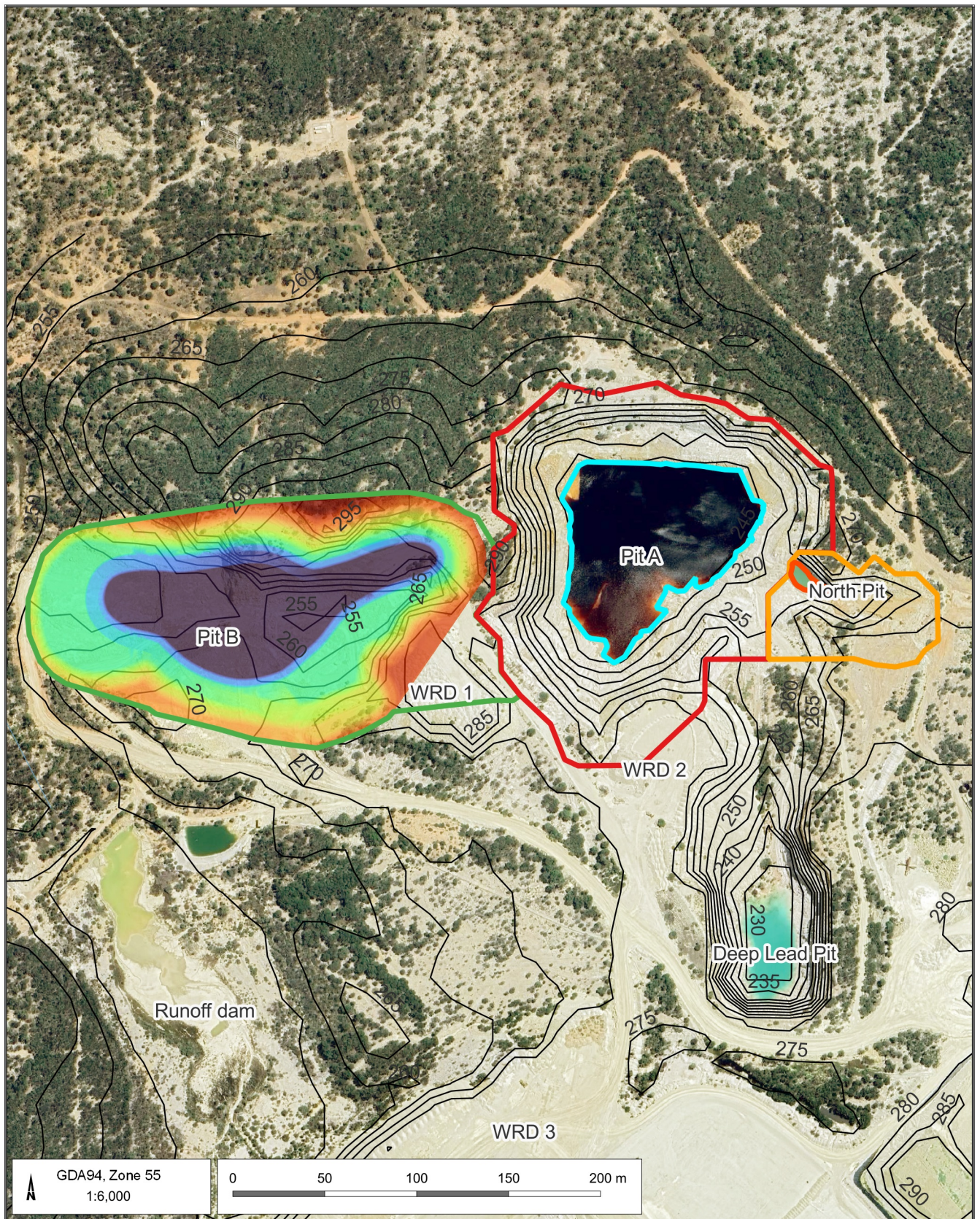
Figure 13.3 Pit lake surface area and volume verses lake elevation for Pit B

13.3.5 Catchment area

The catchment area was delineated in Figure 13.4, with the catchment area defined by the DEM model. For Pit A, the modern conditions were used to produce a validated model; for this model, the catchment area of the North Pit was excluded from the model; for the models used to define the risk of overtopping, the catchment area of the North Pit was included, as it flows into Pit A at water levels >251m AHD.

Table 13.6 Catchment area of pits (includes pit lakes)

Pit	Catchment area (m ²)
Pit A	112,137
Pit A + North Pit	130,525
Pit B	113,230

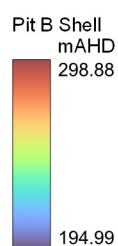


LEGEND

— Elevation (mAHD) - 5m contours, 2023 LiDAR
 Pit B catchment

North Pit
 Catchment
 Pit lake

Pit A
 Catchment
 Pit lake



Wirralie Permeability Testing and Progressive Rehabilitation and Closure Plan (WIR5000.001)

Pit catchment areas



AGE

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 13/11/2023

FIGURE No:

13.4

13.4 Groundwater inflow

Groundwater inflow at any given pit stage is dependent on the hydrogeologic properties of the strata and on the relationship between water level in the pit and the surrounding water table, with lesser inflow occurring when the hydraulic conductivity is smaller and/or when the hydraulic gradient is less.

The approach to estimating groundwater inflow is adopted from Marinelli and Niccoli (2000) and the updated Marinelli and Niccoli equation by Arnold, Langer, and Paschke (2003), which assumes steady-state flow. The solutions consider the effect of decreased saturated thickness near the pit walls, distributed recharge to the water table, and upward flow through the bottom of the pit. The analytical method assumes steady-state, unconfined, horizontal, and axially symmetrical flow towards the area of the pit (Figure 13.5), within a porous media. This solution allows for differing horizontal and vertical conductivity, which is often the case in nature. The pit geometry is idealised as a circular cylinder with a radius equal to that of the void.

The assumptions of this analytical model are general in nature and not intended to be a detailed representation of the geology of the Project site on a local scale. Site geology is somewhat heterogenous, with different groundwater levels and flows in the various hydrostratigraphic units. However, if validated, the estimates from these types of models are effective in providing representative predictions of inflows/outflows. Overestimation of the inflow when the mine life is short, or pit filling is rapid (due to steady state model assumptions), has been avoided by estimating inflows at equilibrium (however, note that inflows will not match recorded pit inflow for this reason).

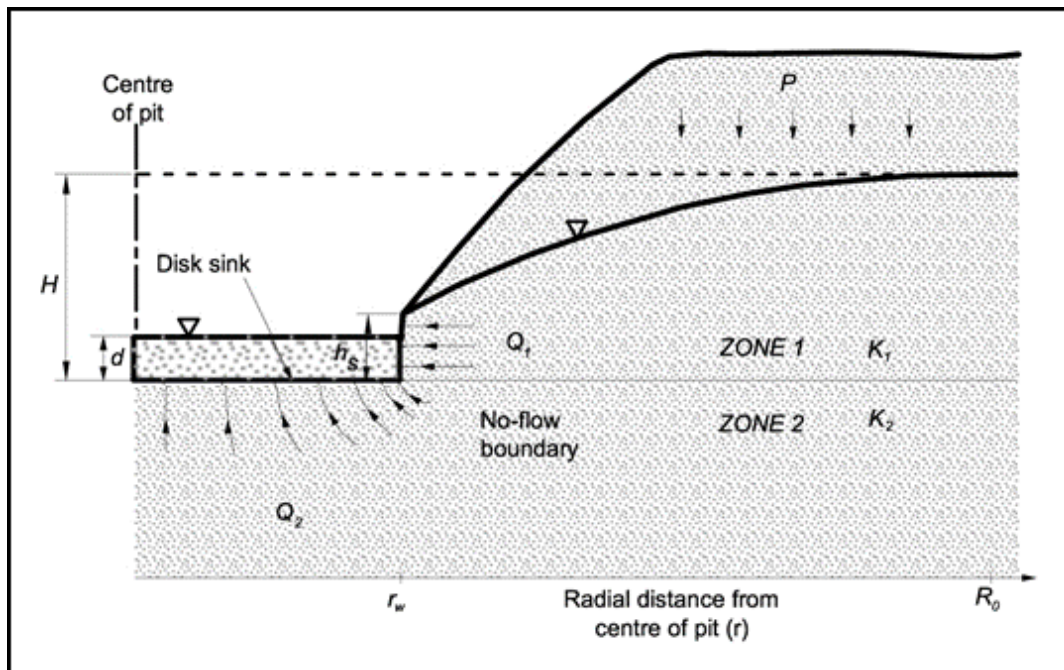


Figure 13.5 Diagram of the conceptual inputs for pit estimations (Marinelli and Niccoli, 2000)

The analytical method used for pit inflow predictions involved the iterative calculation of total inflow (Q_i) as the summation of Q_1 and Q_2 according to Equations 1, 2, and 3:

$$Q_1 = P\pi(R_0^2 - r_w^2) \quad (\text{Equation 1})$$

$$Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d) \quad (\text{Equation 2})$$

$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}} \quad (\text{Equation 3})$$

Where (units):

Q_1 is inflow through seepage face (m³/s)

Q_2 is inflow through mine base (m³/s)

H is height of radius of influence (m)

d is depth of ponded area (m)

K is hydraulic conductivity (m/s)

m_2 is anisotropy

P is distributed recharge (m/s)

r_w is radius of pit (m)

R_0 is radius of influence (m)

In addition, the radius of influence (R_0 – the distance from the region of pumping to where drawdown is negligible) is derived using Equation 4:

$$H = \sqrt{h_s^2 + \frac{P}{K_{h1}} \left[R_0^2 \ln\left(\frac{R_0}{r_w}\right) - \frac{R_0^2 - r_w^2}{2} \right]}$$

Where the input parameters to determine the radius of influence are the same as above, with h_s = saturated thickness to seepage face.

13.4.1 Groundwater parameters

The groundwater pit models used the fixed and variable values listed in Table 13.7. These input parameters are based on observations outlined in Table 13.7. The assumed value for hydraulic conductivity is similar to the measured range of values for the relevant hydrostratigraphic unit (see Section 8). The recharge rate was estimated to be 1% of precipitation, which is consistent with the Project climate (Section 4.1). The model is sensitive to all the input parameters listed in Table 13.7, so no single solution is possible for prediction; however, when combined with the surface budget model, the predictions gave solutions that approximate conditions of the Pit A. Thus, while the model is not a full representation of all details of the sites, it is suitable to the data available and is considered sufficient to assess the risks associated with the Project.

Table 13.7 Input parameters for pit models

Parameter	Symbol	Units	Value	Comments
Height of radius of influence	H	m	Determined from regional potentiometric surface (assumed to be 238 mAHD for Pit A and 242 mAHD for Pit B) and pit water level (variable))	Regional potentiometric surface determined from the conceptual model and groundwater measurements
Pit water level		mAHD	243.6 mAHD for Pit A 195 to 253 mAHD for Pit B	Observed approximate current level for Pit A Variable values for Pit B
Depth of ponded area	d	m	10.6 m for Pit A; Variable for Pit B	Determined from water levels
Radius of Influence	R ₀	m	Determined iteratively within the model	Within the range of observed drawdown for Pit A
Recharge	P	m/s (% of rainfall)	1.85×10^{-10} (1.0%)	Conceptual model and climate data
Radius of pit	r _w	m	pit geometry	pit geometry (Section 13.3.4)
Horizontal conductivity	K _h	m/s (m/d)	1.5×10^{-6} (1.3)	At the upper end of measured conductivity (Section 8.5), but for Pit A this value is consistent with site observations of pit water level
Vertical conductivity	K _v	m/s (m/d)	1.5×10^{-6} (1.3)	As above for horizontal conductivity
Anisotropy	m	-	1	Determined from K _h and K _v

13.5 Results

13.5.1 Void status

The status of each void was assessed with reference to the conceptual framework summarised above. The equilibrium lake level for Pit B was determined by setting the groundwater inflow equal to the surface flux and the void status was determined by comparison of the equilibrium lake level to the regional water table (Table 13.8). A visual representation of the results and brief discussion of the status of each pit is given below.

Table 13.8 Summary of existing and closure void status

Pit	Current status	Equilibrium water level - closure conditions (mAHD)	Regional potentiometric surface (mAHD)	Closure status
Pit A	Flow-through	<243.6 (assumed to drawdown slightly due to influence of Pit B)	238	Flow-through (seasonally alternating between a source and a sink)
Pit B	Mostly dry pit	215 mAHD	242	Sink

13.5.1.1 Pit A

The pit lake has remained relatively small and variable, with seasonal fluctuations in the size of the pit lake. As such, the focus of the model for Pit A was to verify the water budget model; to do so, the water balance was solved several times at mean climate conditions, with variable inputs for hydraulic conductivity; these results are summarised in Table 13.9. Based on the results shown in Table 13.9, the best solution is for a hydraulic conductivity (K) of $\sim 1.5 \times 10^{-6}$ m/s; higher hydraulic conductivity results in groundwater inflow that are too large (i.e. significantly higher than surface water fluxes) and low hydraulic conductivity results in inflow that are too low to maintain a pit lake. As previously discussed, both the groundwater and surface water budgets are sensitive to all the parameters outlined above, so no single solution is possible for prediction; however, when combined, the predictions gave solutions that approximate conditions of the Pit A.

Table 13.9 Summary of Pit A modelling results

Pit water level	Surface water flux (m ³ /year)	Groundwater inflow (m ³ /year)	Water budget (m ³ /year)	K (m/s)	Ro (m)
243.6	-43,200	830	-9,600	1.0×10^{-7}	170
243.6	-43,200	9,300	-1,100	1.5×10^{-6}	340
243.6	-43,200	57,000	46,400	1.0×10^{-5}	650

13.5.1.2 Pit B

The modelling results indicate that, in a climatically average year, surface inputs to the pit are considerably exceeded by evaporative outputs. The pit geometry is such that the pit surface area initially increases more rapidly as lake level increases; because evaporative outputs are strongly correlated with pit lake level, they follow a similar trend; this relationship is shown as the purple line on Figure 13.6. When the evaporative trend is examined in conjunction with the predicted groundwater inflows (the blue line on Figure 13.6), the graphical solution to the model indicated that the predicted equilibrium lake level is ~ 215 mAHD. This solution corresponds with a groundwater inflow of 12,100 m³/yr and a radius of influence for the cone of depression of 340 m. These solutions strongly suggest Pit B will be a groundwater sink in perpetuity, but with a limited radius of influence.

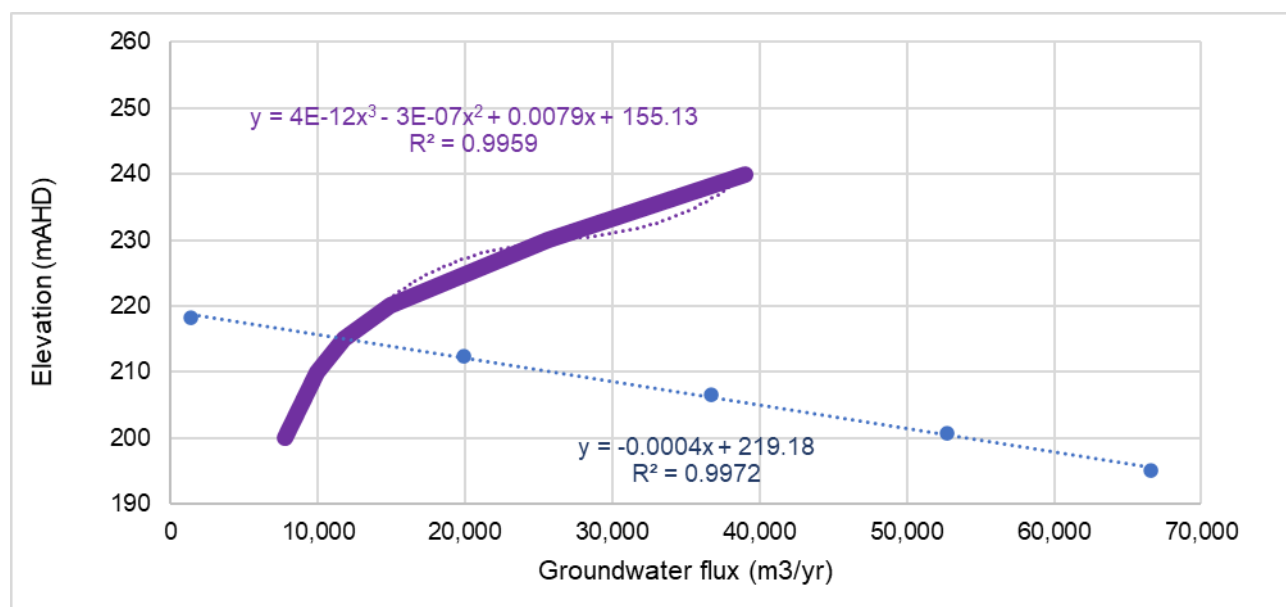


Figure 13.6 Pit B water budget

13.5.2 Risk of overtopping

The PRCP guidelines outlined in Section 2 require assessment of the potential for voids to overtop. This was evaluated by simulating a yearly water budget for 1% and 5% AEP of precipitation on a pit lake at equilibrium

water level (Table 13.8). For Pit A, the additional catchment area of the North Pit was included in this water budget. Both pits are predicted to remain well below their crest, with significant remaining capacity under both 5% and 1% AEP climate conditions (Table 13.8).

Table 13.10 Summary of overtopping risk assessment

Pit	Equilibrium Pit water level (mAHD)	Pit Crest (mAHD)	Water level after 5%AEP year (mAHD)	Remaining capacity after 5% AEP year (m3)	Water level after 1%AEP year (mAHD)	Remaining capacity after 1% AEP year (m3)
Pit A	243.6	250	246.0	167,000	246.3	156,000
Pit B	215	253	216	1,800,000	216	1,786,000

13.5.3 Void stratification

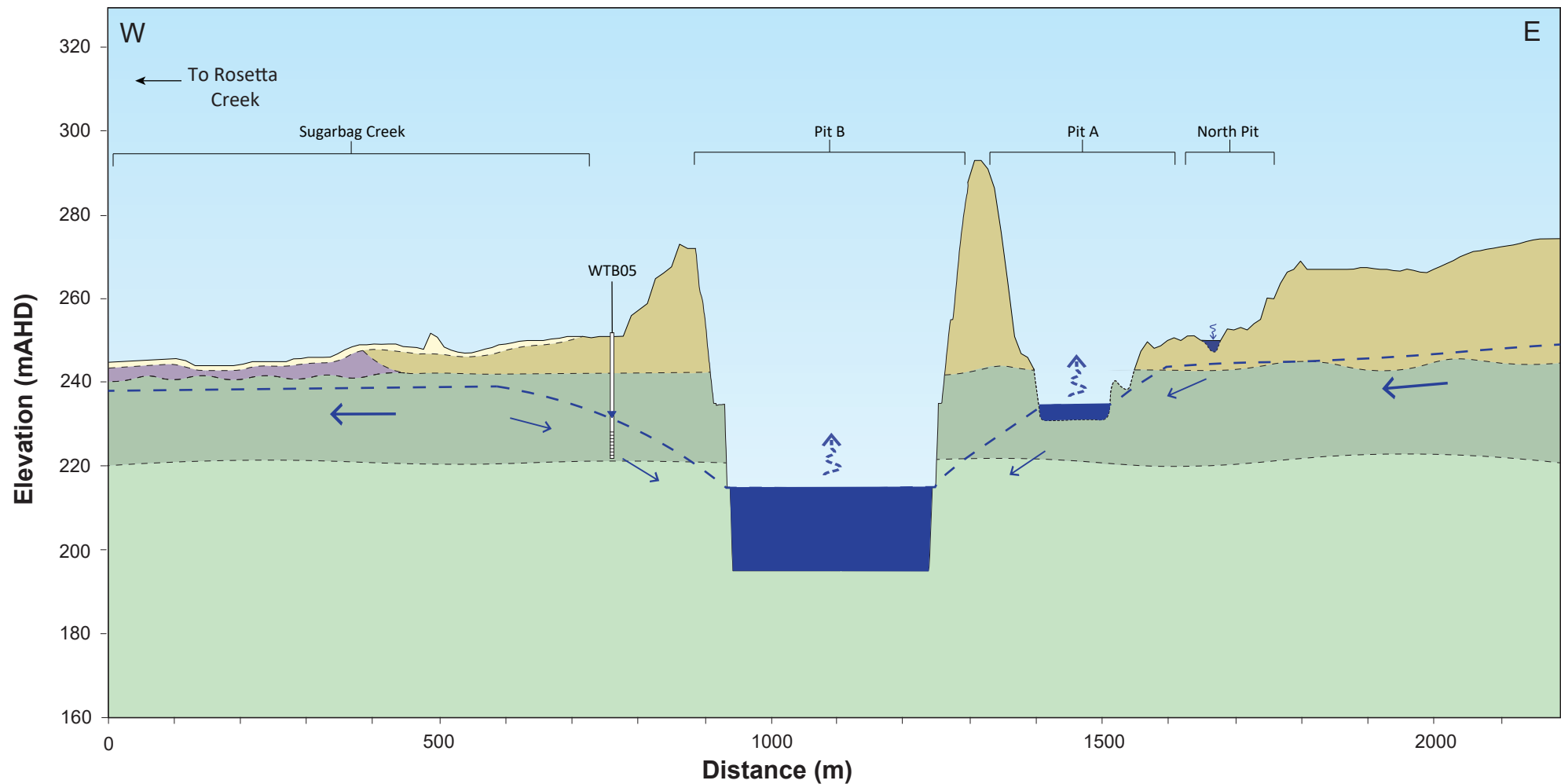
During or following equilibration of pit lake levels with groundwater, the process of stratification of pit water through chemical and physical mechanisms (e.g., redox and temperature) can occur. Typically, this stratification involves the segregation of the lake level by salinity, dissolved oxygen load, or both. This can have relevance for risk assessment as deeper sections of a stratified pit lake may contain less oxygen (thereby reducing the risk of sulfate oxidation) or have higher salinity (reducing the risk of solute release during overtopping); however, the risk assessment and conceptualisation of contaminant transport in this report is unimpacted by the stratification status of the pits. Nevertheless, to fulfill the PRCP requirements, an assessment of the likelihood of stratification during/after closure was undertaken based on the depth, geometry, and status of the voids (Table 13.11).

Table 13.11 Assessment of void water quality and the likelihood of void stratification

Pit	Equilibrium water level -closure conditions (mAHD)	Pit base (mAHD)	Equilibrium lake depth (m)	likelihood of stratification in closure (rational)
Pit A	234	~230	~4	Not possible due to very shallow depth and seasonal inflow
Pit B	215	195	20	Possible, but unlikely due to shallow depth and seasonal inflow

14 Conceptual hydrogeological model in closure

The hydrogeology of the Project area will be significantly different in closure due to mining of Pit B to depths that are well below the local water table. These closure conditions were modelled in Section 13 and are depicted conceptually in Figure 14.1. The key feature of the conceptual model in closure is a pronounced cone of depression around Pit B. This cone of depression will persist due to the status of this pit as a sink; it will extend approximately 340 m from the pit wall and will capture groundwater from near Pit A.



Legend

- | | | | | | | | | | | |
|---|---|--|---|--|--|--|--|---|--|---|
| Alluvium | Suttor Formation | Rosetta Creek Formation | Mount Wyatt Formation | Weathering (grey overlay) | Groundwater table (post-mining) | Inferred groundwater flow direction | Inferred evaporation / evapotranspiration processes | Inferred seepage | Groundwater monitoring bore | Inferred based on available data |
|---|---|--|---|--|--|--|--|---|--|---|

Vertical exaggeration: 1:6

West to East conceptual post-mining cross-section

Figure 14.1

Wirralie Permeability Testing and Progressive Rehabilitation and Closure Plan (WIR5000.001)

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G:\Projects\WIR5000.001 Wirralie Permeability Testing & PRCP\3_GIS\Workspaces\001_PRCP Report\PDFs



15 Groundwater Environmental Values

Groundwater environmental values are often defined on a site-specific basis. An environmental value is defined in Section 9 of the *Environmental Protection Act 1994* (EP Act) to be:

- a) *a quality or physical characteristic of the environment that is conducive to ecological health or public amenity or safety; or*
- b) *another quality of the environment identified and declared to be an environmental value under an environmental protection policy or regulation.*

The Environmental Protection (Water) Policy 2009 (Qld; EPP Water) provides a framework to protect and/or enhance the suitability of Queensland waters for various beneficial uses. Groundwater resources in the vicinity of the Project area are located within Suttor River sub-basin of the Burdekin drainage division (Section 4.2.1). No environmental values (EVs) or water quality objectives (WQOs) are specified for the Suttor River sub-basin under the Environmental Protection (Water and Wetland Biodiversity) Policy 2019. Draft EVs and WQOs for the Burdekin Basin, based on the Burdekin Region Water Quality Improvement Plan 2016 (NQ Dry Tropics 2016), were released for comment in 2017 and are still under review. Draft EVs for Rosetta Creek include:

- Aquatic ecosystems.
- Human uses.
- Irrigation.
- Livestock;
- Visual amenity.
- Drinking water.
- Industrial uses.
- Cultural and spiritual.

As this area is not officially listed in Schedule 1 of the EPP Water, all the environmental values listed in Section 6 (2) of the EPP Water may apply. This list of potential EVs is more encompassing than the draft EVs for Rosetta Creek, and includes:

- for high ecological value waters—the biological integrity of an aquatic ecosystem that is effectively unmodified or highly valued;
- for slightly disturbed waters—the biological integrity of an aquatic ecosystem that has effectively unmodified biological indicators, but slightly modified physical, chemical or other indicators;
- for moderately disturbed waters—the biological integrity of an aquatic ecosystem that is adversely affected by human activity to a relatively small but measurable degree;
- for highly disturbed waters—the biological integrity of an aquatic ecosystem that is measurably degraded and of lower ecological value than waters mentioned in paragraphs (a) to (c);
- for waters that may be used for producing aquatic foods for human consumption—the suitability of the water for producing the foods for human consumption;
- for waters that may be used for aquaculture—the suitability of the water for aquacultural use;
- for waters that may be used for agricultural purposes—the suitability of the water for agricultural purposes;
- for waters that may be used for recreation or aesthetic purposes, the suitability of the water for—
 - (i) primary recreational use; or
 - (ii) secondary recreational use; or
 - (iii) visual recreational use;
- for waters that may be used for drinking water—the suitability of the water for supply as drinking water;
- for waters that may be used for industrial purposes—the suitability of the water for industrial use;
- the cultural and spiritual values of the water.

A description of each environmental value from EEP Water in relation to groundwater at the Project is provided below.

As part of this EV assessment, a review of registered groundwater bores within 10 km of the site was undertaken (Figure 15.1). Apart from the Wirralie monitoring network bores and the older Rosetta and Harry Marsh borefields (comprised of unregistered bores), there are five registered bores within 10 km of the site; all have been plugged/destroyed and abandoned. The original purpose of most of these bores is not listed in their registration records (Table 15.1). BH001477 is listed as a stratigraphic reference bore.

Table 15.1 Registered bores within 10km of Wirralie

Bore ID	Easting (GDA94 z54)	Northing (GDA94 z54)	Drilled date	Bore depth (mBGL)	Screened interval (mBGL)	Ground RL (mAHD)	Screened Lithology	Bore Status	Original name	Facility
BH001477	520879	7661408	30/01/1987	NR	NR	NR	NR	Plugged and abandoned	Mount Coolon 6	GSQ Reference
25863	536993	7660370	04/05/1965	15.24	NR	313.91	NR	Abandoned and destroyed	Wirralie No.1	Sub-Artesian
25864	535556	7662829	05/05/1965	33.52	NR	NR	NR	Abandoned and destroyed	Wirralie No. 2	Sub-Artesian
25865	535703	7663905	06/05/1965	18.28	NR	286.49	NR	Abandoned and destroyed	Wirralie No. 3	Sub-Artesian
182745	526455	7668710	14/11/2020	36.00	NR	NR	NR	Abandoned and destroyed	NR	Sub-Artesian

Notes: NR = not recorded

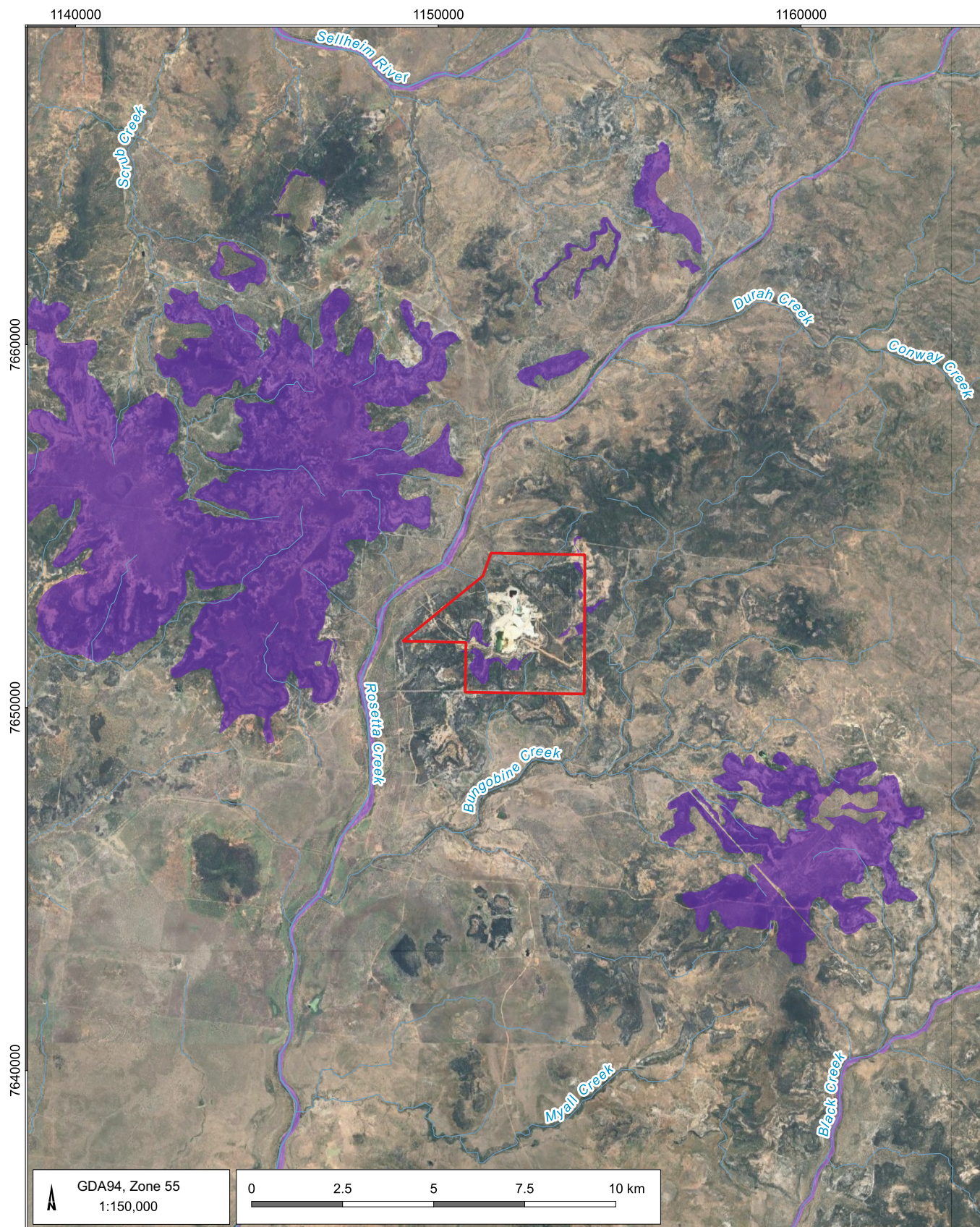
GSQ = Geoscience Queensland

15.1 Biological integrity of ecosystems

According to the Groundwater Dependent Ecosystems Atlas (GDE Atlas/BoM, 2016), there are ecological areas in the region of the Project that are potentially dependent on groundwater to some degree for ecological function (Figure 15.2 and Figure 15.3). The GDE Atlas provides an indication of the potential groundwater dependence of ecosystems across the state and is obtained through application of a standardised method (Doody et al., 2017). The Atlas was generated by catchment scale mapping that integrated local expert knowledge and the best available spatial data (Doody et al., 2017). Notwithstanding this, there can be discrepancies between mapped areas and true on-site ecological characteristics, especially in remote areas. According to the GDE Atlas, there are no high potential GDEs of any type within the Project area; other mapped potential terrestrial and aquatic GDEs that are present in the region are discussed below.

15.1.1 Aquatic GDEs

The definition of an aquatic GDE is an ecosystem (be it an aquatic, riparian or wetland ecosystem) that is dependent to some degree on the surface expression of groundwater. Therefore, for an aquatic GDE to be present, a surface expression of groundwater must be suspected or identified. There are no known springs in the area (GDE Atlas/BOM, 2016) and according to the GDE Atlas, moderate potential aquatic GDEs are mapped on the southwest and east of the mining lease (Figure 15.2); however, the presence of aquatic GDEs in these area is highly unlikely as groundwater across the Project area is too deep (10-25 m bgl) to have surface expressions. From regional studies, additional zones of low and moderate potential GDEs were identified. The low potential for GDEs occurs along nearby creeks and rivers including Rosetta Creek, Sellheim River and Black River (Additional moderate potential GDE zones exist within 10km of Wirralie (e.g. area across Rosetta Creek or Bugobine Creek), but these are unlikely to be hydraulically connected to the Project area as they are located across drainages. As such, the only potential aquatic GDEs that are considered receptors for the Project are those mapped along Rosetta Creek; however, as discussed in Section 10.4, these are unlikely to exist.



LEGEND

- Mining Lease
- Aquatic GDEs
 - Moderate potential GDE - from regional studies
 - Low potential GDE - from regional studies

Wirralie Permeability Testing and Progressive Rehabilitation and Closure Plan (WIR5000.001)

Potential aquatic groundwater dependent ecosystems (GDEs)



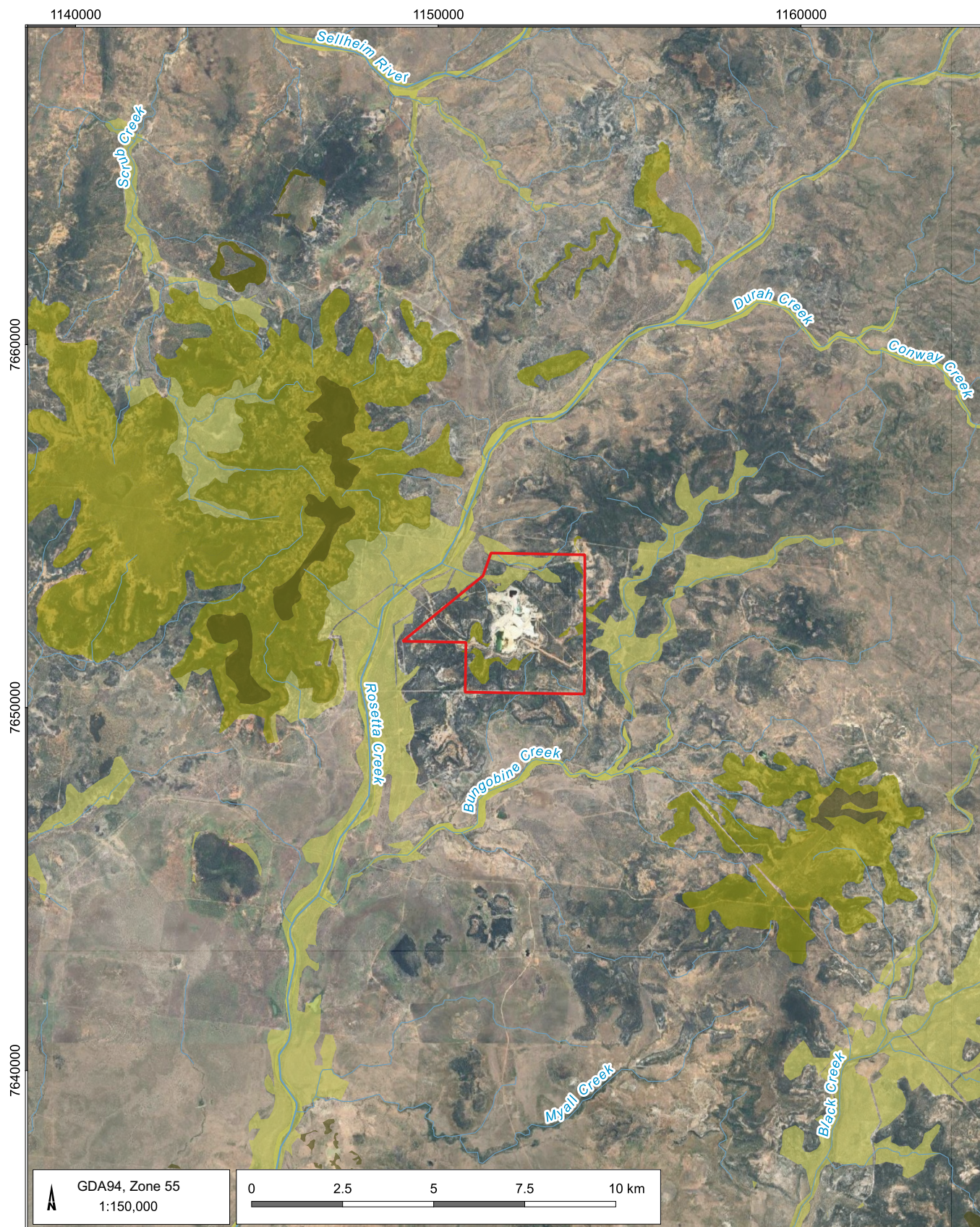
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DATE
14/12/2023

FIGURE No:
15.2

15.1.2 Terrestrial GDEs

A terrestrial GDE is an ecosystem that is present above the ground surface, which is reliant on groundwater below the ground surface (e.g., vegetation that can access groundwater for transpiration from the water table). Low to moderate potential terrestrial GDEs are present within the mining lease. Moderate to low potential GDEs are present across the mining lease and high potential terrestrial GDEs are also located in the wider project area (Figure 15.3), with the closest area being along Rosetta and Bungobine Creek. Groundwater present in the Project area is between 10 and 30 m bgl, which is potentially in the rooting zone of GDEs. As such, this receptor is considered potentially present in the mapped areas (including those on the mining lease), but an ecological survey is required to confirm their potential presence.



LEGEND

- Mining Lease
- Terrestrial GDEs
 - High potential GDE - from regional studies
 - Moderate potential GDE - from regional studies
 - Low potential GDE - from regional studies

Wirralie Permeability Testing and Progressive Rehabilitation and Closure Plan (WIR5000.001)

Potential terrestrial groundwater dependent ecosystems (GDEs)



AGE

DATE
14/12/2023

FIGURE No:
15.3

15.1.3 Subterranean GDEs

The definition of subterranean GDEs is an ecosystem that is dependent to some degree on the sub-surface expression of groundwater and exists within the subsurface. These types of GDEs mainly include stygofauna and cave ecosystems. There are no mapped subterranean GDE areas, and no known caves, within the Project MLs or the vicinity of the Project. Therefore, no subterranean GDEs are considered as potential receptors for the Project.

15.2 Beneficial use in production of foods

Groundwater in the vicinity of the Project is not used for production of foods for human consumption.

15.3 Beneficial use in aquaculture

Groundwater in the vicinity of the Project is not used for aquaculture purposes.

15.4 Beneficial use in agriculture

Prior to mining, the land of the mining lease was used for low-quality cattle grazing. Cattle grazing and dryland cropping (sugarcane and wheat) are still the predominant land-uses in the Suttor River Sub-basin and Whitsunday Regional Council area. Thus, groundwater in the vicinity of the Project is not used for irrigation purposes. Groundwater is potentially used for livestock (usually beef cattle) watering on properties in the greater region; however, there are no functioning registered bores within 10 km of the Project. Due to the lack of groundwater bores within 10 km of the Project, livestock watering is not considered an EV for groundwater for the Project (despite the PMLU for much of the site being low intensity grazing on native pasture).

15.5 Suitability for primary, secondary, or visual recreational use

Groundwater is not used for primary, secondary, or visual, recreational use in the region.

15.6 Suitability of the water for supply as drinking water

Groundwater is currently not used as a drinking water supply in the vicinity of the Project. Thus, drinking water supply is not an applicable EV.

15.7 Suitability of the water for industrial use

The main user of groundwater for industrial use in the region has been the Project itself and other historical mining operators. There is no other known industrial usage of groundwater near the Project.

15.8 Cultural and spiritual values of the water

There are no documented EVs in relation to cultural and spiritual values of groundwater in the region. The cultural and spiritual values of groundwater for the Project are likely linked to the cultural and spiritual values of surface waters. Therefore, it is considered appropriate to value groundwater according to the EVs described above, which likely underpin its cultural value.

16 Impact assessment (source, pathway and fate analysis)

A source-pathway-receptor summary is provided to assess potential impacts for the site. The analysis summarises the critical impact assessment data for the site in tabular format (Table 16.1). Groundwater drawdown at the site is currently limited, but future drawdown impacts are considered because Pit B will intersect groundwater and will remain a long-term groundwater sink. Thus, this impact assessment considers both potential changes in groundwater level and quality.

The main site infrastructure (Section 5) that has the potential to be a source of solutes to groundwater is the pits, the WRDs and the TSF. However, other site infrastructure such as the HLP, ROM, and small onsite water storages may serve as lesser sources. The current groundwater quality of the site indicates that these sources have generated solutes in the past and the historic water quality from the pits indicates a propensity for generation of acidic water. The waste rock characterisation indicates that most material contained in the TSF and WRDs is NAF, a situation that indicates either PAF material is limited to the area directly adjacent to the pit or that sulfides have already been leached from the historic mine waste. The most important potential contaminants (solute) from the infrastructure are acidity, sulfate, salinity, and metals.

The potential receptors are potential aquatic and terrestrial GDEs and water used for industrial purposes. Groundwater bores for stock watering are not considered receptors because none are present within 10 km of the Project. Aquatic GDEs are unlikely to exist due to the depth to groundwater; however, terrestrial GDEs are possibly present, particularly along Rosetta Creek.

The only pathway considered here is groundwater; groundwater is only considered a potential pathway if changes in groundwater flow, level, or quality (either present or future) connects the source to the receptor. The impact assessment presented in Table 16.1 indicates that:

- there is highly unlikely past or future impact predicted for aquatic GDEs due to sources of solutes;
- there is potential past or future impact predicted for terrestrial GDEs due to sources of solutes; and
- there are inconsequential past and future impacts for groundwater used for industrial uses regarding water access and solute concentration.

Table 16.1 Source-Pathway-Receptor analysis for Wirralie

Source (and associated risk)	Receptor (and likelihood that receptor is present)	Potential Pathway	Evidence that pathway is present / absent	Predicted Impact
Drawdown from development of Pit B As groundwater is extracted during periods of mining, a cone of depression will develop and intermittently changed in depth and extent. In closure, the pit will stabilise as groundwater sink	Mapped areas with potential for aquatic GDEs Very low: These potential receptors do not exist onsite as groundwater levels are too deep. These potential receptors are unlikely to exist along Rosetta Creek and if they do exist the closest potential GDEs are approximately 1.3 km away from Pit B.	If groundwater discharges to the surface water features in question had been reduced as a consequence of drawdown, there could be impacts to the GDE.	Not present: The predicted radius of influence (Ro) of the drawdown for Pit B is 440 m, which is considerably less than the distance to the nearest potential GDE.	No past or future impact is predicted.
Pits Acid and sulfate-enriched drainage generation is occurring in the pits (see Section 5.2 for a discussion of pit water quality) due to the exposure of sulfide-bearing ore to oxidation.	Mapped areas with potential for aquatic GDEs Very low: These potential receptors do not exist onsite as groundwater levels are too deep. These potential receptors are unlikely to exist along Rosetta Creek and if they do exist the closest potential GDEs are approximately 1.3 km away from Pit B.	If groundwater which is discharging to the surface water features in question had a change in quality as a consequence of solutes source from the pits, there could be impacts to the GDE. This pathway requires a groundwater flow direction towards the receptor.	Possibly present: The potential receptors along Rosetta Creek are hydraulically downgradient of the pits. The existing pits are considered flow-throughs and may be impacting groundwater quality either currently or historically. In order for impact to occur, solutes would need to travel ~1.4 km without significant attenuation. Preliminary calculations of groundwater flow rates (Section 0), suggest that this transport is possible. Not present in closure: The cone of depression around Pit B will act to contain any solutes from both Pit A and Pit B	Highly unlikely past/current impact due to receptor not likely to be present and the distance to receptor. No future impact is predicted.

Source (and associated risk)	Receptor (and likelihood that receptor is present)	Potential Pathway	Evidence that pathway is present / absent	Predicted Impact
TSF, WRD, and other site infrastructure Acid and sulfate-enriched drainage generation is possible for this infrastructure, although saline mine drainage is more likely (see Section 5 for discussion).	Mapped areas with potential for aquatic GDEs Very low: These potential receptors do not exist onsite as groundwater levels are too deep. These potential receptors are unlikely to exist along Rosetta Creek and if they do exist the closest potential GDEs are approximately 1.3 km away from the nearest site infrastructure.	If groundwater which is discharging to the surface water features in question had a change in quality as a consequence of solutes source from the infrastructure, there could be impacts to the GDE. This pathway requires a groundwater flow direction towards the receptor.	Possibly present: The potential receptors along Rosetta Creek are hydraulically downgradient of the site and the groundwater monitoring bores have water quality indicators of mine sourced solutes (see Section 11). In order for impact to occur, mine sources solutes would need to travel ~1.3 km without significant attenuation. Preliminary calculations of groundwater flow rates (Section 0), suggest that this transport is possible.	Highly unlikely past, current, and future impact due to receptor not likely to be present and the distance to receptor.
Drawdown from development of Pit B Risks as described above.	Mapped areas with potential for terrestrial GDEs Potentially present: regional groundwater is 10 to 30 m bgl, which is within the rooting zone of some terrestrial GDEs.	a) If groundwater levels beneath the terrestrial GDEs had been lowered, vegetation access to water could have been restricted. b) If the terrestrial GDEs are reliant only on moisture in the unsaturated zone, drawdown of the water table is not a pathway that can affect the availability of that water.	a) Drawdown present in the future but is likely not a pathway Predictions (Section 13.5.1) are for a limited cone of depression around Pit B and it is unlikely that the mapped potential terrestrial GDEs are actually present with the predicted cone of depression. Even if they are present, they are likely to be reliant on moisture above the water table. b) Not present There is no pathway for mining activities to change the amount of soil moisture or vadose zone water that is available to the terrestrial GDEs. This is dictated by the amount of rainfall, infiltration, and evaporation. Although clearing for mining may have increased infiltration (e.g., due to decreased transpiration), this is not linked to impacts from groundwater changes.	Highly unlikely future impact due to receptor not likely to be present within the zone of drawdown.
Pits Risks as described above.	Mapped areas with potential for terrestrial GDEs Potentially present: regional groundwater is 10 to 30 m bgl, which is within the rooting zone of some terrestrial GDEs.	If impacted groundwater is present in the rooting zone of vegetation, then it could impact the GDEs. This pathway requires a groundwater flow direction towards the receptor.	Possibly present: The potential receptors in the northern portion of the mining lease and along Rosetta Creek are hydraulically downgradient of the site. The existing pits are considered flowthroughs and may be impacting groundwater quality either currently or historically.	Potential past, current, and future impact, but the presence of the receptors is uncertain.

Source (and associated risk)	Receptor (and likelihood that receptor is present)	Potential Pathway	Evidence that pathway is present / absent	Predicted Impact
TSF, WRD, and other site infrastructure Risks as described above.	Mapped areas with potential for terrestrial GDEs Potentially present: regional groundwater is 10 to 30 m bgl, which is within the rooting zone of some terrestrial GDEs.	a) If impacted groundwater is present in the rooting zone of vegetation, then it could impact the GDEs. This pathway requires a groundwater flow direction towards the receptor. b) If the terrestrial GDEs are reliant only on infiltrating moisture in the unsaturated zone, then migration or diffusion from infiltrating seepage could form a viable pathway for impact.	a) The potential receptors in the northern portion of the mining lease and along Rosetta Creek are hydraulically downgradient of the site. Groundwater monitoring bores on the site have water quality indicators of mine sourced solutes (see Section 11). b) The potential receptors in the northern portion of the mining lease are adjacent to site infrastructure.	Potential past, current, and future impact is possible, but the presence of the receptors is uncertain.
Drawdown from development of Pit B Risks as described above.	Water used for industrial purposes (mining) Present, but limited: Water quality of the groundwater is saline, and therefore limits the beneficial use in for industrial purposes	If groundwater levels at the locations of potential industrial bores had been lowered, groundwater user access to water could have been restricted.	The predicted radius of influence (Ro) of the drawdown for Pit B is 440 m, which is very limited in extent.	Future impact is highly unlikely.
Pits, TSF, WRD, and other site infrastructure Risks as described above.	Water used for industrial purposes (mining) Present, but limited: Water quality of the groundwater is fresh to saline, which may limit the beneficial use in for industrial purposes.	If groundwater quality at the locations of potential industrial bores had been altered to exceed certain water quality objectives, impacts may be experienced by the groundwater user.	Not present: Water quality changes that may have occurred are unlikely to have changed the utility of water used for industrial purposes.	Past changes to groundwater quality beneath infrastructure is known, but this was not an impact to industrial users due to the original groundwater composition. Future impacts are unlikely (or inconsequential).

17 Summary

This report provides an updated understanding of groundwater at Wirralie mine in North Queensland. The hydrogeologic conceptual model was created and tailored to the PRCP requirements, which are summarised in Table 17.1.

Table 17.1 Summary of findings against PRCP Guidelines

PRCP Guideline requirement	Key knowledge
determining the groundwater occurrence including the existence of, and depth to, aquifers and aquitards	The depth to water is generally between 10 and 30 m bgl. The Mount Wyatt Formation is likely a fractured rock aquifer in volcanic rocks of intermediate composition. The Suttor and Rosetta Creek Formation have variable intergranular porosity and likely recharge to the underlying Mount Wyatt Formation. Unsaturated sedimentary units are present along local drainage and are not considered an aquifer.
identifying groundwater recharge and discharge locations locally and regionally	Groundwater recharge is diffuse (although channel infiltration may be important). Recharge is a small proportion of rainfall (~1%). Discharge is via lateral through-flow, and limited evapotranspiration.
groundwater quality within each of the aquifers and from surface expressions (i.e., seeps and springs)	Groundwater is acidic to circum-neutral, variably saline, and enriched in sulfate and copper. There are no surface expressions of groundwater within the mining lease.
current and potential future uses of groundwater including existing groundwater extraction bores	There are potential terrestrial GDEs within the mining lease and potential terrestrial and aquatic GDEs along Rosetta Creek. Outside the mining lease there are no existing bores are registered within 10 km.
- groundwater flow direction and velocity, – including field tests to determine hydraulic conductivity	Current groundwater flow directions are generally to the north-northeast. The linear groundwater flow velocity estimates range from 2 m/yr to 70 m/yr. Field tests to determine hydraulic conductivity are presented for the Mount Wyatt Formation.
the development of potentiometric mapping and hydro stratigraphic cross sections	The maps and cross sections depict groundwater flow directions relative to site infrastructure (sources).
groundwater modelling to determine contaminant transport and potential changes to groundwater level from dewatering or waste storage	The conceptual model informs the risk assessment and is commensurate with the level of knowledge for the site. Calculated flow velocities and the modelled final void status are sufficient as a preliminary assessment of the risks associated with contaminant transport.
prediction of water quality impacts from mining activities	The impact assessment concluded that there is potential past impact, current impacts and possible future impact predicted for potential terrestrial GDEs.
source, pathway and fate of contaminants that have the potential to impact environmental values	The impact assessment found that the GDE receptors around the mine are potentially connected to sources via groundwater pathways.

PRCP Guideline requirement	Key knowledge
void hydrology, addressing the long-term water balance and water level in the voids, stratification, connections to groundwater resources and potential for overflow	Pit A and the Deep Lead Pit are flowthroughs. Pit B will be a long term groundwater sink, capturing water from Pit A. There will continue to be connections between Pit A/Deep Lead Pit and the local aquifer until the cone of depression around Pit B is developed. This is no risk of overflow from the pits and limited potential of the pits to stratify (but this has limited implications for the risk assessment).
groundwater modelling to determine whether the void is acting as a sink or a source for groundwater	As above.

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Appendix A

Groundwater Monitoring Bore Logs

Borehole Log

Borehole ID: WTB - 04

Project Number: 2020.10003

Client: Solomons Gold

Project: Progressive Rehabilitation & Closure Plan

Location: Wirralie Gold Mine, Mt Coolon, QLD

Logged By: MA

Wirralie Gold Mine

Date Commenced: 17/08/2021

Date Completed: 17/08/2021

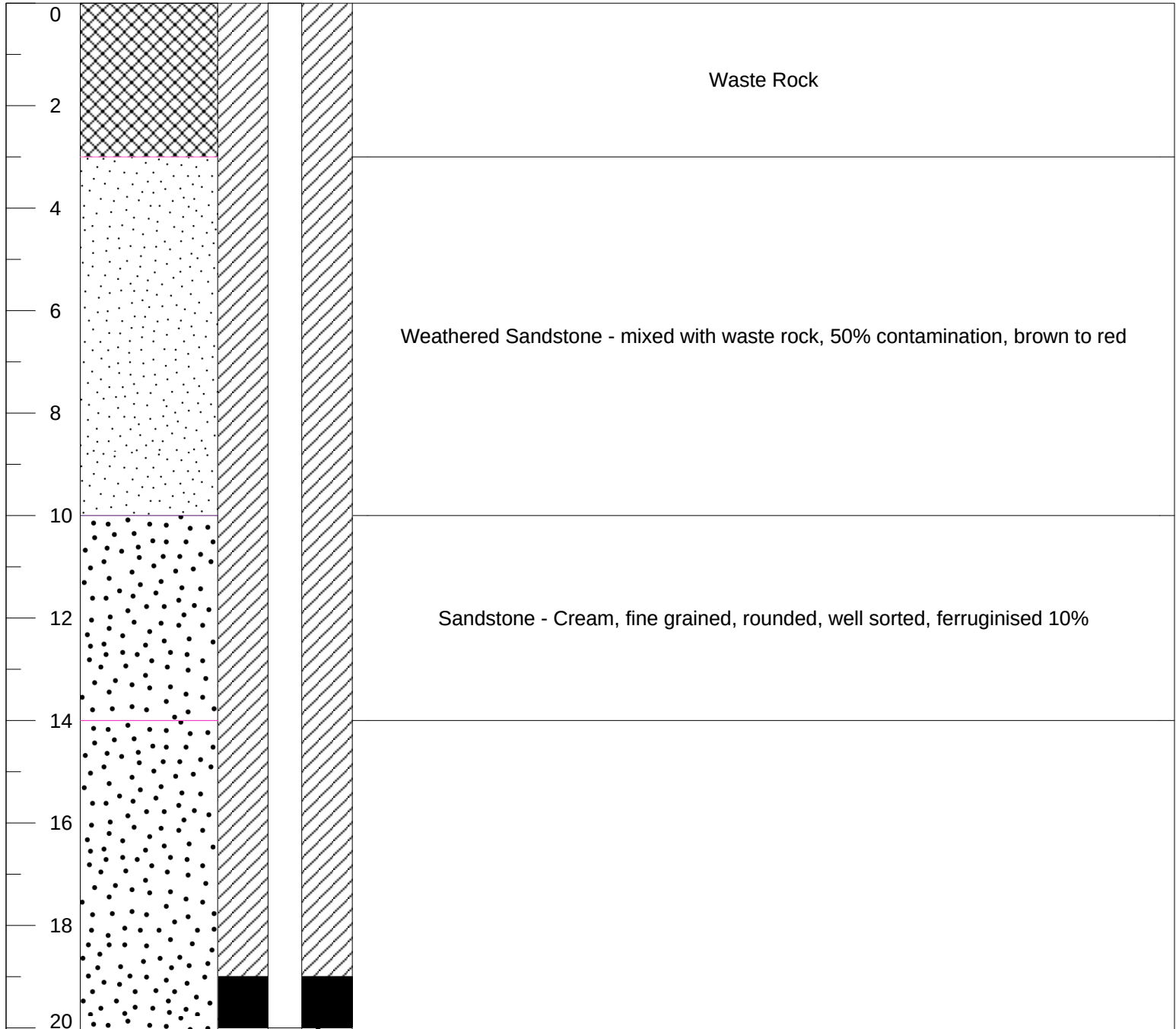
Easting: 527407.00

Northing: 7664918.00

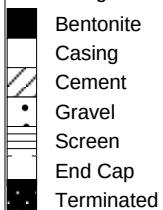


**WULGURU TECHNICAL
SERVICES**

Depth (m)	Graphic Log	Bore Construction	Description
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Bore Legend



Note: GPS Coordinates sourced from handheld devices. Survey conducted post bore establishment.
Bore dry during establishment.

Date: 27/08/2021

Version: V1.0

Page: 1 of 2

Depth (m)	Graphic Log	Bore Construction	Description
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Borehole Log

Borehole ID: WTB - 05

Project Number: 2020.10003

Client: Solomons Gold

Project: Progressive Rehabilitation & Closure Plan

Location: Wirralie Gold Mine, Mt Coolon, QLD

Logged By: MA

Wirralie Gold Mine

Date Commenced: 16/08/2021

Date Completed: 17/08/2021

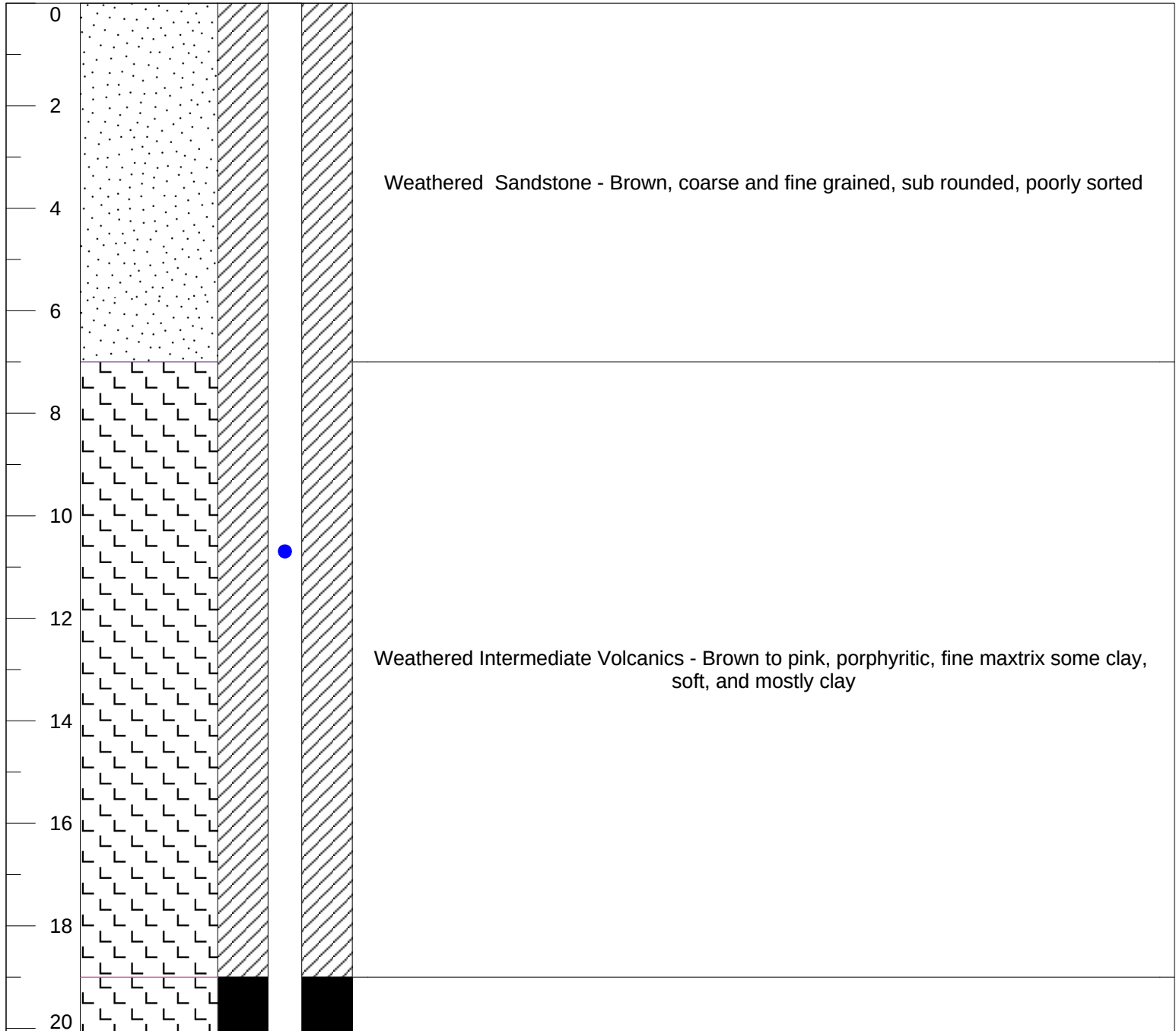
Easting: 526748.00

Northing: 7665239.00

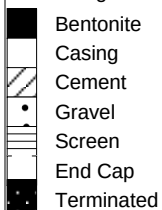


**WULGURU TECHNICAL
SERVICES**

Depth (m)	Graphic Log	Bore Construction	Description
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Bore Legend



Note: GPS Coordinates sourced from handheld devices. Survey conducted post bore establishment.

● Indicates SWL

Date: 27/08/2021

Version: V1.0

Page: 1 of 2

Borehole Log

Borehole ID: WTB - 05

Project Number: 2020.10003

Client: Solomons Gold

Project: Progressive Rehabilitation & Closure Plan

Location: Wirralie Gold Mine, Mt Coolon, QLD

Logged By: MA

Wirralie Gold Mine

Date Commenced: 16/08/2021

Date Completed: 17/08/2021

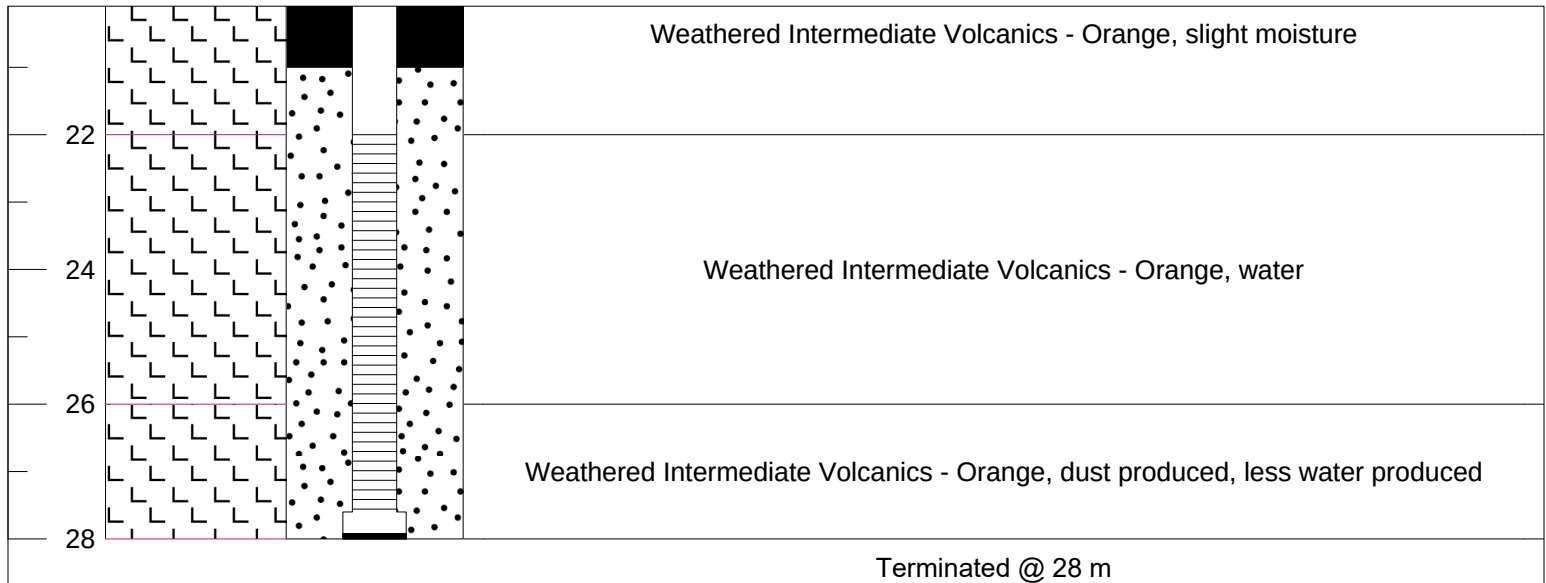
Easting: 526748.00

Northing: 7665239.00

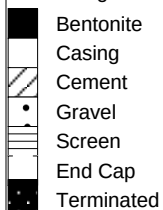


**WULGURU TECHNICAL
SERVICES**

Depth (m)	Graphic Log	Bore Construction	Description
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Bore Legend



Note: GPS Coordinates sourced from handheld devices. Survey conducted post bore establishment.
● Indicates SWL

Date: 27/08/2021

Version: V1.0

Page: 2 of 2

Borehole Log

Borehole ID: WTB - 06

Project Number: 2020.10003

Client: Solomons Gold

Project: Progressive Rehabilitation & Closure Plan

Location: Wirralie Gold Mine, Mt Coolon, QLD

Logged By: MA

Wirralie Gold Mine

Date Commenced: 15/08/2021

Date Completed: 16/08/2021

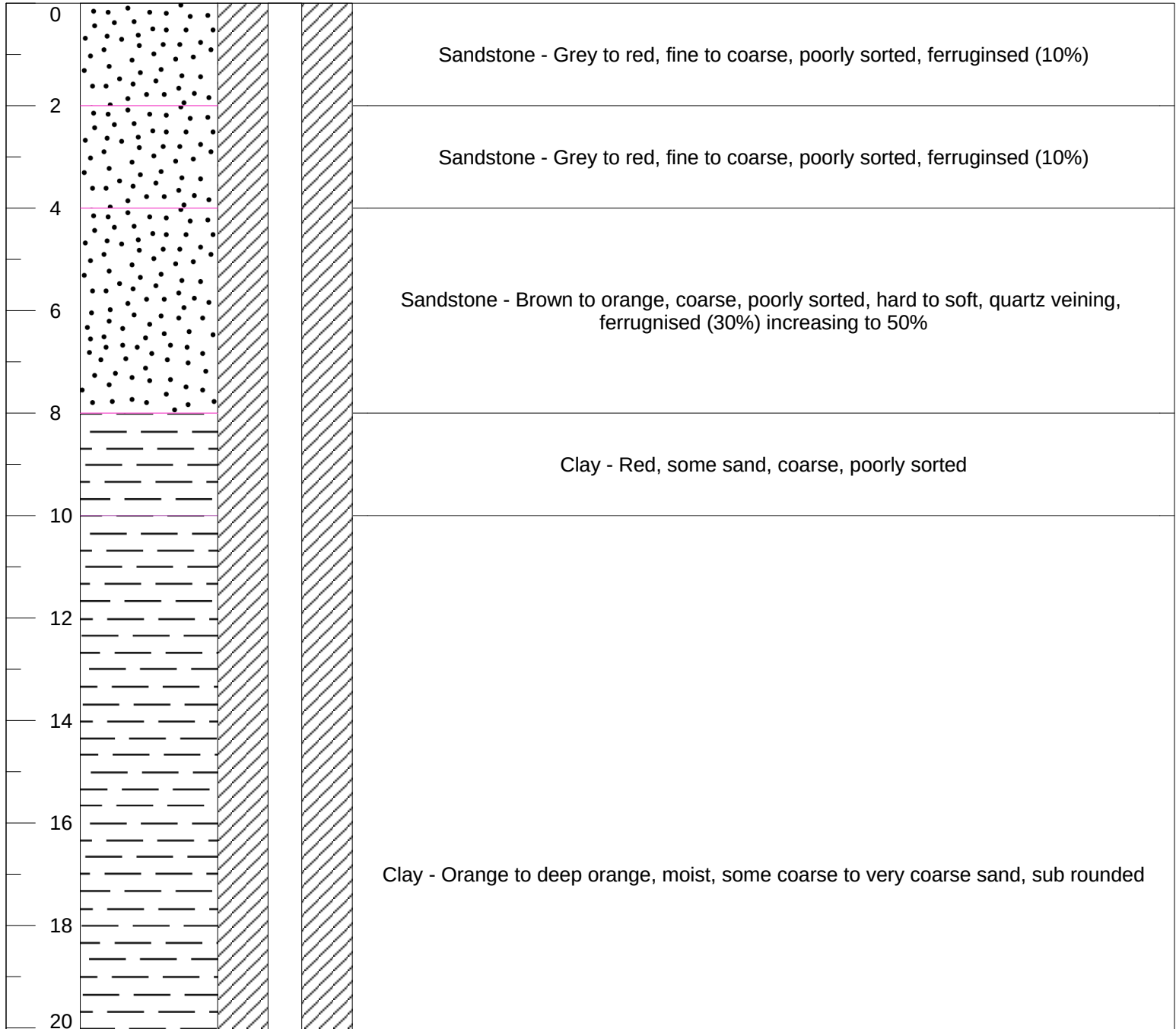
Easting: 527319.00

Northing: 7665825.00

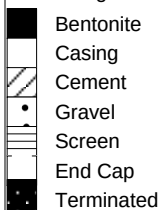


**WULGURU TECHNICAL
SERVICES**

Depth (m)	Graphic Log	Bore Construction	Description
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Bore Legend



Note: GPS Coordinates sourced from handheld devices. Survey conducted post bore establishment.
● Indicates SWL

Date: 27/08/2021

Version: V1.0

Page: 1 of 3

Borehole Log

Borehole ID: WTB - 06

Project Number: 2020.10003

Client: Solomons Gold

Project: Progressive Rehabilitation & Closure Plan

Location: Wirralie Gold Mine, Mt Coolon, QLD

Logged By: MA

Wirralie Gold Mine

Date Commenced: 15/08/2021

Date Completed: 16/08/2021

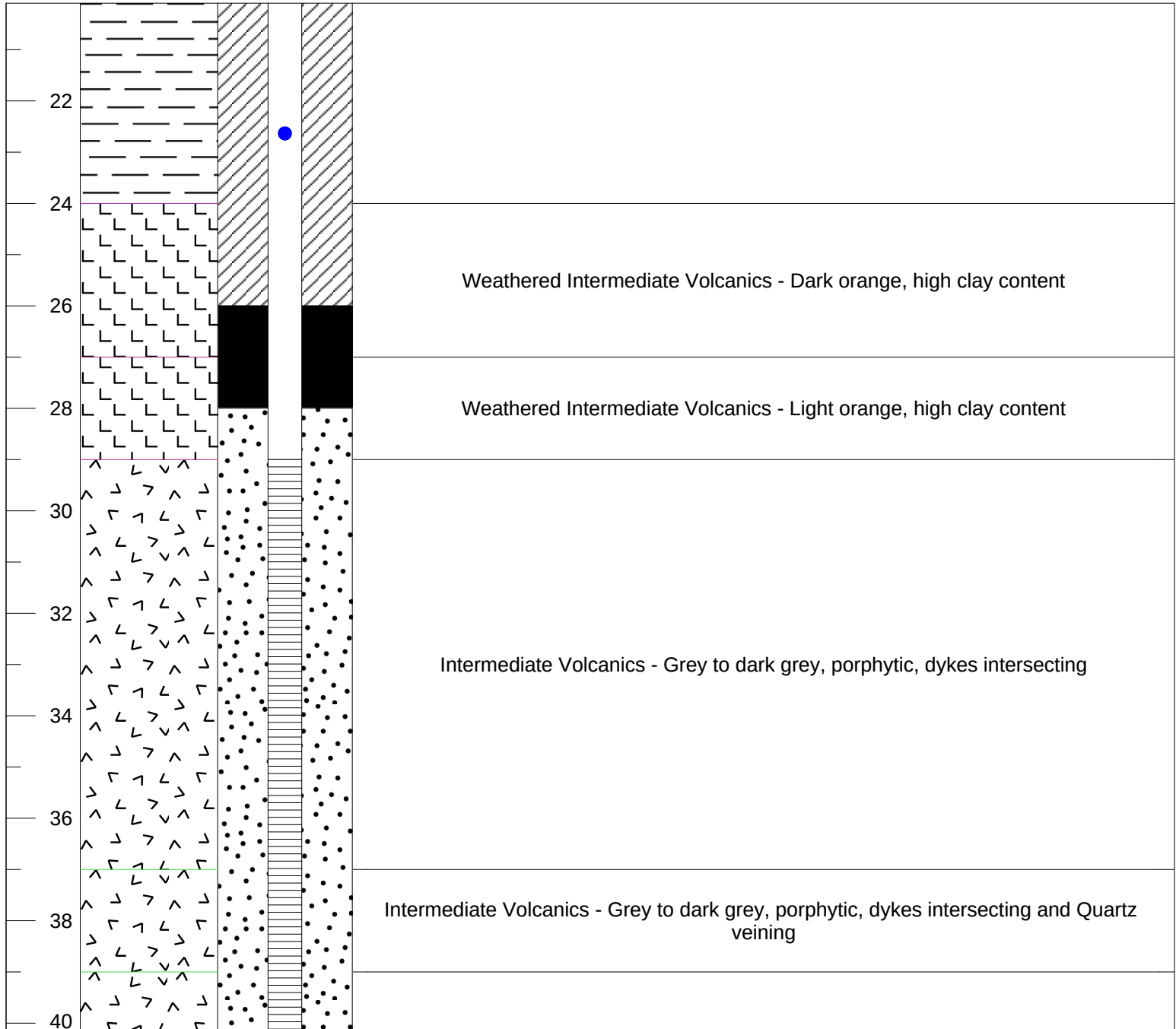
Easting: 527319.00

Northing: 7665825.00

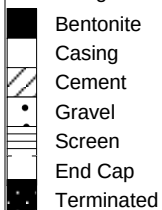


**WULGURU TECHNICAL
SERVICES**

Depth (m)	Graphic Log	Bore Construction	Description
-----------	-------------	-------------------	-------------



Bore Legend



Note: GPS Coordinates sourced from handheld devices. Survey conducted post bore establishment.

● Indicates SWL

Date: 27/08/2021

Version: V1.0

Page: 2 of 3

Borehole Log

Borehole ID: WTB - 06

Project Number: 2020.10003

Client: Solomons Gold

Project: Progressive Rehabilitation & Closure Plan

Location: Wirralie Gold Mine, Mt Coolon, QLD

Logged By: MA

Wirralie Gold Mine

Date Commenced: 15/08/2021

Date Completed: 16/08/2021

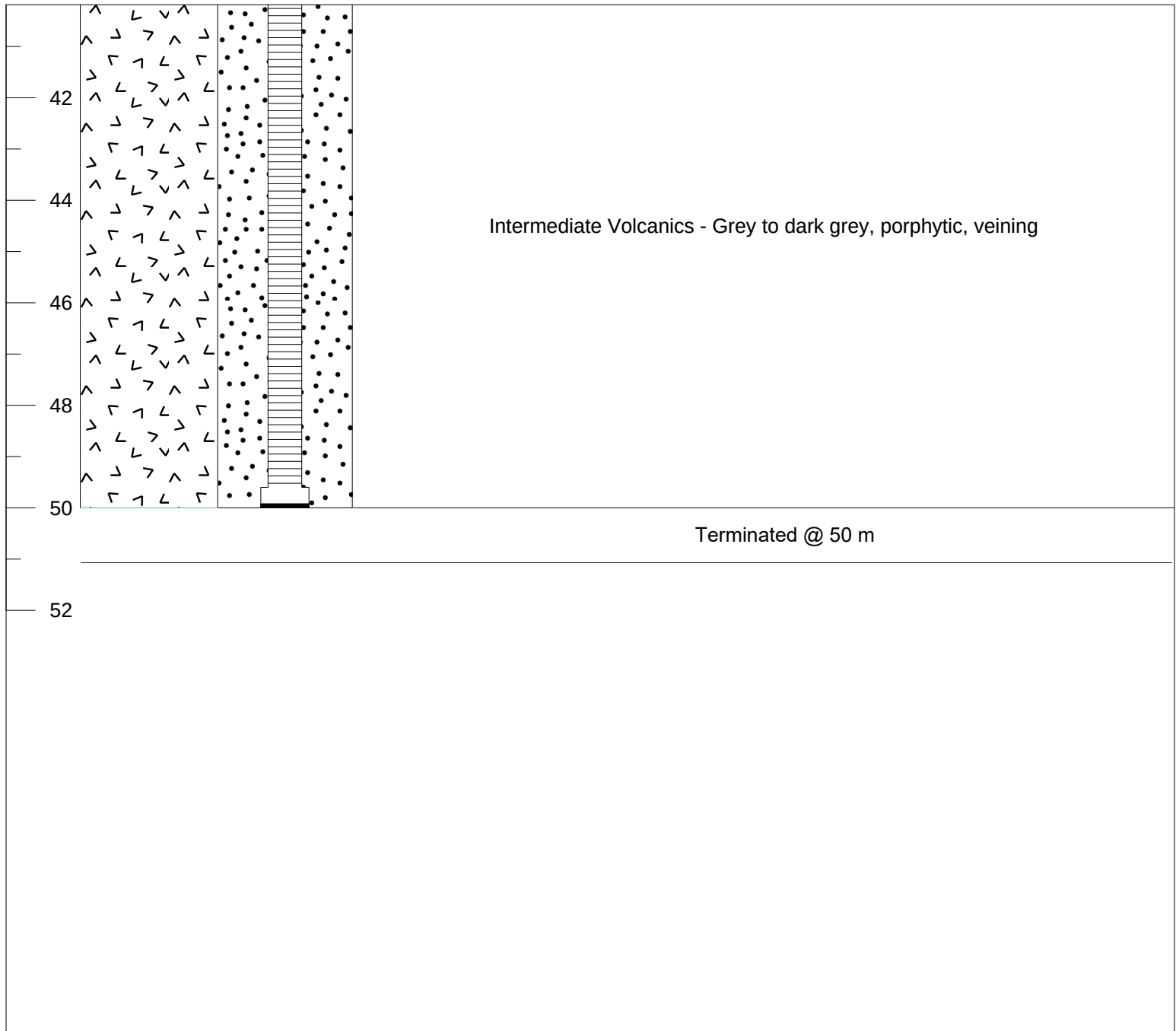
Easting: 527319.00

Northing: 7665825.00

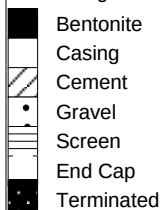


**WULGURU TECHNICAL
SERVICES**

Depth (m)	Graphic Log	Bore Construction	Description
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Bore Legend



Note: GPS Coordinates sourced from handheld devices. Survey conducted post bore establishment.
● Indicates SWL

Date: 27/08/2021

Version: V1.0

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Borehole Log

Borehole ID: WTB - 07

Project Number: 2020.10003

Client: Solomons Gold

Project: Progressive Rehabilitation & Closure Plan

Location: Wirralie Gold Mine, Mt Coolon, QLD

Logged By: MA

Wirralie Gold Mine

Date Commenced: 14/08/2021

Date Completed: 15/08/2021

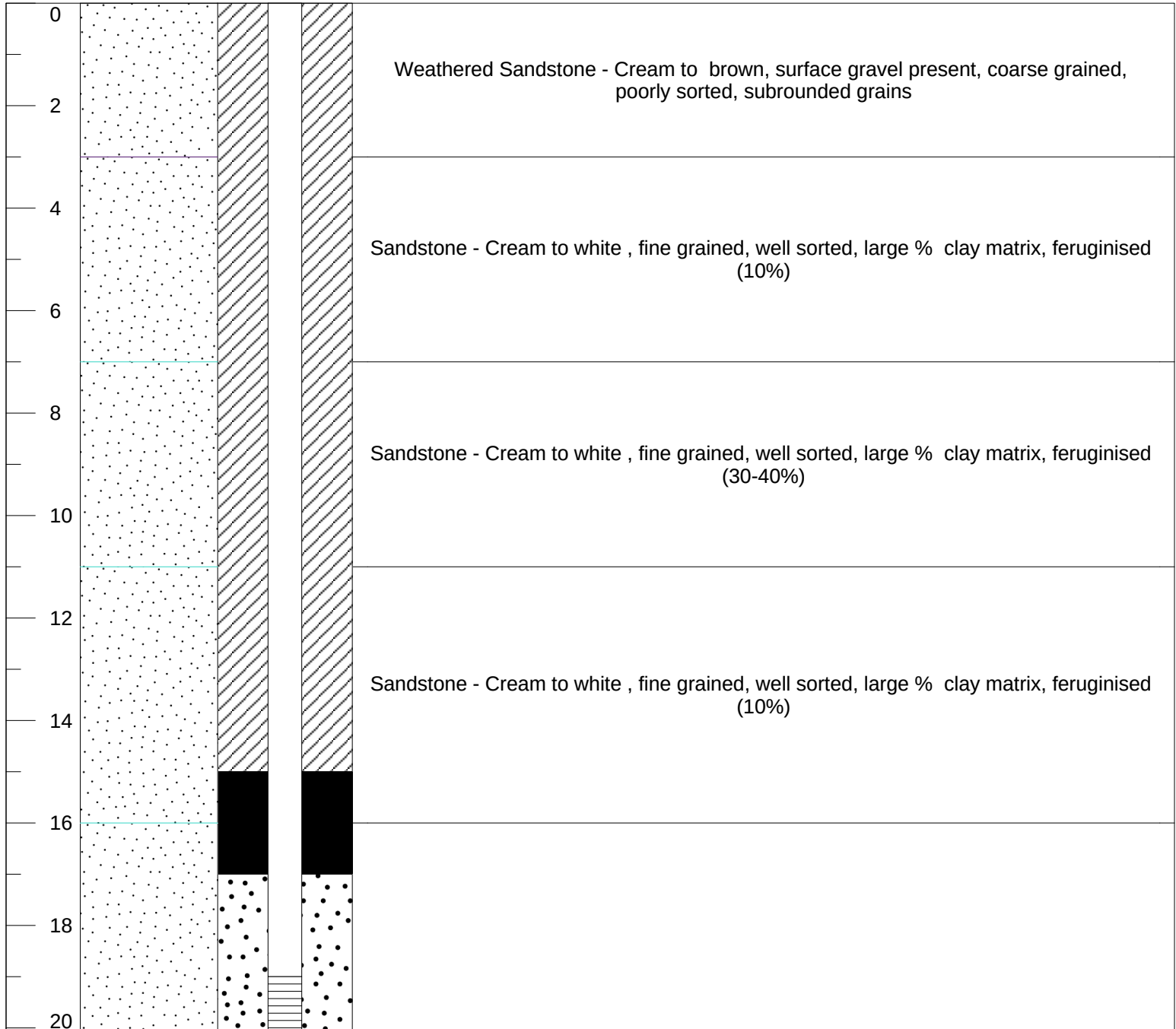
Easting: 526809.00

Northing: 7663693.00

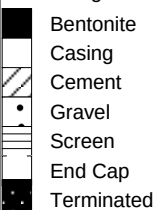


**WULGURU TECHNICAL
SERVICES**

Depth (m)	Graphic Log	Bore Construction	Description
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Bore Legend



Note: GPS Coordinates sourced from handheld devices. Survey conducted post bore establishment.
● Indicates SWL

Date: 27/08/2021

Version: V1.0

Page: 1 of 2

Borehole Log

Borehole ID: WTB - 07

Project Number: 2020.10003

Client: Solomons Gold

Project: Progressive Rehabilitation & Closure Plan

Location: Wirralie Gold Mine, Mt Coolon, QLD

Logged By: MA

Wirralie Gold Mine

Date Commenced: 14/08/2021

Date Completed: 15/08/2021

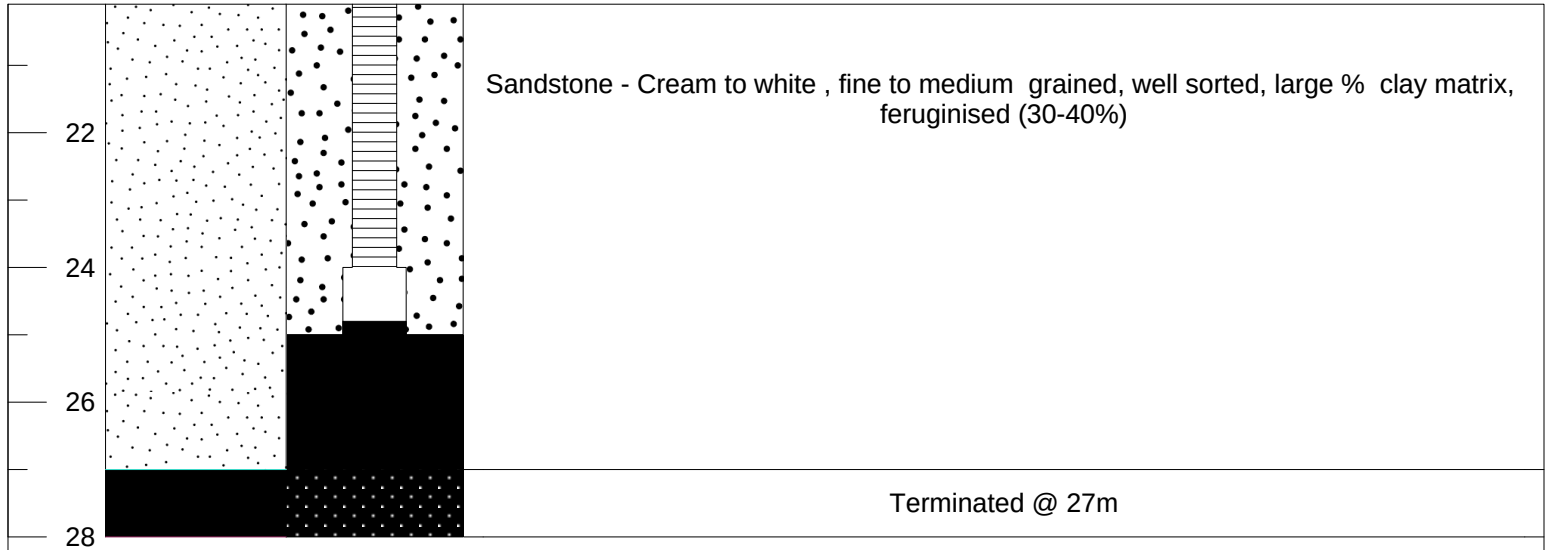
Easting: 526809.00

Northing: 7663693.00

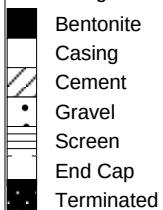


**WULGURU TECHNICAL
SERVICES**

Depth (m)	Graphic Log	Bore Construction	Description
-----------	-------------	-------------------	-------------



Bore Legend



Note: GPS Coordinates sourced from handheld devices. Survey conducted post bore establishment.
● Indicates SWL

Date: 27/08/2021

Version: V1.0

Page: 2 of 2

Borehole Log

Borehole ID: WTB - 08

Project Number: 2020.10003

Client: Solomons Gold

Project: Progressive Rehabilitation & Closure Plan

Location: Wirralie Gold Mine, Mt Coolon, QLD

Logged By: MA

Wirralie Gold Mine

Date Commenced: 15/08/2021

Date Completed: 16/08/2021

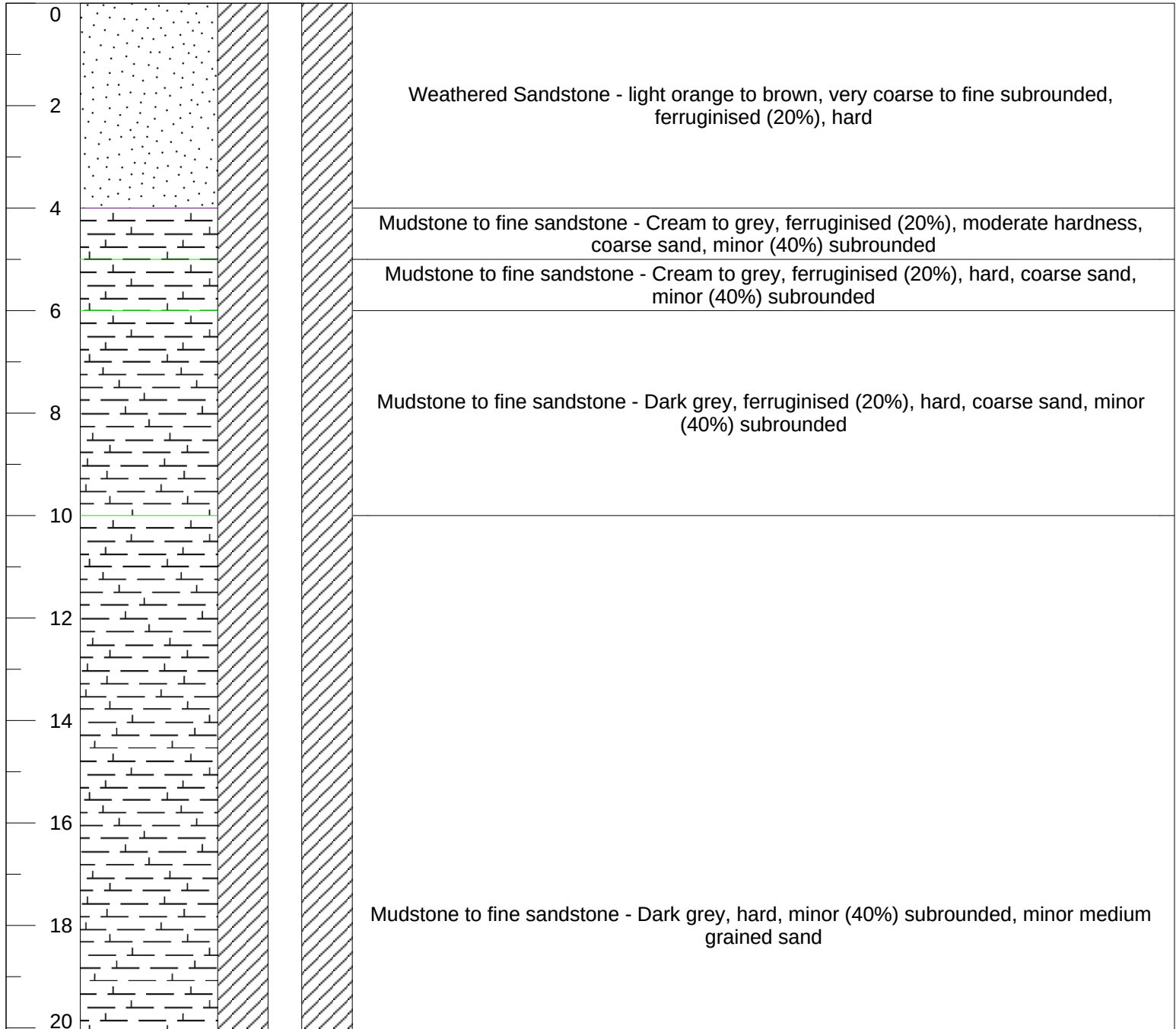
Easting: 526845.00

Northing: 7663693.00

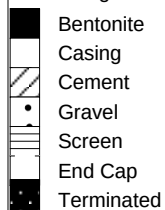


**WULGURU TECHNICAL
SERVICES**

Depth (m)	Graphic Log	Bore Construction	Description
-----------	-------------	-------------------	-------------



Bore Legend



Note: GPS Coordinates sourced from handheld devices. Survey conducted post bore establishment.
● Indicates SWL

Date: 27/08/2021

Version: V1.0

Page: 1 of 4

Borehole Log

Borehole ID: WTB - 08

Project Number: 2020.10003

Client: Solomons Gold

Project: Progressive Rehabilitation & Closure Plan

Location: Wirralie Gold Mine, Mt Coolon, QLD

Logged By: MA

Wirralie Gold Mine

Date Commenced: 15/08/2021

Date Completed: 16/08/2021

Easting: 526845.00

Northing: 7663693.00

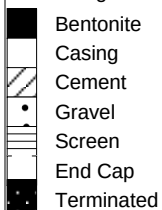


**WULGURU TECHNICAL
SERVICES**

Depth (m)	Graphic Log	Bore Construction	Description
-----------	-------------	-------------------	-------------



Bore Legend



Note: GPS Coordinates sourced from handheld devices. Survey conducted post bore establishment.

● Indicates SWL

Date: 27/08/2021

Version: V1.0

Page: 2 of 4

Borehole Log

Borehole ID: WTB - 08

Project Number: 2020.10003

Client: Solomons Gold

Project: Progressive Rehabilitation & Closure Plan

Location: Wirralie Gold Mine, Mt Coolon, QLD

Logged By: MA

Wirralie Gold Mine

Date Commenced: 15/08/2021

Date Completed: 16/08/2021

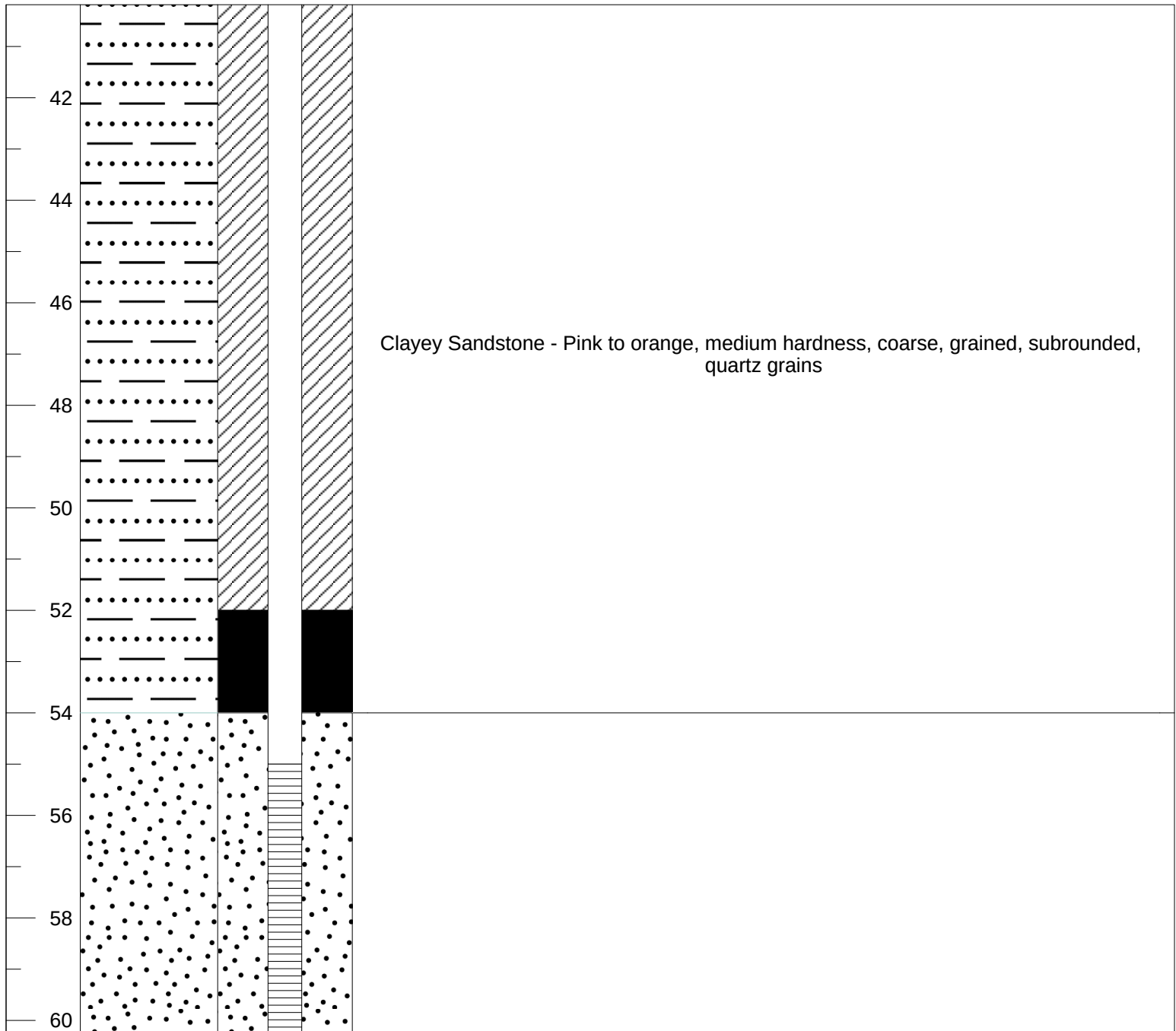
Easting: 526845.00

Northing: 7663693.00

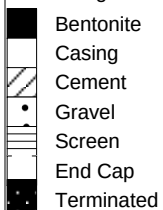


**WULGURU TECHNICAL
SERVICES**

Depth (m)	Graphic Log	Bore Construction	Description
-----------	-------------	-------------------	-------------



Bore Legend



Note: GPS Coordinates sourced from handheld devices. Survey conducted post bore establishment.
● Indicates SWL

Date: 27/08/2021

Version: V1.0

Page: 3 of 4

Borehole Log

Borehole ID: WTB - 08

Project Number: 2020.10003

Client: Solomons Gold

Project: Progressive Rehabilitation & Closure Plan

Location: Wirralie Gold Mine, Mt Coolon, QLD

Logged By: MA

Wirralie Gold Mine

Date Commenced: 15/08/2021

Date Completed: 16/08/2021

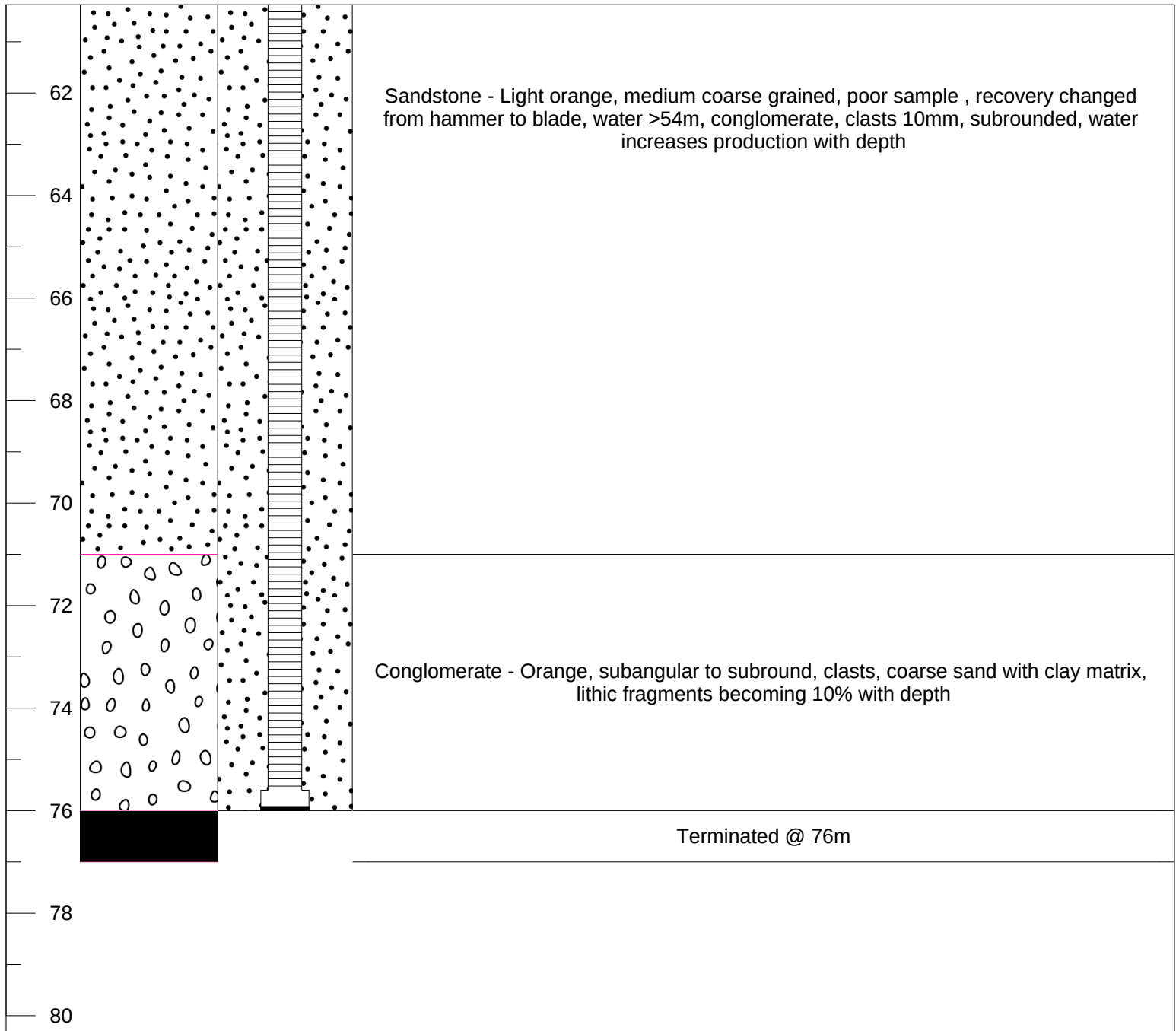
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Northing: 7663693.00

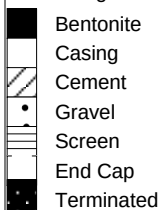


**WULGURU TECHNICAL
SERVICES**

Depth (m)	Graphic Log	Bore Construction	Description
-----------	-------------	-------------------	-------------



Bore Legend



Note: GPS Coordinates sourced from handheld devices. Survey conducted post bore establishment.
● Indicates SWL

Date: 27/08/2021

Version: V1.0

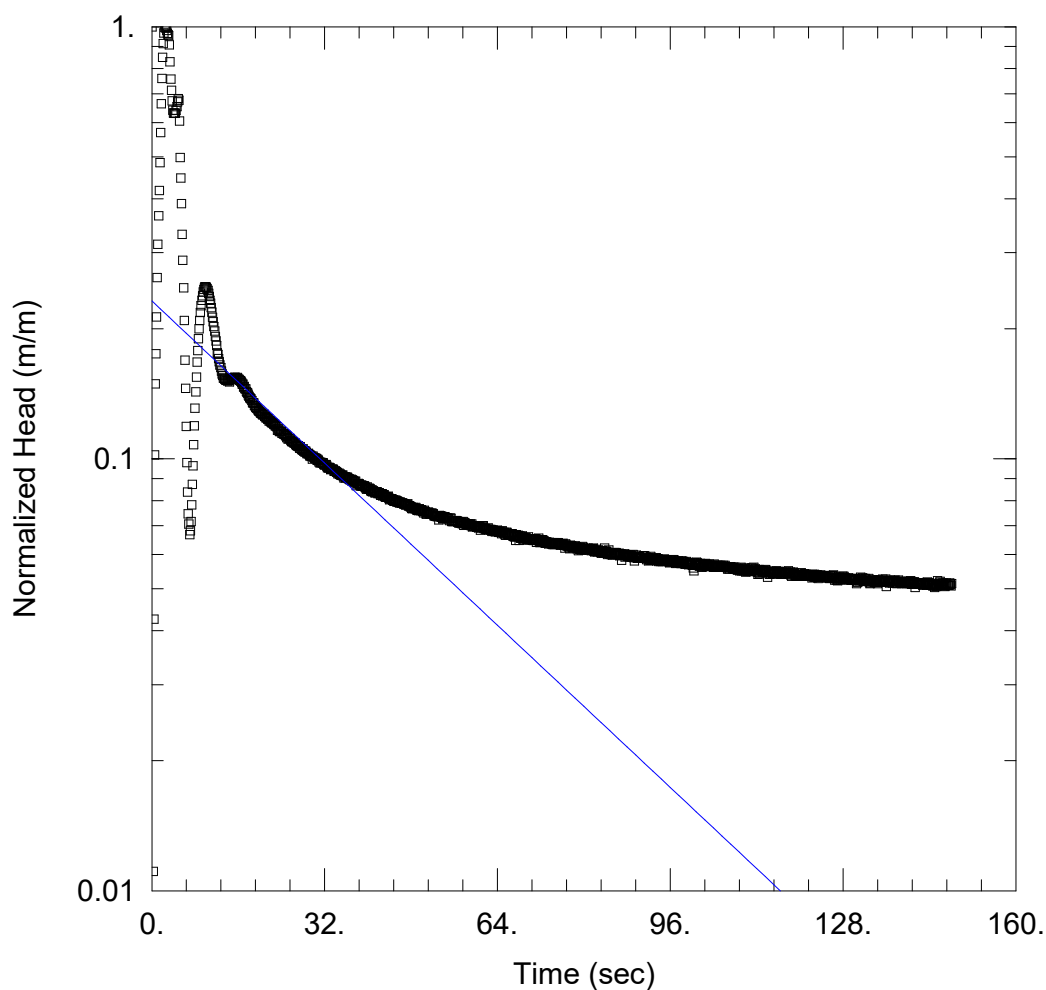
Page: 4 of 4

Appendix B

Rising Head Tests and Falling Head Tests results

Table B.1 Hydraulic properties

Bore ID	Test type	Aquifer model	Mathematical model	K value (m/day)	Goodness of fit	Representative range	Screened lithology	Formation
WTB05	FHT_2	Unconfined	Bouwer-Rice	0.4947	OK	0.4947 - 0.6314 m/day	Weathered intermediate volcanics	Mount Wyatt Formation
			Hvorslev	0.5424	OK			
	RHT_2		Bouwer-Rice	0.5252	OK			
			Hvorslev	0.6314	OK			
	FHT_3	Unconfined	Bouwer-Rice	0.5032	OK	0.5032 - 1.131 m/day	Weathered intermediate volcanics	Mount Wyatt Formation
			Hvorslev	0.5269	OK			
	RHT_3		Bouwer-Rice	0.8195	OK			
			Hvorslev	1.131	OK			
WTB06	FHT_1	Unconfined	Bouwer-Rice	1.767 x 10 ⁻³	OK	0.0007587 - 0.002225 m/day	intermediate volcanics	Mount Wyatt Formation
			Hvorslev	2.225 x 10 ⁻³	OK			
	RHT_1		Bouwer-Rice	7.587 x 10 ⁻⁴	Good			
			Hvorslev	9.668 x 10 ⁻⁴	Good			
	FHT_1	Confined	Bouwer-Rice	1.767 x 10 ⁻³	OK	0.0007587 - 0.002225 m/day	Weathered intermediate volcanics	Mount Wyatt Formation
			Hvorslev	2.225 x 10 ⁻³	OK			
	RHT_1		Bouwer-Rice	7.587 x 10 ⁻⁴	Good			
			Hvorslev	9.668 x 10 ⁻⁴	Good			



FALLING HEAD TEST (T2)

Data Set: G:\...\WTB05_T2_FHT_Bouwer-Rice.aqt

Date: 11/21/23

Time: 11:21:34

PROJECT INFORMATION

Company: AGE Consultants

Client: Solomons Mine Pty Ltd

Project: WIR5000.001

Location: Wirralie Gold Mine

Test Well: WTB05

Test Date: 5/8/2023

AQUIFER DATA

Saturated Thickness: 19.4 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (WTB05)

Initial Displacement: 0.496 m

Total Well Penetration Depth: 28. m

Casing Radius: 0.025 m

Static Water Column Height: 19.4 m

Screen Length: 6. m

Well Radius: 0.1015 m

Gravel Pack Porosity: 0.

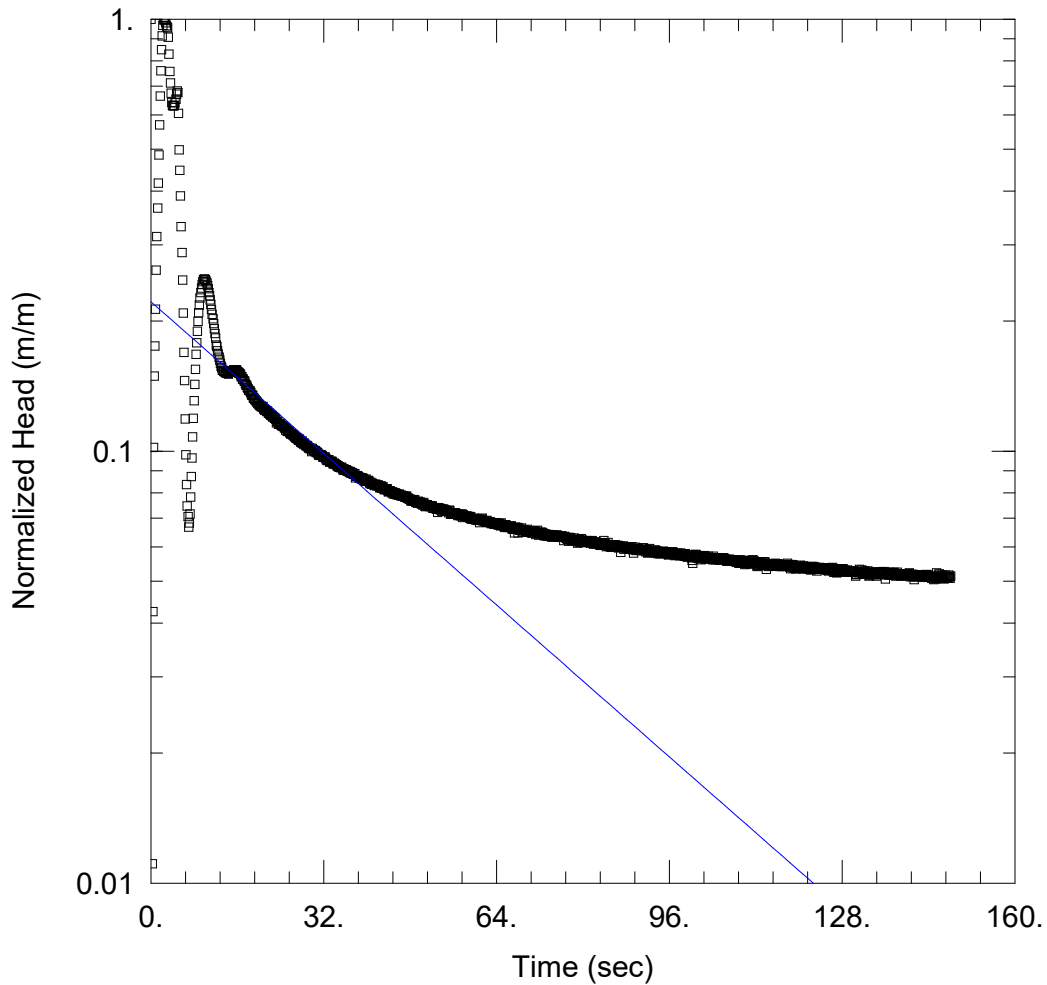
SOLUTION

Aquifer Model: Unconfined

$K = 0.4947$ m/day

Solution Method: Bouwer-Rice

$y_0 = 0.1151$ m



FALLING HEAD TEST (T2)

Data Set: G:\...\WTB05_T2_FHT_Hvorslev.aqt

Date: 11/21/23

Time: 12:31:49

PROJECT INFORMATION

Company: AGE Consultants

Client: Solomons Mine Pty Ltd

Project: WIR5000.001

Location: Wirralie Gold Mine

Test Well: WTB05

Test Date: 5/8/2023

AQUIFER DATA

Saturated Thickness: 19.4 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (WTB05)

Initial Displacement: 0.496 m

Static Water Column Height: 19.4 m

Total Well Penetration Depth: 28. m

Screen Length: 6. m

Casing Radius: 0.025 m

Well Radius: 0.1015 m

Gravel Pack Porosity: 0.

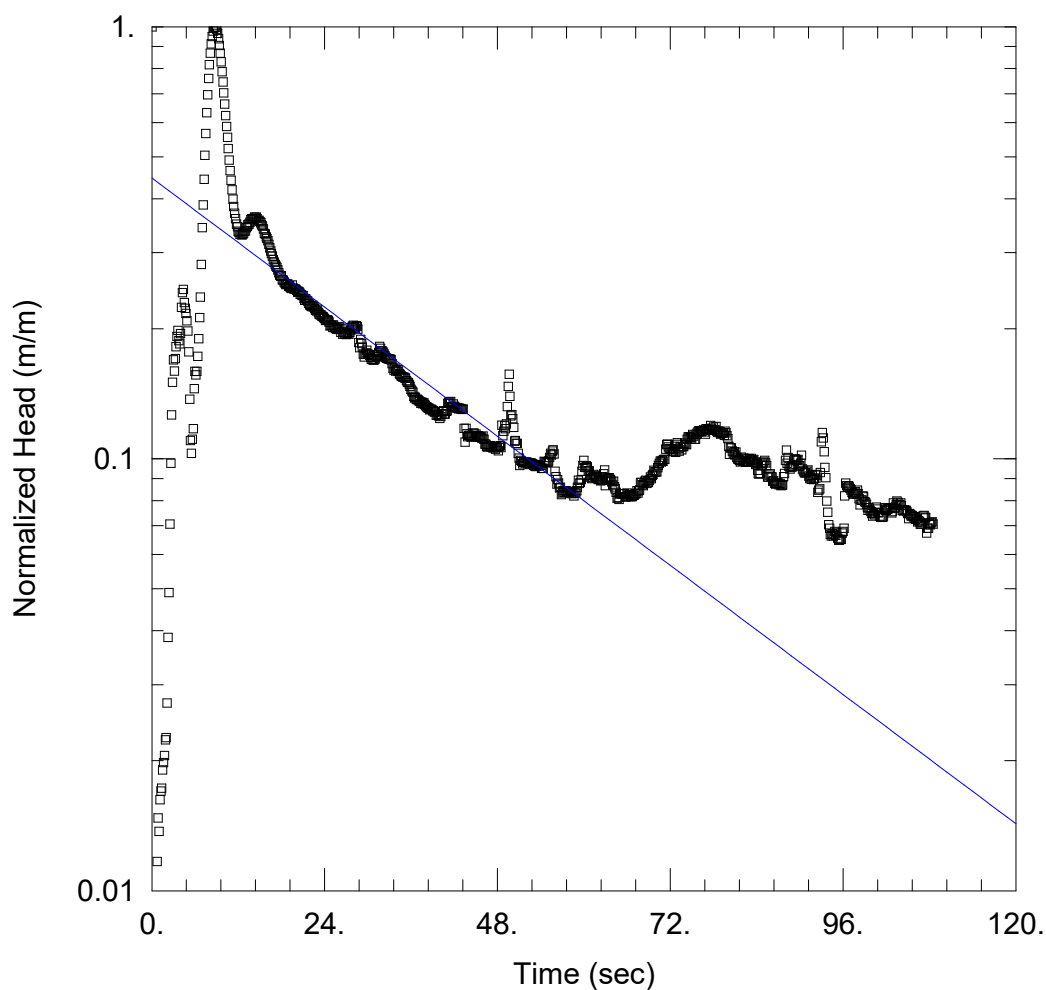
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

$K = 0.5424$ m/day

$y_0 = 0.1099$ m



RISING HEAD TEST

Data Set: G:\...\WTB05_T2_RHT_Bouwer-Rice.aqt

Date: 11/21/23

Time: 11:25:40

PROJECT INFORMATION

Company: AGE Consultants

Client: Solomons Mine Pty Ltd

Project: WIR5000.001

Location: Wirralie Gold Mine

Test Well: WTB05

Test Date: 5/8/2023

AQUIFER DATA

Saturated Thickness: 19.4 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (WTB05)

Initial Displacement: 0.3936 m

Total Well Penetration Depth: 28. m

Casing Radius: 0.025 m

Static Water Column Height: 19.4 m

Screen Length: 6. m

Well Radius: 0.1015 m

Gravel Pack Porosity: 0.

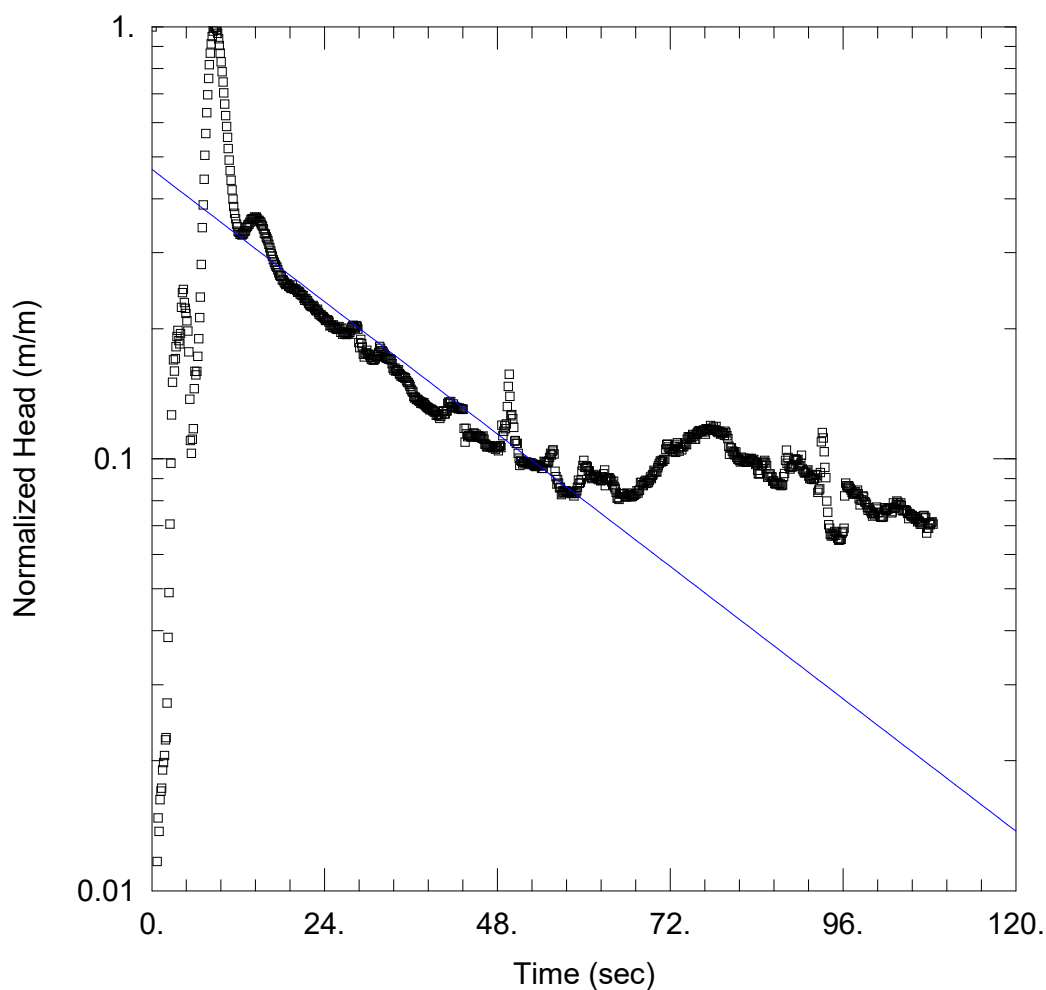
SOLUTION

Aquifer Model: Unconfined

$K = 0.5252$ m/day

Solution Method: Bouwer-Rice

$y_0 = 0.1759$ m



RISING HEAD TEST

Data Set: G:\...\WTB05_T2_RHT_Hvorslev.aqt

Date: 11/21/23

Time: 11:24:00

PROJECT INFORMATION

Company: AGE Consultants

Client: Solomons Mine Pty Ltd

Project: WIR5000.001

Location: Wirralie Gold Mine

Test Well: WTB05

Test Date: 5/8/2023

AQUIFER DATA

Saturated Thickness: 19.4 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (WTB05)

Initial Displacement: 0.3936 m

Total Well Penetration Depth: 28. m

Casing Radius: 0.025 m

Static Water Column Height: 19.4 m

Screen Length: 6. m

Well Radius: 0.1015 m

Gravel Pack Porosity: 0.

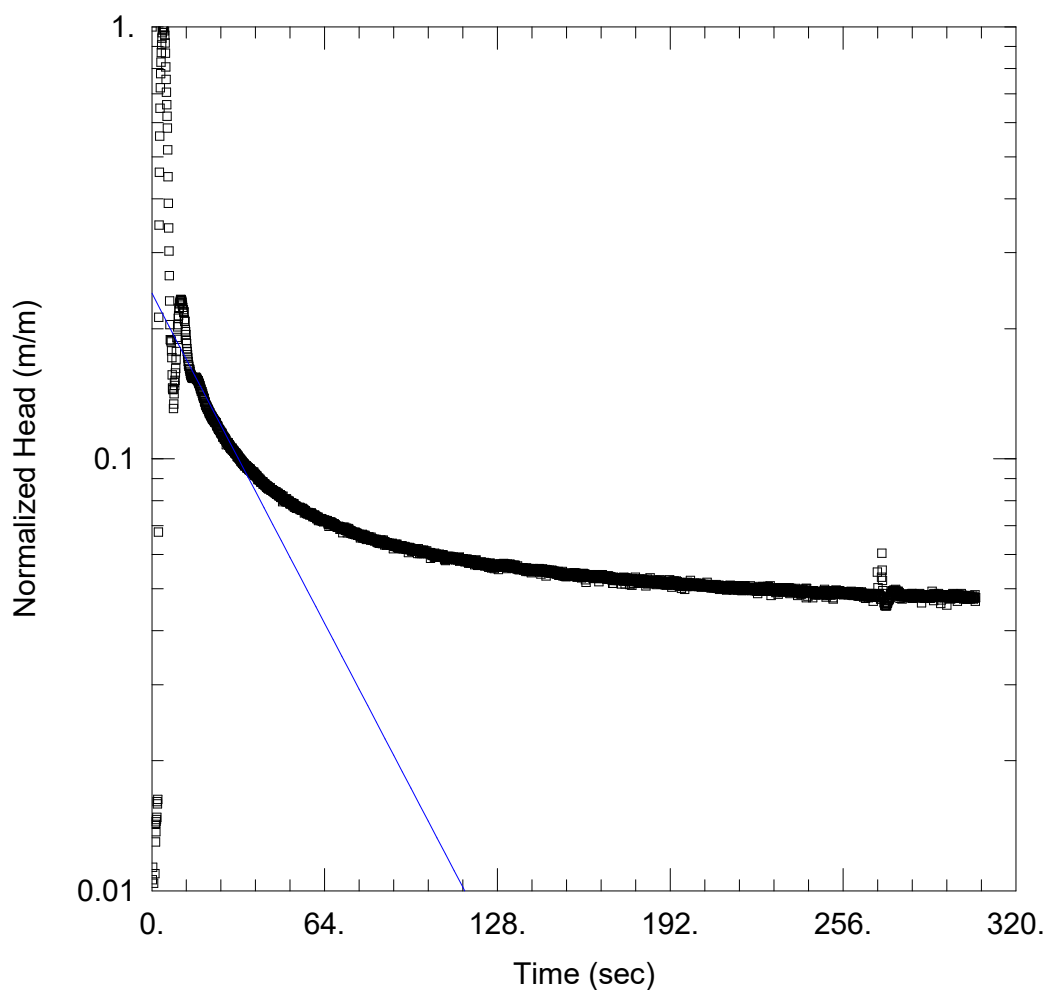
SOLUTION

Aquifer Model: Unconfined

$K = 0.6314$ m/day

Solution Method: Hvorslev

$y_0 = 0.1841$ m



WELL TEST ANALYSIS

Data Set: G:\...\WTB05_T3_FHT_Bouwer-Rice.aqt

Date: 11/21/23

Time: 11:29:54

PROJECT INFORMATION

Company: AGE Consultants

Client: Solomons Mine Pty Ltd

Project: WIR5000.001

Location: Wirralie Gold Mine

Test Well: WTB05

Test Date: 5/8/2023

AQUIFER DATA

Saturated Thickness: 19.39 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (WTB05)

Initial Displacement: 0.5472 m

Total Well Penetration Depth: 28. m

Casing Radius: 0.025 m

Static Water Column Height: 19.39 m

Screen Length: 6. m

Well Radius: 0.1015 m

Gravel Pack Porosity: 0.

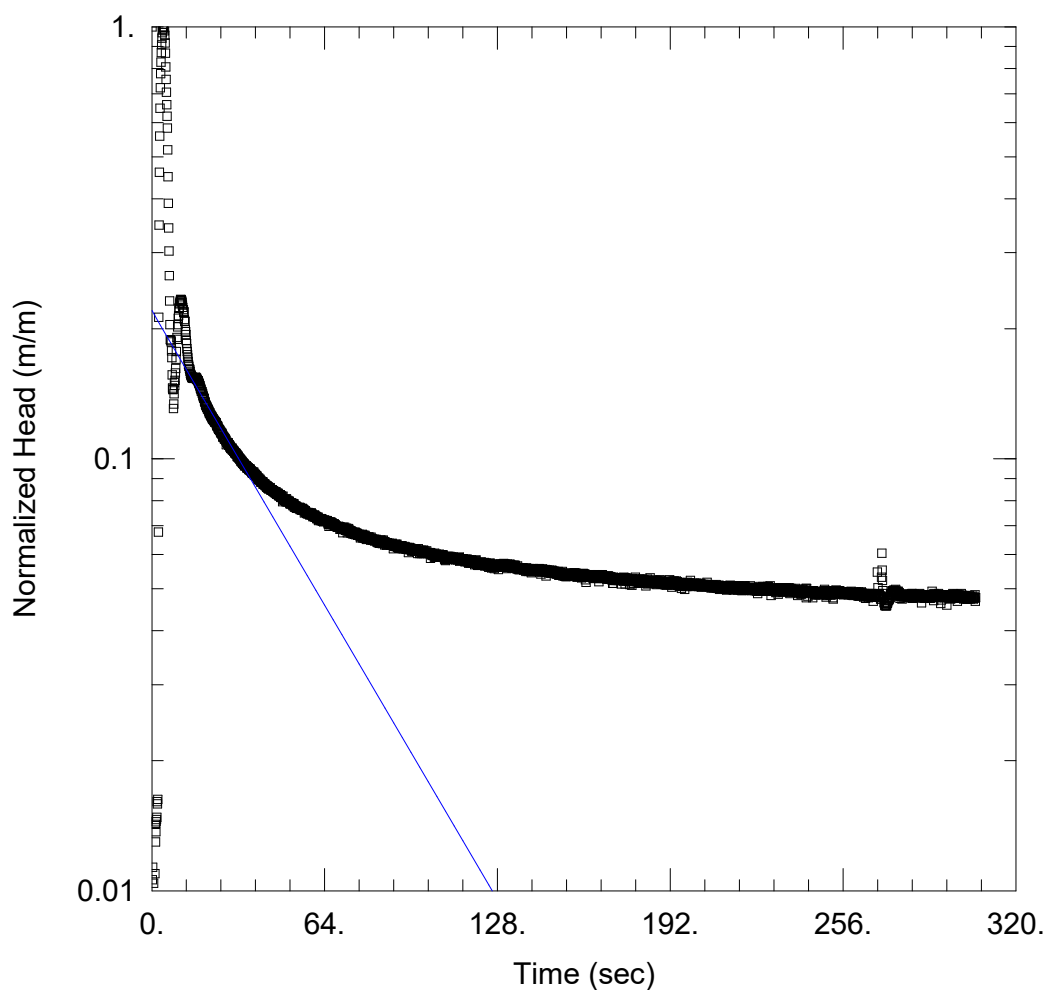
SOLUTION

Aquifer Model: Unconfined

$K = 0.5032$ m/day

Solution Method: Bouwer-Rice

$y_0 = 0.1322$ m



WELL TEST ANALYSIS

Data Set: G:\...\WTB05_T3_FHT_Hvorslev.aqt

Date: 11/21/23

Time: 11:31:41

PROJECT INFORMATION

Company: AGE Consultants

Client: Solomons Mine Pty Ltd

Project: WIR5000.001

Location: Wirralie Gold Mine

Test Well: WTB05

Test Date: 5/8/2023

AQUIFER DATA

Saturated Thickness: 19.39 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (WTB05)

Initial Displacement: 0.5472 m

Total Well Penetration Depth: 28. m

Casing Radius: 0.025 m

Static Water Column Height: 19.39 m

Screen Length: 6. m

Well Radius: 0.1015 m

Gravel Pack Porosity: 0.

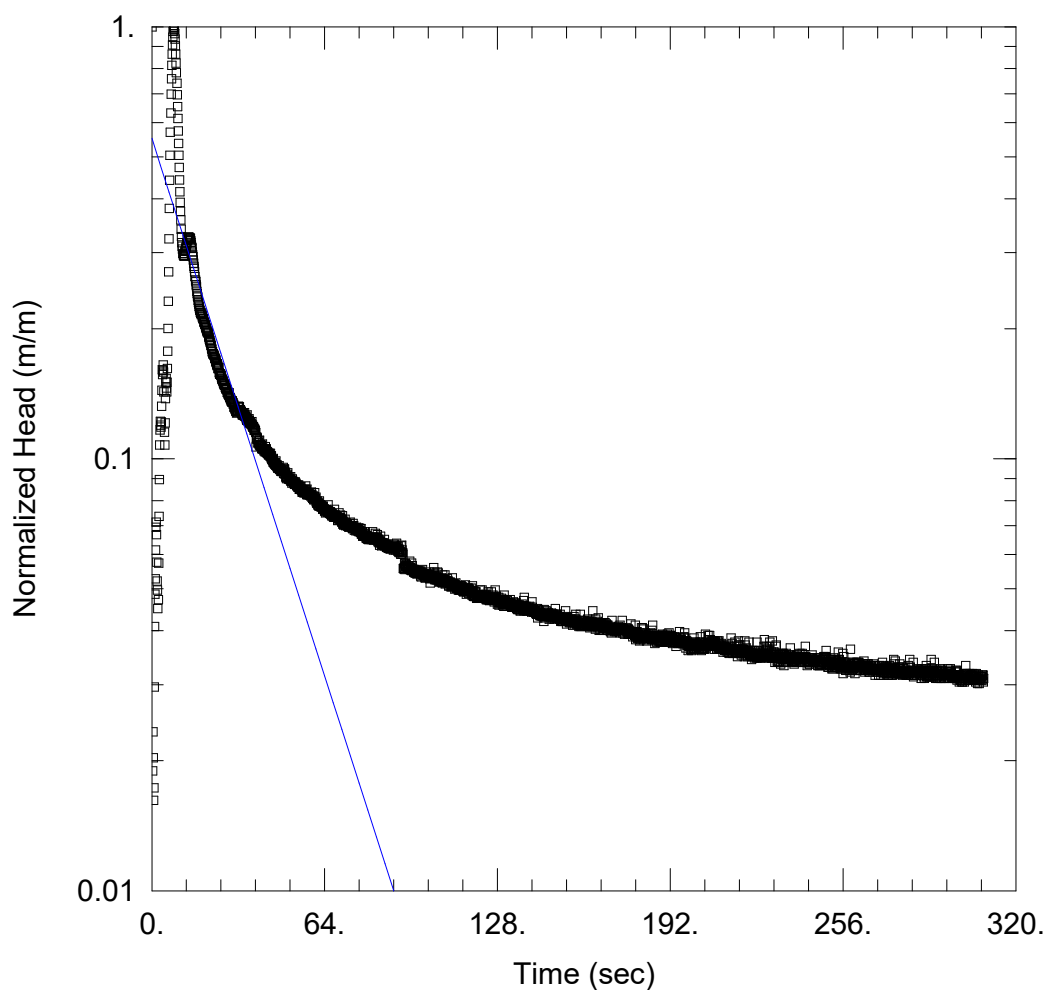
SOLUTION

Aquifer Model: Unconfined

$K = 0.5269$ m/day

Solution Method: Hvorslev

$y_0 = 0.1206$ m



RISING HEAD TEST

Data Set: G:\...\WTB05_T3_RHT_Bouwer-Rice.aqt

Date: 11/21/23

Time: 11:36:48

PROJECT INFORMATION

Company: AGE Consultants

Client: Solomons Mine Pty Ltd

Project: WIR5000.001

Location: Wirralie Gold Mine

Test Well: WTB05

Test Date: 5/8/2023

AQUIFER DATA

Saturated Thickness: 19.4 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (WTB05)

Initial Displacement: 0.3643 m

Total Well Penetration Depth: 28. m

Casing Radius: 0.025 m

Static Water Column Height: 19.4 m

Screen Length: 6. m

Well Radius: 0.1015 m

Gravel Pack Porosity: 0.

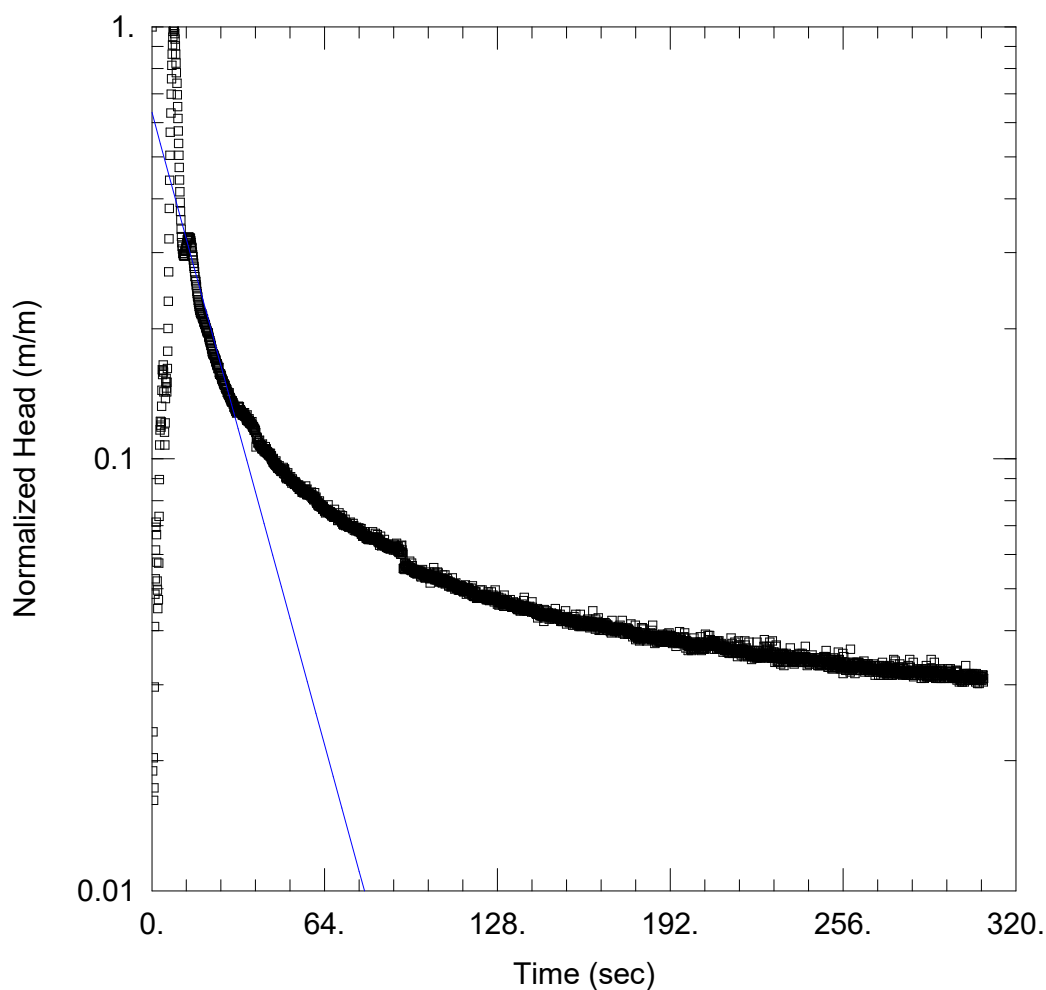
SOLUTION

Aquifer Model: Unconfined

$K = 0.8195$ m/day

Solution Method: Bouwer-Rice

$y_0 = 0.2011$ m



RISING HEAD TEST

Data Set: G:\...\WTB05_T3_RHT_Hvorslev.aqt

Date: 11/21/23

Time: 12:19:27

PROJECT INFORMATION

Company: AGE Consultants

Client: Solomons Mine Pty Ltd

Project: WIR5000.001

Location: Wirralie Gold Mine

Test Well: WTB05

Test Date: 5/8/2023

AQUIFER DATA

Saturated Thickness: 19.4 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (WTB05)

Initial Displacement: 0.3643 m

Total Well Penetration Depth: 28. m

Casing Radius: 0.025 m

Static Water Column Height: 19.4 m

Screen Length: 6. m

Well Radius: 0.1015 m

Gravel Pack Porosity: 0.

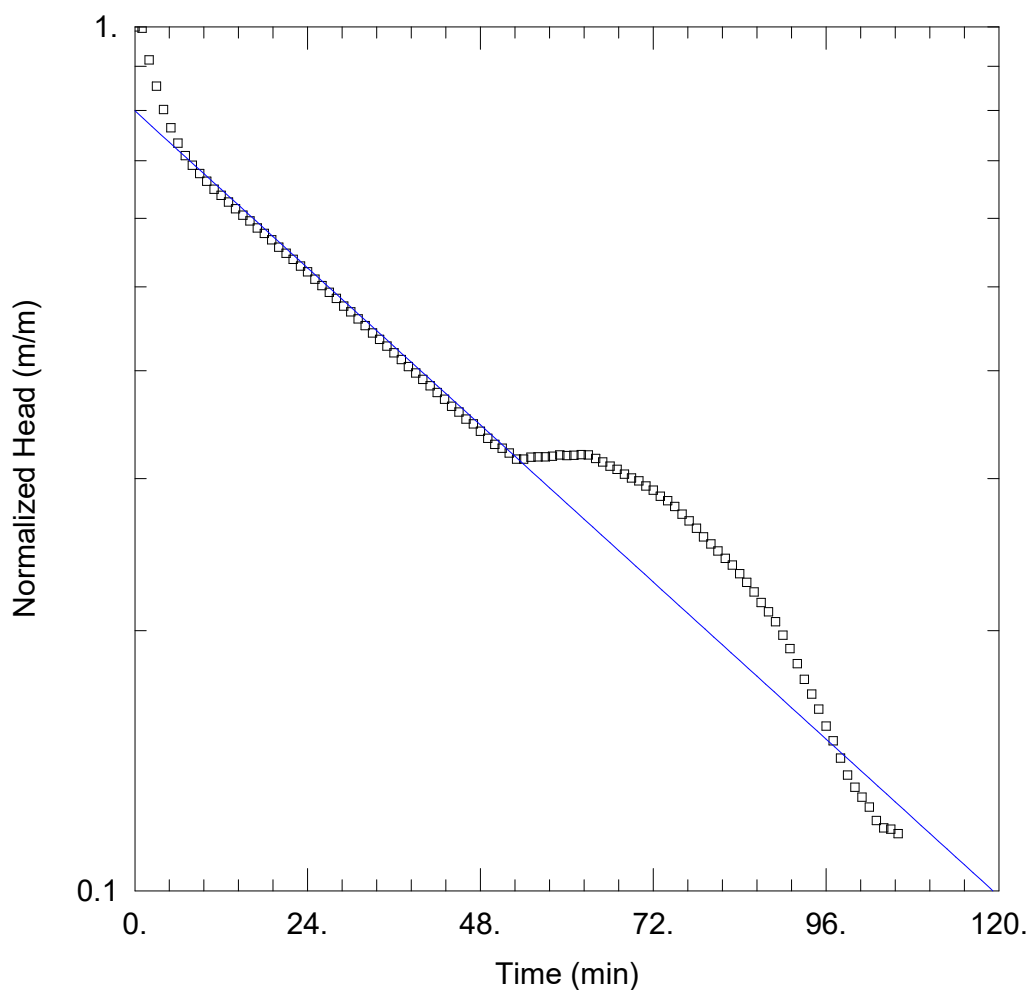
SOLUTION

Aquifer Model: Unconfined

$K = 1.131$ m/day

Solution Method: Hvorslev

$y_0 = 0.2309$ m



FALLING HEAD TEST

Data Set: G:\...\WTB06_T1_FHT.aqt

Date: 11/21/23

Time: 10:33:06

PROJECT INFORMATION

Company: AGE Consultants

Client: Solomons Mine Pty Ltd

Project: WIR5000.001

Location: Wirralie Gold Mine

Test Well: WTB06

Test Date: 3/8/2023

AQUIFER DATA

Saturated Thickness: 29.71 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (WTB06)

Initial Displacement: 0.6383 m

Total Well Penetration Depth: 50. m

Casing Radius: 0.025 m

Static Water Column Height: 29.71 m

Screen Length: 21. m

Well Radius: 0.1015 m

Gravel Pack Porosity: 0.

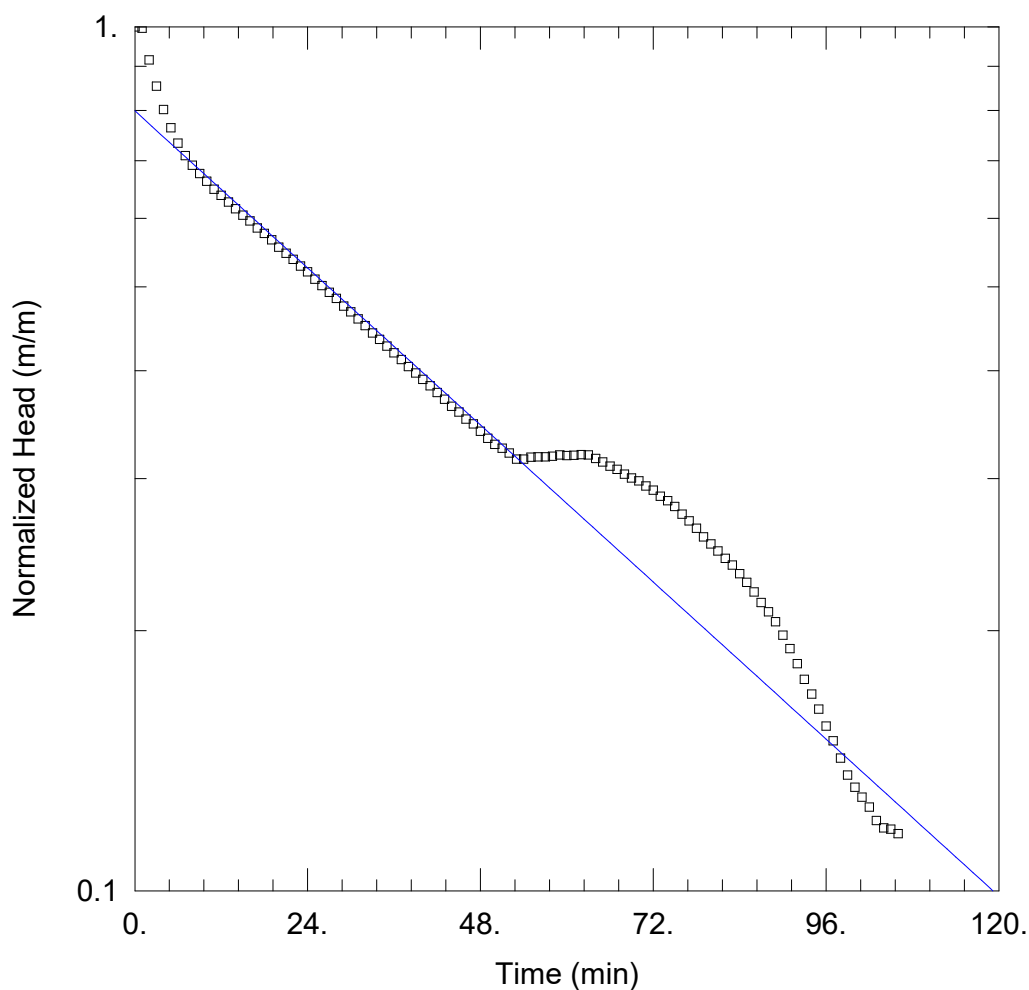
SOLUTION

Aquifer Model: Confined

$K = 0.001767$ m/day

Solution Method: Bouwer-Rice

$y_0 = 0.5102$ m



FALLING HEAD TEST

Data Set: G:\...\WTB06_T1_FHT.aqt

Date: 11/21/23

Time: 10:35:02

PROJECT INFORMATION

Company: AGE Consultants

Client: Solomons Mine Pty Ltd

Project: WIR5000.001

Location: Wirralie Gold Mine

Test Well: WTB06

Test Date: 3/8/2023

AQUIFER DATA

Saturated Thickness: 29.71 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (WTB06)

Initial Displacement: 0.6383 m

Total Well Penetration Depth: 50. m

Casing Radius: 0.025 m

Static Water Column Height: 29.71 m

Screen Length: 21. m

Well Radius: 0.1015 m

Gravel Pack Porosity: 0.

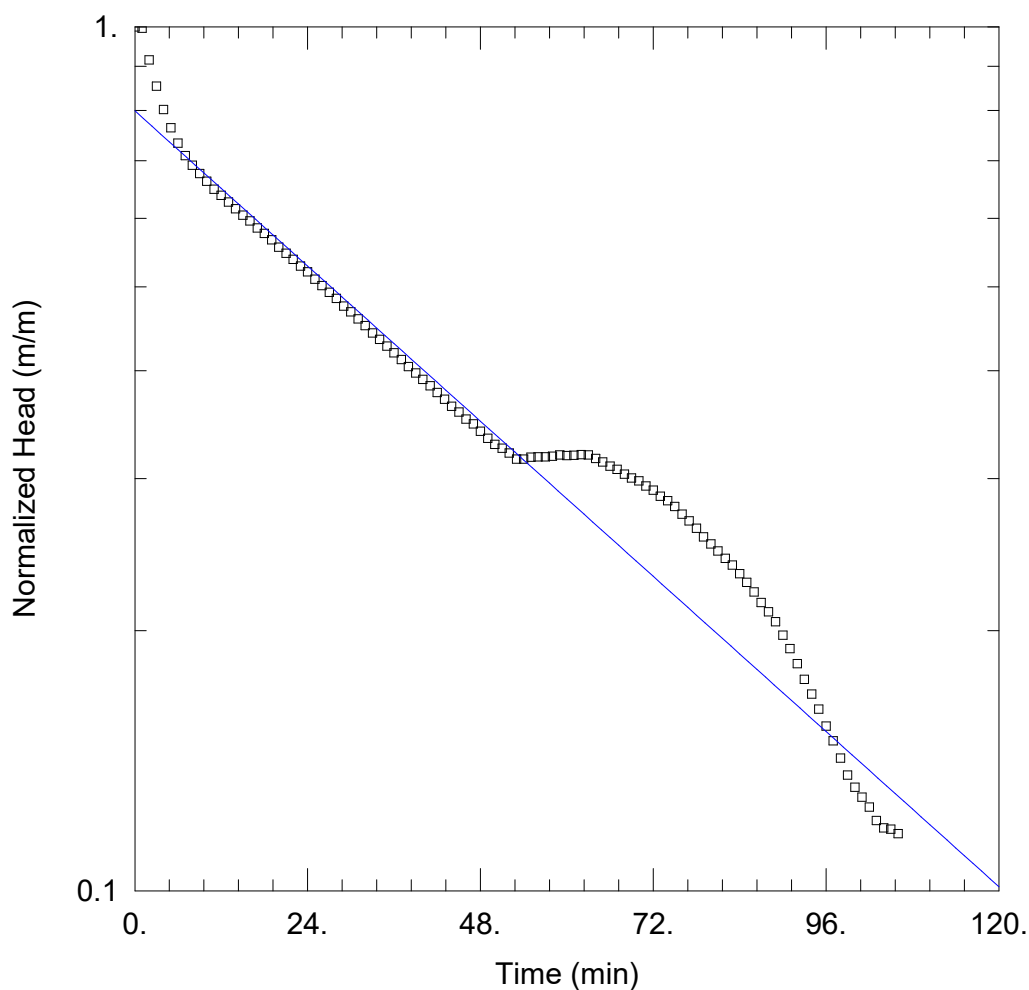
SOLUTION

Aquifer Model: Unconfined

$K = 0.001767$ m/day

Solution Method: Bouwer-Rice

$y_0 = 0.5102$ m



FALLING HEAD TEST

Data Set: G:\...\WTB06_T1_FHT.aqt

Date: 11/21/23

Time: 10:31:17

PROJECT INFORMATION

Company: AGE Consultants

Client: Solomons Mine Pty Ltd

Project: WIR5000.001

Location: Wirralie Gold Mine

Test Well: WTB06

Test Date: 3/8/2023

AQUIFER DATA

Saturated Thickness: 29.71 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (WTB06)

Initial Displacement: 0.6383 m

Total Well Penetration Depth: 50. m

Casing Radius: 0.025 m

Static Water Column Height: 29.71 m

Screen Length: 21. m

Well Radius: 0.1015 m

Gravel Pack Porosity: 0.

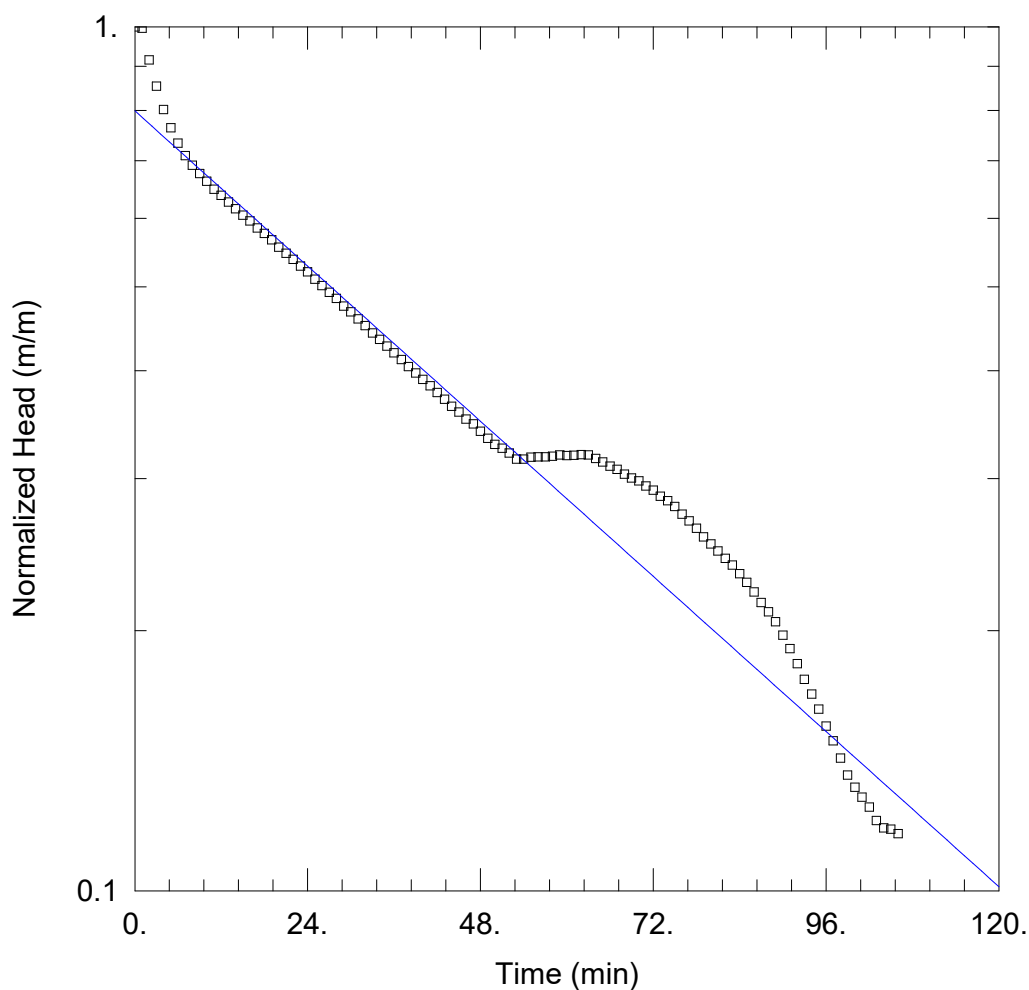
SOLUTION

Aquifer Model: Confined

$K = 0.002225$ m/day

Solution Method: Hvorslev

$y_0 = 0.5102$ m



FALLING HEAD TEST

Data Set: G:\...\WTB06_T1_FHT.aqt

Date: 11/21/23

Time: 10:36:02

PROJECT INFORMATION

Company: AGE Consultants

Client: Solomons Mine Pty Ltd

Project: WIR5000.001

Location: Wirralie Gold Mine

Test Well: WTB06

Test Date: 3/8/2023

AQUIFER DATA

Saturated Thickness: 29.71 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (WTB06)

Initial Displacement: 0.6383 m

Total Well Penetration Depth: 50. m

Casing Radius: 0.025 m

Static Water Column Height: 29.71 m

Screen Length: 21. m

Well Radius: 0.1015 m

Gravel Pack Porosity: 0.

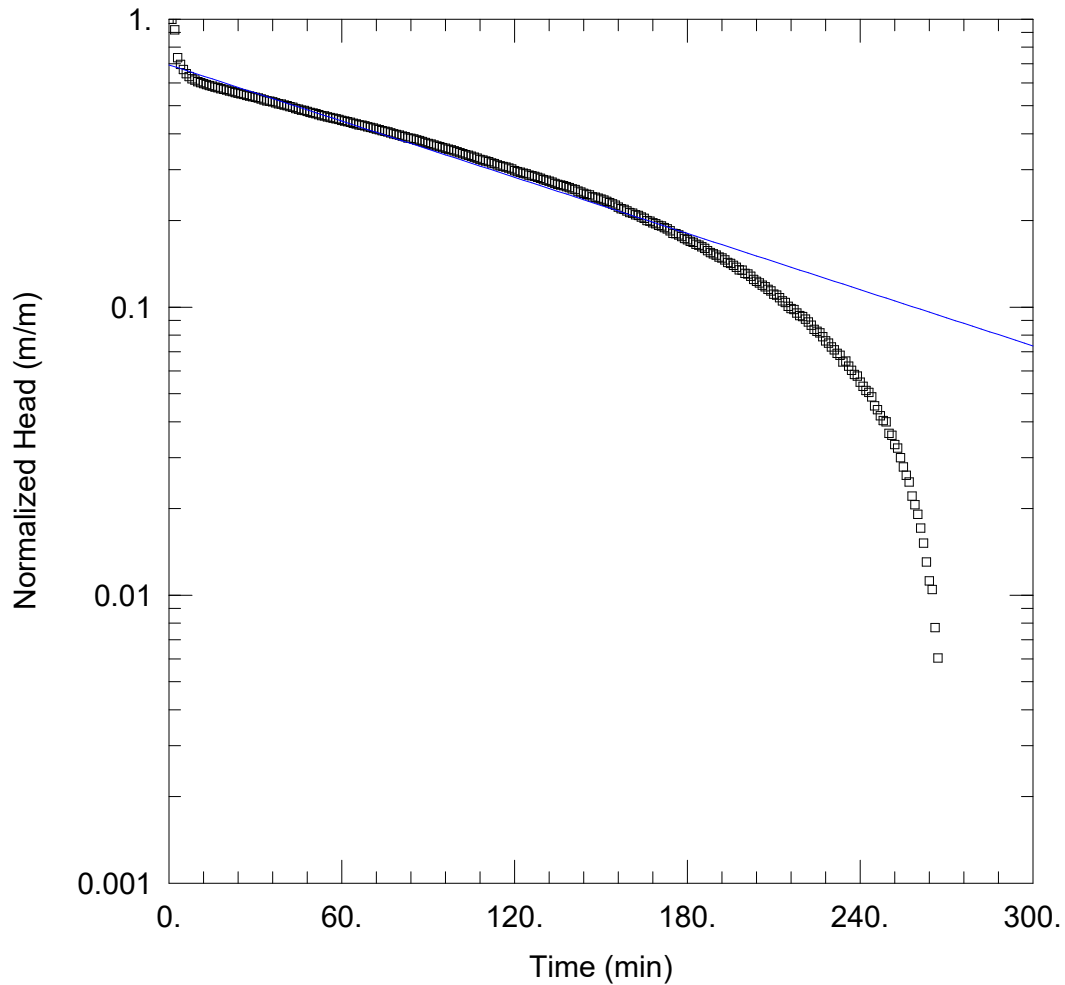
SOLUTION

Aquifer Model: Unconfined

$K = 0.002225$ m/day

Solution Method: Hvorslev

$y_0 = 0.5102$ m



RISING HEAD TEST

Data Set: G:\...\WTB06_T1_RHT.aqt
 Date: 11/21/23

Time: 15:19:35

PROJECT INFORMATION

Company: AGE Consultants
 Client: Solomons Mine Pty Ltd
 Project: WIR5000.001
 Location: Wirralie Gold Mine
 Test Well: WTB06
 Test Date: 3/8/2023

AQUIFER DATA

Saturated Thickness: 29.84 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (WTB06)

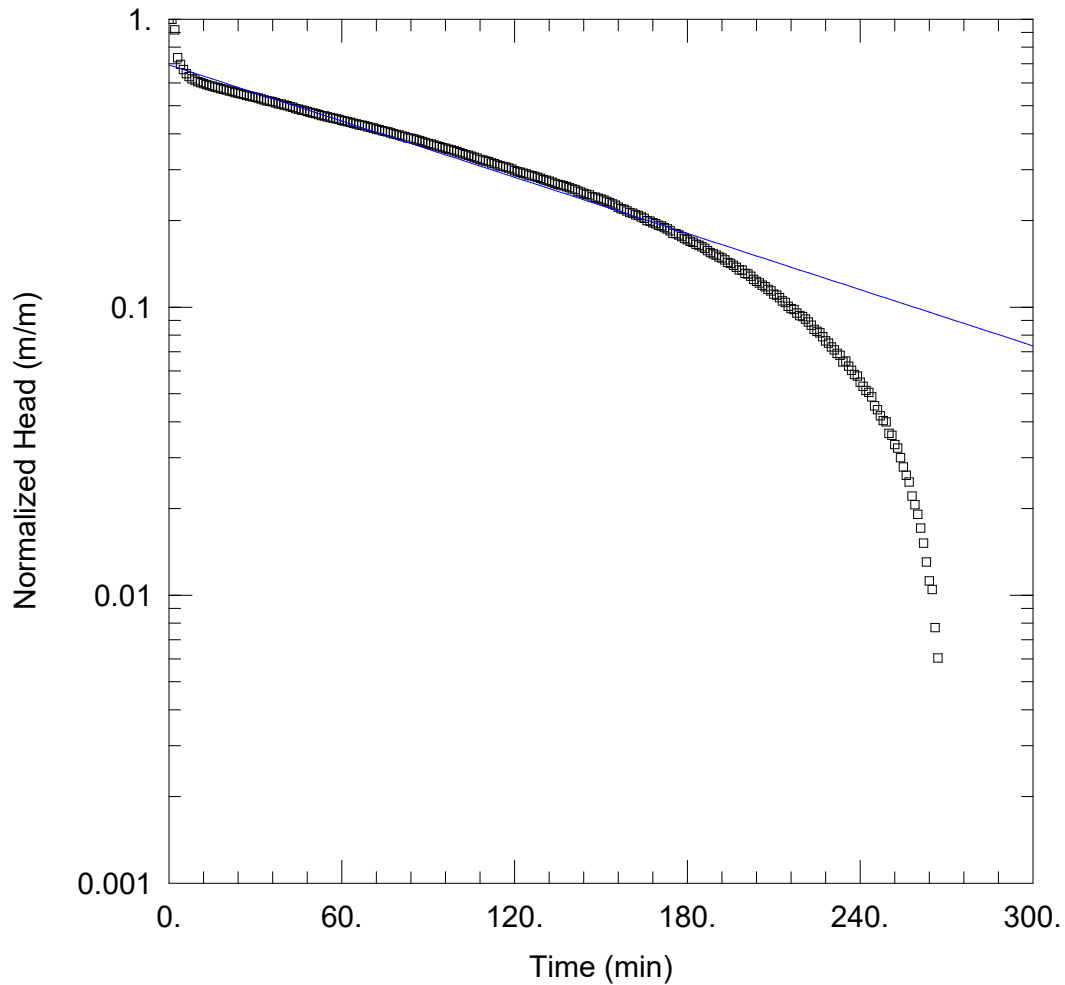
Initial Displacement: 0.6606 m
 Total Well Penetration Depth: 50. m
 Casing Radius: 0.025 m

Static Water Column Height: 29.84 m
 Screen Length: 21. m
 Well Radius: 0.1015 m
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
 $K = 0.0007587$ m/day

Solution Method: Bouwer-Rice
 $y_0 = 0.4581$ m



RISING HEAD TEST

Data Set: G:\...\WTB06_T1_RHT.aqt
 Date: 11/21/23

Time: 15:21:02

PROJECT INFORMATION

Company: AGE Consultants
 Client: Solomons Mine Pty Ltd
 Project: WIR5000.001
 Location: Wirralie Gold Mine
 Test Well: WTB06
 Test Date: 3/8/2023

AQUIFER DATA

Saturated Thickness: 29.84 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (WTB06)

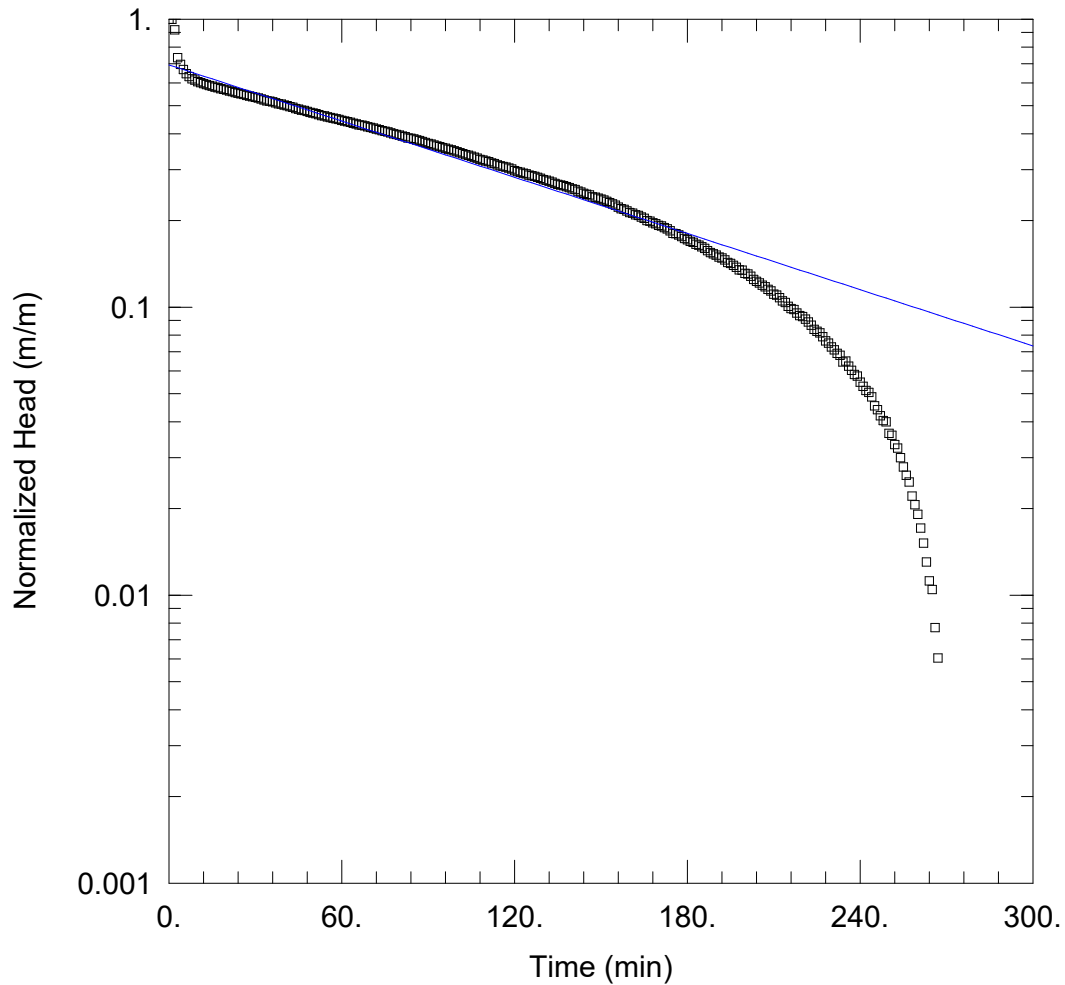
Initial Displacement: 0.6606 m
 Total Well Penetration Depth: 50. m
 Casing Radius: 0.025 m

Static Water Column Height: 29.84 m
 Screen Length: 21. m
 Well Radius: 0.1015 m
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
 $K = 0.0007587$ m/day

Solution Method: Bouwer-Rice
 $y_0 = 0.4581$ m



RISING HEAD TEST

Data Set: G:\...\WTB06_T1_RHT.aqt

Date: 11/21/23

Time: 15:20:23

PROJECT INFORMATION

Company: AGE Consultants

Client: Solomons Mine Pty Ltd

Project: WIR5000.001

Location: Wirralie Gold Mine

Test Well: WTB06

Test Date: 3/8/2023

AQUIFER DATA

Saturated Thickness: 29.84 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (WTB06)

Initial Displacement: 0.6606 m

Total Well Penetration Depth: 50. m

Casing Radius: 0.025 m

Static Water Column Height: 29.84 m

Screen Length: 21. m

Well Radius: 0.1015 m

Gravel Pack Porosity: 0.

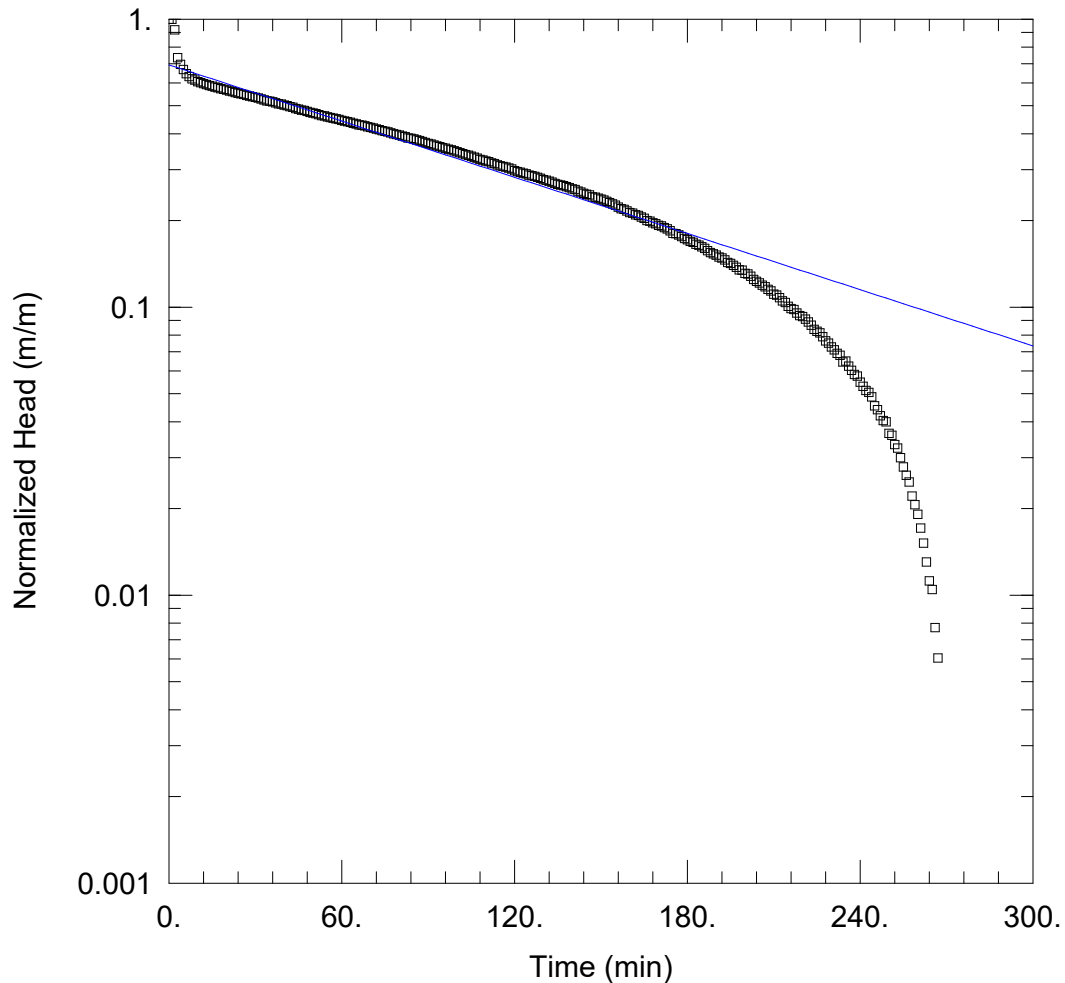
SOLUTION

Aquifer Model: Confined

$K = 0.0009668$ m/day

Solution Method: Hvorslev

$y_0 = 0.4581$ m



RISING HEAD TEST

Data Set: G:\...\WTB06_T1_RHT.aqt

Date: 11/21/23

Time: 15:18:31

PROJECT INFORMATION

Company: AGE Consultants

Client: Solomons Mine Pty Ltd

Project: WIR5000.001

Location: Wirralie Gold Mine

Test Well: WTB06

Test Date: 3/8/2023

AQUIFER DATA

Saturated Thickness: 29.84 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (WTB06)

Initial Displacement: 0.6606 m

Total Well Penetration Depth: 50. m

Casing Radius: 0.025 m

Static Water Column Height: 29.84 m

Screen Length: 21. m

Well Radius: 0.1015 m

Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined

$K = 0.0009668$ m/day

Solution Method: Hvorslev

$y_0 = 0.4581$ m

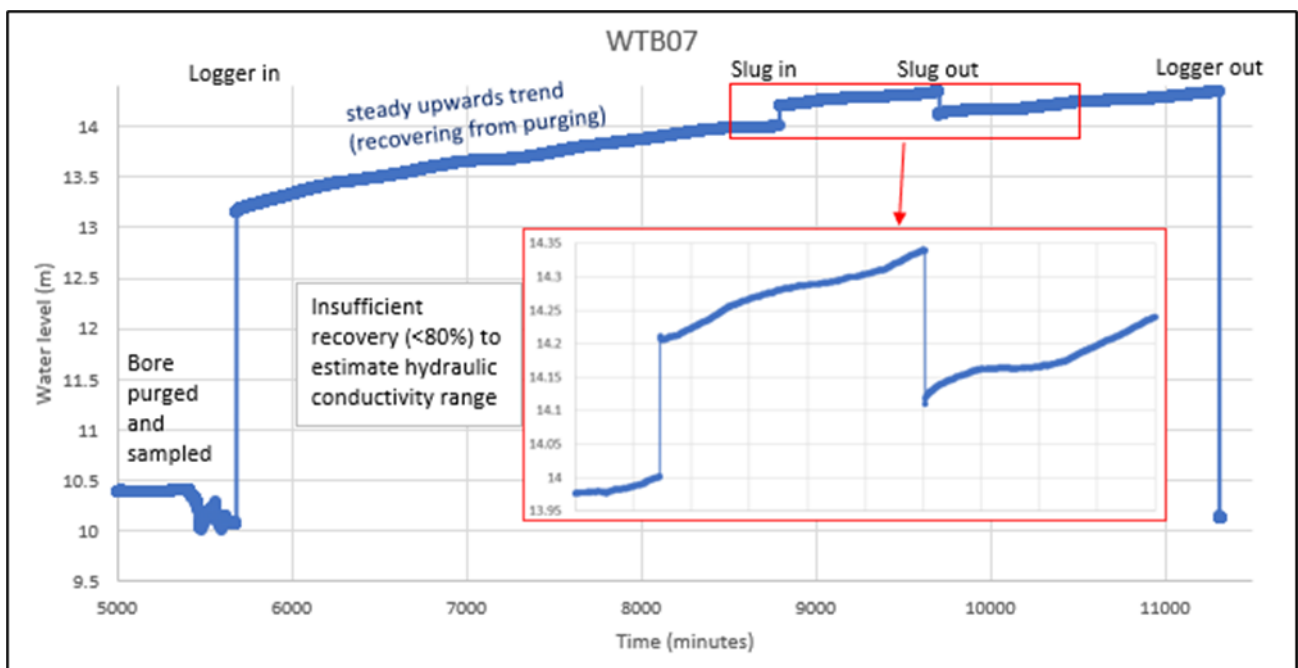


Figure B.1 WTB07 rising head test and falling head test

Appendix I: ATC Williams (2022) Wirralie Gold Mine Concept Closure Methodology and Water Balance Model

REPORT

WULGURU TECHNICAL SERVICES
PTY LTD

Wirralie Gold Mine
Concept Closure Methodology and
Water Balance Model

121130.01R001.rev0
MARCH 2022





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1 INTRODUCTION

1.1 Background

Australian Solomons Gold Pty Ltd (Solomons) owns and operates the Wirralie Gold Mine (WGM) site under EPML00772413 and took over the site in late 2013. The mine has had several operating owners over the years, including multiple owner changes from 1987 to 1993 before a break in operations. The mine operated again from 1999 to 2001, before being placed into care and maintenance in 2002. Rehabilitation efforts were initiated in 1993 and again in 2001 to targeted areas within the site, such as the waste rock dumps, final voids, the Tailings Storage Facility (TSF), process and ancillary areas. Operations by Solomons plan to process up to 400,000 tonnes of ore per annum over a minimum 10 year life of mine. This volume of processing is on a significantly reduced scale when compared to past mining campaigns. Refer **Appendix A** which illustrates the mine site layout plan.

Solomons have commissioned Wulguru Technical Services (WTS) to provide assistance with the completion of the Progressive Rehabilitation Closure Plan (PRCP) and Estimated Rehabilitation Cost (ERC) submitted (reference no. 101/0008112). As part of the PRCP and ERC requirements, ATC Williams (ATCW) have been engaged by WTS to develop a Mine Concept Closure and Water Balance Model for the WGM site.

1.2 Scope of Works

The scope of this report includes a Water Balance Model (WBM) and conceptual closure phase construction methodology. The WBM aims to assess the potential water storage performance of pits over the post-closure phase. This is to identify if there is any potential for pit spillage that may cause unwanted discharge of contaminated water to the surrounding downstream environment. All site pits are proposed to be retained as residual voids, including Pit A (PA), Pit B (PB), Northern Pit (NP) and Deep Lead Pit (DLP). Refer to **Appendix A** and **Figure 002**.

The concept closure methodology aims to outline conceptual works and/or site requirements to enable the successful rehabilitation of the mine site. The closure methodology identifies high level surface water management requirements such as erosion and sediment controls and water storage to inform staging of the rehabilitation works.

1.3 Legal and Regulatory Requirements

1.3.1 Progressive Rehabilitation Closure Plan

A Progressive Rehabilitation and Closure Plan (PRCP) [9] for the site is a requirement of the Environmental Protection Act (EPA) 1994 [10], and is an integral requirement of EA holders when applying for a new site-specific mining activity. The PRCP aims to:

- Require the holder of an EA to plan for how and where activities will be carried out on land in a way that maximises the progressive rehabilitation of the land to a stable condition
- Provide for the condition to which the holder must rehabilitate the land before the EA may be surrendered

This is in response to the state's Mined Land Rehabilitation Policy (MLRP) which aims to provide certainty to rehabilitation outcomes and timings amongst mining companies through implementation of binding, time-based milestones for PRC actions. As per MLRP, mined disturbed lands are deemed to be rehabilitated if the land is safe, stable, does not cause environmental impact, and is able to sustain the post-mining land use approved in the PRCP [9].

1.3.2 Relevant EA Requirements

The WGM site is approved under the Environmental Authority (EA) permit number EPML00772413. This assessment aims to mitigate any unwanted discharge of mine contaminated waters to



downstream waterways, and the following EA condition relates to release of waters (however noting that the EA would be surrendered post-closure):

- (C1-1) *Receiving waters affected by the release of process water or storm water contaminated by the mining activities or both must be monitored at the locations and frequencies defined in Schedule C – Table 1 and comply with the contaminant limits defined in Schedule C – Table 2.*

The following EA condition site is relevant to the rehabilitation of the regulated pits and dams:

Rehabilitation Landform Criteria

- (F1-1) *All areas significantly disturbed by mining activities must be rehabilitated to a stable landform with a self-sustaining vegetation cover in accordance with Schedule F-Table 1.*

Schedule F – Table 1

<i>Disturbance Type</i>	<i>Projective Surface Area (ha)</i>	<i>Post-mine Land Description</i>	<i>Post-mine Land Classification</i>
<i>Tailings Dam*</i>	<i>72</i>	<i>Open Pasture</i>	<i>VII</i>
<i>Infrastructure</i>	<i>69</i>	<i>Open Pasture</i>	<i>VII</i>
<i>Waste Dump</i>	<i>22</i>	<i>Low Hill</i>	<i>VII</i>
<i>Exploration</i>	<i>19</i>	<i>Open Pasture</i>	<i>VII</i>
<i>Open Cut Pit</i>	<i>19</i>	<i>Open Void</i>	<i>VIII</i>
<i>Stockpile Area</i>	<i>14</i>	<i>Open Pasture</i>	<i>VII</i>
<i>Village</i>	<i>12</i>	<i>Low Hill</i>	<i>VII</i>
<i>Borrow Pit</i>	<i>8</i>	<i>Open Pasture</i>	<i>VII</i>
<i>Processing Plant</i>	<i>7</i>	<i>Open Pasture</i>	<i>VII</i>
<i>Runoff Dam</i>	<i>5</i>	<i>Water Storage</i>	<i>VIII</i>
<i>ROM Pad</i>	<i>3</i>	<i>Low Hill</i>	<i>VII</i>

*Note that the Tailings Dam is also noted as a Tailings Storage Facility (TSF) in this report.

Residual Void Outcome

- (F2-1) *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.*

Dams containing hazardous waste

- (F3-1) *The construction or operation of any dam containing hazardous waste within operational land must comply with Schedule F – Table 2.*

1.4 Report Summary and Structure

This report outlines conceptual findings based on the limited background information and site data available at the time of reporting. Therefore, this report requires revision following further site

investigations to confirm the outcomes stated in the report meet DES requirements. Detailed investigations that are required include:

- Groundwater monitoring and hydrogeology reporting;
- Water quality monitoring data;
- Waste Rock and Tailings material characterisation;
- Detailed site survey and elevation data.

A summary of the report outcomes are provided below.

The water contained with the site pits is assumed to have the potential to cause contamination of downstream waters if released. Therefore, the water balance assessment detailed in **Section 4** demonstrate that the pits are unlikely to spill within the modelled period and therefore are not expected to cause any adverse effects to the surrounding environment and downstream waterways in the post-closure phase. This is on the basis that the spillway of the Northern Pit is re-directed to the central Pit A to reduce the risk of downstream spills from the Northern Pit.

The closure methodology outlines high level surface water management requirements and likely temporary erosion and sediment control measures. It is proposed to stage the rehabilitation works as two main Stages nominated below:

- Stage 1 – Rehabilitation of mine infrastructure areas, and eastern extent of the TSF.
- Stage 2 – Rehabilitation of the remaining western extent of the TSF.

Staging allows for more effective temporary erosion and sediment control by splitting up the rehabilitation works into two main work areas. Stage 1 aims to rehabilitate the eastern extent of the TSF by using the western extent (Stage 2) as a temporary water and sediment storage area. Once Stage 1 has achieved suitable vegetation cover, Stage 2 can be rehabilitated with the use of a temporary High Efficiency Sediment (HES) basin for erosion and sediment control. The HES basin can also provide water storage for Stage 2 irrigation to encourage vegetation establishment. It is proposed to re-locate the TSF spillway further east to allow the rehabilitation staging, however, this is dependant on detailed site survey which was not available at the time of this report.

The associated mine infrastructure areas and TSF are proposed to be rehabilitated to a Post-Mining Land Use (PMLU) as a Class VII land use (land not suitable for cultivation and only careful pastoral use) as per Schedule F – Table 1 of the EA. Class VII land use areas are to be rehabilitated with vegetation and minimal changes to the topography. For all areas that drain to the TSF, no sediment basin would be required during the Stage 1 rehabilitation phase. The existing water storages within the site (TSF and runoff dam) would be adequate to contain sediment laden runoff (to be confirmed through future implementation of the site's operational water management plan) and can be used as irrigation water for vegetation establishment. There are some minor catchments as identified on **Figure 002**, that discharge directly downstream and therefore may need individual erosion and sediment control via bunding or temporary sediment basins whilst rehabilitation works are undertaken.

The pits are to be left as residual voids and form Non-use Management Areas (NUMA) under a Class VIII land use (unsuited to agricultural use or grazing areas). The runoff dam is to be left as a stock water source, also under a Class VIII land use.

The report structure is as follows:

- | | |
|-------------------|--|
| Section 2: | Provides a brief description of the project site and the regional climate. |
| Section 3: | Presents an overview of the outcomes of the desktop contaminant source study. |
| Section 4: | Presents the site water balance model and results. |
| Section 5: | Outlines a brief overview of the recommended closure methodology to be undertaken at mine closure. |
| Section 6: | States the conclusions and recommendations. |



2 PROJECT SITE

2.1 Background

As described in the Plan of Operations [4] report by Northern Resource Consultants Pty Ltd (NRC), historical mining operations have occurred intermittently at the WGM site since the late 1980's. Operations mainly involved the extraction of run-of-mine (ROM) ore from four separate pits. A mining campaign from 1999 to 2001 reinstated and upgraded the previous 1.5 mtpa treatment plant, before the mine was placed into care and maintenance. In both 1993 and 2001, the site was significantly rehabilitated within the following operational areas:

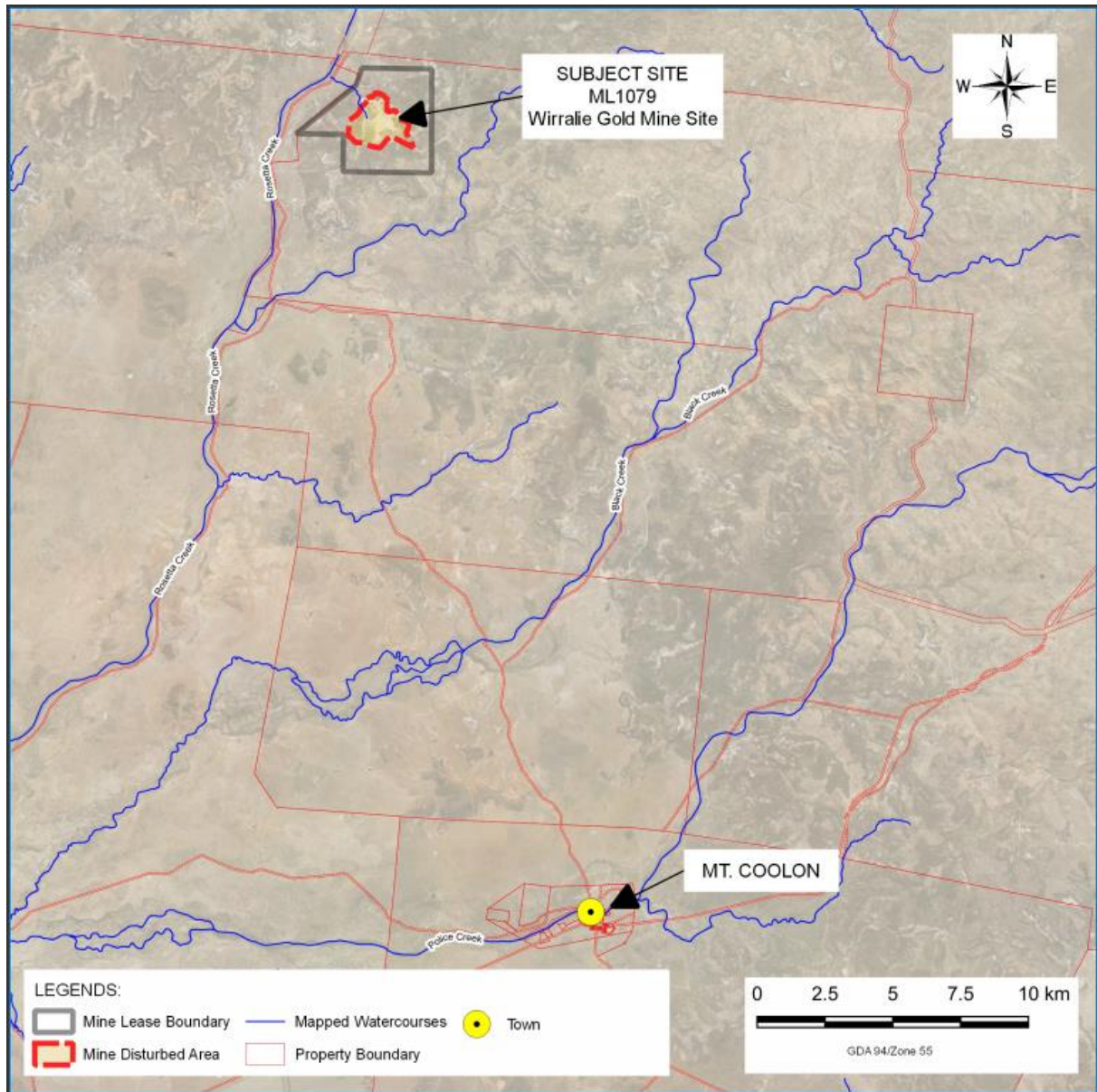
- Waste rock dumps, backfilled voids, and stockpile areas.
- Final voids.
- Tailings dam (rehabilitation trials).
- Process areas.
- Ancillary areas (including ROM, exploration facilities, landfill, air-strip, accommodation village).

The proposed mining operation by Solomons is a significantly smaller operation, with an annual processing rate of 400,000 tpa. It is also proposed to operate within the previous infrastructure and mining operation footprint, and thus, no additional clearing or disturbance is required.

2.2 Site Location

WGM site operates within mine lease ML1079 located in the central Queensland region. The bounding allotment is described as Lot 3272 on SP237696, approximately 30.3 km north-northwest of the Mount Coolon township, approximately 200 km west of Mackay. **Appendix A** and **Diagram 1** illustrates the general site layout and overall site locality of the mine site.

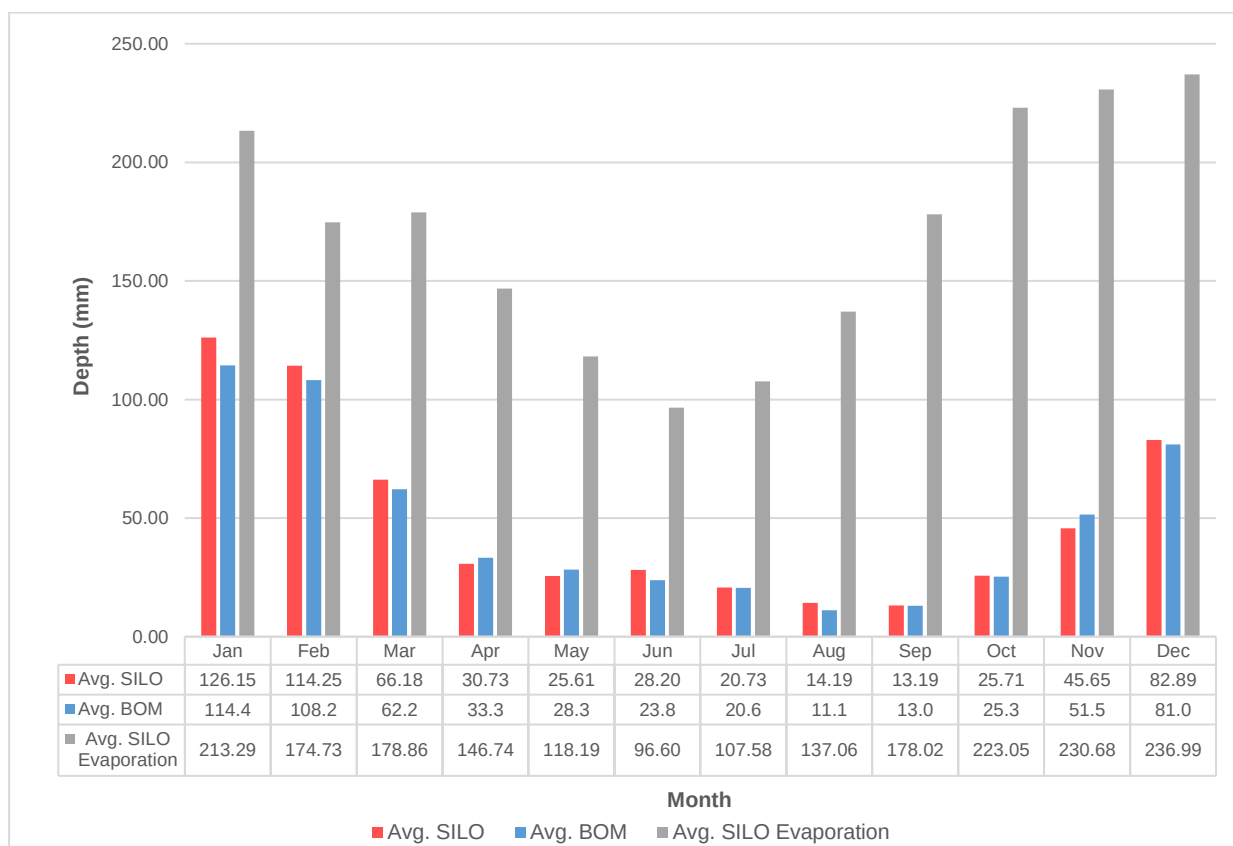
DIAGRAM 1: SITE LOCALITY MAP



2.3 Climate

The WGM site is located in central Queensland region which has a sub-tropical climate and annual rainfall average of 577 mm. The climate is driven by a wet season during the warmer months of December to March, and a mostly dry season for the remaining months of the year. Monthly rainfall statistics were sourced from BOM's [1] available data at the Mt. Coolon Hotel station from 1913 to 2004. Point location SILO data [8] from 1889 to 2020 for rainfall and evaporation was also extracted for the site. **Graph 1** illustrates the BOM and SILO climate statistics.

GRAPH 1: SITE CLIMATE DATA



Sources: BOM [3] Station: Mt. Coolon Hotel (Station No. 034006); [4] SILO Data Drill [8]

2.4 Topography and Hydrology

The WGM site comprises undulating to hilly terrain with sparse to medium dense vegetation surrounding the storage pits and dams. The southern extent of the mine appears to be located along an existing ridgeline that runs west to east. The levels within the site ranges from approximately RL 292 m along the ridgeline, to RL 270 m within the site. The lowest elevation of RL237 m is at the bottom of Pit A. The mining area is mostly disturbed due to the pits, TSF, processing areas, waste rock dump, and associated roads/pads. Currently, runoff within the site is directed to the site pits, TSF, and runoff dam via bunds and drainage diversions. Some minor catchment areas as identified on **Figure 002** appear to discharge directly downstream and likely need erosion and sediment control measures to be installed as part of the operational water management plan.

Any overtopping flows from the site water storages would discharge to the north to the local unnamed flow paths, before joining with Rosetta Creek. A flow diversion bund is located along the eastern extent of disturbance to divert natural catchment flows to the north-west.

Rosetta Creek discharges south and joins with Police Creek some 40 km downstream of the site, before flowing into Suttor River and then discharging into Lake Dalrymple (formed by Burdekin Dam) some 100 km downstream of the site. Flow from the Burdekin Dam eventually discharges through the Ayr and into the Coral Sea some 300 km from WGM.

Regional flood hazard overlay extents have been addressed in a separate technical memorandum by ATCW (reference 121130-01M001.rev0), and demonstrates that the flood extents are well clear of the WGM site voids.

Note that no detailed site survey was available at the time of this report and coarse satellite data was adopted for the assessment. Due to the poor-quality elevation data available for the site, the details presented in report are high-level only and require confirmation with detailed site survey data.



2.5 Hydrogeology

No hydrogeology information was available at the time of this assessment. The site pits have been left untouched for an extended period, and it is therefore assumed that the standing water level represents the approximate groundwater level. No seepage from the pits has been modelled or would be expected due to the geology of the pits.



3 DESKTOP CONTAMINANT SOURCE STUDY

3.1 Objective

A desktop Contaminant Source Study (CSS) has been conducted for the site and is summarised in the following sections. The objective of the CSS is to identify potential sources of contaminants within the site for the rehabilitation works and post-closure scenario that could be detrimental to the downstream environment if released.

The findings in the following sections are founded on past reporting information from historic site investigations. As part of the current PRCP site investigations, a detailed geochemistry analysis is currently being undertaken. Initial advice from this investigation is presented in the below dot points and generally aligns with historic information.

- Waste Rock Dumps have come back NAF, low Salinity (<300µS/cm) and with arsenic enrichment (<100 mg/ kg).
- Tailings Storage Facility has NAF, salinity low-mod (median 1,175 µS/cm) and with arsenic and mercury enrichment (<300 mg/ kg and <10 mg/kg respectively).

This section should be updated following completion of the latest geochemistry investigation.

3.2 Receiving Environment

3.2.1 Regulatory Context

Schedule C of the EA (EPML0072413) outlines Water related conditions and was used as a basis for the CSS and the proposed rehabilitated site water management. Table 1 of Schedule C within the EA illustrates the required receiving water monitoring locations and minimum frequencies, as is reproduced in **Table 1**. Furthermore, the receiving water contaminant limits at the monitoring locations must not exceed those outlined in **Table 2**.

TABLE 1: WATER MONITORING LOCATIONS AND FREQUENCIES

Monitoring Point	AMG North	AMG East	Monitoring Frequency
SW1 – Tailings Dam spillway	7663974	526752	Monthly when flowing
SW2 – Tailings dam runoff dam	7664998	526747	Monthly when flowing
Tailings dam ponded water	7664832	527793	Six Monthly
SW4 – Rosetta Creek	7665490	524242	Monthly when flowing
SW5 – Sugar Bag Creek	7665405	526557	Monthly when flowing
Sugar Bag Creek (Release Point 1)	7665700	526350	Opportunistic rising stage sample at 1.8 m
Drainage to Pit (Release Point 2)	7665094	527800	Monthly when flowing

TABLE 2: WATER CONTAMINANT LIMITS

Quality Characteristic	Trigger Levels	Limit Type	Release Limit
pH		Range	6-9
Total Dissolved Solids	mg/L	Maximum	4000
Sulfate	mg/L	Maximum	1000
Arsenic	mg/L	Maximum	0.5
Cadmium	mg/L	Maximum	0.01
Copper	mg/L	Maximum	0.5
Lead	mg/L	Maximum	0.1
Mercury	mg/L	Maximum	0.002
Molybdenum	mg/L	Maximum	0.05
Selenium	mg/L	Maximum	0.02
Zinc	mg/L	Maximum	20
WAD Cyanide	mg/L	Maximum	0.2

3.2.2 Environmental Values and Beneficial Users

Schedule 1 of the Environmental Protection (Water) Policy 2007 (EPP Water) is subordinate legislation to the Environmental Protection Act 1994 (EPA) [10], and documents waterways where the legislation applies. The applicable waterways are to be enhanced or protected and the legislation specifies relevant Environmental Values (EVs) and water quality objectives (WQOs). Review of Schedule 1 indicates that the mine site does not currently have defined environmental values. Notwithstanding, generalised assessment under the EPP Water can be based on the determined nature of the receiving environment.

The Wirralie site is situated in a rural landscape that has historically been subjected to low-density grazing. Using EPP Water, EV's can be identified that are relevant to the receiving environment and which has been assumed to be characterised as "slightly disturbed waters", and a slightly to moderately disturbed ecosystem. The context for EV's for this ecosystem is characterised under the EPP Water as follows:

"the biological integrity of an aquatic ecosystem that has effectively unmodified biological indicators, but slightly modified physical, chemical or other indicators".

Further to the above, the following additional surface water EV's are considered:

- Stock water; and
- Irrigation.

3.3 Water Quality Monitoring

Water quality monitoring of the stored water within the TSF was conducted in 2016 and at the spillway in 2014 (as described by NRC [7]). The findings demonstrated that the water mostly meets ANZECC Livestock Drinking Water Guidelines, with the exception of Sulphate and Total Dissolved Solids



exceedances in 2014. The results are illustrated in **Table 3**. No other water quality tests were available at the time of this report.

TABLE 3 – RECEIVING WATER CONTAMINANT LIMITS

Quality Characteristic	Unit	TSF Spillway (2014)	TSF Ponded Water (2016)	ANZECC Limits
pH	pH Units	7.1	7.1	-
Total Dissolved Solids Dried at 175-185°C	mg/L	9100	2000	5000
Zinc, Zn	mg/L	<0.01	0.007	-
Sulfur as Sulfate, SO ₄	mg/L	4300	900	1000
Molybdenum, Mo	mg/L	1400	<0.005	-
Arsenic, As	mg/L	0.014	0.006	-
Copper, Cu	mg/L	0.80	0.004	-
Cadmium, Cd	mg/L	<0.003	0.0007	-
Lead, Pb	mg/L	0.0065	<0.001	-
Selenium, Se	mg/L	<0.003	0.003	-
Mercury	mg/L	0.014	<0.00005	-
Total Zinc	mg/L	<0.01	0.007	20
Total Molybdenum	mg/L	0.014	<0.005	0.15
Total Arsenic, As	mg/L	0.81	0.009	0.5-5
Total Cadmium, Cd	mg/L	0.0069	0.007	0.01
Total Copper, Cu	mg/L	<0.003	0.005	1 (Cattle)
Total Lead, Pb	mg/L	<0.003	<0.001	0.1
Total Selenium, Se	mg/L	0.014	0.004	0.02
Total Mercury	mg/L	<0.00005	<0.001	0.002
Weak Acid Dissociable Cyanide	mg/L	<0.004	<0.004	-

3.4 Saline, Metalliferous and Acid Rock Drainage

A historical geochemical study by Woodward-Clyde (1998) [11] was conducted as part of a previously proposed (but unsuccessful) expansion, prior to the site being placed into care and maintenance. As described by NCR [7], the results of this study indicated that:

- The chromium, molybdenum and lead levels in some samples were elevated, however considered low for a mineralised system. These were considered consistent with background levels of the system and likely to be indistinguishable from background.
- Arsenic levels in the waste rock are elevated above trigger levels and suggest surface dumping of waste rock would require capping and management of surface runoff. Levels in material tested from the B pit (Pit B) ranged from 30-198 ppm.



- Sulphur levels ranged from 0.001 to 1.34%, indicating low levels of sulphur in the totally oxidised material and some partly oxidised materials. Waste from Pit B ranged from 0.01 to 0.02% sulphur content, <0.02% is considered to have low acid forming characteristics.

As part of the proposed operations, NCR [7] stated that a waste characterisation program is to be undertaken. This would involve a program of progressive sampling and characterisation of the waste rock to identify any acid producing potential and metal concentrations of the waste rock. The waste rock characterisation involves characterisation samples being taken for laboratory analysis at a minimum of 1 sample per 100,000 t of waste rock produced. This program aims to effectively predict any potential environmental effects of the in-pit disposal strategy so that these can be mitigated.

This waste characterisation program will be important for the rehabilitation strategy and must consider the proposed PRCP that will be in place. Any changes that may impact the rehabilitation methodology may need updates to the overall PRCP.

3.5 Tailings Dam Material

A geochemical investigation by EGI in 2002 [5], is described in NCR [7], and indicates the following:

- The net acid producing potential (NAPP) for surface salts ranged from 17 to 95 kg H₂SO₄/t, with NAGpH values ranging 7.2 to 8.4, although most of the sulfur in the samples occurred as non-reactive salts and are therefore non-acid forming (NAF). The NAPP for depth profiled tailings samples ranged from 0 to 8 kg H₂SO₄/t, with NAGpH values ranging 6.1 to 6.7. This material is expected to be relatively barren of acid generation and therefore have a low acid forming potential.
- Multi-elemental scans performed on the tailings indicate elevated arsenic concentrations above ANZECC guidelines. Mercury, antimony and selenium were enriched however in most samples this was below ANZECC guidelines. Silver was enriched in some of the samples tested.

3.6 Potential Contaminant Sources

Based on NCR [7] and the geochemistry report [5], the potential contaminants identified within the site are presented in **Table 4**:

TABLE 4: POTENTIAL CONTAMINANT SOURCES

Potential Contaminant Source	Likely Contaminants	Comments
Run-of-Mine (ROM) Pad	Suspended solids	To be rehabilitated
Waste Rock Dump (WRD)	Suspended solids, metals	Non-acid forming materials and already rehabilitated
Tailings Dam	Suspended solids, Sulphate, Total Dissolved Solids, Mercury, Antimony and Selenium, metals	Water quality monitoring undertaken in 2016. To be capped and rehabilitated
Pits	Suspended solids, Sulphate, Total Dissolved Solids, Arsenic, metals	Assumed to be contaminated and WBM to demonstrate low risk of spilling
Admin Area/Offices	Suspended solids	To be rehabilitated

4 WATER BALANCE MODEL

4.1 Objectives

The key objective of the Water Balance Model (WBM) is to assess the water storage performance of the pits within the site for the post-closure period. This assessment will inform if any mitigation measures are required for the post-closure scenario.

4.2 Data and Assumptions

4.2.1 Climate Data

The rainfall data adopted for the model was sourced from SILO [8] which is an enhanced database for Australian climate data and has available data dating back to 1889. It is hosted by the Science Delivery Division of the Department of Science, Information Technology, Innovation and the Arts (DSITIA) which also provides other daily meteorological datasets such as evaporation and evapotranspiration data suitable for modelling purposes.

4.2.2 Climate Change

The water balance outcomes are primarily influenced by long-term climate conditions, and climate change has not been explicitly modelled as part of this assessment. It is noted that projected climate change scenarios suggest the following factors that would potentially impact the WBM results:

- Intensity of Individual Events
 - Extreme rainfall and weather events are projected to increase in intensity, as described in Australian Rainfall and Runoff [1]
- Long Term Climate Conditions
 - An increase in average temperatures is projected in the majority of climate models, implying an inferred increase in evaporation and decrease in rainfall. Specific guidance for modelling these climate sequences is not currently available [1].

Although there is general agreement that in some degree the above climate changes are likely to occur within the next century, there is high uncertainty in the magnitude of expected changes. Assessing the many possible climate change scenarios within this WBM would require an extensive assessment beyond the scope of this report.

4.2.3 Catchment Delineation and Site Survey

No site survey was available at the time of this report, and therefore this assessment is based only on available satellite survey data [6] that is a coarse resolution. An updated assessment following a detailed site survey should be conducted to confirm the catchment delineation and pit storage curves. The assumed operational catchment delineation is illustrated in **Figure 002**, attached to this report.

4.2.4 Storage Conditions

Primary water balance inputs for site storages are outlined in **Table 5**, estimated from the available satellite elevation data. Noting that North Pit did not appear to have a consistent storage curve and drains into Pit A. Pit A and North Pit were therefore combined as a single storage due to the irregular geometry of North Pit.

Due to the poor quality elevation data available for the site, the WBM results presented in report are a high-level estimate only and require confirmation with detailed site survey data.



TABLE 5: SITE STORAGE CAPACITIES

Storage	Spillway Elevation	Max Storage Capacity (ML)	Initial Water Level
Pit A and North Pit	RL 267.0m	1539	RL 235.7m
Pit B	RL 278.0m	77.42	RL 266.2m
Deep Lead Pit	RL 258.5m	497.10	RL 221.1m

No current water level data or groundwater inflows were available for the pit storages due to the lack of site data (refer to **Section 4.2.3**). Initial water levels were based off aerial imagery and elevation data, and were assumed to be at the groundwater equilibrium. It is assumed the pits will be at the approximate groundwater level at the start of the post-closure scenario.

The pit storage curves presented in **Figure 1** to **Figure 3** were generated using the satellite elevation data described in **Section 4.2.3**.

FIGURE 1: COMBINED PIT A & NORTHERN PIT STORAGE CURVE

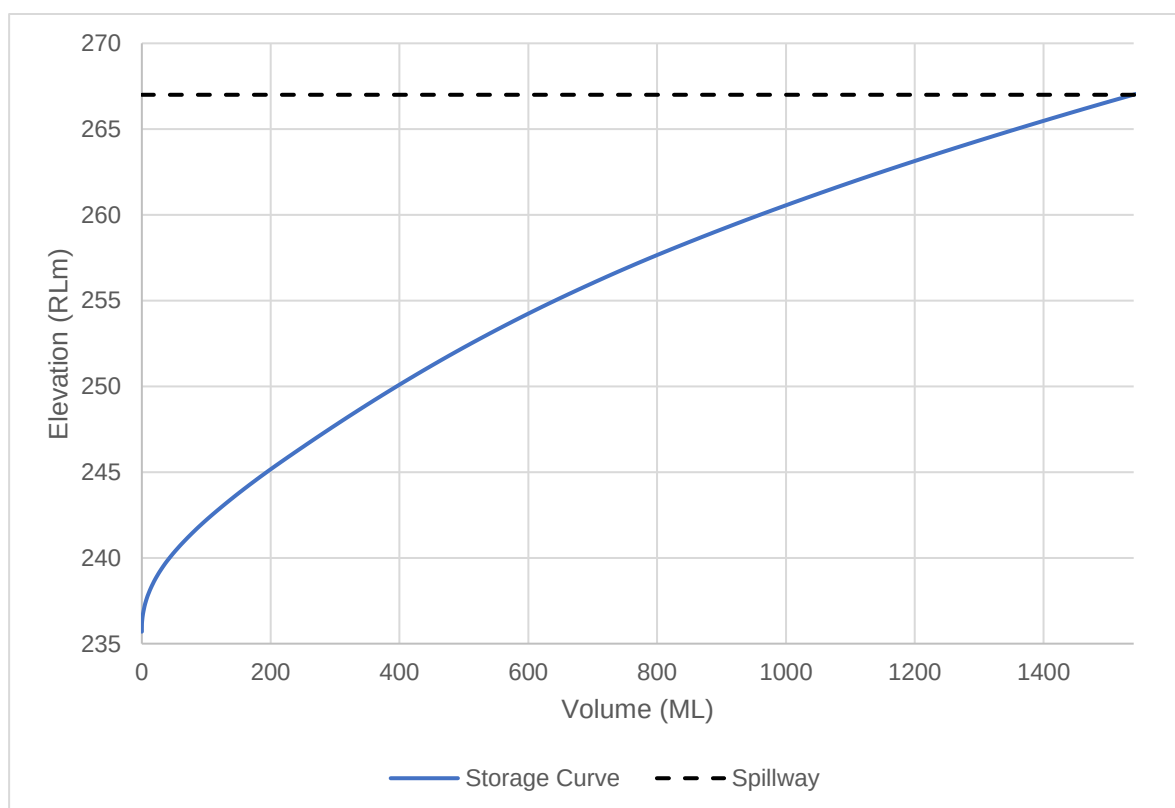




FIGURE 2: PIT B STORAGE CURVE

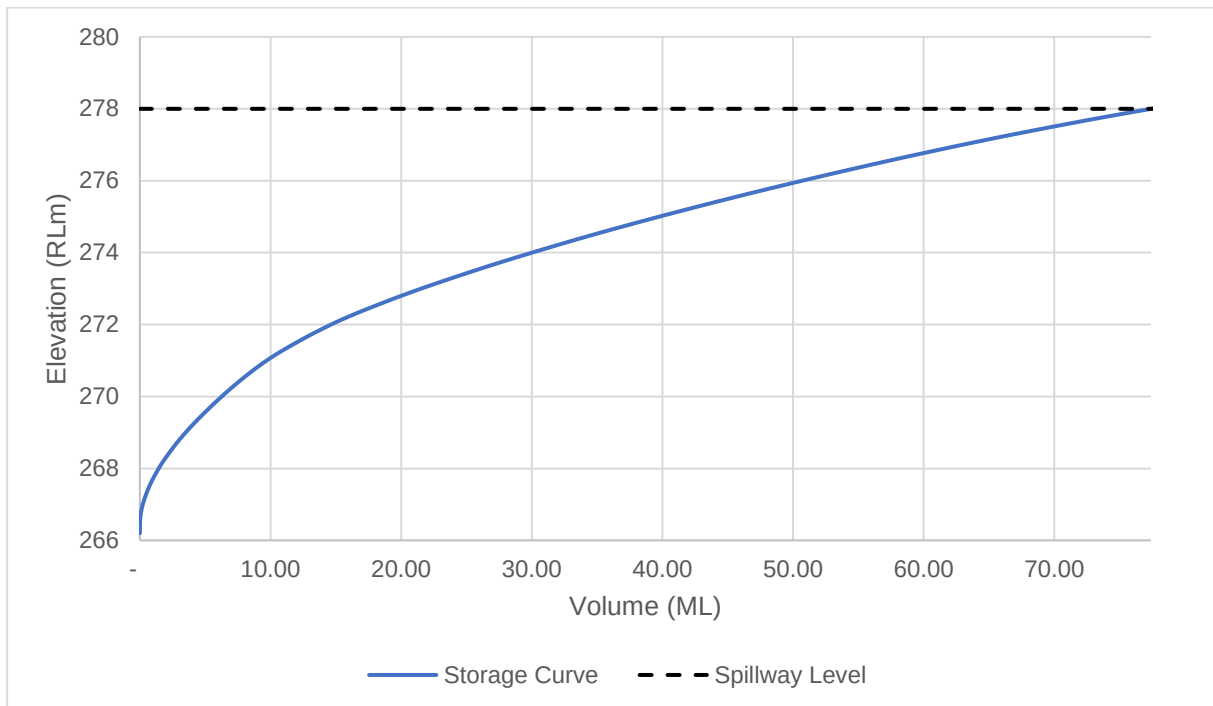
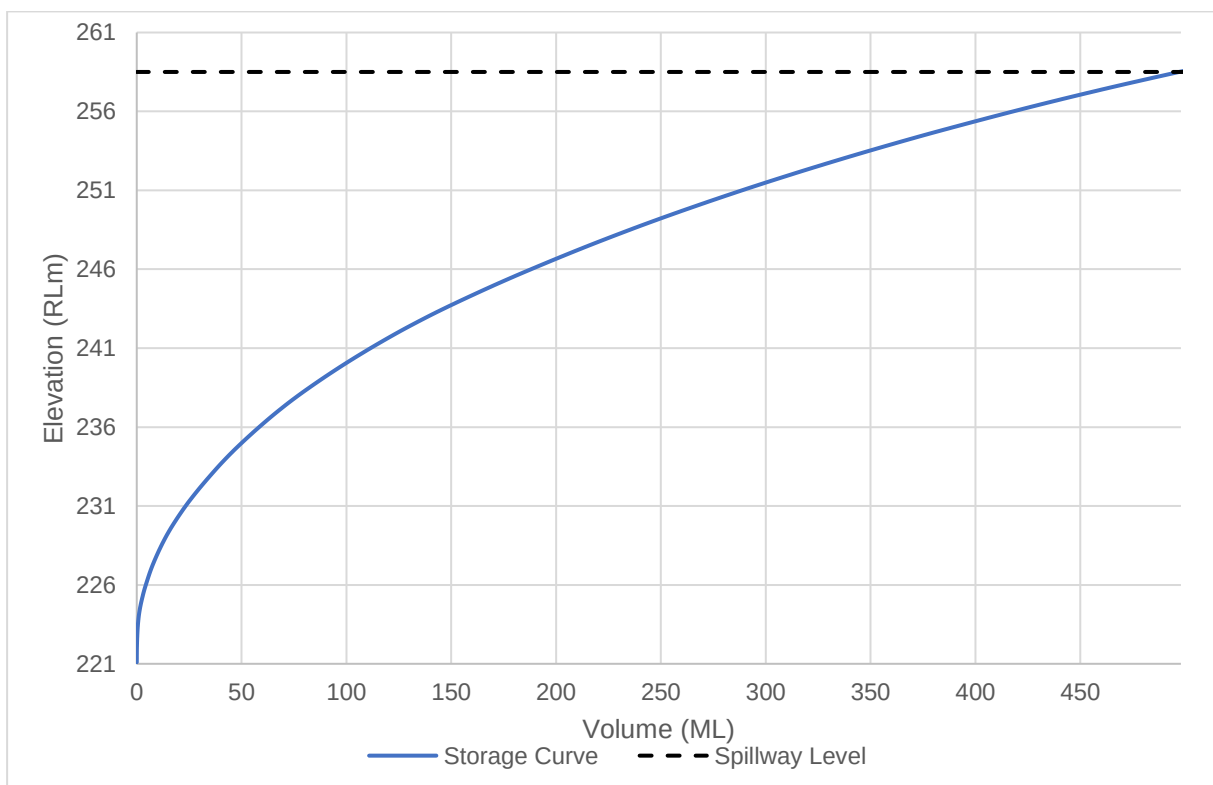


FIGURE 3: DEEP LEAD PIT STORAGE CURVE

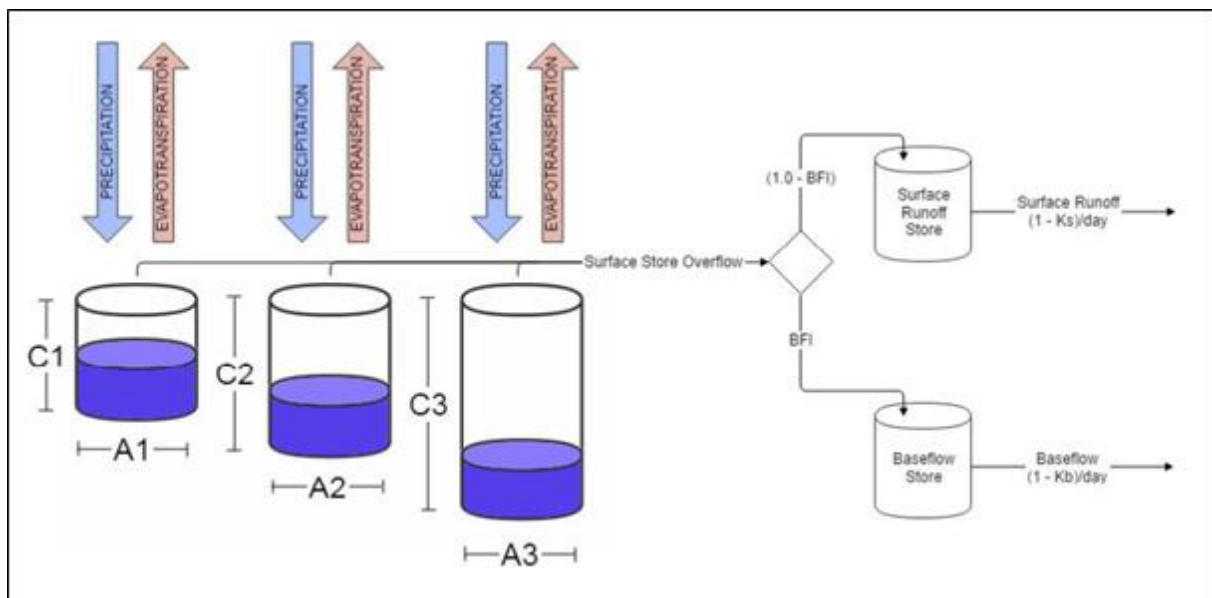


4.3 Model Development

4.3.1 Inflows and Adopted Runoff Model

Stormwater runoff estimations in the WBM were undertaken using the Australian Water Balance Model (AWBM). The AWBM is a surface runoff model that routes rainfall through a series of surface stores with defined depths, subtracting daily evapotranspiration rates to represent soil and surface conditions in site catchments [2]. The AWBM is an antecedent rainfall model, which considers the wetting and drying process that occurs over time. The model can represent a range of runoff conditions, based upon seasonal and climatic differences over the calendar year. A schematic of the AWBM model structure is depicted in **Diagram 2**.

DIAGRAM 2: AWBM SCHEMATIC



Source: Boughton, 2004 [2]

Where:

C1 – C3	= Surface Storage Capacities
A1 – A3	= Partial Areas Represented by Surface Storages
BFI	= Baseflow Index
K_b	= Daily Baseflow Recession Constant
BS	= Current Volume in Baseflow Store
K_s	= Daily Surface Flow Recession Constant
S	= Current Volume in Surface Store Routing

The catchment types and AWBM model parameters adopted are summarised in **Table 6**. Model parameters have been selected based on experience with similar water balance model studies and AWBM recommendations. No site data was available for calibration of catchment parameters.

**TABLE 6: AWBM MODEL PARAMETERS**

AWBM Parameters	Split Areas (sum=1.0)			Storage Capacities (mm)			Ks (day-1)	BFI	Kb (day-1)
	A1	A2	A3	C1	C2	C3			
Natural	0.3	0.35	0.35	12	120	250	0	0.1	0.8
Hardstand	1	-	-	5	-	-	0	0	-
Waste	0.2	0.8	-	10	50	-	0	0	-
Open Cut	0.1	0.9	-	5	20	-	0	0	-
Tailings	0.2	0.8	-	5	50	-	0	0	-

Runoff calculated from the AWBM formed the only inflow to the pit storages. Groundwater was assumed to stay at a constant level for each pit.

4.3.2 Outflows and Transfer Systems

No outflows were modelled for the site other than natural evaporation. One transfer logic was included to divert potential spillage from Pit B to Pit A, which can be constructed as part of the closure phase earthworks.

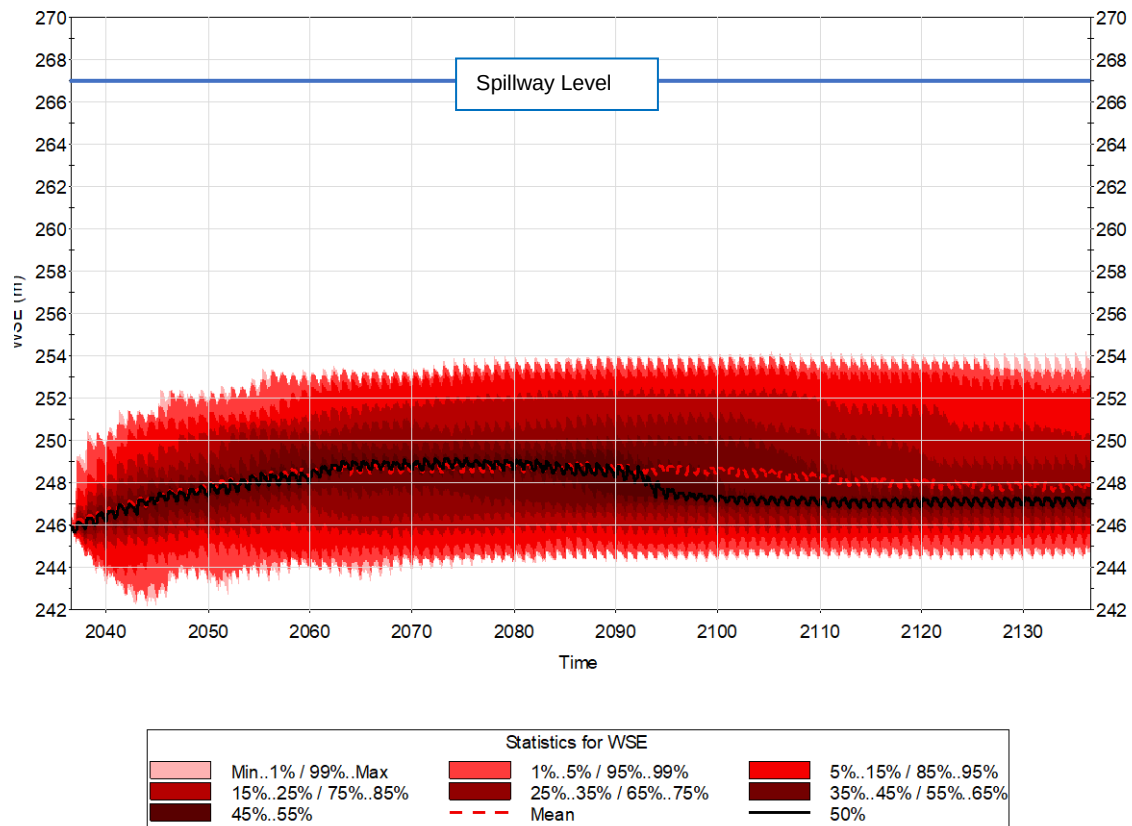
4.4 Water Balance Results

Outputs from the water balance modelling for each of the modelled storages are presented in **Graph 2** to **Graph 4**. Each graph provides a plot of maximum water elevation versus the model duration for each of the storages, presented as a combined plot for:

- Mean and median;
- Upper and lower bounds; and
- 5%, 25%, 75% and 95% (percentiles).

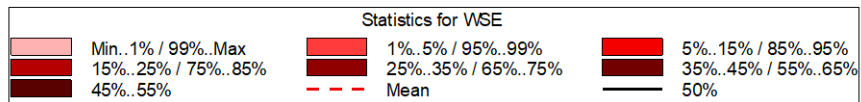
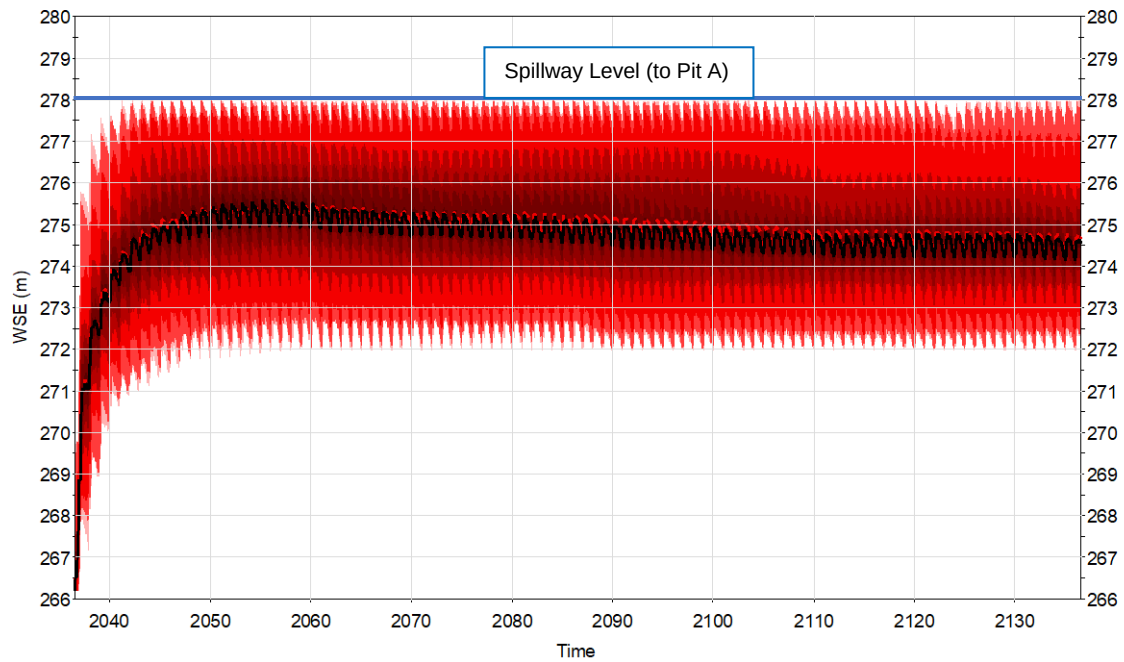


GRAPH 2: COMBINED PIT A AND NORTH PIT MODELLED MAXIMUM WATER ELEVATION





GRAPH 3: PIT B MODELLED MAXIMUM WATER ELEVATION



GRAPH 4: DEEP LEAD MODELLED MAXIMUM WATER ELEVATION

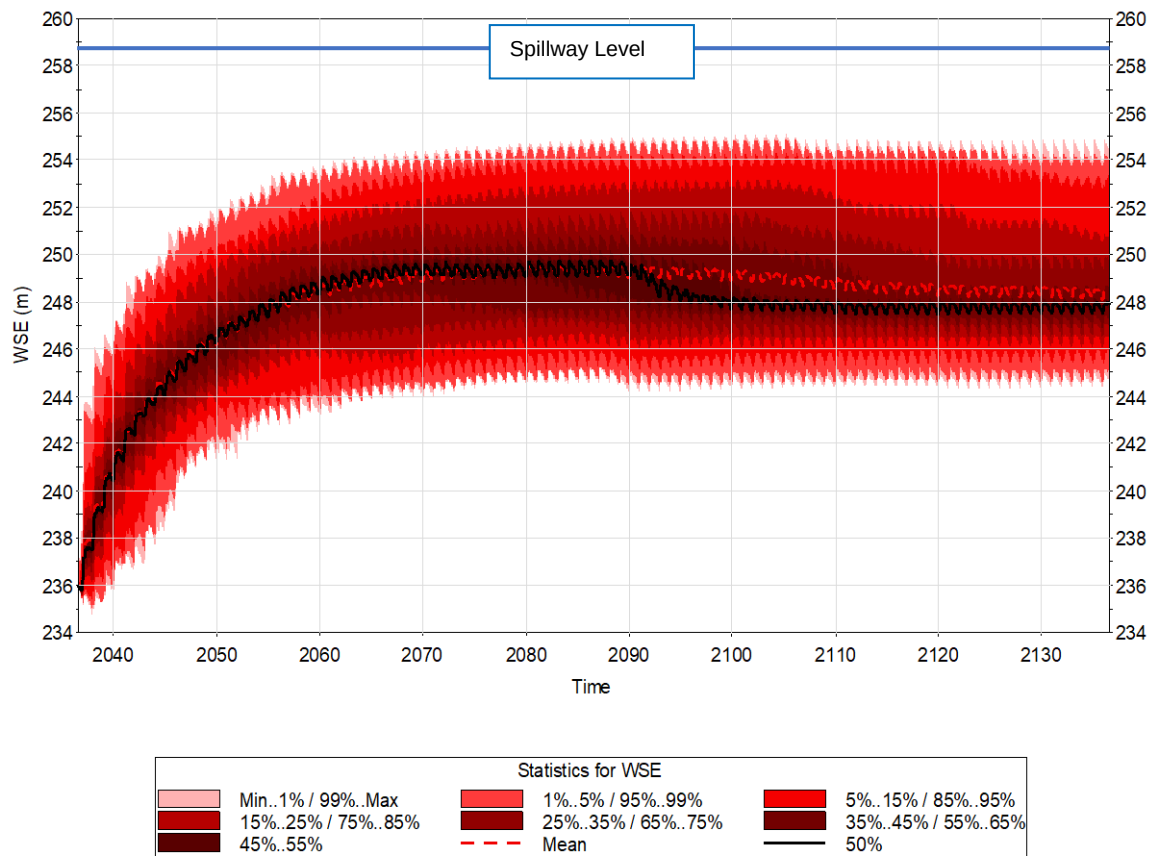


TABLE 7: SPILL PROBABILITIES

Storage	Spill Probability (to 2130)
Pit A and North Pit	<1%
Pit B	<1%
Deep Lead Pit	<1%

4.5 Performance Implications

Each pit appears to gradually increase in storage before fluctuating around a relatively consistent water level. This is due to the small contributing catchments to each pit, and the high evaporation rates for the region. It was found through the initial model development that Pit B had a slightly greater than 1% chance of spilling due to the existing spillway level and irregular geometry of the pit. The model was therefore adjusted to have a transfer logic from Pit B to Pit A if Pit B reaches the spillway level to reduce the risk of spilling. This can be achieved by re-locating Pit B's spillway to discharge into Pit A as part of rehabilitation earthworks. Refer to **Figure 002**, that illustrates the concept spillway location. This proposal results in a less than 1% chance of any of the site pits spilling to the downstream environment.



4.6 Key Assumptions

Due to the lack of site data, several assumptions had to be made in order to develop the WBM. The key assumptions are listed in **Table 8**.

TABLE 8: KEY ASSUMPTIONS

Data	Recommendation
Elevation Data	Detailed site survey to be conducted to confirm pits storages, site contours, catchment delineations etc. WBM to be revised once adequate data is available.
Groundwater Level	To be estimated via monitoring bores and pit water levels and WBM to be revised once adequate data is available.
Water Quality	Pit water and monitoring locations to be recorded at regular intervals. WBM may need updates to confirm assumptions.
AWBM Parameters	On-site water management and runoff to be monitored where possible to allow calibration of WBM parameters. WBM may need updates to confirm assumptions.

5 CLOSURE METHODOLOGY

5.1 Background

A conceptual closure plan has been developed by ATCW which informed the WBM undertaken (refer **Section 4**) and includes proposed drainage measures to be incorporated into the rehabilitation works. Generally, it is proposed that the closure mining catchments maintain a similar hydrology to that of the pre-mining scenario. The eastern post-mining catchments (Catchment A1-4) once rehabilitated will reduce the overall catchment area by approximately 30 ha as the residual voids are not proposed to discharge downstream. The post-mining western catchments (Catchment B1-2) will also slightly reduce (~12 ha) the overall catchment area when compared to the assumed pre-mining conditions. However, given the large catchment of the downstream Rosetta creek, it is expected that this will result in only minor localised changes to volumetric flow and stream velocities and is not of significance.

The following sections outline the indicative closure phase plan for the mine site, and generally is in accordance with the NRC [7] proposed rehabilitation methodology. Land-uses proposed are outlined in Schedule F – Table 1 of the site's EA and reproduced in **Section 1.3.2**.

The closure methodology outlines high level surface water management requirements and likely temporary erosion and sediment control measures. It is proposed to stage the rehabilitation works as two main Stages nominated below:

- Stage 1 – Rehabilitation of mine infrastructure areas, and eastern extent of the TSF.
- Stage 2 – Rehabilitation of the remaining western extent of the TSF.

Staging allows for more effective temporary erosion and sediment control by splitting up the rehabilitation works into two main work areas. Stage 1 aims to rehabilitate the eastern extent of the TSF by using the western extent (Stage 2) as a temporary water and sediment storage area. Once Stage 1 has achieved suitable vegetation cover, Stage 2 can be rehabilitated with the use of a temporary High Efficiency Sediment (HES) basin for erosion and sediment control. The HES basin can also provide water storage for Stage 2 irrigation to encourage vegetation establishment. It is proposed to re-locate the TSF spillway further east to allow the rehabilitation staging, however, this is dependant on detailed site survey which was not available at the time of this report.

The associated mine infrastructure areas and TSF are proposed to be rehabilitated to a Post-Mining Land Use (PMLU) as a Class VII land use (land not suitable for cultivation and only careful pastoral use) as per Schedule F – Table 1 of the EA. Class VII land use areas are to be rehabilitated with vegetation and minimal changes to the topography. For all areas that drain to the TSF, no sediment basin would be required during the Stage 1 rehabilitation phase. The existing water storages within the site (TSF and runoff dam) would be adequate to contain sediment laden runoff (to be confirmed through future implementation of the site's operational water management plan) and can be used as irrigation water for vegetation establishment. There are some minor catchments as identified on **Figure 002**, that discharge directly downstream and therefore may need individual erosion and sediment control via bunding or temporary sediment basins whilst rehabilitation works are undertaken.

The pits are to be left as residual voids and form Non-use Management Areas (NUMA) under a Class VIII land use (unsuited to agricultural use or grazing areas). The runoff dam is to be left as a stock water source, also under a Class VIII land use.

5.2 Site Infrastructure Areas – Stage 1 Rehabilitation Areas

5.2.1 Process Area (assumed adjacent to the Admin Area)

The processing area is approximately 6.2 ha, and decommissioning of plant is to be undertaken including removal of all infrastructure. Localised re-grading may be required to fill in excavations and achieve free-draining grades. Rehabilitation through vegetation establishment is to be conducted to all disturbed areas. Runoff to be directed to the TSF storage area for water capture and sediment storage (refer **Section 5.3**). Land-use to be Class VII - Open Pasture.

5.2.2 Product Stockpile Area (stockpile locations vary across the site)

The product stockpile area is approximately 16 ha, with 14 ha being previously rehabilitated. Closure phase works are to rehabilitate any disturbed areas through vegetation establishment, in addition to locally re-grading batters to an erosion resistant slope (if required). Rehabilitation works may require removal of surface material up to 0.5 m deep, for disposal to Pit A due to potential low-level contamination [7]. The scattered 2 ha of stockpiled material areas can be placed on existing cleared areas, with the aim to bring the stockpiled areas back to pre-stockpile levels and to be vegetated. Land-use to be a PMLU, Class VII - Open Pasture.

5.2.3 ROM Pad

The ROM pad consists of approximately 100,000 m³ of inert mine overburden over an area of 3 ha. As stated by NCR [7], the ROM pad material is stable, and competent oxidised material extending to an approximate 5 m above surface. This material can be used for rehabilitation/capping of problematic site areas. The pad area itself requires re-grading to blend-in as a low hill and reduce erosion potential to the batter slopes before being rehabilitated through vegetation establishment. Runoff to be directed to the TSF storage area for water capture and sediment storage until suitable vegetation cover is achieved (refer **Section 5.3**). Land-use to be a PMLU, Class VII – Low Hill.

5.2.4 WRD

The waste rock dump has been previously rehabilitated and therefore is not expected to require any further rehabilitation works at the closure phase of the mine. However, during the next year (within 2022) of operations, it is recommended that mine operations undertake a new vegetation and establishment regime across the WRD to achieve a targeted vegetation surface cover of around 70%. Land-use to be a PMLU, Class VII – Low Hill.

5.2.5 Admin Areas, Abandoned Village, and other associated infrastructure pads

The admin, abandoned village, and associated infrastructure areas are to be decommissioned and rehabilitated through vegetation establishment, with minimal level changes proposed. Localised filling may be required to excavated areas, and/or to achieve free-draining grades prior to the surfaces being rehabilitated. Localised erosion and sediment control may be required during the rehabilitation works. Where possible, runoff is to be directed to the TSF storage area for water capture and sediment storage until suitable vegetation cover is achieved (refer **Section 5.3**). Land-use to be a PMLU, Class VII – Open Pasture, and Low Hill (Village).

5.3 Tailings Dam and Heap Leach Pad

The Tailings Dam (or TSF) including the heap leach pad, covers an area of approximately 72 ha and is to be classified as a PMLU, Class VII – Open Pasture land-use. Current fall on the TSF allows water to pond at the western end of the TSF, covering approximately 25 ha of area. The heap leach pad area covers an area of approximately 5 ha. Previous rehabilitation trials to the TSF surface cover an of 3.5 ha area within the southern portion of the overall TSF area. NCR [7] state that the tailings are considered consolidated, and suitable for earthworks. As mentioned in **Section 3.5**, the tailings are considered to have a low risk of acid forming potential. However, the material is saline and contains relatively soluble arsenic concentrations that may be of concern to rehabilitation [7]. The recommendation by [7], is that a cover layer over the tailings is required to isolate the risks associated with arsenic levels.

One of NCR [7] suggestions is that the TSF could be left as a semi-permeant wetland due to the relatively consistent water level witnessed. However, a wetland on the TSF is not recommended by ATCW due to the following factors:

- It is not desirable to store water on the TSF due to likely spilling/overtopping and risks of dam erosion.
- It is not desirable to store water on the TSF due to likely seepage through the tailings and dam embankment.



- The wet and drying from water level fluctuations of the tailings material may erode the surface and expose underlying soils.

It is recommended that the TSF surface is capped and graded to achieve free-draining fall to the downstream environment. Rehabilitation works would benefit from splitting up the TSF catchment area and potentially re-locating the spillway. This would allow a north-south split (via bunding) throughout the rehabilitation works to separate the TSF areas into a western and eastern catchment. The eastern catchment (Stage 1) should be rehabilitated first, with the western catchment (Stage 2) being used as a water and sediment storage area to capture runoff from the disturbed areas. Following Stage 1 achieving suitable vegetation cover, Stage 2 can be rehabilitated and a temporary High Efficiency Sediment (HES) basin would likely be required to temporarily capture Stage 2 dirty water runoff during the rehabilitation works. The existing spillway could be decommissioned and cut in further east towards the natural Sugar Bag Creek line if levels allow adequate fall to this location.

Detailed design details are to be confirmed following an accurate and detailed survey pick-up. Furthermore, the cap design shall be addressed separately as part the detailed design and is likely subject to further rehabilitation trials. Detailed design of the surface grading will also need to be consider long-term settlement of the tailings to determine minimum grades.

5.4 Runoff Dam

The runoff dam is to be left as a water storage for stock water under a Class VIII – Water Storage land-use. Minor rehabilitation of embankment batters may be required to achieve vegetation cover.

5.5 Residual Voids (Pit A, Pit B, North Pit, Deep Lead Pit)

All pits are to be left as residual voids in the closure phase scenario as the WBM indicates there is a low likelihood (<1%) of spilling to the downstream environment provided the spillway of Pit B is re-directed to Pit A. Rehabilitation of the pits would require local spillway earthworks and installing safety measures due to being significant hazards. The pits are to be classified as a Class VIII – Open Void land-use, and is a NUMA.

Furthermore, the residual voids are clear of the regional flood extents as per the technical memorandum by ATCW (reference 121130-01M001.rev0). Bunding along the eastern extent of the voids must be maintained post-closure to divert the natural flow to the east away from the pits.



6 CONCLUSIONS AND RECOMMENDATIONS

Solomons primarily owns and operates the Wirralie Gold Mine (WGM) site under EPML00772413 and took over the site in late 2013. Mining operations are proposed to be re-commenced, and Solomons have commissioned Wulguru Technical Services to provide assistance with the required Progressive Rehabilitation Closure Plan (PRCP) and Estimated Rehabilitation Cost (ERC). As part of the PRCP and ERC requirements, ATC Williams (ATCW) have been engaged by WTS to develop a concept closure plan methodology and a Water Balance Model (WBM) for the post-closure scenario.

This report outlines conceptual findings based on the limited background information and site data available at the time of reporting. Therefore, this report requires revision following further site investigations to confirm the outcomes stated in the report meet DES requirements. Detailed investigations that are required include:

- Groundwater monitoring and hydrogeology reporting;
- Water quality monitoring data;
- Waste Rock and Tailings material characterisation;
- Detailed site survey and elevation data.

The results of the WBM indicates that the four residual voids are not likely to spill (<1% chance) to the downstream environment, with the model run for over 100 years. This is provided the spillway of Pit B is diverted into Pit A as a mitigation measure. It should be made clear that the elevation data used in the WBM is coarse satellite data and may not provide an accurate representation of the site features and/or pit storage curves. The outcomes of this WBM are therefore high-level and a detailed site survey is required to confirm the modelling results. No climate change scenarios were modelled as part of the WBM.

A conceptual closure plan methodology was developed and the rehabilitation requirements were identified. This plan proposes to undertake rehabilitation in two stages. The concept closure plan proposes to decommission infrastructure areas and plant/machinery in order rehabilitate the areas and achieve vegetation growth with minimal changes to the site topography as part of Stage 1. The Tailings Storage Facility requires minor capping due to the saline nature of the material and relatively soluble arsenic concentrations. It is proposed to split the TSF catchment into two, Stage 1 will involve the rehabilitation of approximately half the TSF catchment area whilst allowing for temporary erosion and sediment control and water storage within the Stage 2 area. Stage 2 would then require re-locating the existing spillway location and potentially re-grading some of the tailings surface to achieve free-draining fall to the outlet. A HES Basin is likely required to capture dirty runoff during the rehabilitation works and enable water storage for irrigation to support vegetation growth. A semi-permanent wetland over the tailings surface is not supported.

The WBM and concept closure plan methodology presented in this report are generally in accordance with the Department of Environment and Science PRCP guidelines. It is recommended that the concept measures outlined in this report are adopted for future detailed designs and further investigations.



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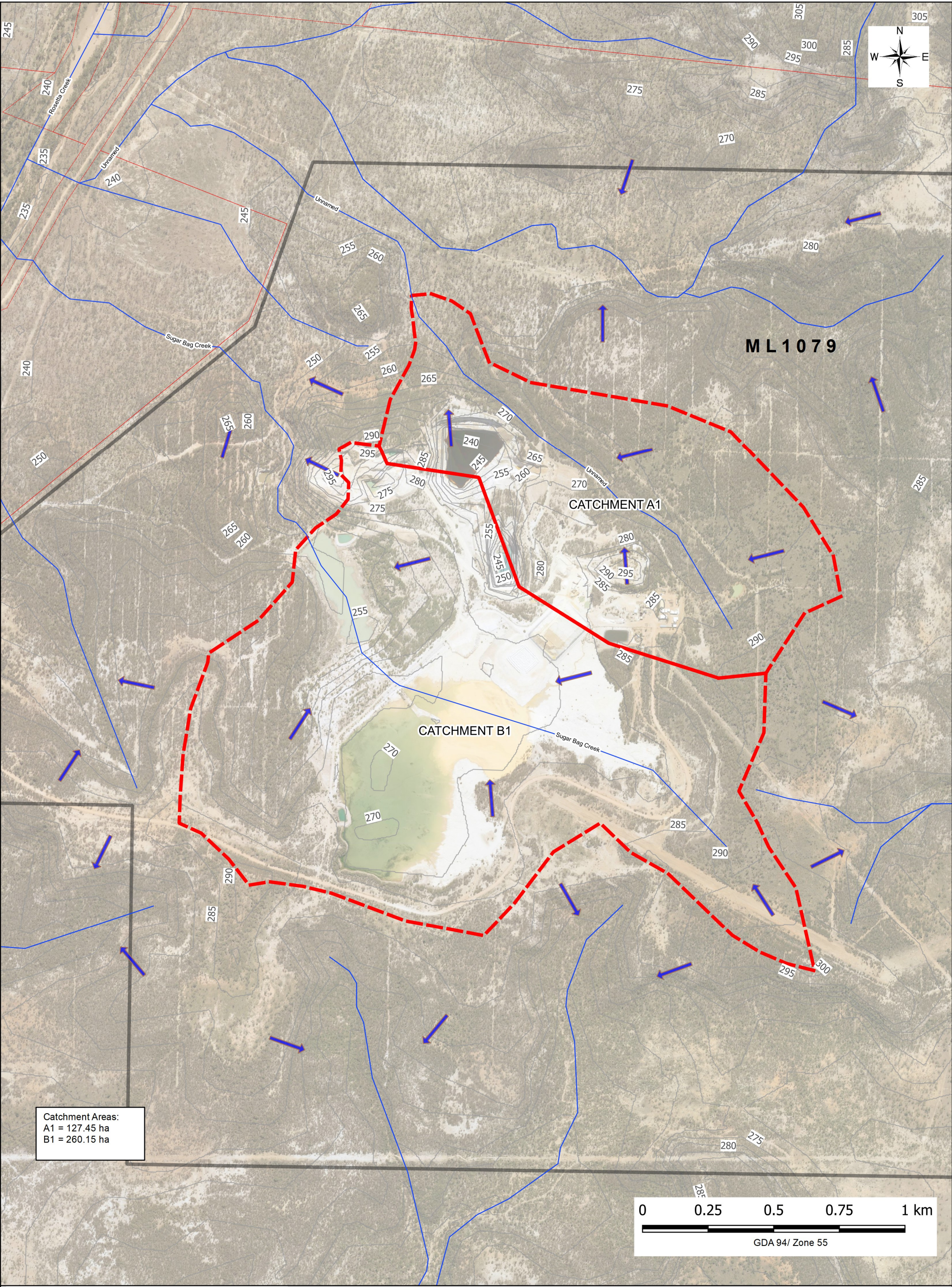


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FIGURES





APPENDICES



APPENDIX A – MINE SITE LAYOUT FIGURES



SOLOMONS GOLD

WIRRALIE GOLD MINE MOUNT COOLON

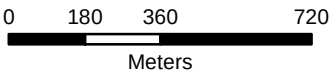
CADASTRE

Legend

-  Wirralie Mining Lease
-  Cadastre Whitsunday Shire

Credits:
Mine Lease boundary and
QLD Cadastre
© State of Queensland
(Department of Natural
Resources and Mines) 2016.

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 22-Sep-16



Scale: 1:18,000 at A3





Document Path: \\nrc-desktop\lib_gis\GIS Projects\Solomons\NRC_data\Wirralie\Maps_mxd\160922_Wirralie_Rehab.mxd

SOLOMONS GOLD

WIRRALIE GOLD MINE MOUNT COOLON

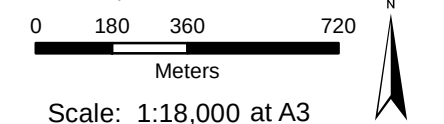
REHABILITATION
OCTOBER 2001

Legend

-  Wirralie Mining Lease
-  Contoured - No topsoil
-  Never Disturbed
-  Previously rehabilitated - ACM
-  Topsoil Stockpile
-  Topsoil by Delta
-  Safety Bund

Credits:
Mine Lease boundary
© State of Queensland
(Department of Natural
Resources and Mines) 2016
Imagery supplied by Client
30/09/2010

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 22-Sep-16



Scale: 1:18,000 at A3





SOLOMONS GOLD

WIRRALIE GOLD MINE MOUNT COOLON

REMNNANT VEGETATION

Legend

 Wirralie Mining Lease

 Watercourse

Remnant Vegetation

Status

 Endangered-dominant

 Endangered-subdominant

 Of Concern - dominant

 Of Concern - subdominant

 Least Concern

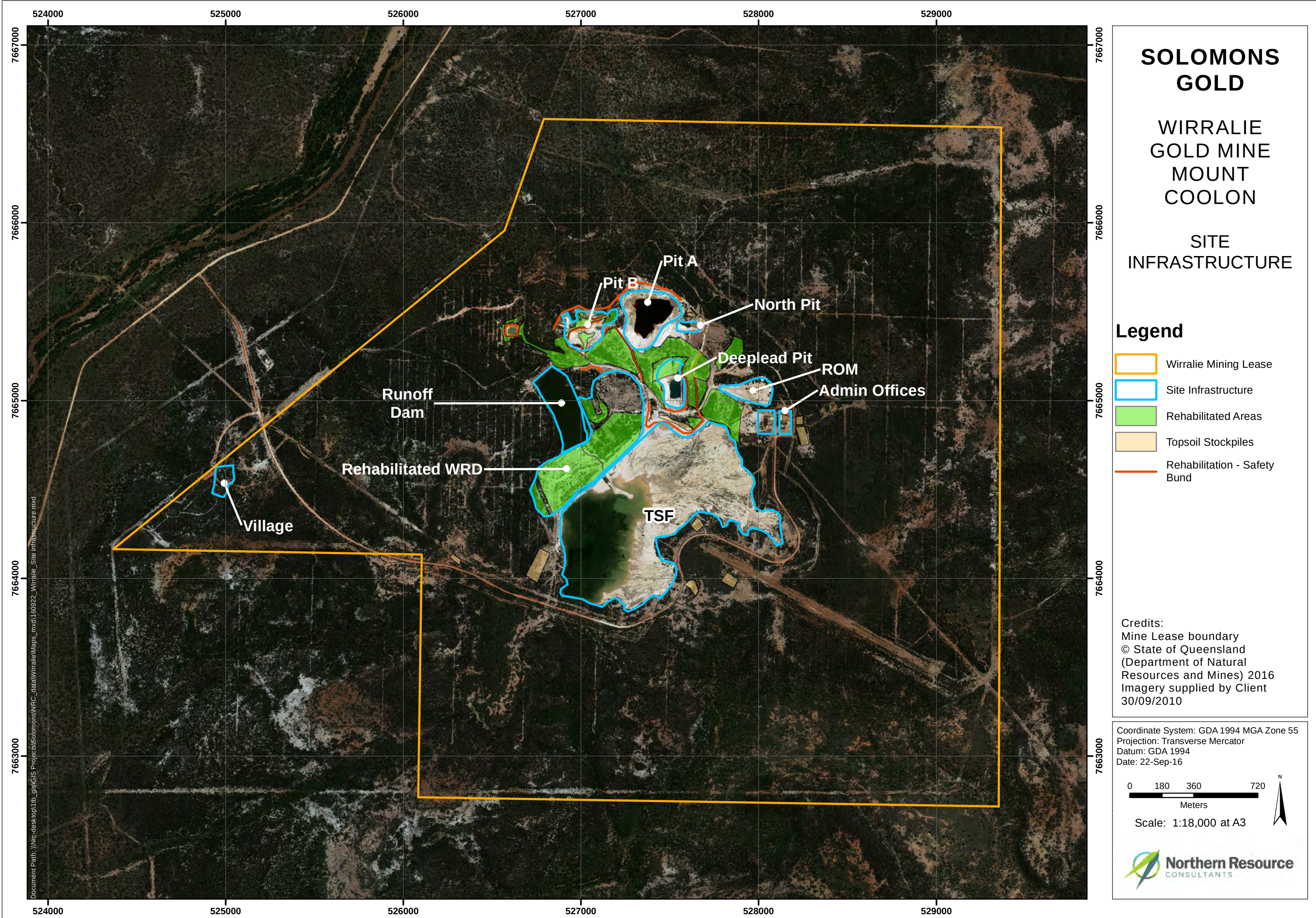
Credits:
Mine Lease boundary
© State of Queensland
(Department of Natural
Resources and Mines) 2016
Imagery supplied by Client
30/09/2010

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 22-Sep-16

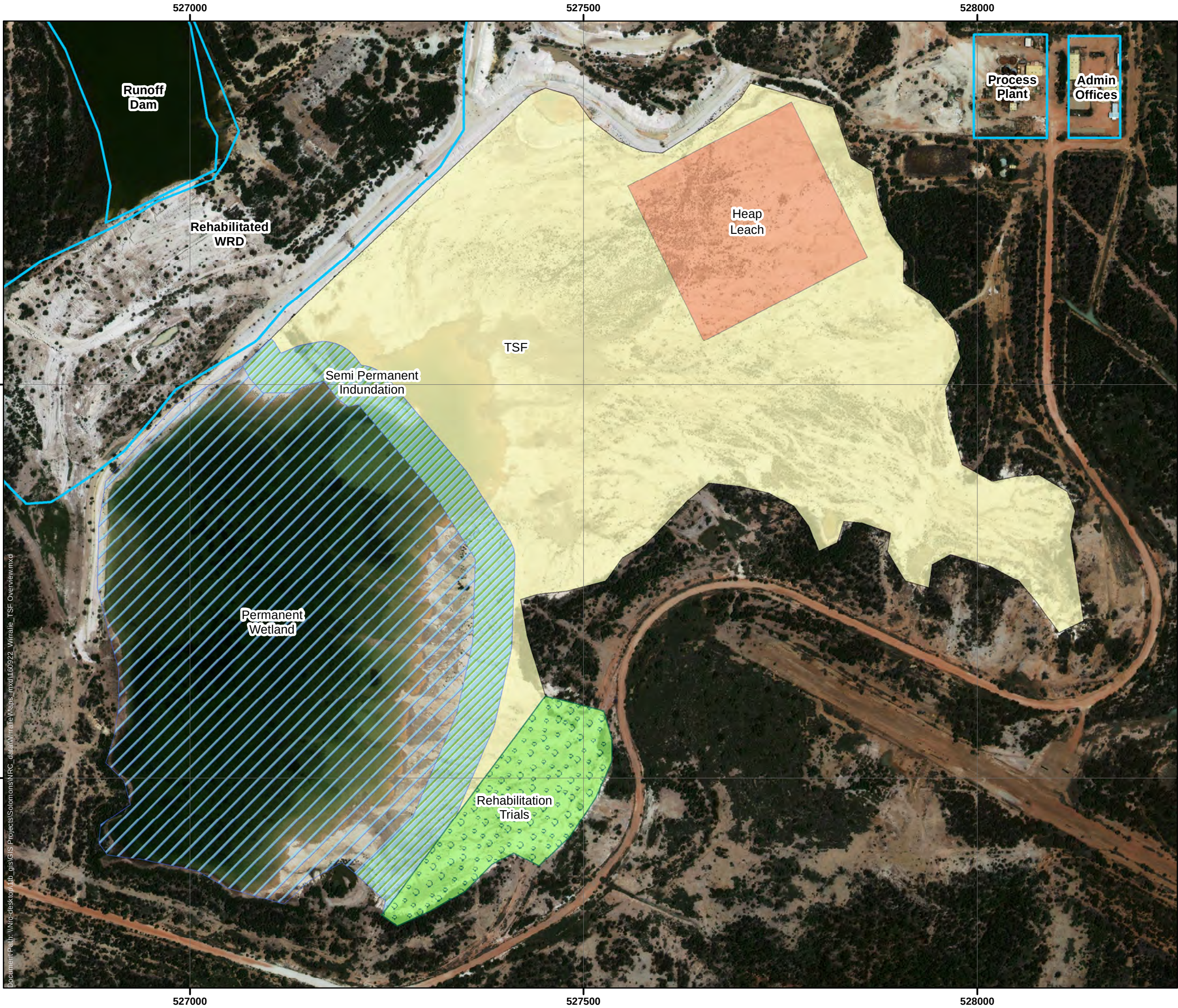
0 180 360 720
Meters

Scale: 1:18,000 at A3









SOLOMONS GOLD

WIRRALIE GOLD MINE MOUNT COOLON

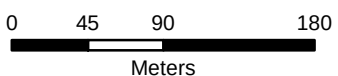
TAILING STORAGE FACILITY OVERVIEW

Legend

- Site Infrastructure
- Tailing Storage Facility Overview**
 - TSF - 42Ha
 - Heap Leach - 5Ha
 - Rehabilitation Trials - 3.5Ha
 - Semi Permanent Indundation - 5Ha
 - Permanent Wetland - 25Ha

Credits:
Imagery supplied by Client
30/09/2010

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 22-Sep-16



Scale: 1:4,500 at A3



Appendix J: C&R Consulting (2022) Waste Rock Characterisation Supporting Letter - Cadmium and Selenium



C&R CONSULTING

Geochemical & Hydrobiological Solutions Pty Ltd

ABN 72 077 518 784

Underground Coal Gasification / Coal Seam Gas Investigations
Mineralogical, Geological, Petrographic and Soils Services
Hydrogeomorphic and Palaeogeomorphic Evaluations
Terrestrial and Aquatic Fauna and Flora Surveys
Climate History and Extreme Events Analysis
Contaminated Site and Mine Water Analysis
Environmental Compliance and Monitoring
Estuarine and Marine Water Assessments
Registered Research and Development
Surface and Groundwater Hydrology

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22 March 2022

Scott Hayes-Stanley
Director
Wulguru Technical Services
Suite 3, Level 1
559 Flinders Street
Townsville, QLD 4810

Dear Mr Hayes-Stanley,

C&R Consulting Pty Ltd (C&R) recently completed a waste rock characterisation report (C&R, 2022¹) for the Wirralie Gold Mine (WGM), for Wulguru Technical Services (WTS), to support WGM's progressive rehabilitation and closure plan (PRCP). It is understood that, following the review of this document, the Department of Environment and Science (DES) raised concerns about contaminants within the tailings storage facility (TSF) at WGM. The issues related to the potential for the formation of moderately/highly saline waters and the potential mobilisation of elevated cadmium and selenium levels. The salinity matter was addressed in the letter from C&R (dated 17 March 2022) which stated:

"Based on the above assessment it is suggested that risk associated with salinity from the waste rock (including tailings) at WGM is considered low/moderate with the potential of brackish runoff/infiltration."

Therefore, this letter aims to address the concerns of DES around the potential for elevated levels of cadmium and selenium to mobilise and transport to receiving environments.

Table 8 in C&R (2022) details the recorded levels of various analytes (including cadmium [Cd] and selenium [Se]) from up to four kinetic leach experiments. It should be noted that the results in successive columns are cumulative. Therefore, when the results for cadmium are reviewed for each individual leach fewer exceedances of guideline values are noted. For instance, in TSF01 with a comparison contaminant limit of 0.01 mg/L, leach 0 has a level of 0.00690 mg/L and leach 1 a concentration of 0.01100 mg/L (i.e. exceeding the contaminant limit). However, when the certificate of analysis (COA) sheet for leach 1 is examined (in Appendix B of C&R, 2022), the value given is 0.00410 mg/L. That is the fluid passing the material for leach 1 only produced 0.00410 mg/L dissolved cadmium, a level compliant with the contaminant limit. Similarly, analyses of the fluids actually passing through in leaches 2, 3 and 4 respectively were 0.00180, 0.00130 and 0.00080 mg/L, all compliant with the contaminant limit.

For cadmium in TSF 03, the initial level was 0.3430 mg/L, with 0.02910 mg/L added in leach 1 and a further 0.01080 mg/L in leach 2 to give a cumulative total of 0.07490 mg/L. All the individual values

¹ C&R (2022). *Wirralie Gold Mine: Waste Rock Characterisation*. Report prepared for Wulguru Technical Services.

and the cumulative levels are non-compliant with the contaminant limit, leach 2 only slightly at 0.01080 mg/L.

Similar data for selenium indicate comparable trends. For TSF 02 (contaminant limit of selenium is 0.02 mg/L) an initial compliant level of 0.0200 mg/L for leach 0 is supplemented by 0.0050 mg/L in leach 1 to give a cumulative total of 0.0250 mg/L. This level of supplementation is also observed in leaches 2, 3 and 4 to give a final cumulative total of 0.0400 mg/L. Thus, although cumulative totals may be non-compliant, all individual leach results meet the contaminant limit of 0.0200 mg/L.

For TSF 03 the cumulative data for leaches 0, 1 and 2 are 0.030, 0.060, and 0.070 mg/L respectively (refer to Table 8 in C&R, 2022) with individual additions of 0.030 and 0.010 mg/L for leaches 1 and 2. The initial level and the first leach (both 0.030 mg/L) are non-compliant with the contaminant limit of 0.020 mg/L. The increase from leach 1 to leach 2 (of 0.010 mg/L) is compliant with the contaminant limit. The levels of selenium in these samples from TSF 03 may show a degree of correlation with iron in the fluid.

A recent review of cadmium in soils and groundwater (Kubier *et al.*, 2019²) indicates that in groundwaters cadmium mainly occurs as the divalent cation and is mobilised in oxic, acidic conditions. The sorption of cadmium is enhanced by the presence of hydrous oxy-hydroxides (iron, aluminium, manganese and silicon), clay minerals and organic matter. Its mobility is further influenced by pH, redox and the ionic strength of the solution. The association of cadmium with the zinc sulphide (sphalerite) is well documented as is the existence of cadmium chloride and cadmium sulphate solution species in the associated fluids

Generally, the mobility of dissolved cadmium is high but its adsorption by the hydrous oxy-hydroxide species (which usually occur as colloids) and/or clay minerals may limit its mobility and bio-availability. The hydrous oxy-hydroxides of iron, aluminium, manganese and silicon as well as clay minerals (smectite, kaolinite and illite) are present in the materials of the WGM TSF. Therefore, it is likely that they will moderate the mobility of cadmium in the system.

A review by Gebreeyessus and Zewge (2018³) on environmental issues associated with selenium indicates that the mobility and bio-availability of this element is complex. Recorded selenium may occur in the environment in several forms:

- as selenide, the divalent anion;
- as the element selenium;
- as the quadrivalent species which is present in the divalent anion selenite (SeO_3^{2-}); and
- as the hexavalent species which is represented by the divalent anion selenate (SeO_4^{2-}).

Selenium speciation in acidic and reducing conditions reduce organic selenites to elemental selenium whereas alkaline oxidising conditions favour the formation of selenates in the environment. The solubility of both selenites and selenates in water means that selenium in leachates from soils is favoured under oxic (i.e. oxygenated), alkaline conditions. Selenides are insoluble and are favoured under wet, anoxic conditions. Similar to cadmium, the adsorption of selenites and selenates to hydrous oxy-hydroxides of iron, aluminium and possibly manganese, as well as clay minerals will restrict mobility of these species. Selenium mobility may also be reduced by micro-biological interactions.

² Kubier, A., Wilkin, R.T., and Pichier, T. (2019). Cadmium in soils and groundwaters: A review. *Applied Geochemistry*, **108**: 1-16.

³ Gebreeyessus, G.D., and Zewge, F. (2018). A review on environmental selenium issues. *Springer Nature. Applied Sciences*. Published on line 22 November 2018.

RECIPIENT: WULGURU TECHNICAL SERVICES
SUBJECT: WIRRALIE GOLD MINE: CD & SE MOBILISATION
DATE: 22 MARCH 2022



Given that the leach solutions are only of low to moderate salinity (not moderate to high) and the presence of hydrous oxy-hydroxides of iron, aluminium, manganese and silicon, as well as clay minerals (smectite, kaolinite and illite) in the TSF, leachate from the material within the TSF is considered low to moderate risk.

Regards,

A handwritten signature in black ink that reads 'Christopher Cuff'. The signature is stylized, with a large 'C' at the beginning and a distinctive flourish at the end.

Dr. Christopher Cuff

Principal Scientist/Geochemist – Director
C&R Consulting Pty Ltd

Appendix K: C&R Consulting (2022) Waste Rock Characterisation Supporting Letter – Salinity



C&R CONSULTING

Geochemical & Hydrobiological Solutions Pty Ltd

ABN 72 077 518 784

*Underground Coal Gasification / Coal Seam Gas Investigations
Mineralogical, Geological, Petrographic and Soils Services
Hydrogeomorphic and Palaeogeomorphic Evaluations
Terrestrial and Aquatic Fauna and Flora Surveys
Climate History and Extreme Events Analysis
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17 March 2022

Scott Hayes-Stanley
Director
Wulguru Technical Services
Suite 3, Level 1
559 Flinders Street
Townsville, QLD 4810

Dear Mr Hayes-Stanley,

C&R Consulting Pty Ltd (C&R) recently completed a waste rock characterisation report (C&R, 2022¹) for the Wirralie Gold Mine (WGM), for Wulguru Technical Services (WTS), to support WGM's progressive rehabilitation and closure plan (PRCP). It is understood that – following the review of this document by the Department of Environment and Science (DES) – a number of issues were raised around the salinity levels of material within the tailings storage facility (TSF), and whether these levels should be categorised as hypersaline. Therefore, this letter aims to provide additional information/explanation of the findings discussed within the C&R (2022) report with respect to the risk from the levels of salinity observed.

The salinity of waste rock (including tailings) was determined through two different methods within the C&R (2022) report. The first method employed the standard 1:5 water/soil mixture (paste) to determine the electrical conductivity (EC; as a proxy for salinity) of the soils/waste rock themselves, whereas the second method used a kinetic leach column test from which the resultant waters were tested (refer to Section 3.2 of C&R [2022] for further discussion of the methods).

The kinetic leach column test aims to provide an indication of the quality of runoff/infiltration waters after extended contact with the waste rock. There are no Queensland guidelines that provide definitions for the various ranges/categories of salinity in waters and the associated risks. Therefore, when assessing the results from the WGM waste rock testing, C&R compared the water quality values from the kinetic leach tests to the categories detailed by the US Geological Survey (refer to <https://www.usgs.gov/special-topics/water-science-school/science/saline-water-and-salinity>).

The salinity ranges detailed by the US Geological Survey are (once converted to $\mu\text{S}/\text{cm}$ by a simple multiplying factor):

- Fresh water = $<1,560 \mu\text{S}/\text{cm}$;
- Slightly saline = $1,560 - 4,680 \mu\text{S}/\text{cm}$;
- Moderately saline = $4,680 - 15,600 \mu\text{S}/\text{cm}$; and

¹ C&R (2022). *Wirralie Gold Mine: Waste Rock Characterisation*. Report prepared for Wulguru Technical Services.

RECIPIENT: WULGURU TECHNICAL SERVICES
SUBJECT: SALINITY CHARACTERISTICS
DATE: 17 MARCH 2022



- Highly saline = 15,600 – 56,000 $\mu\text{S}/\text{cm}$.

There is no allocation/definition for hypersaline within the US Geological Survey criteria for waters. However, the Wetland Info website of DES refers to hypersaline waters as '*denoting or relating to an aquatic environment that is saltier than typical seawater*' (<https://wetlandinfo.des.qld.gov.au/wetlands/resources/glossary.html#g=>). Further, the attached Queensland Government document (*Science Notes – Land series – L137*) also states that seawater is typically about 55,000 $\mu\text{S}/\text{cm}$. Based on this, hypersaline would be any EC value greater than the *highly saline* category stipulated by the US Geological Survey (see above). Further, under these definitions, the potential runoff from the WGM waste rock/tailings material would not be considered hypersaline.

C&R only recorded one kinetic leach sample that was in the US Geological Survey *highly saline* category (but was still $<20,000 \mu\text{S}/\text{cm}$ when the tests were completed). All other results were less than 12,000 $\mu\text{S}/\text{cm}$, which (in the attached Queensland Government document) is considered brackish water.

Notably, the attached Queensland Government document (*Science Notes – Land series – L137*) does provide salinity classes for soils (i.e. the results of the C&R static [1:5] tests). The mean EC value of static (i.e. using a 1:5 water mix) tailings material samples was 1,592 $\mu\text{S}/\text{cm}$ (based on 50 samples). This value is deemed as slightly saline *soils* by the Queensland Government (refer to document attached). The maximum static value of 4,860 $\mu\text{S}/\text{cm}$ is classed as moderately saline under the attached document for soils. This means that the '*yield of salt sensitive plants*' would be '*restricted*'. However, in no circumstances are any of the results detailed within the C&R (2022) report considered hypersaline in accordance with available US Geological Survey criteria or Queensland Government definitions.

Based on the above assessment, it is suggested that the risk associated with salinity from the waste rock (including tailings material) at WGM is considered low to moderate, with the potential of brackish runoff/infiltration and a restricted yield of salt-sensitive plants.

Regards,

A handwritten signature in black ink that reads 'Christopher Cuff'.

Dr Christopher Cuff

Principal Scientist/Geochemist – Director
C&R Consulting Pty Ltd

Measuring salinity

Salinity is the accumulation of salt in soil and water. High salt levels can adversely affect plant growth, soil structure, water quality and infrastructure.

High salt levels occur naturally in many parts of the Australian landscape but in many cases have been exacerbated where human activities accelerate the mobilisation and accumulation of salt.

Methods for measuring salinity

It is important to identify saline areas so they can be appropriately managed. There are a range of methods for measuring salinity. Two common ways are by using an electrical conductivity (EC) meter or by measuring how much salt is in a solution of soil or water.

An EC meter measures how much electricity moves through a solution—the saltier the solution, the more electricity moves through it and the higher the conductivity reading. EC can be easily measured in the field or in a laboratory. A wide range of EC meters are available, ranging in price and size.

Electrical conductivity can be expressed in different units—for soil, EC is measured in dS/m (deci-Siemens/metre), while water is measured in $\mu\text{S}/\text{cm}$ (micro-Siemens/centimetre). It is important to always calibrate the EC meter before use.

Another way to detect salinity is by measuring how much salt is in a solution—this measurement is called total dissolved solids (TDS) or total dissolved ions (TDI). It is measured in units of mg/l (milligrams/litre) or ppm (parts per million). Higher readings mean more salt is present in the solution.

Measuring salinity in water

Salinity in surface water and groundwater can be easily measured in the field by collecting a water sample, inserting an EC probe into the sample and reading the value shown on the meter.

Alternatively, a water sample can be collected and forwarded to a laboratory for testing of salinity and chemical composition. The container should be entirely filled with the water sample to exclude air. Samples for laboratory analysis should be forwarded as quickly as possible. Delays and high temperatures will change the composition of salts in the sample, affecting the results. Typical salinity values for water are given in Table 3.

Measuring salinity in soil

EC is usually measured in the field using a 1:5 soil:water suspension (EC1:5), or in a laboratory using a soil saturation extract EC (EC_{se}) or a 1:5 solution.

To measure EC1:5 in the field, put approximately 10 millilitres of distilled water, rainwater or tank water into a jar, container or tube. Add small soil particles until the contents of the container increase by 5 millilitres to bring the volume to 15 millilitres. Add additional water to bring the total volume to 30 millilitres. Shake intermittently for five minutes and allow it to settle for five minutes. Dip an EC probe into the solution and take a reading. Remember to wash the EC probe after using it.

The interpretation of EC values to determine soil salinity levels depends on the texture of the soil. Salts are readily dissolved out of sandy soils whereas salts are more tightly held by clay soils. This means that the same amount of salt will have a greater impact on sandy soils than it will on clay soils. As a guide, sandy or loamy

soils are moderately saline if EC1:5 is above 0.3 deci- Siemens/metre, and clay soils are moderately saline if EC1:5 is above 0.6 deci- Siemens/metre.

As the EC1:5 is measured on a diluted sample, a more realistic measurement of the actual salt levels that a plant will encounter can be measured on a saturated extract (EC_{se}). This can be done by some laboratories. As a guide, soils are generally considered saline if their EC_{se} is greater than 2– 4 deci- Siemens/metre.

Salinity tolerance ratings for soils are usually based on EC_{se} values, rather than EC1:5. To convert EC1:5 to EC_{se}, identify the texture of the soil, and use the guide in Table 1

Table 1. Conversion of EC1:5 to EC_{se} for a range of soil textures

Soil type	Multiply EC1:5 by
Sand	23
Sandy loam	14
Loam	10
Clay loam	9
Light clay	7.5
Heavy clay	6

For example, sand with an EC1:5 of 0.3 dS/m is equivalent to an EC_{se} of 6.9 dS/m, while a heavy clay with an EC1:5 of 0.3 dS/m is equivalent to an EC_{se} of 1.8 dS/m. Soil salinity classes are shown in Table 2.

Table 2. Approximate soil salinity classes

Salinity rating	EC _{se} (dS/m)	
Slightly saline	1.5—2	Salinity effects usually minimal
Moderately saline	2—6	Yield of salt sensitive plants restricted
Highly saline	6—15	Only salt tolerant plants yield satisfactorily
Extremely saline	>15	Few salt tolerant plants yield satisfactorily

Salinity tolerance of crops

As a general guide, salt tolerant crops include barley, canola, cotton, beetroot, soybean, wheat, olives and sorghum. Moderately salt tolerant crops include lucerne, tomato, cabbage, potato and carrots. Low salt tolerant crops include maize, sugar cane, celery, lettuce and pumpkin.

Table 3. Guide to typical salinity limits for waters. It is important to also check other water quality parameters (e.g. chemical composition, sodium adsorption ration, metals etc) before use.

		Electrical conductivity (EC)		TDS
		($\mu\text{S/cm}$)	(dS/m)	(mg/l or ppm)
Distilled water		1	0.001	0.67
Rainfall		30	0.03	20
Sewage effluent		840	0.84	565
Freshwater		0-1500	0-1.5	0-1000
Great Artesian Basin Water		700-1000	0.7-1.0	470-670
Brackish water		1500-15000	1.5-15	1000-10050
Upper limit recommended for drinking		1600	1.6	1070
Tolerances of livestock to salinity in drinking water (at these values, animals may have an initial reluctance to drink, but stock should adapt without loss of production)	Beef cattle	5970-7460	5.9-7.5	4000-5000
	Dairy cattle	3730-5970	3.7-5.9	2500-4000
	Sheep	7460-14925	7.5-14.9	5000-10000
	Horses	5970-8955	5.9-8.9	4000-6000
	Pigs	5970-8955	5.9-8.9	4000-6000
	Poultry	2985-4475	2.9-4.4	2000-3000
General limits for irrigation	Salt sensitive crops	650	0.65	435
	Moderately salt sensitive crops	1300	1.3	870
	Salt tolerant crops	5200	5.2	3485
	Generally too saline for crops	8100	8.1	5430
Salt water swimming pool		5970-8955	5.9-8.9	4000-6000
Seawater		55000	55	36850
Dead sea		110000	110	73700

Note: To convert from $\mu\text{S/cm}$ to dS/m, divide by 1000. To approximately convert from $\mu\text{S/cm}$ to mg/l, multiply by 0.67.

References

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- Price G (ed) (2006). Australian Soil Fertility Manual, 3rd Edition. CSIRO Publishing and Fertilizer Industry Federation of Australia, Collingwood.
- Salcon (1997). Salinity Management Handbook. Department of Natural Resources, Indooroopilly.

Further information

This and other science notes are available from the Queensland Government website www.qld.gov.au – search ‘science notes’. For further information about this science notes series phone **13 QGOV** (13 74 68) – ask for science notes – Land series L137.

For further information about salinity visit < <http://www.qld.gov.au/environment/land/soil/salinity/>> or email soils@qld.gov.au.