

REPORT

EVOLUTION MINING LIMITED
ABN: 74 084 669 036

Mount Rawdon Operation
Tailings Storage Facility
Field Cover System Trials
Detailed Design Report

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CONTENTS

1	INTRODUCTION	1
1.1	Mount Rawdon Operation	1
1.1.1	Mining and Processing Operations	1
1.1.2	Environmental Authority	1
1.1.3	Progressive Rehabilitation and Closure Plan	1
1.2	Scope	1
1.2.1	Exclusions	2
1.3	Report Structure	2
1.4	Project Objectives	2
2	TAILINGS STORAGE FACILITY	4
2.1	Location and Layout	4
2.2	Development and Construction	4
2.3	Water Management	4
2.3.1	Seepage Control Measures	4
2.3.2	Catchment and Emergency Spillway	4
2.3.3	Decant	4
2.4	Waste Management	4
3	SITE SETTING	6
3.1	Climate	6
3.1.1	Rainfall and Evaporation	6
3.1.2	Long Term Projections	6
3.2	Topography	7
3.3	Drainage	7
3.4	Groundwater	7
3.5	Geology	8
3.6	Soil Types	8
3.7	Pre-Mining Land Use	10
3.8	Regional Ecosystems	10
4	MATERIAL CHARACTERISATION	13
4.1	Previous Investigations	13
4.1.1	2013 Soil and Land Suitability Assessment	13
4.1.2	2015 TSF2 Site Investigation	13
4.1.3	2016 Borrow Pit Investigation	13
4.1.4	2016 Irrigation Investigation	13
4.1.5	2022 Borrow Pit Investigation	13
4.1.6	2023 Irrigation Investigation	14
4.1.7	Summary	14
4.2	Borrow and Stockpiled Material	14
4.2.1	Overview	14
4.2.2	Material Investigation	14
4.2.2.1	Method	14
4.2.2.2	Results and Discussion	15
4.2.3	Topsoil Stockpiles	16
4.2.3.1	Method	16
4.2.3.2	Results and Discussion	16
5	BASIS OF DESIGN	18
5.1	Legal and Other Requirements	18
5.1.1	Environmental Authority	18
5.1.2	Criteria for Discharge	18
5.1.3	Progressive Rehabilitation and Closure Plan	19
5.1.3.1	Rehabilitation Trials	19



5.2	Conceptual Cover System Design	20
5.2.1	Global Acid Rock Drainage Guide	20
5.2.2	Risk Profile	20
5.2.3	Requirements and Desirable Attributes	21
5.2.4	Performance Criteria	21
5.2.4.1	General Rehabilitation	21
5.2.4.2	Cover System Trials	22
5.3	Previous Studies.....	23
5.3.1	2007 Cover Options Assessment.....	23
5.3.2	2016 Cover Options Assessment.....	23
5.3.3	Pre-Feasibility Study Level Cover System Design	23
5.3.4	Conceptual Cover System Design	24
5.4	Cover System Selection	25
5.4.1	Cover System Options	25
5.4.2	Cover System Modelling	26
5.4.2.1	Options to Progress to the Cover System Trials	26
6	PERFORMANCE MONITORING SYSTEMS.....	28
6.1	Instrumentation.....	29
6.2	Data Logger	30
6.3	Weather Station.....	30
6.4	Suction Plate Lysimeter.....	30
6.5	Vibrating Wire Piezometer.....	30
6.6	Surface Water Runoff Flume.....	30
6.7	Omitted Monitoring Equipment.....	31
6.7.1	Oxygen Sensors.....	31
6.7.2	Large-scale Lysimeters	31
7	CONSTRUCTION PLAN.....	32
7.1	Location	32
7.1.1	Selection Criteria	32
7.1.2	Justification.....	32
7.2	Layout	32
7.3	Construction Works	33
7.4	Vegetation	33
7.5	Reporting	33
7.5.1	As-Built Report	33
7.5.2	Sensor Performance Verification.....	34
8	MONITORING AND MAINTENANCE PLAN.....	35
8.1	Data Collection	35
8.2	Evaluation and Reporting	36
8.2.1	Monitoring Reports	36
8.2.2	Annual Reports.....	36
8.2.3	Final Report.....	36
9	PROGRESSIVE REHABILITATION AND CLOSURE PLAN	37
	REFERENCES	38



TABLES

TABLE 1: PROJECTED ANNUAL CLIMATE SUMMARY	7
TABLE 2: REGIONAL ECOSYSTEMS	10
TABLE 3: GEOTECHNICAL UNIT SUMMARY [25].....	15
TABLE 4: RECEIVING ENVIRONMENT WATER QUALITY OBJECTIVES	18
TABLE 5: COVER SYSTEM TRIAL OBJECTIVES AND PERFORMANCE CRITERIA	22
TABLE 6: TSF PLATEAU COVER SYSTEM OPTIONS	24
TABLE 7: OPTIMISED COVER SYSTEM OPTIONS	27
TABLE 8: MATERIAL BALANCE	27
TABLE 9: SUMMARY OF PERFORMANCE MONITORING SYSTEMS.....	28
TABLE 10: SENSOR INSTRUMENTATION DEPTH	29
TABLE 11: MONITORING AND MAINTENANCE PLAN	35
TABLE 12: PROGRESSIVE REHABILITATION AND CLOSURE PLAN REQUIREMENTS	37

DIAGRAMS

DIAGRAM 1: GARD GUIDE COVER SYSTEMS AND CLIMATE TYPES	20
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CHARTS

CHART 1: MEAN CLIMATE DATA	6
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MAPS

MAP 1: SOIL MAP UNITS	9
MAP 2: AUSTRALIAN SOIL CLASSIFICATION ORDER	9
MAP 3: REMNANT REGIONAL ECOSYSTEMS	12



DRAWINGS

- DRAWING 1: EXISTING FEATURES PLAN
- DRAWING 2: LAYOUT PLAN – SHEET 1 OF 2
- DRAWING 3: LAYOUT PLAN – SHEET 2 OF 2
- DRAWING 4: TYPICAL SECTIONS – SECTION A-D
- DRAWING 5: TYPICAL SECTIONS – PRIMARY NEST
- DRAWING 6: TYPICAL SECTIONS – SECONDARY NEST
- DRAWING 7: FLUME DETAIL PLAN
- DRAWING 8: MONITORING FLUME DETAILS – TYPE HS – LOW FLOW
- DRAWING 9: MONITORING FLUME DETAILS – TYPE H – HIGH FLOW

FIGURES

- FIGURE 1: KEY SITE FEATURES
- FIGURE 2: TOPOGRAPHY AND DRAINAGE
- FIGURE 3: TEST PIT LOCATIONS
- FIGURE 4: TOPSOIL STOCKPILES



1 INTRODUCTION

ATC Williams Pty Ltd (ATCW) has been engaged by Evolution Mining Limited (Evolution) to develop field scale cover system trials on a designated area of the Tailings Storage Facility (TSF) at the Mount Rawdon Operation (MRO); herein referred to as the trials.

The purpose of the trials is to evaluate the performance of potential cover system options for the rehabilitation and closure of the TSF.

1.1 Mount Rawdon Operation

MRO is an open cut gold mine located approximately 80 kilometres (km) southwest of Bundaberg in South East Queensland. It is owned and operated by Evolution via its subsidiary Mt Rawdon Operations Pty Ltd. MRO includes the following key features:

- Single open pit;
- TSF;
- Waste rock dumps including:
 - North Waste Rock Dump (NWRD); and
 - West Dump;
- Topsoil stockpiles;
- Several storage and sediment dams;
- Roads and associated supporting infrastructure.

1.1.1 Mining and Processing Operations

Mining, processing of ore and tailings deposition commenced in January 2001. Gold ore was extracted from the open pit using conventional drill and blast/load and haul methods and is processed at a centralised processing plant. The processing plant consists of primary and secondary crushing, Semi-Autogenous Grinding (SAG) and ball milling, followed by conventional cyanidation leaching. It is understood that mining operations have ceased with processing expected to end in October 2025.

1.1.2 Environmental Authority

MRO is authorised to undertake Environmentally Relevant Activities by the Department of Environment, Science, and Innovation (DESI) under Environmental Authority (EA) EPML00712113 on Mining Lease (ML) 1231, ML 1259, ML 50119, ML 100059, ML 1192, ML 1203, ML 1204, ML 1206, and ML 1210.

1.1.3 Progressive Rehabilitation and Closure Plan

Evolution made an application for a proposed Progressive Rehabilitation and Closure Plan (PRCP) on 14 November 2022 [1]. Evolution was issued an Information Request Notice from DESI and is planning to submit a revised PRCP in late 2024.

The PRCP must meet the information requirements in the *Statutory guideline: Progressive rehabilitation and closure plans (PRC plans)* (PRCP Guideline) [2]. As required by Section 3.7 of the PRCP Guideline, the PRCP must detail any planned rehabilitated trials.

1.2 Scope

This Detailed Design Report (Report) provides the rationale, design considerations and technical requirements for the trials. It should be read in conjunction with the Technical Specification [3].

1.2.1 Exclusions

The University of Queensland's (UQ's) Sustainable Minerals Institute (SMI) and Geotechnical Engineering Centre (GEC) in the School of Civil Engineering has been awarded a grant to:

- Procure and instrument the trials; and
- Develop and monitor vegetation performance trial plots; herein referred to as the UQ trials.

ATCW's scope does not include procurement or instrumentation of the trials, or the development or monitoring of the UQ trials.

1.3 Report Structure

The Report has been divided into the following sections:

- SECTION 2:** Tailings Storage Facility: A description of the TSF including location and layout, construction and development, and water and waste management strategies.
- SECTION 3:** Site Setting: A brief description of the site setting including climate, and topography, soil and geology, drainage, groundwater, regional ecosystems and pre-mining land use.
- SECTION 4:** Material Characterisation: A summary of previous material characterisation investigations and work undertaken to support the development of the trials.
- SECTION 5:** Basis of Design: The rational used to design and select the conceptual cover system options to evaluated in the trials.
- SECTION 6:** Performance Monitoring Systems: Presents an overview of the performance monitoring systems for the trials.
- SECTION 7:** Construction Plan: A detailed description of the construction methods and materials required to implement the trials.
- SECTION 8:** Monitoring and Maintenance Plan: A plan for monitoring the performance of the cover systems during the trials as well as the necessary maintenance procedures.
- SECTION 9:** Progressive Rehabilitation and Closure Plan Integration: Describes how the outcome of the trials will be integrated into the PRCP.

1.4 Project Objectives

Generally, the rehabilitation and closure of the TSF aims to return the land to a condition that is safe, stable, non-polluting and able to sustain an agreed Post Mining Land Use (PMLU).

The primary objectives of the cover system are to limit net percolation into the TSF, in order to minimise the generation of Acid and Metalliferous Drainage (AMD), as well as promote the establishment of sustainable vegetation cover suitable for the PMLU.

The trials are designed to provide data to evaluate and verify the performance of conceptual cover system design options for the rehabilitation and closure of the TSF. The primary objectives of the trials are to:

- Evaluate cover system performance:
 - Track the evolution of the cover system performance in response to site specific physical processes over time.
 - Quantify water ingress into and through each cover system.
 - Quantify sediment run-off via cover surface surveys.
 - Quantify vegetation cover.
 - Measure vegetation evapotranspiration performance.



- Monitor the volume of water that runs off the cover system during rainfall events.
- Inform design and construction:
 - Provide a practical demonstration of the selected cover system design's functionality under field conditions.
 - Provide performance data for calibration of the numerical modelling and refinement of the final cover system design for full-scale implementation.
 - Develop confidence in the long term closure performance of the cover system of the selected cover system designs via numerical modelling and calibration of the cover system model based on observed monitoring data.
 - Inform selection of the cover system design for full scale closure of the TSF.
 - Identify and address any potential construction challenges associated with each cover system design prior to full scale implementation on the TSF.

2 TAILINGS STORAGE FACILITY

2.1 Location and Layout

The TSF is located northwest of the process plant and comprises a valley type storage formed by three embankments:

- Northern (Downstream) Embankment: A primary embankment at the northern end;
- Southern (Upstream) Embankment: An embankment at the southern end that extends around the eastern perimeter; and
- Western (Saddle) Embankment: A saddle embankment formed on the western perimeter.

The layout and key features of the TSF is shown in **FIGURE 001**.

2.2 Development and Construction

Since 2000, the TSF has been developed over several staged construction campaigns (Stage 1 to Stage 5F embankment raises). The staged construction methodology comprised of both upstream and downstream raises. The initial embankments, up to the Stage 2B embankment, were formed using rockfill with a clay fill core and associated filter zone within the upstream embankment face, with the later stages including rock fill buttressing. The most recent embankment raises (Stage 5E and Stage 5F) increased the crest elevation to RL189.5 m [4], [5]. The total footprint of the tailings surface plateau is approximately 130 hectares (ha).

2.3 Water Management

2.3.1 Seepage Control Measures

A series of seepage control measures have been incorporated into the TSF construction stages, including a seepage collection system comprising:

- Return pumps to recover seepage from downstream of the Northern Embankment in the area of the former Rawdon Creek drainage alignment; and
- Surface toe perimeter drains that intercept seepage to the west, north and south of the TSF collected in SD1 and South Dams and returned to the TSF decant pond.
- Subsurface drains, sump and pump systems located to the east of the TSF adjacent to the processing plant and the Western Embankment.

Water accumulating in the TSF either tailings supernatant, stormwater or recovered seepage is used in process water make up.

2.3.2 Catchment and Emergency Spillway

Stormwater inflows are limited to the TSF surface area and a minor catchment to the west. The current Stage 5F Emergency Spillway is located on the western perimeter along the Northern Embankment. The Stage 5F Emergency Spillway invert is RL 188.5 m.

2.3.3 Decant

The decant was originally located at the northeastern area of the TSF. It was relocated to the southwestern portion of the TSF as part of the construction works for the Stage 5A Embankment raise.

2.4 Waste Management

RGS Environmental Consultants Pty Ltd (RGS) has been assessing the static and kinetic geochemistry of tailings and waste rock since 2009 [6], [7], [8], [9]. While the static geochemical testing indicates the tailings themselves are unlikely to generate significant acidity, the tailings contain sulphur and may generate salinity as water interacts with them. Kinetic geochemical test results



indicate that the initial surface runoff and seepage from tailings material is likely to have a relatively low salinity value. However, the salinity of the tailings contact water may temporarily increase as major ions are released from the tailings initially. Overall, the risk of salinity impacting surrounding water bodies is considered low taking into account current monitoring and interception methods.

RGS has categorised waste rock into three categories based on if it is potentially acid forming (PAF). The categories are Non-acid Forming (NAF), Medium Capacity Potentially Acid Forming (PAF-MC) and High Capacity Potentially acid forming (PAF-HC). PAF-MC and PAF-HC waste rock generated from mining operations is currently stored on the western perimeter of the TSF. PAF-HC waste rock has been used to construct the Decant within the TSF. The remaining PAF waste rock has been free dumped to the west of the Decant.

The presence of PAF waste rock within the TSF will follow the closure strategy of encapsulation with tailings and/or NAF waste rock and the application of a cover system to mitigate the risk of generating and mobilising acid leachate.

The Conceptual Closure, Decommissioning and Rehabilitation Plan (CDaR Plan) [10] developed by RGS, included the following waste management strategies:

- The continued placement of PAF-HC waste rock into the decant structures within the TSF to fully encapsulate this material within fine grained NAF low permeability tailings. This is to eliminate [or to reduce] oxygen entry into bulk PAF-HC waste rock materials and thus reduce/prevent sulphide oxidation and acid generation.
- Placement of PAF-MC waste rock into a series of low-profile benches on the western TSF cell that will be encapsulated progressively within NAF tailings. The key design criteria for this are that PAF-MC waste rock will not be placed within 25 m horizontal of the natural ground to the west of the TSF, 50 m of the external final TSF landform, and 3 m of the final top surface of the NAF tailings.

Based on anticipated end of processing operations in Q1 2025, the placement of 3 m of tailings over the PAF waste rock may not be achievable. As a result of this, ATCW undertook an options assessment to management PAF waste rock placed within the TSF, including a high level risk assessment for each option, as presented in [11]. Three options were considered:

1. Cover system constructed over PAF waste rock with no rehandling/minimal rehandling of the PAF waste rock.
2. Tailings hydraulically placed over PAF waste rock (rehandled or minimal rehandling of PAF waste rock).
3. Tailings mechanically placed over PAF waste rock (truck and shovel from existing dry tailings beach).

The options assessment indicated that option 2, which involves the hydraulic placement of tailings over the PAF waste rock was the preferred option under the specified assessment criteria.

Tailings deposition modelling was undertaken by ATCW based on the remaining production schedule [12]. The deposition modelling indicates that the water pond can be directed west towards the proposed discharge outlet location for the TSF final landform.



3 SITE SETTING

3.1 Climate

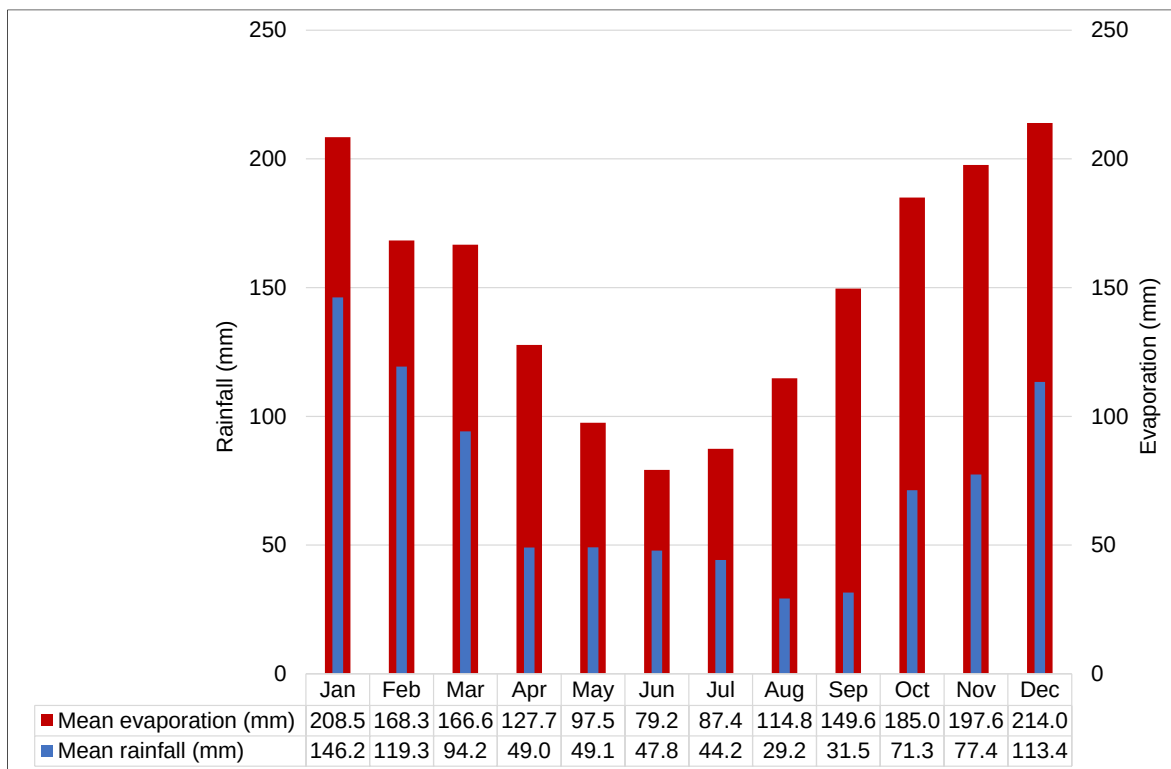
3.1.1 Rainfall and Evaporation

The closest operational weather station is the Mingo Creek Alert weather station (BoM Station Number 039340), located approximately 6 km southwest of MRO, which commenced operation in 1997. The Mt Perry The Pines weather station (BoM Station Number 039070) has been operational since 1886 and is located approximately 15 km northwest of MRO.

Local climate data have been sourced from the Scientific Information for Land Owners (SILO) to provide a patched point dataset, which is more complete and spatially continuous. The patched point data combines observed climate data from existing weather stations with interpolated estimates to provide a complete daily time series for the selected location [13].

There is a distinct wet and dry season with majority of rainfall occurring between October and March (refer **CHART 1**). The wettest month is January with an average rainfall of 146.2 millimetres (mm) and the driest month is August with an average rainfall of 29.2 mm. Mean annual rainfall is 872.6 mm and mean annual evaporation is approximately 1796.2 mm. Evaporation exceeds rainfall in all months by a factor of 1.4 (June) to 4.7 (September).

CHART 1: MEAN CLIMATE DATA



3.1.2 Long Term Projections

Climate projections data have been generated using 28 Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) global climate models (GCMs) and four Representative Concentration Pathways (RCP 2.6, RCP 4.5, RCP 6.0, and RCP 8.5), which define a range of possible future climates. While more recent climate projects are available in the IPCC's Sixth Assessment Report (AR6), the AR5 data was available at the time of the Forage climate projections report development [14]. The median values for the historical data (1960-2010) and climate projections for 2030, 2050 and 2070 are presented in **TABLE 1**.



TABLE 1: PROJECTED ANNUAL CLIMATE SUMMARY

CLIMATE VARIABLE (MEDIAN ANNUAL)	HISTORICAL 1960-2010	PROJECTION 2030	PROJECTION 2050	PROJECTION 2070
Rainfall (mm)	828.5	798.0	778.6	762.1
Evaporation (mm)	1,778.2	1,858.0	1,905.7	1,947.9
Mean Temperature (°C)	20.8	21.6	22.2	22.6
Maximum Temperature (°C)	27.0	27.9	28.5	29.0
Minimum Temperature (°C)	15.7	16.7	17.3	17.8

Source: Forage Report: Regional Climate Projections Lot on Plan: BN37400,2SP138073,38BON559 [14]

Median annual rainfall is expected to decrease in 2030, 2050 and 2070, while median annual evaporation and temperature is expected to increase. Notwithstanding, the State of the Climate 2022 biennial report and IPCC's AR6 predicts greater variability and intensity in rainfall, more extreme weather events such as heat waves, droughts and floods [15], [16]. While climate change projections indicate greater variability and increase of rainfall intensity and frequency, leading to higher runoff volumes, these factors primarily influence surface water management rather than cover system performance. While surface water management is a primary concern, extended dry periods due to changing precipitation patterns can lead to reduced net infiltration rates and reduced water storage in the cover. This can impact vegetation coverage.

3.2 Topography

The TSF landform displays a relatively flat plateau section (tailings) with steeper angle of repose slopes on the embankments.

Local topography is characterised by steep hills and valleys to the north and west of the TSF and rolling hills to the east (refer **FIGURE 002**). There is a gently sloping valley to the north towards Swindon Creek.

The highest point in the area is Mount Rawdon, which has an elevation of approximately 400 metres Australian Height Datum (m AHD). The surrounding steep hills are generally lower between 120-150 m AHD. Mount Prazier is located to the north and has a small summit area and steep slopes.

3.3 Drainage

Site surface water drainage features are depicted in **FIGURE 002** and described as follows:

Northward – Perry River Catchment:

Surface water runoff flows via Swindon Creek, Rawdon Creek, and Twelve Mile Creek into the Perry River. The Perry River is dammed by the Perry River Dam. Flow over the Perry River Dam is conveyed via the Perry River to the Burnett River confluence point.

Southward – Mingham Creek Catchment:

Surface water runoff flows into Mingham Creek via unnamed tributaries into a reach of the Burnett River upstream of the Paradise Dam.

The TSF is located on Rawdon Creek, a minor tributary of the Perry River, which flows south to north. The Perry River is located approximately 2 km north of the TSF.

3.4 Groundwater

Pre-mining groundwater flows were largely controlled by topography and drainage, with groundwater flowing from elevated areas towards the major creek lines and drainage systems. The flow direction

was historically towards the northeast towards Perry River. Since the commencement of mining, the TSF has become a source of recharge to groundwater, while the pit has become an active sink. The TSF is now considered the highest head feature in the area, with mounding occurring within the TSF. The mounding is likely to impact the local groundwater in several direction around the TSF, based on groundwater elevations in bore drilled adjacent to the embankments as well as the occurrence of artesian conditions. Rainfall is the primary source of recharge at MRO.

Aquifers occur in soil/weathered rock as well as in semi-pervious to impervious fractured rock. The compartmentalised, and highly fractured, groundwater storages have variable transmissivity in different parts of the ML's [17].

3.5 Geology

The geological setting is described as follows [18]:

The Maryborough geological map (1:250 000 scale:1968) indicates the geology of the area to comprise late Triassic Aranbanga Volcanic Group and/or Mount Rawdon Volcanics sequences, which consist typically of rhyolitic or andesitic volcanoclastics. Jurassic aged Hogback Tonalite and much older Permian aged Biggenden Beds also occur on a more regional scale. Jointing/lineations associated with this geology is reported to be subparallel with the Perry fault, which trends generally south to north through the Boolbunda Range.

The local geology, based on previous site investigation works within the project area, appears to vary considerably ranging from metasediments to tuff, with trachyte dykes throughout the site. These rocks have been interpreted to be principally volcanics, possibly rhyolite, forming part of the Aranbanga Volcanic Group. Notwithstanding the origin, these sequences are generally deeply weathered, with very weak to weak rock extending to depths greater than 6 m.

3.6 Soil Types

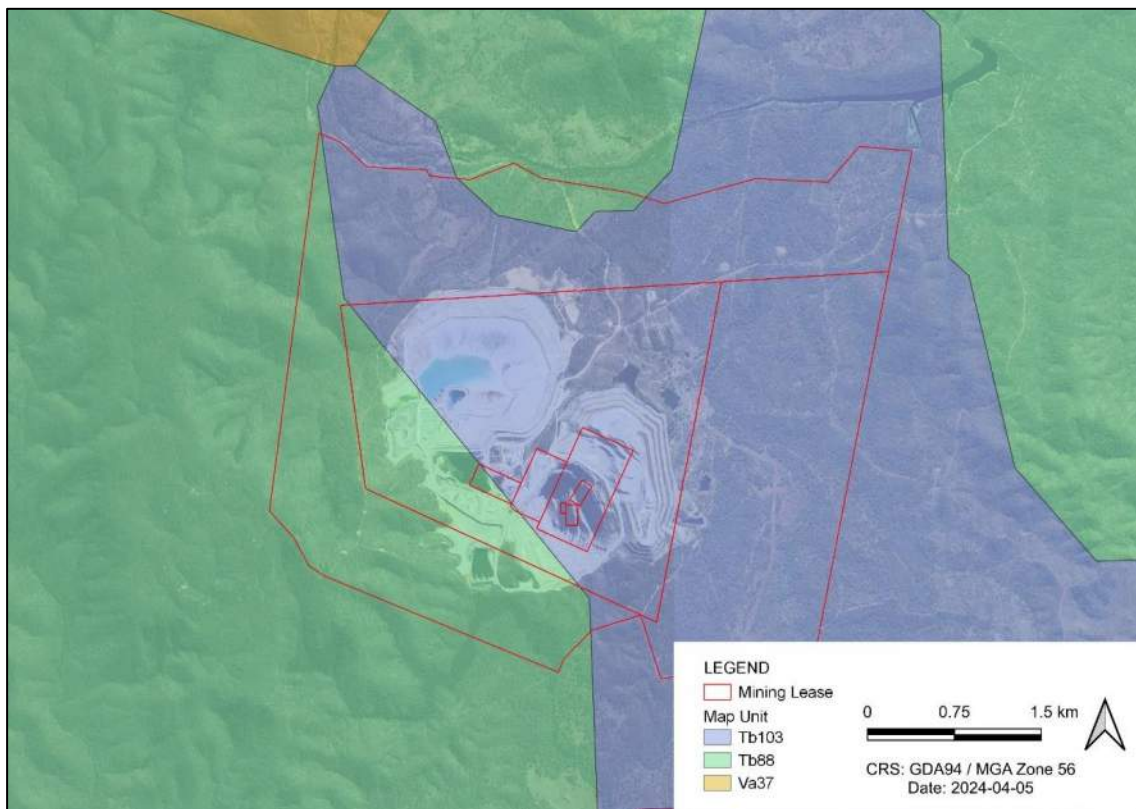
Map units in the Atlas of Australian Soils represent soil landscapes, which encompass the spatial distribution of soils with similar characteristics and formed under similar environmental conditions. These map units are shown in **MAP 1**. There are two distinctive soil groups present in proximity of the MRO site:

- Tb103:** Low to moderately hilly lands on phyllites and schists; a close pattern of hills with short to moderate slopes: chief soils are gravelly hard acidic yellow mottled soils (Dy3.41) and (Dy2.41) with shallow gravelly loamy soils (Um2.12) and (Um4.1) on crests and upper slopes. Associated are gravelly (Dr3.41) soils. Minor soil occurrences include gradational non-calcareous grey soil (Gn3.42).
- Tb88:** Steep hilly to mountainous country on metasediments: chief soils are hard acidic yellow mottled soils (Dy3.41) with hard acidic red soils (Dr3.41) and (Dr2.41), all often stony. Associated are shallow loams (Um1.42) and (Um2.12) on the steeper slopes; (Dr2.21), (Dy2.21), and (Dy2.23) soils with smaller areas of (Uc1.21 and Uc1.23) on included granites; and (Uf6.41) and (Gn3.11) soils on included basic rocks.

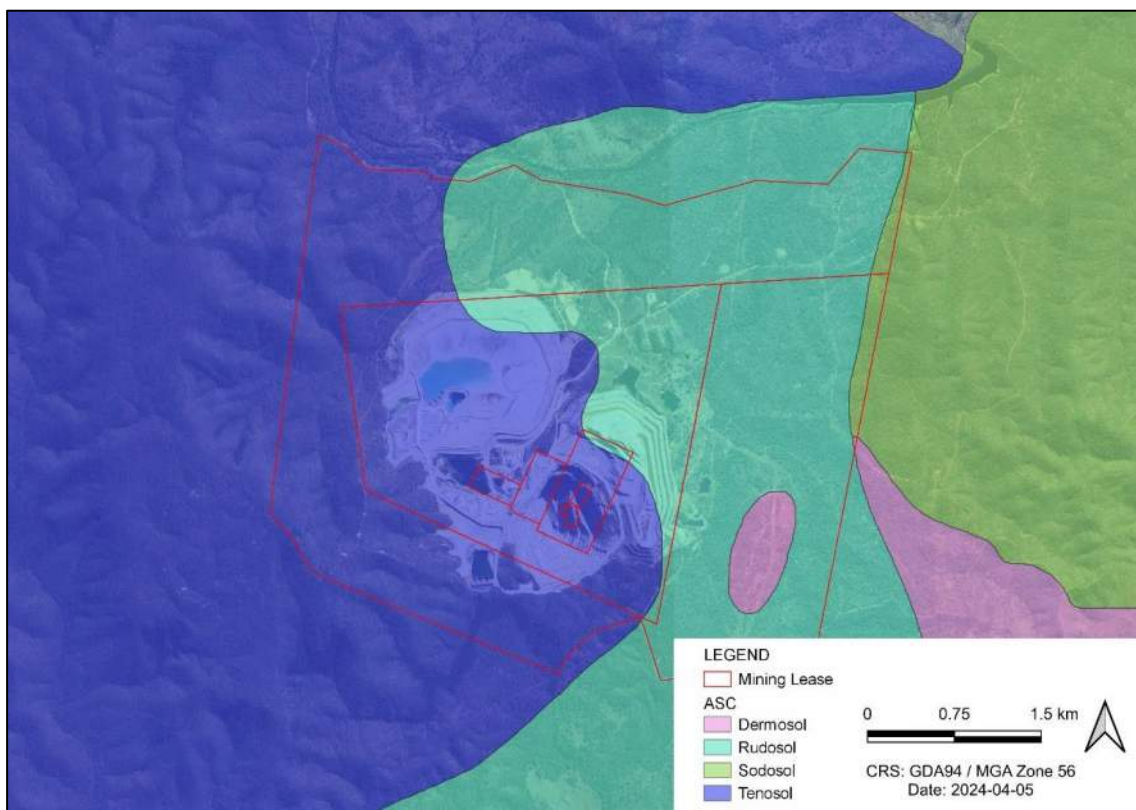
The Australian Soil Classification (ASC) order is shown in **MAP 2** and shows soils are typically classed as:

- Tenosol: Shallow, stony, uniform medium/ fine textured soils.
- Rudosol: Very shallow to shallow, uniform, medium textured soils over rock.

MAP 1: SOIL MAP UNITS



MAP 2: AUSTRALIAN SOIL CLASSIFICATION ORDER





3.7 Pre-Mining Land Use

The site is located within Swindon Cattle Station, which is an approximately 3,000 ha grazing property. The Swindon Cattle Station is one of six large cattle grazing properties in the region and has been operating since early settlement. The land surrounding the site is used primarily for low intensity cattle grazing. Prior to its current land use for mining operations, the site was used for low intensity cattle grazing. Occasionally, low-intensity sub-economic grazing may occur as a land management tool for conservation reasons.

The Grosvenor Timber Reserve, which is protected under the *Forestry Act 1959*, is located approximately 1 km northwest of the TSF.

3.8 Regional Ecosystems

Remnant Regional Ecosystem's (REs), found within a few kilometres surrounding the site, along with the Biodiversity Status (BD Status) are shown in **MAP 3** and summarised in **TABLE 2**. Remnant RE's primarily consist of woodland and closed forest vegetation types. It is important to note that some of the remnant RE descriptions relate to landscapes that are steep and hilly or flat alluvial plans.

The TSF will be revegetated with species endemic to the area with no declared pest species. The REs will form the basis for the selection of endemic plant species to achieve the PMLU of open woodland. The RE list is not exhaustive and reference should be made to the full technical descriptions of REs produced by the Queensland Herbarium.

The BD Status shown in **MAP 3** is based on an assessment of the condition of remnant vegetation in addition to the criteria used to determine the class under the *Vegetation Management Act 1999* (VM Act) and are listed as No Concern (NC), Of Concern (OC) and Endangered (E).

TABLE 2: REGIONAL ECOSYSTEMS

RE	VM ACT STATUS	BC ACT STATUS	SHORT DESCRIPTION	TOTAL AREA (hectares (ha))
RE 12.11.6/ RE 12.11.12/ RE 12.11.8 *(70/15/15)	LC/ OC/ OC	NC/ OC/ OC	<i>Corymbia citriodora ssp. variegata</i> , <i>Eucalyptus crebra</i> woodland on metamorphics +/- interbedded volcanics <i>Araucarian</i> complex microphyll vine forest on metamorphics +/- interbedded volcanics; usually northern half of bioregion <i>E. melanophloia</i> , <i>E. crebra</i> woodland on metamorphics +/- interbedded volcanics	361.3
RE 12.11.6/ RE 12.3.7/ RE 12.12.5 *(70/20/10)	LC/ LC/ LC	NC/ OC/ NC	<i>C. citriodora ssp. variegata</i> , <i>E. crebra</i> woodland on metamorphics +/- interbedded volcanics <i>E. tereticornis</i> , <i>Casuarina cunninghamiana</i> <i>ssp. cunninghamiana</i> +/- <i>Melaleuca spp.</i> fringing woodland <i>C. citriodora ssp. variegata</i> , <i>E. crebra</i> woodland on Mesozoic to Proterozoic igneous rocks	29.3

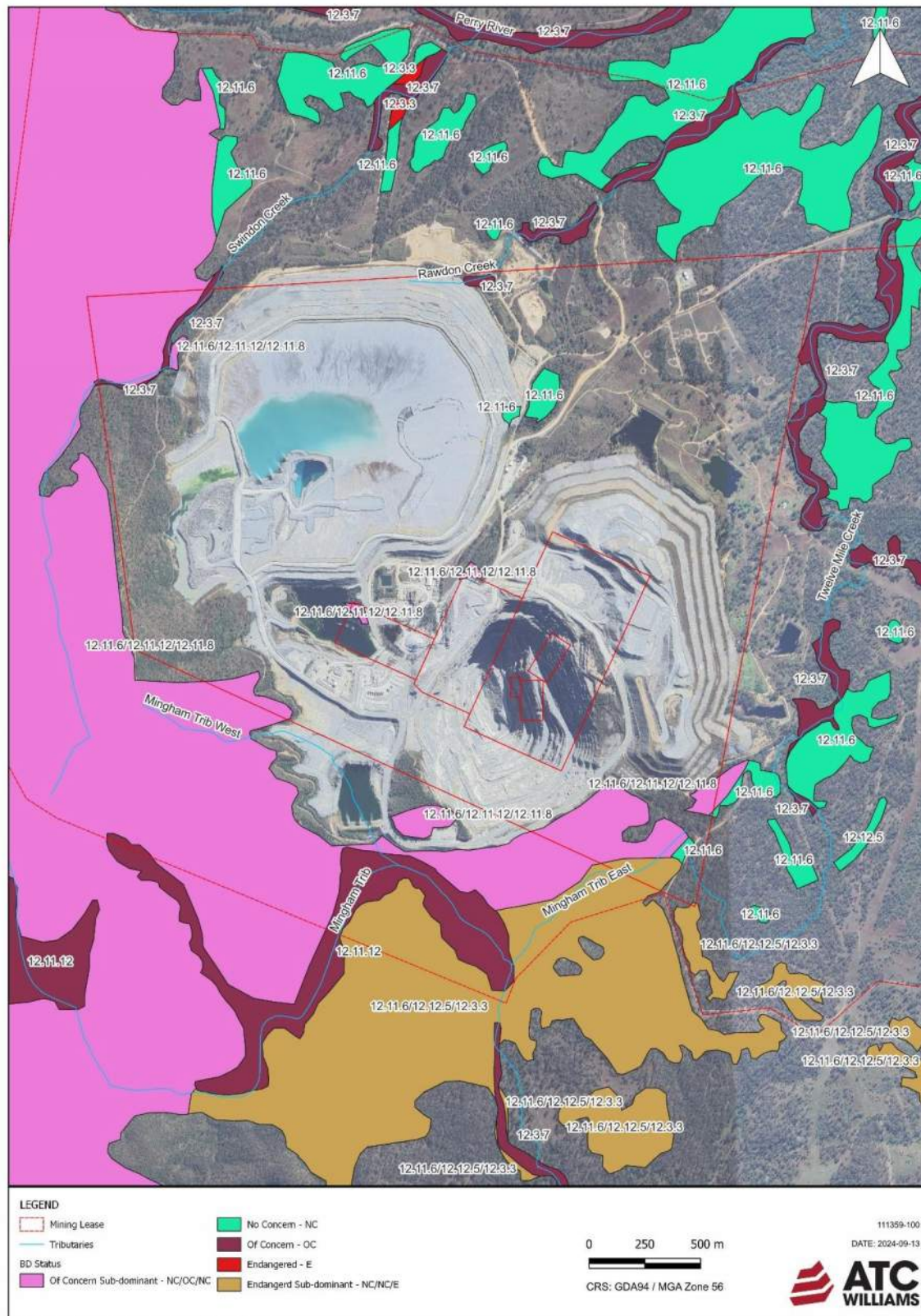


RE	VM ACT STATUS	BC ACT STATUS	SHORT DESCRIPTION	TOTAL AREA (hectares (ha))
RE 12.11.6/ RE 12.12.5/ RE 12.3.3/ RE 12.3.7 *(50/25/15/10)	LC/ LC/ E/ LC	NC/ NC/ E/ OC	<i>C. citriodora</i> ssp. <i>variegata</i> , <i>E. crebra</i> woodland on metamorphics +/- interbedded volcanics <i>C. citriodora</i> ssp. <i>variegata</i> , <i>E. crebra</i> woodland on Mesozoic to Proterozoic igneous rocks <i>E. tereticornis</i> woodland on Quaternary alluvium <i>E. tereticornis</i> , <i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i> +/- <i>Melaleuca</i> spp. fringing woodland	36.9
RE 12.3.7	LC	OC	<i>Eucalyptus tereticornis</i> , <i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i> +/- <i>Melaleuca</i> spp. fringing woodland	42.3
RE 12.11.12	OC	OC	Araucarian complex microphyll vine forest on metamorphics +/- interbedded volcanics; usually northern half of bioregion	20.1
RE 12.11.6	LC	NC	<i>Corymbia citriodora</i> subsp. <i>variegata</i> , <i>Eucalyptus crebra</i> woodland on metamorphics +/- interbedded volcanics	169.6
RE 12.3.3	E	E	<i>Eucalyptus tereticornis</i> woodland on Quaternary alluvium	1.4
RE 12.12.5	LC	NC	<i>Corymbia citriodora</i> subsp. <i>variegata</i> , <i>Eucalyptus crebra</i> woodland on Mesozoic to Proterozoic igneous rocks	1.6

Note: NC = No Concern at present; LC = Least Concern, OC = Of Concern, E = Endangered.
*Composition %.



MAP 3: REMNANT REGIONAL ECOSYSTEMS



4 MATERIAL CHARACTERISATION

The selection of suitable cover system materials is important for the successful rehabilitation and closure of the TSF. The following sections summarise previous site and material investigations undertaken.

4.1 Previous Investigations

Several investigations have been done to characterise borrow material available on site. Six investigations were undertaken from 2013 to 2023 [10], [19], [20], [21], [22], [23]. These investigations are summarised in [24] and the following sections.

4.1.1 2013 Soil and Land Suitability Assessment

In 2013, Northern Resource Consultants Pty Ltd completed a soil and land suitability assessment for the West Dump development south of the TSF [19]. Test pits were excavated at six locations (Pit 1, Pit 2, Pit 3, Pit 4, Pit 5, and Pit 6) up to 2 m depth. These test pit locations are shown in **FIGURE 003**. Thirteen samples were analysed for a range of agronomic chemical parameters but did not include Soil Water Characteristic Curve's (SWCC's) or other physical parameters.

4.1.2 2015 TSF2 Site Investigation

In 2015, ATCW completed a site investigation for a proposed TSF2, which was to provide additional tailings storage capacity [20]. The proposed location of TSF2 was adjacent to and northeast of the TSF.

The site investigation included six geotechnical boreholes drilled to maximum depth of 50 m below existing ground level (BH01 to BH06) and 40 test pits (TP01 to TP40), which were excavated to depths ranging between 0.6 m to 5.3 m below existing ground level (refer **FIGURE 003**). The site investigation focussed on the deeper layers and not on the nearer surface soils.

4.1.3 2016 Borrow Pit Investigation

In 2016, RGS Environmental Pty Ltd (RGS) and ATCW completed test pit and drilling program to quantify volumes and soil quality, geochemical and physical properties of pedolith units that could be used to construct the cover system as part of the development of the CDaR Plan [10].

RGS and ATCW identified four potential borrow areas where six test pits and six drilling locations were selected (refer **FIGURE 003**). Six sub samples were analysed for a range of parameters but did not include SWCCs.

4.1.4 2016 Irrigation Investigation

In 2016, 14 soil profiles, up to 0.8 m, in six investigation areas to the east and north of the TSF were described by NRC for their potential irrigation capability [21] (refer **FIGURE 003**). Twelve samples were recovered and analysed for a range of agronomic chemical parameters.

4.1.5 2022 Borrow Pit Investigation

In 2022, Evolution collected five bulk samples from the potential borrow pit locations on behalf of RGS as part of the erosion measurement and modelling undertaken to support the development of the proposed PRCP [22]. The five bulk samples were analysed for a range of chemical and physical testing, including rainfall simulations. The locations were not reported, however, were described as:

- Sample #1: Topsoil recovered from an existing stockpile.
- Sample #2: Topsoil (0 to 1 m bgl) recovered from a potential borrow area to the northwest of the TSF.
- Sample #3: Topsoil (0 to 1 m bgl) recovered from the West Hill between West Dam and the Pit.
- Sample #4: Saprolite (1 to 2 m bgl) recovered from the West Hill between West Dam and the Pit.

Sample #5: Saprock recovered from exposed material on the access track of West Hill between West Dam and the Pit.

4.1.6 2023 Irrigation Investigation

In 2023, SLR Consulting Australia Pty Ltd (SLR) undertook field sampling for soil monitoring as part of the Annual Irrigation Management and Monitoring Program (IMMP) Report [23]. The soil monitoring sites were selected based on areas identified as the land on site receiving mine affected water for irrigation. Five test pits were excavated (refer **FIGURE 003**).

4.1.7 Summary

These investigations were summarised by ATCW in [24]:

- The material encountered generally exhibits plant growth limitations due to low levels of nitrogen and phosphorus as well as other key soil fertility indicators such as exchangeable cations and total organic carbon. Exchangeable Sodium Percentage (ESP) and salinity generally increased with depth. High ESP could cause soil stability issues.
- Topsoil depth is shallow ranging from approximately 0.2m to 0.3m to the northeast of the TSF. Excavation refusal was encountered in a number of test pits within the weathered quartzite/sandstone.

The previous extensive investigations were either targeted at shallow depths to 1m or targeted to deeper depths at >2m and ignored the nearer surface layers. ATCW recommended that additional test pitting is undertaken to gain a better understanding of the material distribution and characteristics [24].

4.2 Borrow and Stockpiled Material

4.2.1 Overview

The proposed PRCP identified the area to the north of the TSF as the borrow source for the rehabilitation and closure of the TSF [1]. ATCW undertook a test pit and sampling program to supplement previous investigations to north and northeast of the TSF and identify available and suitable/borrow materials (material investigation) (**SECTION 4.2.2**).

A topsoil stockpile sampling and testing program was undertaken by Evolution on behalf ATCW to determine the suitability of available resources for use in rehabilitation (**SECTION 4.2.3**).

4.2.2 Material Investigation

4.2.2.1 Method

In April 2024, ATCW undertook a test pit and sampling program to supplement previous investigations to north and northeast of the TSF (refer **SECTION 4.1**) and identify available/suitable borrow material for use in the construction of the TSF cover system [25]. The area to the west appeared too steep and the soil is likely to be relatively shallow (refer **SECTION 3.2**).

Fifteen test pits were excavated using a CAT 44F2 backhoe with a 300 mm toothed bucket. An ATCW engineer was present to oversee and facilitate the material investigation, including providing sample description and collecting samples for laboratory analysis. Test pits excavation depths ranged from 0.4 m to 2.4 m below ground level (m BGL). Excavation depths were to the maximum reach of the equipment or until practical refusal on encountered impenetrable materials (as directed by ATCW).

Test pit sub-samples were analysed by Environmental Analysis Laboratory (EAL) Southern Cross University for pH (one part sample to five parts water (1:5)) and Electrical Conductivity (EC) (1:5)). Due to time constraints, the selection of composite samples was undertaken based on geotechnical logs and not on screening analyses as originally proposed. Ten select test pit and composite sub-samples were analysed by EAL for the following:

- pH (1:5) and EC (1:5);
- Available (Ammonium, Nitrate, And Sulphur);



- Exchangeable (Sodium, Potassium, Calcium, Magnesium, Hydrogen, Aluminium, Cation Exchangeable Capacity (CEC));
- Colwell (Phosphorus);
- Available Micronutrients (Zinc, Manganese, Iron, Copper, Boron, and Silicon);
- Total Carbon;
- Total Nitrogen;
- Organic Matter; and
- Five-point SWCCs.

EAL is a National Association of Testing Authorities (NATA) and Australian Soil and Plant Analysis Council (ASPAC) accredited laboratory.

In addition, select test pit sub-samples were analysed by Construction Sciences Rockhampton Laboratory, a NATA accredited laboratory, for the following physical testing:

- Particle Size Distribution (Sieve and Hydrometer);
- Standard Compaction;
- Saturated Hydraulic Conductivity;
- Atterberg Limits and Linear Shrinkage; and
- Emerson Class.

4.2.2.2 Results and Discussion

Geotechnical logging was undertaken in accordance with AS1726:2017 and are presented in [25] and summarised in **TABLE 3**.

TABLE 3: GEOTECHNICAL UNIT SUMMARY [25]

TESTPIT ID	TOPSOIL	SLOPE WASH	ALLUVIUM	RESIDUAL	XW MATERIAL	WEATHERED ROCK
ATP001	0.0 - 0.1	-	0.1 - 0.3	0.3 - 1.1	-	1.1 - 1.3 ^{TD}
ATP002	0.0 - 0.1	-	0.1 - 0.25	0.25 - 0.9	-	0.9 – 2.0 ^{TD}
ATP003	0.0 - 0.1	-	0.1 - 0.3	0.3 - 1	1 - 1.8 ^{TD}	-
ATP004	0.0 - 0.1	-	0.1 - 0.3	-	-	0.3 - 0.4 ^{TD}
ATP005	-	-	0 - 0.3	0.3 - 1.1	1.1 - 1.9 ^{TD}	-
ATP006	0.0 - 0.15	-	0.15 - 0.9	0.9 - 1.4	-	1.4 - 1.6 ^{TD}
ATP007	0.0 - 0.1	-	0.1 - 0.7	0.7 - 1.6	1.6 - 1.7	1.7 – 2.0 ^{TD}
ATP008	0.0 - 0.1	-	0.1 - 0.4	0.4 - 0.5	-	0.5 - 0.7 ^{TD}
ATP009	0.0 - 0.1	-	0.1 - 0.4	0.4 - 1.6	1.6 - 2.2	2.2 - 2.4 ^{TD}
ATP010	0.0 - 0.1	-	0.1 - 0.4	0.4 – 2.3 ^{TD}	-	-
ATP011	-	0.0 - 0.1	0.1 - 0.8	0.8 – 2.0	2 - 2.3 ^{TD}	-
ATP012	0.0 - 0.1	-	0.1 - 0.3	0.3 - 0.5	-	0.5 - 0.75 ^{TD}
ATP014	0.0 - 0.08	-	0.08 - 0.2	0.2 - 1.3	1.3 - 2.1 ^{TD}	-
ATP015	0.0 - 0.1	-	0.1 - 0.5	0.5 - 0.9	-	0.9 - 1.3 ^{TD}
ATP016	0.0 - 0.1	-	0.1 - 1.6	1.6 - 1.8	-	1.8 - 1.9 ^{TD}

Notes: TD denotes termination depth. XW Material is extremely weathered rock.

Laboratory analysis was completed by EAL Southern Cross University, Construction Sciences Rockhampton Laboratory, and ATCW Melbourne Laboratory. These laboratory test results are presented in [25].

Material encountered composed of shallow, undeveloped sandy topsoil over yellow or grey clay. The topsoil was generally acidic, non-saline, and had low fertility, while the residual layer varies in acidity and salinity. Both materials have potential for mass movement and erosion due to their properties. The extremely weathered (XW) material and weathered rock also exhibited variable properties and has a higher erosion potential due to the silt and fine sand content and low calcium.

Based on the laboratory test results [25], the following recommendations were made for material use and treatment:

- Topsoil/Alluvium: Topsoil/Alluvium to be used for the topsoil layer. Organic matter and a slow-release fertiliser may be applied to improve soil structure and fertility.
- Residual: Residual material to be used for the RPL. The placement near the surface in areas with variable pH and salinity should be avoided.
- XW Material/Weathered Rock: XW Material/Weathered Rock material to be used for the ISL. The incorporation of a calcium source (e.g., gypsum) and compaction to 85-90% Maximum Dry Density should be done to reduce the potential for tunnelling.

4.2.3 Topsoil Stockpiles

4.2.3.1 Method

Several topsoil stockpiles are located across the site. Topsoil stockpiles were inspected during a site visit undertaken by ATCW on 29 May 2024 and 30 May 2024 [26]. During the site visit, it was noted that topsoil stockpiles were generally undisturbed with grasses and trees present, however, several topsoil stockpiles were depleted or not accessible.

A topsoil stockpile sampling and testing program was undertaken by Evolution and ATCW to determine the suitability of available resources for use in rehabilitation [27]. Evolution collected topsoil stockpile samples in accordance with the Sampling and Analysis Quality Plan (SAQP) prepared by ATCW [28].

Topsoil stockpile samples were sent to EAL and analysed for:

- pH (1:5) and EC (1:5);
- Available Ammonium, Nitrate and Sulphur;
- Exchangeable Cations (Sodium, Potassium, Calcium, Magnesium, Hydrogen, Aluminium) and CEC (calculated);
- Colwell Phosphorus;
- Available Micronutrients (Zinc, Manganese, Iron, Copper, Boron and Silicon);
- Total Carbon and Organic Matter (calculated);
- Total Nitrogen;
- Emerson Class;
- Particle Size Distribution by sieving and hydrometer.

The laboratory testing was targeted to provide a rapid assessment of the similarities between the stockpiled materials and the *in situ* material described in [25] (refer **SECTION 4.2.2**).

4.2.3.2 Results and Discussion

The results indicate that the topsoil stockpiles were variable in terms of soil properties, consistent with the stockpiles containing a mixture of natural materials; however there are a number of differences highlighted above between the *in situ* soil characterised to the north and northwest of the TSF [27]. Generally, the stockpiled soil is slightly acidic, non-saline, calcium deficient, non-calclac, low fertility and moderately erodible.



The logs suggest that there are areas of topsoil within many of the topsoil stockpiles, which could be visually separated; however, the Emerson Class of 2 or 3 suggests that this topsoil has been mixed with other layers resulting in a hard setting behaviour that is not ideal for placement as a topsoil without amendment.

In summary it was recommended that:

- Stockpiled soil only be used for topsoil material where topsoil can be separated from subsoil and rock material. This topsoil material can be ameliorated with lime (raise pH) or gypsum (no change in pH but reduction in aluminium toxicity potential) as required. A slow-release organic fertiliser suitable for native plant species should also be applied along with a suitable compost.
- Stockpiled soil be used for the ISL as it contains clay which will assist in storing moisture and does not appear to present any significant impediment to vegetation growth. All stockpiles can potentially be used for the ISL but if placed within 0.5 m of the surface should be treated with lime or gypsum to reduce erosion potential. Stockpiled materials displaying a mix of fine and rocky material can be used for this purpose.
- Stockpiled soil is not suitable for use as an RPL. Screening of the material is unlikely to yield sufficient clay. Whilst it is acknowledged that clay was observed during sampling, the laboratory results for the bulk samples reported high rock and sand content.
- Routine inspection and control of weeds is undertaken to prevent excessive competition to planted vegetation.



5 BASIS OF DESIGN

A cover system will be constructed over the tailings plateau. This section describes the basis of design for the cover system options to progress to the trials.

5.1 Legal and Other Requirements

5.1.1 Environmental Authority

Condition G1 of EA EPML00712113 requires the TSF to be rehabilitated to achieve the following rehabilitation objectives:

- Safe for humans and wildlife;
- Non-polluting;
- Stable;
- Able to sustain an agreed PMLU;
- Revegetated with species endemic to the area with no declared pest species;
- Compliant with all conditions of the EA.

5.1.2 Criteria for Discharge

The TSF is situated within the Burnett Basin. Currently, the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP Water and Wetland Biodiversity) has not scheduled Environmental Values (EVs) and Water Quality Objectives (WQOs) for the surface water and groundwater within the Burnett Basin.

The TSF is required to meet the conditions of the EA. WQOs for the Perry River are listed in *Table E12* (reproduced in **TABLE 4**) and must be monitored at the locations and frequency in *Table E11* of the EA.

TABLE 4: RECEIVING ENVIRONMENT WATER QUALITY OBJECTIVES

CONTAMINANT	WATER QUALITY OBJECTIVES (TOTALS) FOR PERRY RIVER	WATER QUALITY OBJECTIVES (DISSOLVED) FOR PERRY RIVER
pH (pH units)	6.5 (minimum) or 5 th percentile of reference sites, whichever is higher 8.5 (maximum) or 95 th percentile of reference sites, whichever is lower	
Electrical Conductivity	1,000 µS/cm or 95 th percentile of reference sites, whichever is higher	
Total dissolved solids	600 mg/L or 95 th percentile of reference sites, whichever is higher	Refer to WQOs (totals)
Sulphate	250 mg/L or 95 th percentile of reference sites, whichever is higher	Refer to WQOs (totals)
Arsenic	0.05 mg/L	0.013 mg/L or 95 th percentile of reference sites whichever is higher
Cadmium	0.005 mg/L	0.0002 mg/L or 95 th percentile of reference sites whichever is higher



CONTAMINANT	WATER QUALITY OBJECTIVES (TOTALS) FOR PERRY RIVER	WATER QUALITY OBJECTIVES (DISSOLVED) FOR PERRY RIVER
Copper	0.04 mg/L	0.0014 mg/L or 95 th percentile of reference sites, whichever is higher
Zinc	0.15 mg/L	0.008 mg/L or 95 th percentile of reference sites whichever is higher
Cyanide	Not applicable	0.007 mg/L
Dissolved Inorganic Nitrogen (DIN)	No net increase from background.	
Ammonia	No net increase from background.	
Total nitrogen (Nitrite and Nitrate)	No net increase from background.	

5.1.3 Progressive Rehabilitation and Closure Plan

A PMLU must be rehabilitated to a stable condition in accordance with the following definition from section 111A of the *Environmental Protection Act 1994* (EP Act):

Land is in stable condition if:

- a. *The land is safe and structurally stable; and*
- b. *There is no environmental harm being caused by anything on or in the land; and*
- c. *The land can sustain a PMLU.*

The PMLU for the TSF in the proposed PRCP is open woodland and low intensity grazing [1]. Based on discussion with Evolution, the primary PMLU for the TSF will be open woodland, noting that the PRCP has not yet been approved.

The milestone criteria in the proposed PRCP requires a minimum of 100 mm of topsoil to be applied for rehabilitation across the site. This is consistent with the shallow topsoil material encountered (refer **SECTION 4.2.2.2**).

5.1.3.1 Rehabilitation Trials

In accordance with the section 126C(1)(j) of the EP Act, if rehabilitation trials are planned, the PRCP must state the following:

- The objective of the trials;
- The trial design including, but not limited to, the location, underlying land characteristics and potential issues;
- The details of how the trials will be carried out;
- When the trials will commence;
- The duration of the trials;
- How the trials will be assessed for success;
- How the results of the trials will be incorporated into rehabilitation strategies and the development of milestones; and
- Where the trials have previously been carried out by the applicant.

5.2 Conceptual Cover System Design

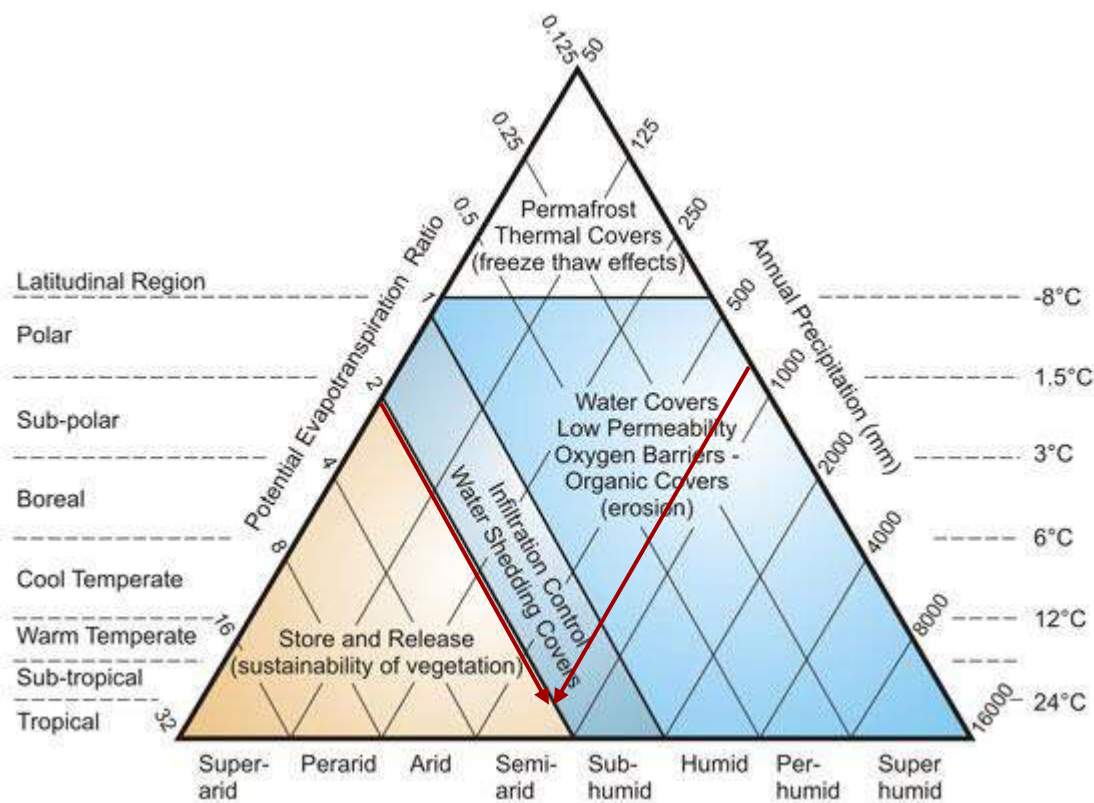
5.2.1 Global Acid Rock Drainage Guide

The Global Acid Rock Drainage Guide (GARD Guide) provides general guidance on appropriate cover types for climates ranging from arid to high rainfall and tropical to polar climates.

Applying the GARD Guide cover criteria to the climate experienced at MRO suggests a store and release or water shedding cover are likely to be the most suitable cover types for the TSF (**DIAGRAM 1**). Store and release covers perform best in wet/dry climates with high potential evaporation equal to two-or three-times rainfall (refer **SECTION 3.1.1**).

A store and release cover can be thought of as a 'natural analogue' that mimics an undisturbed soil profile and can reduce net infiltration by storing water during periods of high rainfall and releasing it as evapotranspiration in dry periods. A store and release cover can be combined and optimised with other engineering controls including a Reduced Permeability Layer (RPL) or synthetic liner.

DIAGRAM 1: GARD GUIDE COVER SYSTEMS AND CLIMATE TYPES



5.2.2 Risk Profile

The risk profile for the TSF considers the risk of contaminant migration to receiving environment based on the characteristics of tailings and PAF waste rock. While the static geochemical testing indicates the tailings themselves are unlikely to generate significant acidity, the presence of PAF waste rock necessitates careful management strategies. Key geochemical considerations are:

- **AMD:** While the presence of PAF waste rock poses a theoretical risk of generating acidic leachate if exposed to oxygen and water, kinetic leach tests indicate a low risk of AMD. Although a lag time before significant acid generation might exist, the tests haven't reached a steady state and show the tailings themselves have balanced alkalinity that can neutralise any acidity generated. Encapsulating the PAF waste rock within the tailings and the application of a cover system further minimises this risk.
- **Sulphate and Salinity:** The tailings themselves contain sulphur and may generate salinity as water interacts with them. Kinetic geochemical test results indicate that the initial surface runoff and seepage from tailings material is likely to have a relatively low salinity value.

However, the salinity of the tailings contact water may temporarily increase as major ions are released from the tailings initially. Overall, the risk of salinity impacting surrounding water bodies is considered low taking into account current monitoring and interception methods. Notwithstanding, the impact on the receiving environment should continue to be monitored.

- **Metal and Metalloid Leaching:** Some metals and metalloids, including Arsenic, Cadmium, Copper and Zinc, are present in the tailings. However, kinetic leach tests also showed that the solubility of these metals was generally low, particularly at the neutral to alkaline pH levels measured in the leachate. This suggests that these metals and metalloids are likely to remain bound to the tailings particles and not readily migrate into the surrounding environment.

5.2.3 Requirements and Desirable Attributes

Based on the risk profile of the TSF, the cover system is required to:

- Ensure that the constructed landform is geochemically stable to the extent that they do not impact on surface and/or groundwater quality.
- Minimise rainfall infiltration to limit seepage from the cover profile into the underlying tailings and PAF waste rock.
- Store rainfall infiltration and release through evaporation from the soil and leaf surfaces and transpiration from the vegetation.
- Provide an environment favourable for the establishment of vegetation to sustain the agreed PMLU.
- Minimise the capillary rise of salts migrating upwards from the tailings and PAF waste rock into the cover system.
- Promote erosional stability and ensure that the agreed PMLU is not compromised by surface instability and erosion.
- Reduce erosion and runoff velocity and provide sustainable flow into the downstream natural drainage and support the WQOs of the Perry River.

The cover system should also have the following desirable attributes:

- The cover system is simple and easy to construct.
- The cover system should provide plant available water capacity to support plant growth.
- The cover system should have suitable chemistry to support plant growth to achieve the PMLU of open woodland.
- Selected vegetation for the open woodland should be compatible with the cover system layers and generally be beneficial to cover system performance.

5.2.4 Performance Criteria

5.2.4.1 General Rehabilitation

ATCW prepared a performance criteria memorandum for the cover system, based on a review of the geochemical characteristics and risk profile of the TSF [30]:

- With respect to achieving a non-polluting landform, the TSF closure design's primary objective is to manage seepage discharge to groundwater and through the embankment toe by limiting water flux through the landform. This is achieved by reducing infiltration through the cover system to the extent practical, effectively isolating the tailings, thus reducing and/or minimising recharge and downward migration of water through the landform.
- The landform design for closure aims to facilitate water shedding while limiting surficial erosion of the cover system and embankments, manage surface flows and generated runoffs to avoid water ponding and saturation of the cover system.



- Without the continued introduction of new water into the tailings underlying the cover system, the saturated tailings will drain excess moisture over time (drain down period) and achieve an equilibrium where seepage flux will decrease along with contaminant loads.
- The cover system should limit the upward movement of constituents of concern from the underlying tailings/PAF waste rock into the root zone through capillary rise.
- The cover system should promote the establishment of sustainable vegetation cover suitable for the agreed PMLU (the proposed PMLU is open woodland). The vegetation cover will intercept rainfall, reduce erosion rates and manage the amount of water that may infiltrate the tailings and PAF waste rock. Over time it is expected that the vegetation cover will support a fully functioning vegetation community of species endemic to the area that is similar in appearance to surrounding RE's.

5.2.4.2 Cover System Trials

The objectives and performance criteria of the trials is summarised in **TABLE 5**.

TABLE 5: COVER SYSTEM TRIAL OBJECTIVES AND PERFORMANCE CRITERIA

OBJECTIVE	MONITORING METHOD	PERFORMANCE CRITERIA/TARGET
Limit Net Percolation	Quantitatively assess flux through soil and at interface between cover system and tailings using VWC and matric suction sensors and suction plate sensors Calibrated water balance modelling for longer term predictions	Net percolation into the TSF should be less than a nominal 10% of the total rainfall depth. This aligns with industry practice (refer to [31]). The number of days with percolation exceeding a nominal 10 mm/day at the interface between the cover system and tailings should be less than 10 days per year.
Limit Capillary Rise	Volumetric water content (+temperature and EC) and matric suction	No capillary rise of salts from underlying tailings/PAF waste rock material to the root zone that may affect plant growth.
Sustain Vegetation	Percentage vegetation cover	Establish >30% vegetation cover, as demonstrated by erosion modelling work (refer to [32]).
	Plant species	Plant species selected are suitable for the PMLU of open woodland and include species endemic to area. The vegetation for final rehabilitation will be subject to the outcome of the UQ trials.
	Invasive and declared species	Weed and pest species at no greater densities than that observed at reference sites. Reference sites are to be selected that reflect the proposed PMLU of open woodland.
Erosional Stability	Soil loss	The target average annual loss rate shall be consistent with natural ground topography (less than 10 t/ha/yr) (considered achievable based on [32]). Noting that this should be confirmed with the field flume measurements.

OBJECTIVE	MONITORING METHOD	PERFORMANCE CRITERIA/TARGET
	Visual observation as ground survey and aerial drone survey are unlikely to pick on soil loss once vegetation is established	Maintain a stable cover system with minimal signs of rilling or gullying. A rill is considered a channel up to 0.3 m deep and a gully is a channel more than 0.3 m deep [33]. Rilling or gullying should not affect cover system integrity and function.

5.3 Previous Studies

5.3.1 2007 Cover Options Assessment

In 2007, Allan Waston Associates Pty Limited (AWA) was commissioned by Equigold NL to complete a cover options assessment for the TSF [35]. Three cover system options were considered: an engineered (low permeability) cover system, direct revegetation and a store and release cover system.

As part of the cover options assessment, one dimensional VADOSE/W modelling was carried out for the three cover options for varying thicknesses. The VADOSE/W modelling adopted material parameters, which were inferred from geotechnical test work available at that stage; no additional test work was carried out as part of this work. Direct revegetation and a store and release cover system were the preferred cover options based on the project outcomes [35].

5.3.2 2016 Cover Options Assessment

In 2016, RGS with ATCW, See Built Earth and Evolution undertook a cover options assessment [10]. Seven cover system options were considered:

- Option 1 – Do Nothing;
- Option 2 – Reprocess Tailings;
- Option 3 – Direct Vegetation;
- Option 4 – NAF Waste Rock Cover;
- Option 5 – HDPE Cover and Power Generation;
- Option 6 – Analogue Soil Cover;
- Option 7 – Engineered Soil Cover.

The preferred cover system option was option 6, which would involve the construction of analogue soil cover over the tailings. Option 1 (do nothing) and option 2 (reprocess tailings) were excluded by all parties.

5.3.3 Pre-Feasibility Study Level Cover System Design

RGS developed a Pre-Feasibility Study (PFS) level cover system design for the TSF [9] which was presented in the proposed PRCP [1]. The PFS level cover design included:

- Construction of a Basal Layer following reprofiling of the tailings plateau to achieve required slopes angles and geomorphology and prior to the construction of the cover system;
- Sourcing, hauling, and placing (surface to tailings material):
 - 0.5 m of topsoil.
 - 1 m of subsoil from the Pedolith; and
 - 1 m of Saprolite.

The PFS level cover system design did not include vadose modelling to understand cover system performance.

5.3.4 Conceptual Cover System Design

In 2023, ATCW was engaged by Evolution to develop a conceptual cover system design for the TSF [36]. ATCW developed four conceptual cover system options for the TSF plateau, which were assessed at two workshops held by Calibre Group Pty Ltd (Calibre) and Evolution (TABLE 6). The preferred cover option for the plateau was the store and release cover (Cover D – Store and Release).

Concept level options for the plateau drainage arrangement and reshaping were considered with respect to water management. The preferred surface water drainage option was to the north into Perry River via Swindon Creek to the west of the TSF. Drainage to the south was excluded based on the following key assumptions:

- There is community interest in Paradise Dam.
- The Paradise Dam has more stringent Environmental Values and Water Quality Objectives than the Perry River Weir.
- The open pit to the south of the TSF may be used for the Mount Rawdon Pumped Hydro (MRPH) Project (subject to approval).

The Forward Management Plan, developed as part of [36], recommended that variations of the store and release cover (i.e., Cover D) should be trialled to verify and allow calibration of vadose zone modelling and assess vegetation establishment prior to full-scale construction of the cover system on the TSF.

TABLE 6: TSF PLATEAU COVER SYSTEM OPTIONS

COVER A – CAPILLARY BREAK	COVER B – BGM
• 0.2 m Topsoil • 1.45 m Infiltration Storage Layer (ISL) • 0.5 m Reduced Permeability Layer (RPL) • 0.6 m Capillary Break	• 0.2 m Topsoil • 1.8 m ISL • Geomembrane (Bituminous Geomembrane (BGM))

COVER C – GCL	COVER D – STORE AND RELEASE
• 0.2 m Topsoil • 1.8 m Infiltration Storage Layer • 0.3 m Reduced Permeability Layer • Geomembrane (Geosynthetic Clay Liner (GCL)) • 0.3 m Reduced Permeability Layer	• 0.2 m Topsoil • 1.3 m Infiltration Storage Layer • 0.6 m Reduced Permeability Layer

5.4 Cover System Selection

5.4.1 Cover System Options

Investigations into the potential cover system options for the TSF have been ongoing since 2007 (refer **SECTION 5.3**). These investigations have identified that a store and release/rainfall shedding cover is the preferred cover system.

Based on the conceptual cover system design (refer **SECTION 5.3.4**), the following potential cover system options were proposed to be adapted for the trials [36]:

- Cover A – Capillary Break: A store and release cover system that incorporates an RPL and a CB layer to disrupt the upward movement of water through capillary action.
- Cover D – Store and Release: A store and release cover system that would shed excess water from the upper landform and allow sufficient rainfall to infiltrate into the cover system profile (i.e., ISL) and incorporating an RPL to minimise net percolation into the underlying tailings and PAF waste rock.
- Modified Cover D – Rainfall Shedding: A modified version of Cover D designed to promote rainfall shedding by having a less permeable, more compacted ISL.

These cover system options include the various layers with the following purpose and function:

- Topsoil Layer: The topsoil layer will serve as the primary medium for vegetation growth. The growth of vegetation will also help prevent surface erosion by stability the soil with plant roots.
- Infiltration Storage Layer: The ISL will store infiltrated water and slowly release it to reduce risk of net percolation into the tailings and maintain soil moisture for vegetation.
- Reduced Permeability Layer: The RPL is designed to limit the downward movement of water, therefore, minimising the risk of water infiltrating the tailings.
- Capillary Break Layer (Cover A only): The Capillary Break (CB) layer will disrupt the upward movement of water through capillary action. The capillary barrier is created by the large change in pore size between the layers of fine and coarse materials.

These layers, when combined, can create an effective cover system designed to control the soil water balance (e.g. evapotranspiration, runoff and drainage) and promote the long term stability of the rehabilitated TSF.

Cover A, which contains a CB layer, was included as a potential cover system option to progress to the trials to compare performance with the store and release cover system and demonstrate that a CB layer is not required. DESI require a CB layer for high risk structures, any structures that contain PAF material, as part of the Estimated Rehabilitation Cost (ERC) [34].

5.4.2 Cover System Modelling

The cover system options, as discussed in **SECTION 5.4.1**, were modelled in SEEP/W, a one dimensional fine element package software used for numerical modelling of saturated and unsaturated within soils [37]. The SEEP/W model adopted the material properties from the material investigation completed by ATCW in **SECTION 4.2.2**.

The SEEP/W model was used to predict cover system performance and optimise the cover system options. The SEEP/W model results indicate that all water, which infiltrates into the cover system, is lost through evaporation resulting in a zero net percolation for all modelled scenarios.

A modified version of the default cover system described by DESI for a high-risk structure was included, comprising a single CB layer. Cover A has been included as a means to demonstrate comparable performance between the store and release cover system. Additionally, the store and release cover system (Cover D) is likely to achieve similar performance compared to Cover A. The model results indicate that the capillary rise is negligible suggesting that a CB layer is not necessary. Although, it important to demonstrate comparable performance in the trials.

The RPL was reduced to 0.40 m, which is considered the minimum practicable thickness for construction if constructed in two lifts. It is recommended that the RPL is constructed in two lifts to ensure the layers meets the required specifications and to reduce the reliance on a single construction phase. This approach mitigates potential risks associated with a single lift approach. The ISL was reduced in Cover A to make it consistent with Cover D in order to compare performance of the CB layer in the trials.

5.4.2.1 Options to Progress to the Cover System Trials

The following optimised cover system options (with the reduced RPL and ISL where required) are to progress to the trials, based on the cover system modelling (**SECTION 5.4.2**), and as shown in **TABLE 7**:

- Cover D – Store and Release (top to tailings surface):
 - Native trees and pasture grasses
 - 0.20 m Topsoil Layer (placed at a density of 1.45-1.55 t/m³ or 80-85% Maximum Dry Density);
 - 1.30 m ISL (placed at a density of 1.39-1.56 t/m³ of 75-85% of the Maximum Dry Density);
 - 0.40 m RPL (compacted to achieve a saturated hydraulic conductivity value less than 10⁻¹⁰ m/s, which is consistent with the laboratory test results in [25]).
- Cover A – Capillary Break (top to tailings surface):
 - Native trees and pasture grasses
 - 0.20 m Topsoil Layer (placed at a density of 1.45-1.55 t/m³ or 80-85% Maximum Dry Density);
 - 1.30 m ISL (placed at a density of 1.39-1.56 t/m³ of 75-85% of the Maximum Dry Density);
 - 0.40 m RPL (compacted to achieve a saturated hydraulic conductivity value less than 10⁻¹⁰ m/s);
 - 0.60 m Capillary Break.



- Modified Cover D – Rainfall Shedding (top to tailings surface):
 - Native trees and pasture grasses
 - 0.20 m Topsoil Layer (placed at a density of 1.45-1.55 t/m³ or 80-85% Maximum Dry Density);
 - 1.30 m ISL (placed at a density of 1.55-1.65 t/m³ of ≥ 90% of Maximum Dry Density);
 - 0.40 m RPL (compacted to achieve a saturated hydraulic conductivity value less than 10⁻¹⁰ m/s).

TABLE 7: OPTIMISED COVER SYSTEM OPTIONS

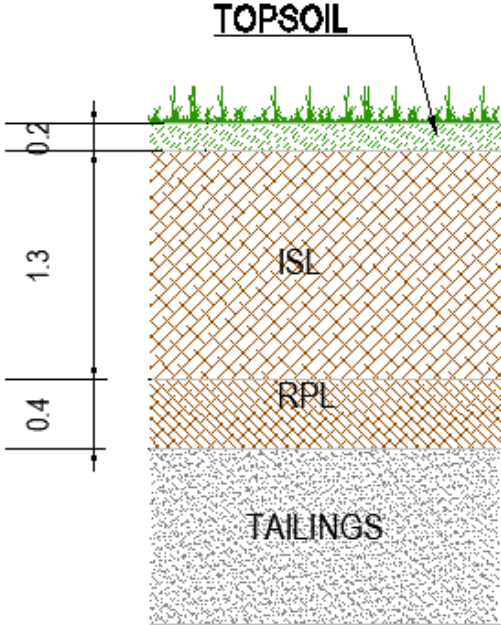
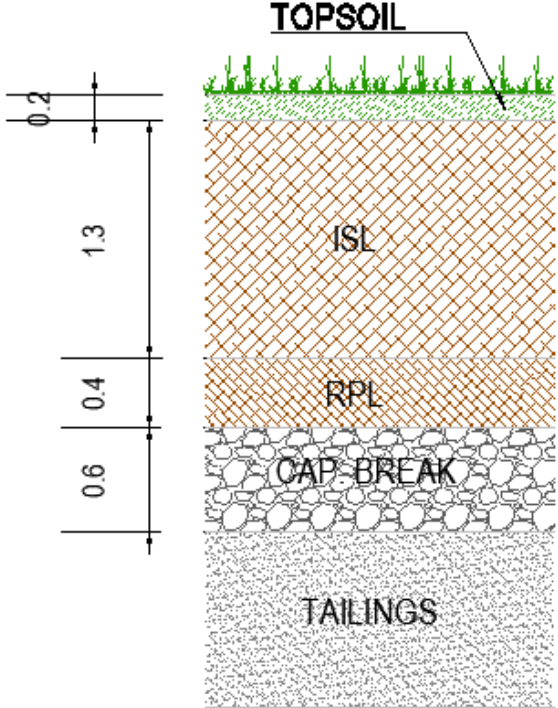
COVER D & MODIFIED COVER D	COVER A
Store and Release & Rainfall Shedding	Capillary Break
	

TABLE 8: MATERIAL BALANCE

LAYER	COVER D & MODIFIED COVER D	COVER A
Topsoil Layer	260,000 m ³	260,000 m ³
ISL	1,690,000 m ³	1,885,000 m ³
RPL	780,000 m ³	650,000 m ³
CB	-	780,000 m ³

Note: Material quantity estimates assume a TSF surface area of 130 ha.



6 PERFORMANCE MONITORING SYSTEMS

The proposed performance monitoring systems have been selected to align with the project objectives (refer **SECTION 1.3**) and address the cover system performance criteria (refer **SECTION 5.2.4**). A summary of these performance monitoring systems is provided in **TABLE 9**, with detailed descriptions presented in subsequent sections.

The performance monitoring systems are required for a period of 5 to 10 years depending on initial monitoring results. This will allow vegetation to establish and the hydraulic properties of the cover system to evolve from the as constructed to post construction condition.

As the performance monitoring systems are required for several years, robust monitoring instrumentation/ equipment should be selected. The trial monitoring system should be integrated in the long term performance monitoring system for the facility, ensuring ongoing data collection and robust demonstration of performance.

Further, to ensure consistency and reliability in data collection for the closure studies being developed by O'Kane Consultants Pty Ltd and UQ's SMI, the use of standardised monitoring instrumentation/ equipment is required. The GEC in the School of Civil Engineering at UQ is responsible for the procurement and installation of monitoring instrumentation/equipment. The agreed instruments are shown in **TABLE 9**.

TABLE 9: SUMMARY OF PERFORMANCE MONITORING SYSTEMS

PERFORMANCE MONITORING SYSTEM	LOCATION	MONITORING COMPONENTS	INSTRUMENTATION
Monitoring Instrumentation	Each Trial Cell	Matric Suction	TEROS 22
		Volumetric Water Content Sensors +Temperature and bulk EC	TEROS 12
		Suction Plate Lysimeter	EcoTech Multi Element Suction Plate
		Vibrating Wire Piezometer	HYDROS 21
Data Logger	As Required by Sensor Loads	Data Logger	UQ SMI Data Logger
Climate Monitoring	Plateau	Weather Station	ATMOS-41
Surface Water Runoff Flume	Berm directing runoff to flume apparatus (Cover D and Modified Cover D only)	Prefabricated Flume	DRAWING 111359-100-008 to 009
		Vibrating Wire Piezometer	CS451
		Ultrasonic Level Sensor	RS485 750cm Ultrasonic Level Sensor



PERFORMANCE MONITORING SYSTEM	LOCATION	MONITORING COMPONENTS	INSTRUMENTATION
		Automated Field Camera	-

6.1 Instrumentation

Cover system monitoring instrumentation will be installed within each cover system layer within each trial cell. These sensors will measure *in situ* matric suction, volumetric water content, temperature and EC. Matric suction and volumetric water content will be used to assess movement of water through the cover from the surface and, potentially, from the tailings.

- Volumetric water content sensors: measure soil water content in the soil profile. They also measure temperature and bulk EC.
- Matric suction sensors: measure soil water suction

The proposed buried sensor depths for each cover system layer are provided in **TABLE 10** and shown in **DRAWING 111359-100-004** and **DRAWING 111359-100-005**.

TABLE 10: SENSOR INSTRUMENTATION DEPTH

LAYER	INSTRUMENTATION DEPTH (m below ground level)			
	#	COVER D/MODIFIED COVER D	#	COVER A
Topsoil	1	0.10	1	0.10
ISL	2	0.25	2	0.25
	3	0.60	3	0.60
	4	0.90	4	0.90
	5	1.15	5	1.15
	6	1.45	6	1.45
RPL	7	1.55	7	1.55
	8	1.70	8	1.70
	9	1.85	9	1.85
CB		NA	10	1.95
			11	2.20
			12	2.45
Tailings	10	1.95	13	2.55
	11	2.25	14	2.85

6.2 Data Logger

Data loggers will be installed to collect and store data from the sensors and monitoring equipment. The Data loggers will be built and programmed by UQ's SMI to record readings at predetermined intervals throughout the monitoring period. The Data Loggers will be powered by a solar panel and recharged battery source. This data will then be automatically downloaded for analysis and evaluation in accordance with the Monitoring and Maintenance Plan in **SECTION 8**.

6.3 Weather Station

The Weather Station will monitor net radiation, air temperature, relative humidity wind speed rainfall and barometric pressure. Rainfall is a key element of the water balance and directly affects net percolation realised through a cover system. Net solar radiation is a dominant factor in the surface energy balance and resulting evaporation and/or transpiration from a soil profile. Potential (or theoretical maximum) rates of evaporation from a soil surface can be determined through measurements of net solar radiation, air temperature, relative humidity and wind speed.

6.4 Suction Plate Lysimeter

A Suction plate lysimeter will be installed to measure the downward movement of water through the cover system profile in accordance with **DRAWING 111359-100-005**. The suction plate lysimeter is placed on top of the tailings surface and buried within each cover system profile, with a porous plate at the bottom. A vacuum is applied to the porous plate, creating a lower pressure environment compared to the surrounding material. This pressure difference causes water from the material to move through the porous plate and into a collection chamber. The collected water is measured over a specified period, allowing for the calculation of water loss from the cover system profile.

The suction plate lysimeter will be installed adjacent to the primary instrumentation nest, equipped with volumetric water content and matric suction sensors. This configuration allows for independent monitoring of both soil water content and water movement within the tailings and cover system profile.

6.5 Vibrating Wire Piezometer

Each primary sensor nest (one per trial plot) will include a vibrating wire piezometer positioned above the RPL in accordance with **DRAWING 111359-100-005**. The vibrating wire piezometer will measure positive pore water pressure potentially developing above the RPL, which would indicate a developing saturation front and phreatic surface within the ISL.

6.6 Surface Water Runoff Flume

Surface water runoff is an important component of the overall water balance of the cover system. A berm will be used to direct surface water runoff of Cover D and Modified Cover D to the Flume as shown in **DRAWING 111359-100-002**.

The Flume was designed to monitor both low and high flow. The Flume Detail Plan is in **DRAWING 111359-100-007**. The monitoring flume details for the:

- Type HB – Low Flow Flume is shown in **DRAWING 111359-100-008**; and
- Type H – High Flow Flume is shown in **DRAWING 111359-100-009**.

The primary purpose is to measure the volume of water that runs off the cover system during rainfall events. These data are critical for evaluating the effectiveness of each cover system design in directing water away from infiltration and potential seepage towards the tailings/PAF waste rock.

It is important that surface water runoff is monitored from as large of an area as possible and typically from a run length of > 20 m. Monitoring from a larger surface area typically incorporates the cumulative processes that will contribute to runoff. This allows the measured runoff to be reliably scaled-up and used in final design of the surface water diversion and management plan for the TSF.



6.7 Omitted Monitoring Equipment

6.7.1 Oxygen Sensors

Oxygen Sensors can be used to measure oxygen ingress into the underlying tailings and PAF waste rock. Given the tailings are classified as NAF, significant oxidation is not anticipated. In addition, changes in water content and temperature can indirectly indicate oxygen within the cover system. This approach prioritises cost effectiveness by focusing on core monitoring parameters that directly influence oxygen availability. The onset of any potential acid generation of PAF waste rock placed within the TSF can be monitored from the seepage at the toe of the TSF embankments. Additionally, the embankment core is lined with a compacted clay layer, this would further reduce infiltration of oxygen through the TSF embankment.

6.7.2 Large-scale Lysimeters

The installation and maintenance of large-scale weighing or non-weighing lysimeters can be expensive and time consuming of lysimeters. The proposed suction plate lysimeters provide easier installation and long term monitoring.

7 CONSTRUCTION PLAN

7.1 Location

7.1.1 Selection Criteria

A site visit was undertaken by ATCW on 29 and 30 May 2024 to inspect the proposed cover system trial location and identify any limitations for construction and operation. The selection of the trial location was based on the following criteria:

- The trial area should resemble the overall site condition of the TSF.
- The trial area should have a similar slope to the proposed final landform.
- The trial area should be compatible with the tailings deposition plan and placement/relocation of PAF waste rock.
- The trial area should not likely be disturbed as the cover system trials will be required an extended period to understand performance.
- The trial area should be accessible for construction, monitoring and maintenance.
- The trial area should be large enough to remove the potential for edge effects.

7.1.2 Justification

The nominated cover system trial location is the southwest corner of the Western Cell as shown in **DRAWING 111359-100-001** to **DRAWING 111359-100-003** and is based on the following:

- It is an isolated cell that is removed from operations.
- The area grades approximately 0.7% to the northwest and representative of the TSF surface.
- There is access via the TSF Western Access and north via the Haul Road and TSF Well 5.
- There are currently an estimated 14 m of tailings deposition (based on comparison of DTM 2017 survey) with an estimated 5m of tailings near the southern boundary of the trials (based on comparison of DTM 2021 survey).
- The area is large enough to facilitate the trials (approximately 50 m by 60 m at the base) and reduce edge effects. The area to the southwest is large enough for three separate UQ trial plots (approximately 30 m by 30 m at the base).

7.2 Layout

The layout is depicted in **DRAWING 111359-100-001** to **DRAWING 111359-100-006**. The general layout for instrumentation distribution is described below:

- Instrumentation: A primary nest of matric suction and volumetric water content sensors will be installed at various depths within the cover system profile of each trial plot (refer **TABLE 10** and **DRAWING 111359-100-005** for instrumentation depths). A suction plate lysimeter and vibrating wire piezometer will be installed on each trial plot. A secondary nest will be installed with volumetric water content sensors to capture spatial variability (refer **TABLE 10** and **DRAWING 111359-100-006** for instrumentation depths).
- Data Logger: A data logger will be installed to collect and store data from the instrumentation and will be located on the surface of the primary nest.
- Weather Station: A single weather station will be installed within a representative area to the east of the trial plot to collect data on the weather conditions.
- Surface Water Runoff Flume: A prefabricated flume will be installed at the Cover D and Modified Cover D to measure runoff volume. Cover A has the same surface profile as Cover D and therefore surface water runoff will not be monitored.

7.3 Construction Works

The construction of the trials will involve the following works as described in the Technical Specification [3]:

1. Survey and Setting Out;
2. Material Stripping and/or Hauling;
3. Placement and Compaction; and
4. Quality Control and Quality Assurance (QC/QA).

The site will be surveyed prior to and during the works to demonstrate that the landform slopes and material thicknesses and/or levels are within the tolerances defined.

The necessary materials for each cover system layer will be stripped and/or hauled to the site for placement and compacted in accordance with **DRAWING 111359-100-001 to DRAWING 111359-100-004**.

A QC/QA process will be followed to ensure that construction and installation and performance of all instrumentation in and above ground is completed in accordance with the design. QC/QA will include material testing and survey control to document the as constructed configuration.

7.4 Vegetation

The establishment of vegetation on the cover system will be an important aspect of the long-term rehabilitation and closure of the TSF. The plant species selected will be consistent on the three trial plots and contain mixed vegetation. The plant species will be determined by MRO and UQ's SMI as part of the UQ trials.

Factors to be considered should include:

- Plant soil-water function (i.e. rooting character and evapotranspiration) aspects favourable to store and release cover performance.
- Selection of suitable plant species adapted to the local climate and soil conditions.
- Establishment methods (e.g., seeding, planting seedlings).
- Potential need for irrigation during the initial establishment phase.

7.5 Reporting

7.5.1 As-Built Report

Following completion of construction, an As-Built Report will be prepared by ATCW. The As-Built Report will document the construction process and note where the trials have deviated from the Technical Specification.

The As-Built Report will typically include the following elements:

- Construction methodology outlining the sequence of construction activities for each trial plot.
- Material documentation including records of all material used in the construction of each cover system layer (i.e., source information, and any relevant test results).
- Construction photographs to document the construction process for each trial plot including images of key stages and completed components.
- Deviations and corrective actions from the planned construction methodology and the corrective actions taken to address them.
- Documentation of the final placement and installation details for all sensors and monitoring equipment within each trial plot.



7.5.2 Sensor Performance Verification

Prior to initiating regular data collection, a verification process will be conducted to confirm the proper functioning of all installed sensors and monitoring equipment. This verification process may involve the following steps:

- **Sensor Calibration Checks:** Using portable calibration equipment to ensure all sensors are recording accurate readings within their specified ranges.
- **Data Logger Functionality Testing:** Verifying the data logger is properly programmed to collect data from all sensors at the predetermined intervals and store the data electronically.
- **Data Transmission Verification:** If remote data transmission is employed, testing the system's functionality to ensure data is transmitted reliably from the field to the central data storage location.

A successful verification process will ensure the collected data accurately reflect the performance of each cover system design, allowing for a robust evaluation during the monitoring period.



8 MONITORING AND MAINTENANCE PLAN

Monitoring and data collection will begin shortly after the construction of the trials. This Monitoring and Maintenance Plan is designed to gather data on the performance of each cover system throughout the trial period. The data will be used to evaluate the performance of each cover system design in achieving the performance criteria listed in **SECTION 5.2.4**.

TABLE 11 outlines the monitoring requirements including frequency of data collection and reporting for the trial.

TABLE 11: MONITORING AND MAINTENANCE PLAN

TASK	MINIMUM FREQUENCY	RESPONSIBILITY	TASK TYPE
Sensor reading	Minimum Hourly, or Event Based	Datalogger/ Datalogger Program	Automated
Data download	Daily	Datalogger/ Datalogger Program	Automated
Data QA/QC	Monthly	UQ's SMI	Specialist/ Technical
Data interpretation and assessment against performance criteria	Quarterly	MRO/ACTW*	Specialist/ Technical
Performance monitoring report	Annual	ATCW	Specialist/ Technical
Vegetation Monitoring	Six monthly**	UQ's SMI	Specialist/ Technical

Note:

*Quarterly monitoring by ATCW is suggested during the early stages to ensure monitoring performance as data interpretation is required.

**Subject to confirmation from UQ's SMI.

8.1 Data Collection

Data collection will be conducted regularly at predetermined intervals throughout the monitoring period. The specific frequency of data collection may be adjusted based on seasonal variations and observed trends. The following methods may be used for data collection:

- **Automated Data Acquisition:** A central data logger will be programmed to collect readings from the installed sensors (matric suction and volumetric water content) at regular intervals. The data logger will store these data electronically for download and analysis.
- **Manual Data Collection:** Manual data collection will be conducted at the monitoring stations to supplement the automated data. This may include:
 - Recording rainfall data from the climate station.
 - Measuring surface water runoff volume from the flumes after rainfall events.
 - Ground survey and/or aerial survey for any signs of erosion, cracking, or other potential issues
 - Vegetation establishment monitoring.

8.2 Evaluation and Reporting

8.2.1 Monitoring Reports

Regular monitoring should be undertaken throughout the trial period. Regular monitoring should review the collected data from the various instruments, including:

- Matric suction and volumetric water content readings;
- Rainfall and climate data; and
- Surface water runoff volumes.

Monitoring reports should be prepared to consolidate the collected data and include data analysis and interpretation, along with any observations or trends identified.

8.2.2 Annual Reports

On an annual basis, the collected data will be compiled, analysed and interpreted to assess the performance of each cover system design. The data evaluation process should involve:

- Data Quality Control: The collected data will be subjected to quality control procedures to ensure accuracy and consistency.
- Data Analysis: Statistical analysis will be performed to identify trends and patterns in the data. This may include evaluating relationships between rainfall events, infiltration rates, and surface water runoff volumes.
- Interpretation: The analysed data will be interpreted in the context of the overall closure objectives. This will involve assessing the effectiveness of each cover system design in controlling infiltration, minimising seepage, and promoting long-term stability.

The data collection should be used to calibrate a cover system model, which is used to predict the water balance performance over a longer time period. The calibration of a cover system model would depend on the monitoring results and recommended by the Annual Report.

An Annual Report should be prepared summarising the overall findings and recommendations.

If practical, the cover trials should be integrated in the final closure landform to ensure long term performance monitoring of the closed TSF.

8.2.3 Final Report

A Final Report should be written when the trial is considered to be completed. The trials are considered to be completed when:

- Plant roots are removing moisture to at least 0.9 m depth. This can be shown by active removal of moisture from deeper layers; and
- Fair to good establishment of plants, based on soil cover; and
- Self-seeding and succession of native grasses is evident; and
- The cover system performance has a minimum of 5 to 10 years of data collection, depending on the monitoring results.

The Final Report should summarise the overall findings and recommendations for selecting the most effective cover system design for the closure of the TSF.

Should the trials monitoring system become inoperable or the trials are removed/destroyed, a Post-Mortem report should be completed to assess the overall performance of the trials.



9 PROGRESSIVE REHABILITATION AND CLOSURE PLAN

In accordance with the section 126C(1)(j) of the EP Act, if rehabilitation trials are planned, the PRCP must provide further details, as listed in **TABLE 12**. The report section, which addresses each requirement, is also provided in **TABLE 12**.

TABLE 12: PROGRESSIVE REHABILITATION AND CLOSURE PLAN REQUIREMENTS

PRCP REQUIREMENT	REPORT REFERENCE
The objective of the trials	SECTION 1.3 describes the objectives of the trials.
The trial design including, but not limited to, the location, underlying land characteristics and potential issues	This Report provides the rationale, design considerations and technical requirements for the trials. SECTION 7.1 includes further detail about the location for the trials.
The details of how the trials will be carried out	The cover system options selected to progress to the trials are in SECTION 5.4. The trials will be constructed in accordance with the SECTION 7. The equipment and instrumentation will be installed as per the design and in accordance with the manufacturers requirements. The procurement and installation of equipment and instrumentation will be undertaken by UQ's SMI/GEC. Regular monitored will be undertaken to assess the performance of the trials. The Monitoring and Maintenance Plan is provided in SECTION 8
When the trials will commence	The trials are schedule to commence in January 2025, following the installation of equipment and instrumentation.
The duration of the trials	The trials will be required for a minimum of 5 to 10 years, depending on initial monitoring results, to gain an understanding of cover system performance. The trials should be retained in the longer term and integrated into the long term monitoring system.
How the trials will be assessed for success	SECTION 5.2.4 includes the performance criteria that will be used to monitor the trials. Monitoring should be undertaken in accordance with the Monitoring and Maintenance Plan in SECTION 8.
How the results of the trials will be incorporated into rehabilitation strategies and the development of milestones	The results of the trials will be used to calibrate a water balance model to more accurately predict the longer-term performance of the covers and thereby select the best cover system for the rehabilitation for the TSF. An optimised cover system design can then be implemented for full scale construction of the cover system.
Where the trials have previously been carried out by the applicant	No cover system trials have been previously undertaken.



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DRAWINGS

TOC10 ALIGNMENT HORIZONTAL POINTS					
PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING
IP 1	0.000	374.070.453	7204660.608	189.283	280°00'00.89"
IP 2	50.637	374.020.585	7204669.401	188.664	
IP 3	60.788	374.014.764	7204661.085	188.619	
IP 4	69.835	374.017.105	7204652.347	188.658	
IP 5	78.882	374.011.916	7204644.935	188.611	
IP 6	90.543	374.014.933	7204633.672	189.300	
IP 7	107.575	374.011.975	7204616.898	189.300	
IP 8	157.575	374.061.215	7204608.216	189.882	
IP 9	210.775	374.070.453	7204660.608	189.276	9°59'59.53"

LEGEND

COVER TRIAL DESIGN

200

DESIGN CONTOUR - MAJOR

DESIGN CONTOUR - MINOR

200

EXISTING CONTOUR - MAJOR

EXISTING CONTOUR - MINOR

- - -

TRIAL CELLS

RUNOFF FLUME

INSTRUMENTATION

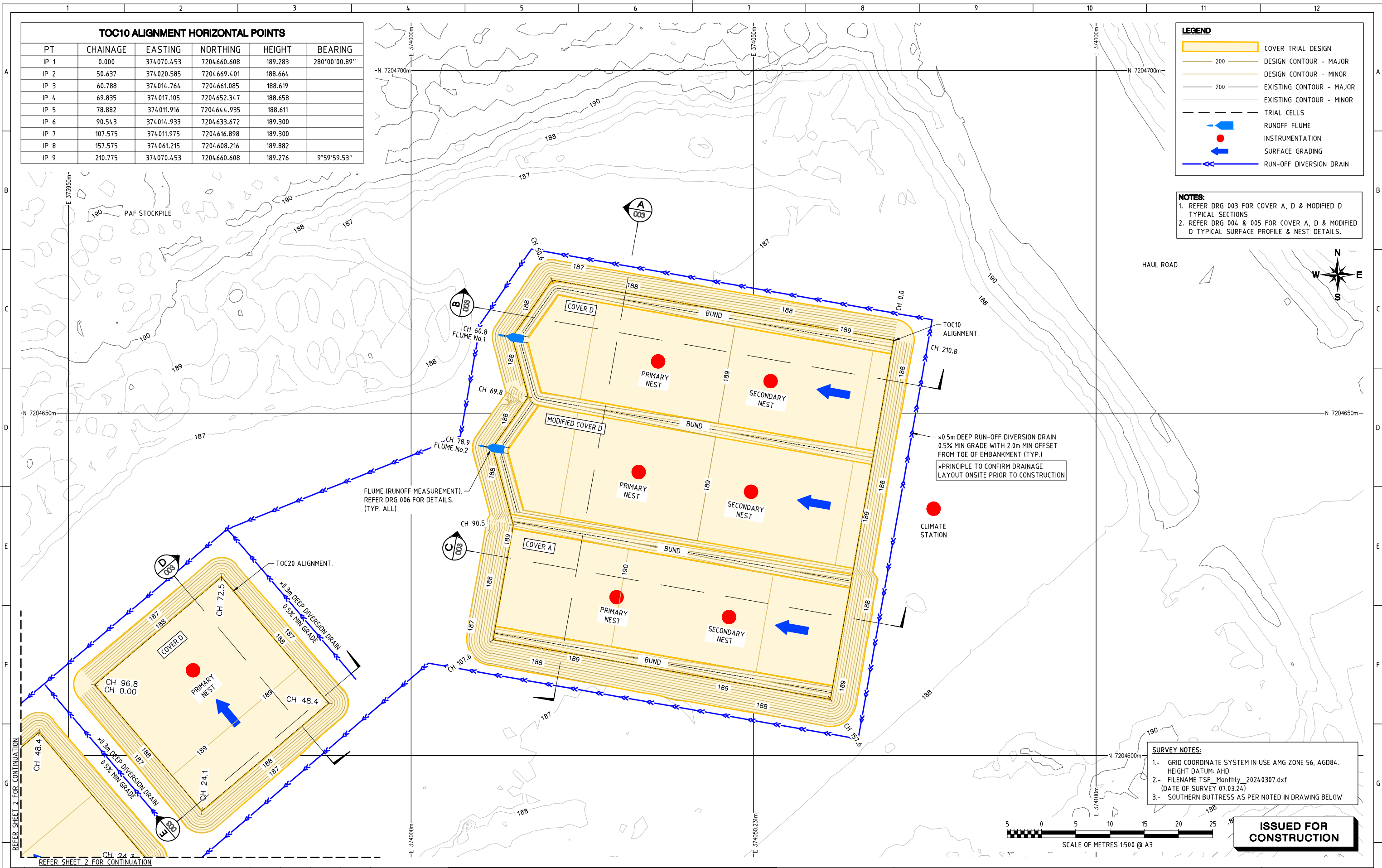
SURFACE GRADING

RUN-OFF DIVERSION DRAIN

NOTES:

1. REFER DRG 003 FOR COVER A, D & MODIFIED D TYPICAL SECTIONS

2. REFER DRG 004 & 005 FOR COVER A, D & MODIFIED D TYPICAL SURFACE PROFILE & NEST DETAILS.

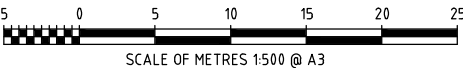


SURVEY NOTES:

1.- GRID COORDINATE SYSTEM IN USE AMG ZONE 56, AGD84. HEIGHT DATUM: AHD

2.- FILENAME TSF_Monthly_20240307.dxf (DATE OF SURVEY 07.03.24)

3.- SOUTHERN BUTTRESS AS PER NOTED IN DRAWING BELOW



ISSUED FOR CONSTRUCTION

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SCALE: 1:500

JOB No. 111359-100

DATE AUGUST 2024

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EVOLUTION MINING LIMITED

MOUNT RAWDON OPERATION

TAILINGS STORAGE FACILITY

REHABILITATION AND COVER SYSTEM TRIALS

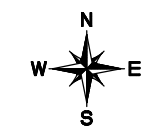
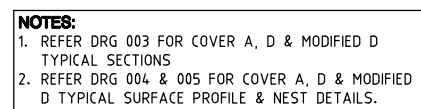
LAYOUT PLAN - SHEET 1 OF 2

DWG. No. 111359-100-002

SHEET SIZE A3 Rev. D

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SHEET 2 OF 9



TOC20 ALIGNMENT HORIZONTAL POINTS				
PT	CHAINAGE	EASTING	NORTHING	HEIGHT
IP 1	0.000	373953.840	7204610.305	188.326
IP 2	24.124	373969.468	7204591.928	188.566
IP 3	48.424	373987.980	7204607.670	188.562
IP 4	72.548	373972.351	7204626.047	188.326
TOC30 ALIGNMENT HORIZONTAL POINTS				
PT	CHAINAGE	EASTING	NORTHING	HEIGHT
IP 1	0.000	373942.789	7204569.272	188.371
IP 2	24.301	373961.301	7204585.015	188.371
IP 3	48.401	373945.688	7204603.374	188.134
IP 4	72.701	373927.177	7204587.632	188.133
TOC40 ALIGNMENT HORIZONTAL POINTS				
PT	CHAINAGE	EASTING	NORTHING	HEIGHT
IP 1	0.000	373916.063	7204546.675	188.181
IP 2	24.300	373934.574	7204562.417	188.181
IP 3	48.300	373919.026	7204580.700	187.941
IP 4	72.601	373900.514	7204564.957	187.940

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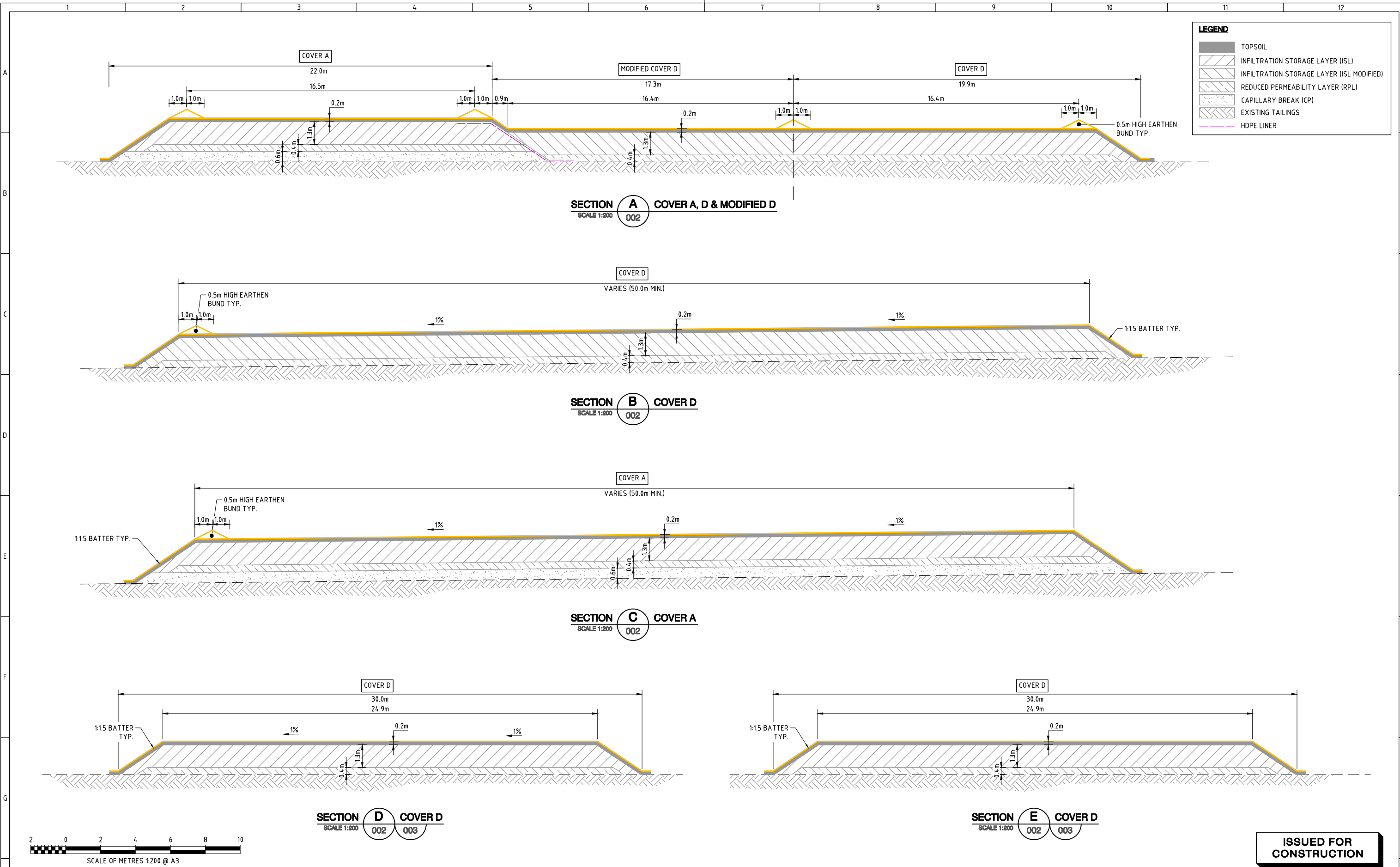
**TAILINGS STORAGE FACILITY
REHABILITATION AND COVER SYSTEM TRIALS
LAYOUT PLAN - SHEET 2 OF 2**

DWG. No.	111359-100-003
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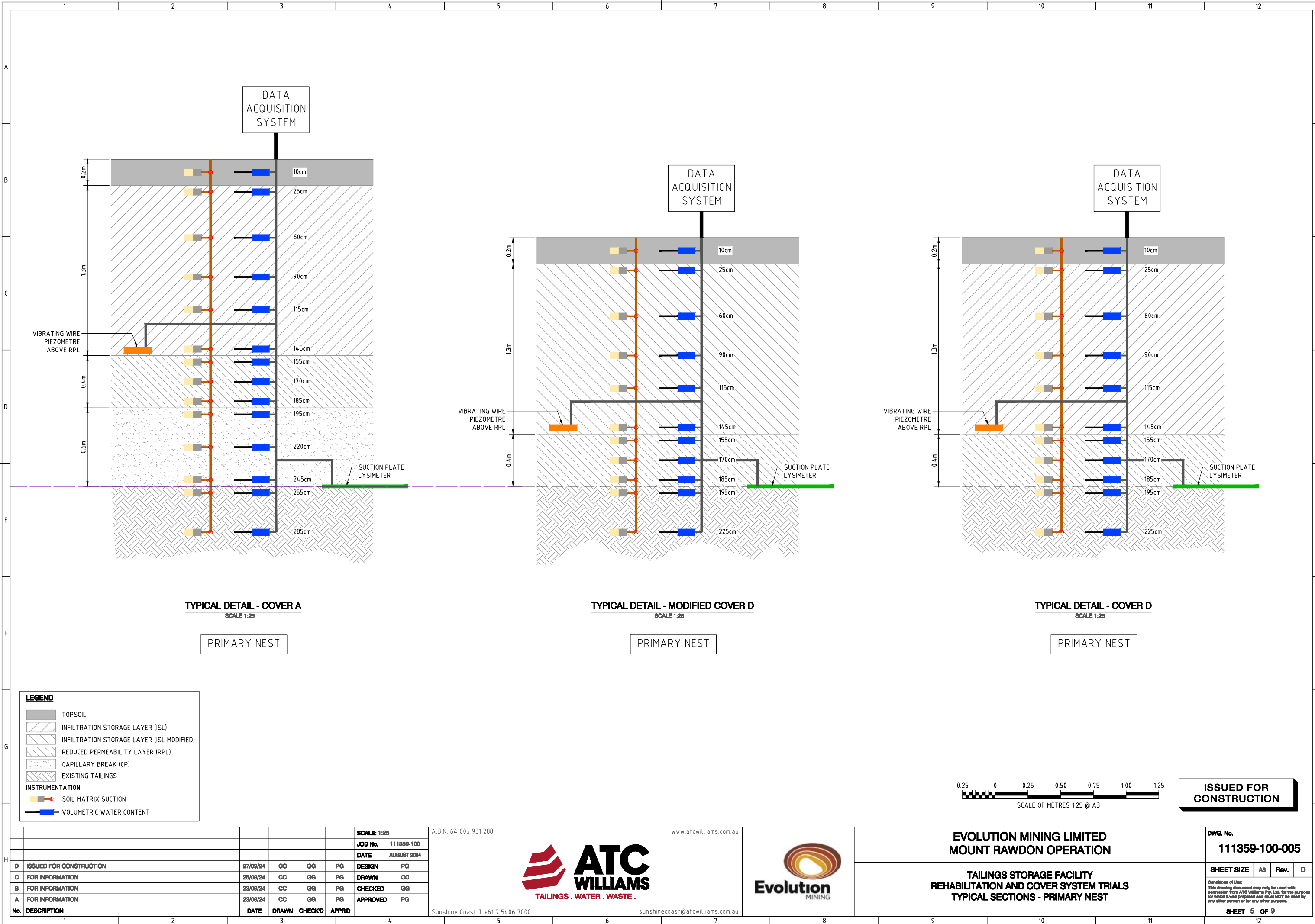
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REHABILITATION AND COVER SYSTEM TRIALS
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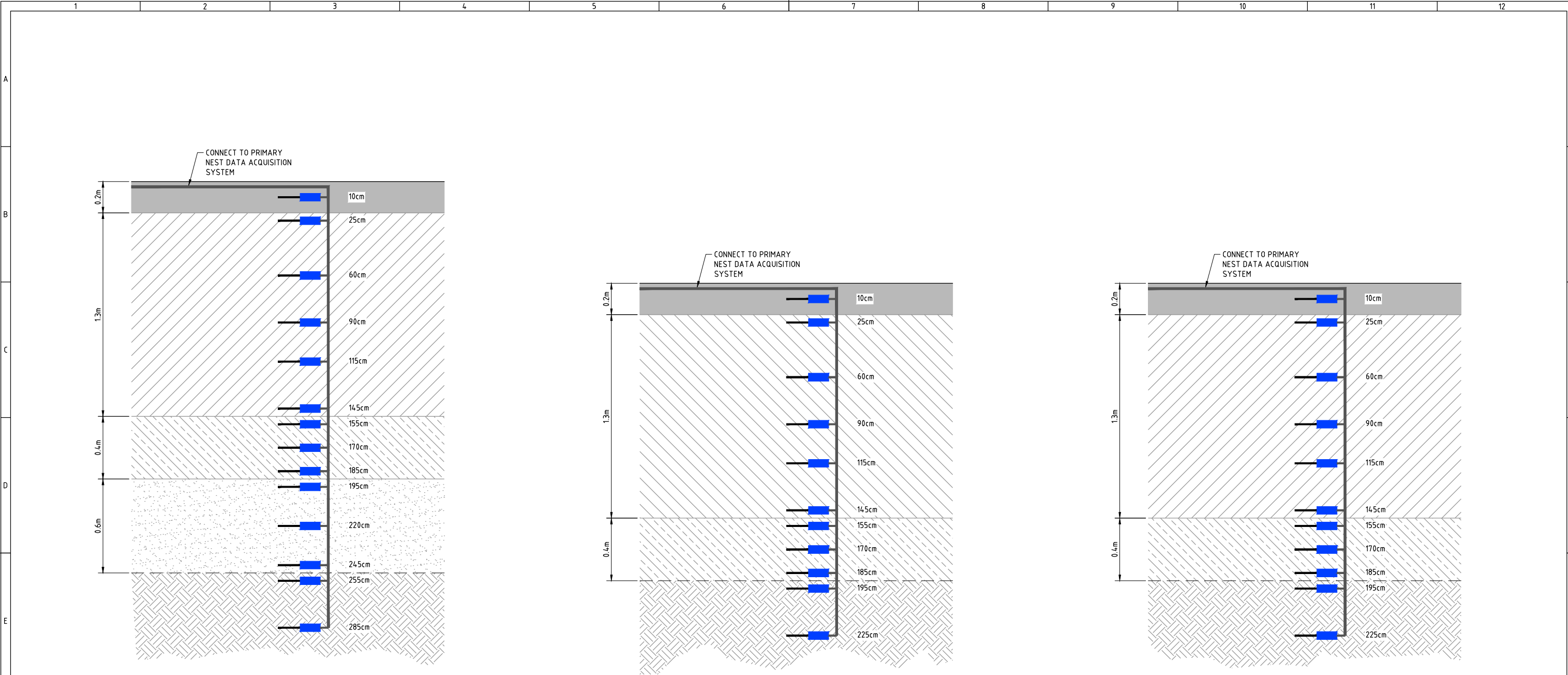
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TYPICAL DETAIL - COVER A
SCALE 1:25

TYPICAL DETAIL - COVER D
SCALE 1:25

TYPICAL DETAIL - COVER D MODIFIED
SCALE 1:25

SECONDARY NEST

SECONDARY NEST

SECONDARY NEST

LEGEND

TOPSOIL

INFILTRATION STORAGE LAYER (ISL)

INFILTRATION STORAGE LAYER (ISL MODIFIED)

REDUCED PERMEABILITY LAYER (RPL)

CAPILLARY BREAK (CP)

EXISTING TAILINGS

INSTRUMENTATION

VOLUMETRIC WATER CONTENT

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TYPICAL SECTIONS - SECONDARY NEST

DWG. No.

111359-100-006

SHEET SIZE

A3

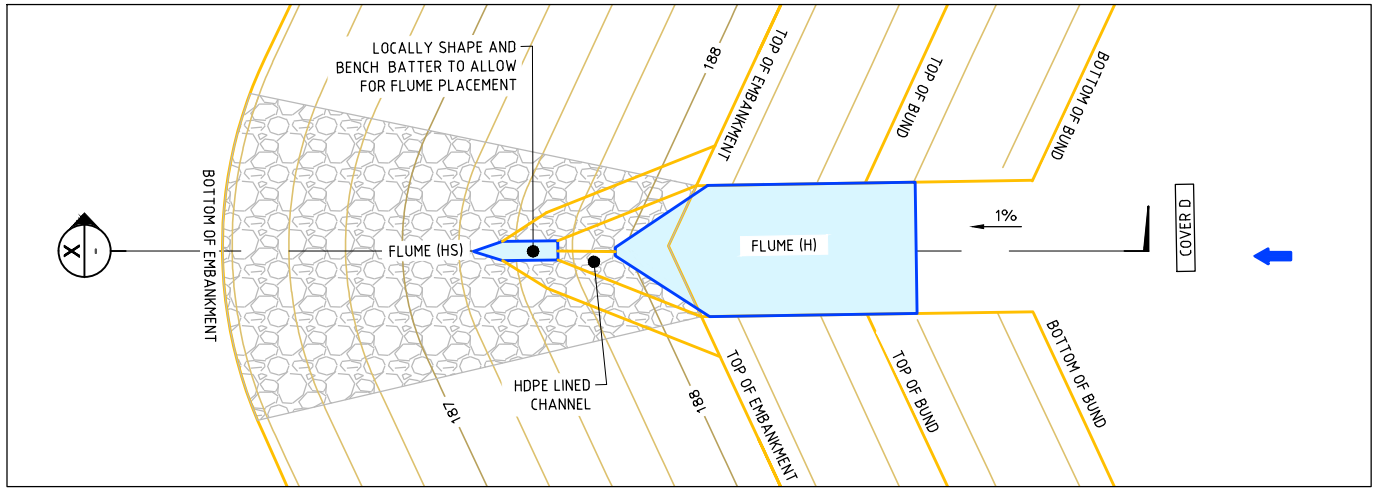
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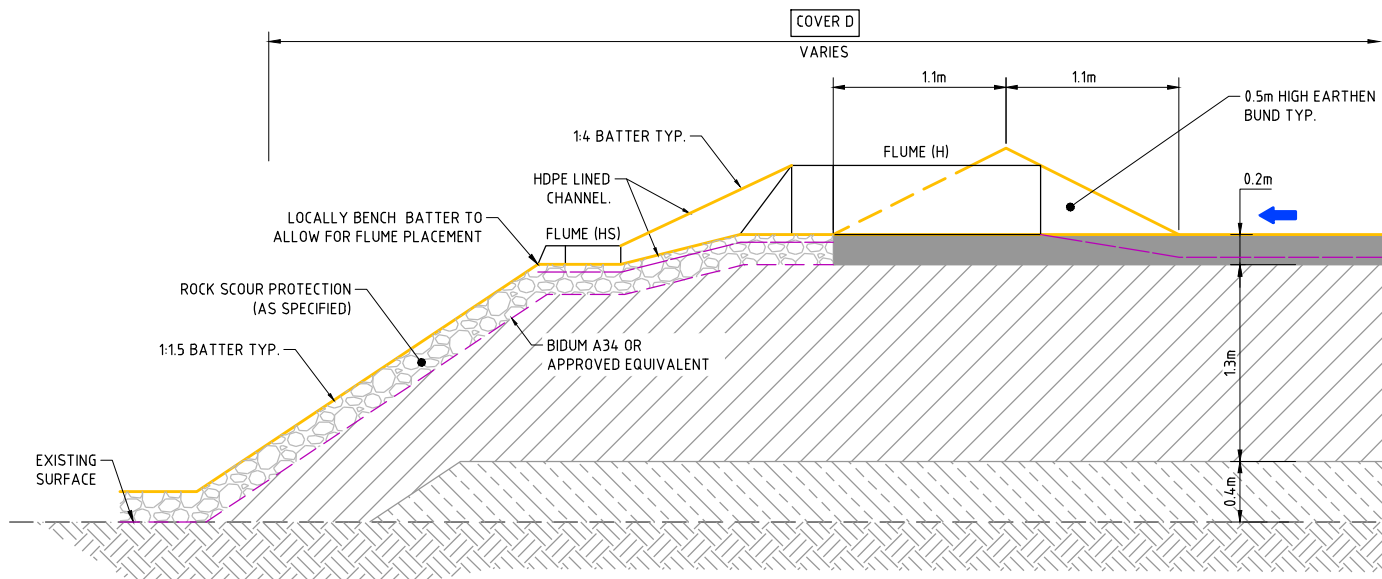
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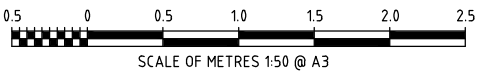
FLUME (H & HS) DETAIL
SCALE 1:50



SECTION X
SCALE 1:50

LEGEND

- TOPSOIL
- INFILTRATION STORAGE LAYER (ISL)
- REDUCED PERMEABILITY LAYER (RPL)
- ROCK SCOUR PROTECTION
- EXISTING TAILINGS
- DESIGN CONTOUR - MAJOR
- DESIGN CONTOUR - MINOR
- TRIAL CELLS
- HDPE LINER
- RUNOFF FLUME (H & HS)
- SURFACE GRADING



ISSUED FOR CONSTRUCTION

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REHABILITATION AND COVER SYSTEM TRIALS
FLUME DETAIL PLAN

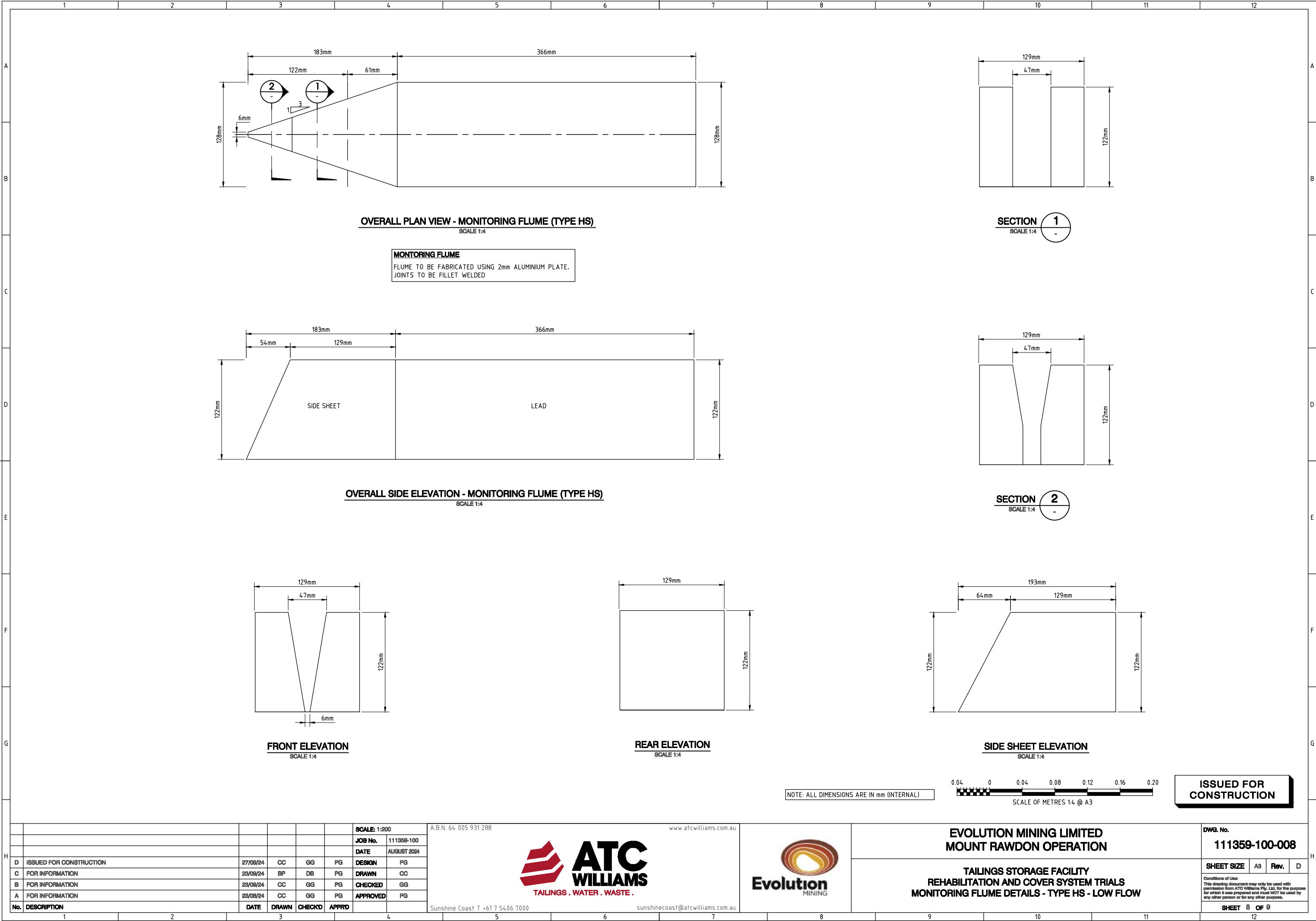
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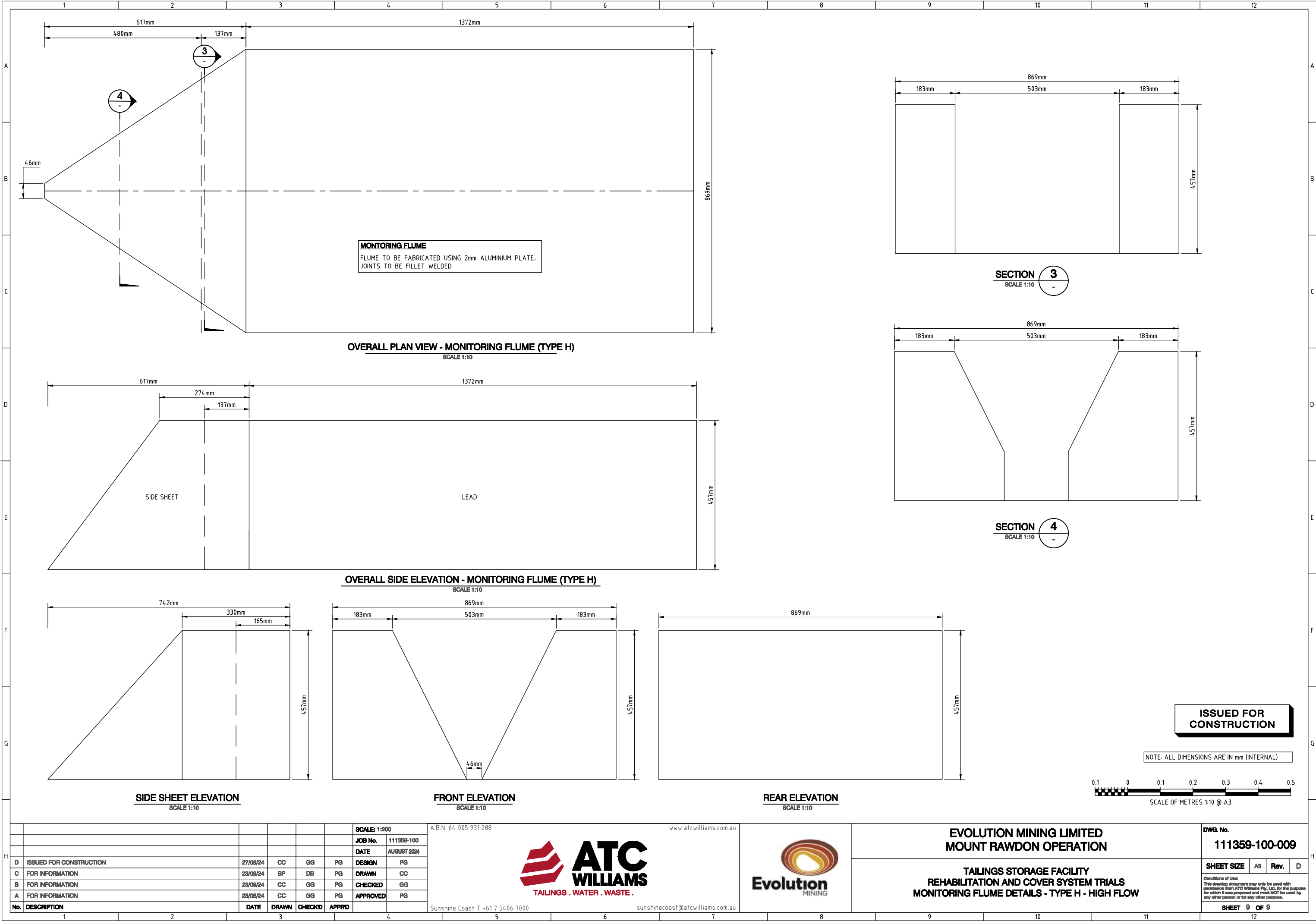
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FIGURES



- LEGEND
- Site Features
 - Tributaries
 - ▭ Mining Lease

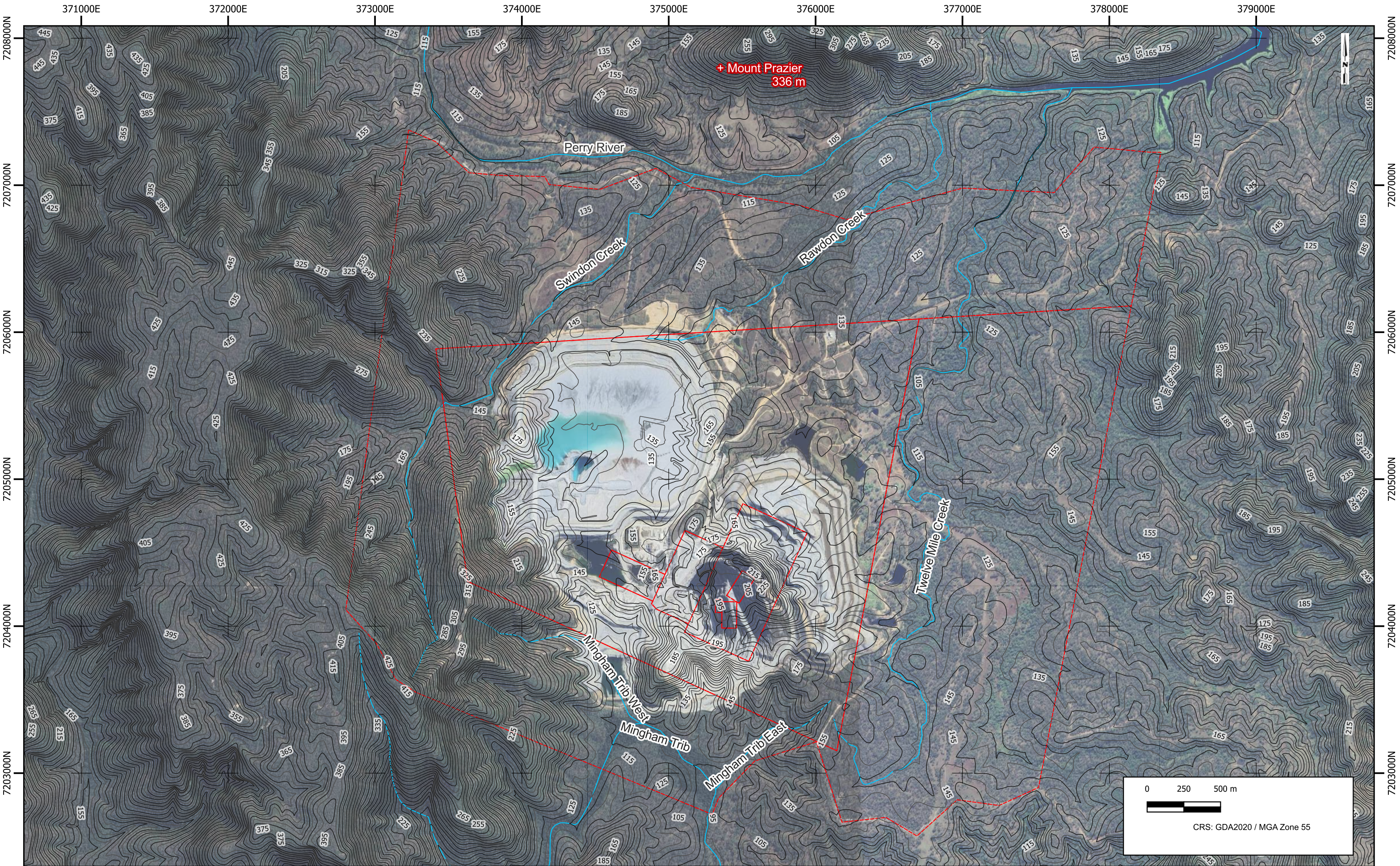
MOUNT RAWDON OPERATION

FIGURE 001
KEY SITE FEATURES



FIGURE 001

111359-100
DATE: 2024-12-06



LEGEND

— Tributaries Contours
- - Mining Lease — 5m

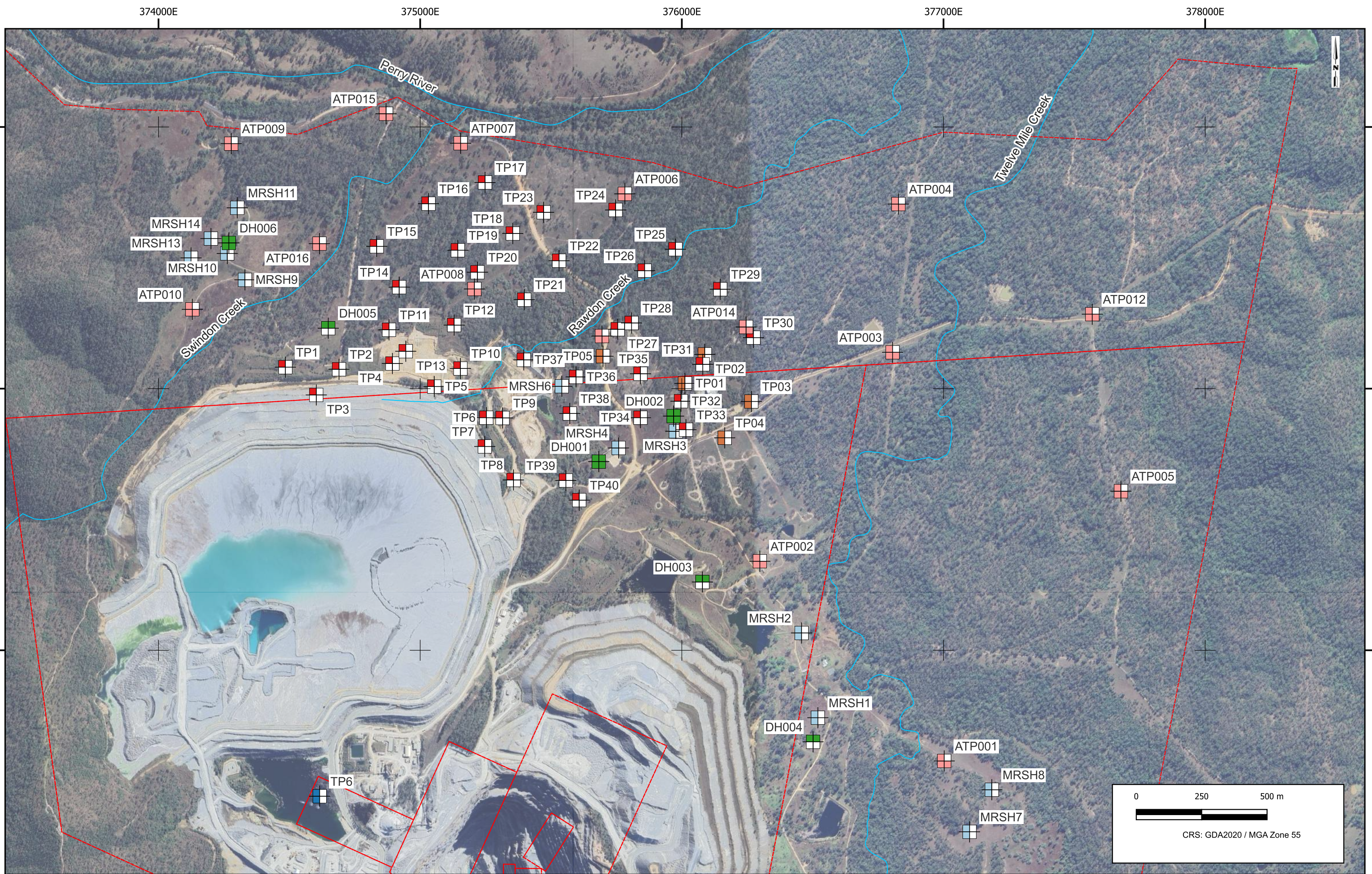
MOUNT RAWDON OPERATION

FIGURE 002
TOPOGRAPHY AND DRAINAGE



FIGURE 002

111359-100
DATE: 2024-12-06



LEGEND

Tributaries	2024 Material Investigation	2015 TSF2 Site Investigation	2016 Irrigation Investigation
Mining Lease	Historic Test Pits	2016 Borrow Pit Investigation	2023 Irrigation Investigation
2013 Soil and Land Suitability Assessment		Test Pit	Test Borehole
		Chemical Properties	Physical Properties

MOUNT RAWDON OPERATION

FIGURE 003

TEST PIT LOCATIONS

111359-100

DATE: 2024-12-06

FIGURE 003



- LEGEND
- Tributaries
 - Mining Lease
 - Topsoil Stockpiles Sampled

MOUNT RAWDON OPERATION

FIGURE 004
TOPSOIL STOCKPILES



FIGURE 004

111359-100

DATE: 2024-12-06