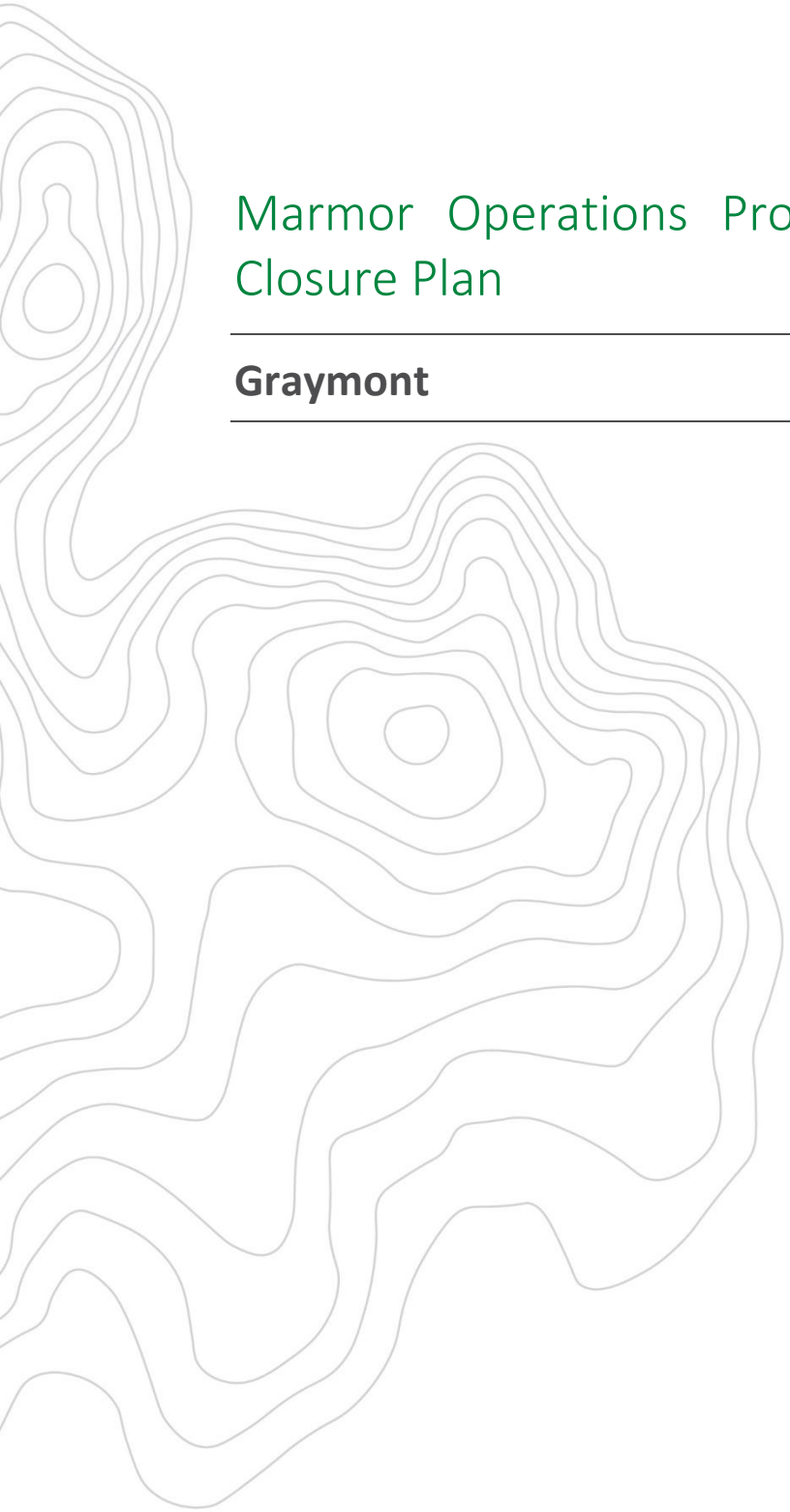
Marmor Operations Progressive Rehabilitation and Closure Plan

Graymont



eco logical AUSTRALIA
A TETRA TECH COMPANY

1300 646 131
www.ecoaus.com.au

Marmor Operations Progressive Rehabilitation and Closure Plan – Rehabilitation Planning Part	
Version:	3
Document reference:	22MUD3257
Date of submission:	21/10/2022
Tenure:	ML5763 and ML5764
EA Holder:	GRAYMONT (NSW) PTY LTD
EA Contact:	Michelle Muir 22MUD3257 Level 16 111 Pacific Highway North Sydney NSW 2060 Australia M +61 419 634 794; T +61 2 8413 8705

DOCUMENT TRACKING

Project Name	Marmor Operations Progressive Rehabilitation and Closure Plan
Project Number	22MUD3257
Project Manager	Andrew Butler
Prepared by	Andrew Butler, Rachel Firmer, Emily Bathgate, Mitch Ross, Adam Garthwaite, Alex Harland, John Kraft and Alireza Sadeghi Pouya
Reviewed by	**Rachel Murray (ELA), Michelle Muir (Graymont)**
Approved by	**Rachel Murray (ELA), Michelle Muir (Graymont)**
Version Number	**Version 4**
Last saved on	**21 October 2022**

Template 2.8.1

Contents

List of Figures

List of Tables

Abbreviations

Abbreviation	Description
AHD	Australian Height Datum
AQP	Appropriately qualified person
bgl	Below ground level
DES	Department of Environment and Science
EA	Environmental Authority
ECe	Saturated paste electrical conductivity
ERA	Environmentally Relevant Activity
EP Act	Qld Environmental Protection Act 1994
ERC	Estimated Rehabilitation Cost
ESP	Exchangeable sodium percentage
LOD	Land Outcome Document
ML	Mining Lease
MSES	Matter of State Environmental Significance
NUMA	Non-use management area
PMLU	Post-Mine Land Use
PRCP	Progressive Rehabilitation and Closure Plan
PRCP Schedule	Progressive Rehabilitation and Closure Plan Schedule
RA	Rehabilitation Area
RL	Reduced level
RM	Rehabilitation Milestone
ROM	Run of Mine

1. Introduction

Marmor Limestone Quarry and Lime works (Marmor Operations) is owned and operated by Graymont Pty Ltd (Graymont). The site is located within the Rockhampton Regional Local Government Area, approximately 40 km south of Rockhampton in Central Queensland, adjacent to the township of Marmor (Figure 1).

Marmor Operations is comprised of Mining Leases (MLs) ML5763 and ML5764, covering a total area of approximately 31.3 ha. The site is situated within the Reden Range, at the southern end of a small limestone ridge. Historically, open cut mining progressed along the eastern slope of this ridge.

Marmor lime works began operation in 1904, when it was established by Mount Morgan Mining Company to supply limestone for fluxing in their smelter operations. Since then, the site has changed ownership several times, until it was acquired by Graymont in 2019 from Sibelco Lime Pty Ltd (Sibelco). Sibelco owned and operated the site from 2004 to 2019. The site has been in care and maintenance from May 2016 to present.

This rehabilitation planning part of the Progressive Rehabilitation and Closure Plan (PRCP) has been prepared to meet the requirements of the *Environmental Protection Act* 1994 (EP Act).

1.1 Purpose and scope

The Marmor Operation PRCP rehabilitation planning part provides guidance on the progressive rehabilitation of land affected by mining activities and the closure requirements of the mine once operations cease. The main purpose of a PRCP is to enable an EA holder to plan for how and where mining activities will be carried out on land in a way that maximises the progressive rehabilitation of the land to a stable condition; and provide details of the condition to which the EA holder must rehabilitate the land before the EA may be surrendered. This is a critical element of mine closure and ultimate relinquishment of the mining leases.

This PRCP has been prepared with reference to requirements for the preparation of a PRCP as set out in the Queensland Government Department of Environment and Science, *Progressive Rehabilitation and Closure Plans (PRC Plans) Guideline (ESR/2019/4964)* (PRCP guideline) (DES 2021) effective from 17 March 2021.

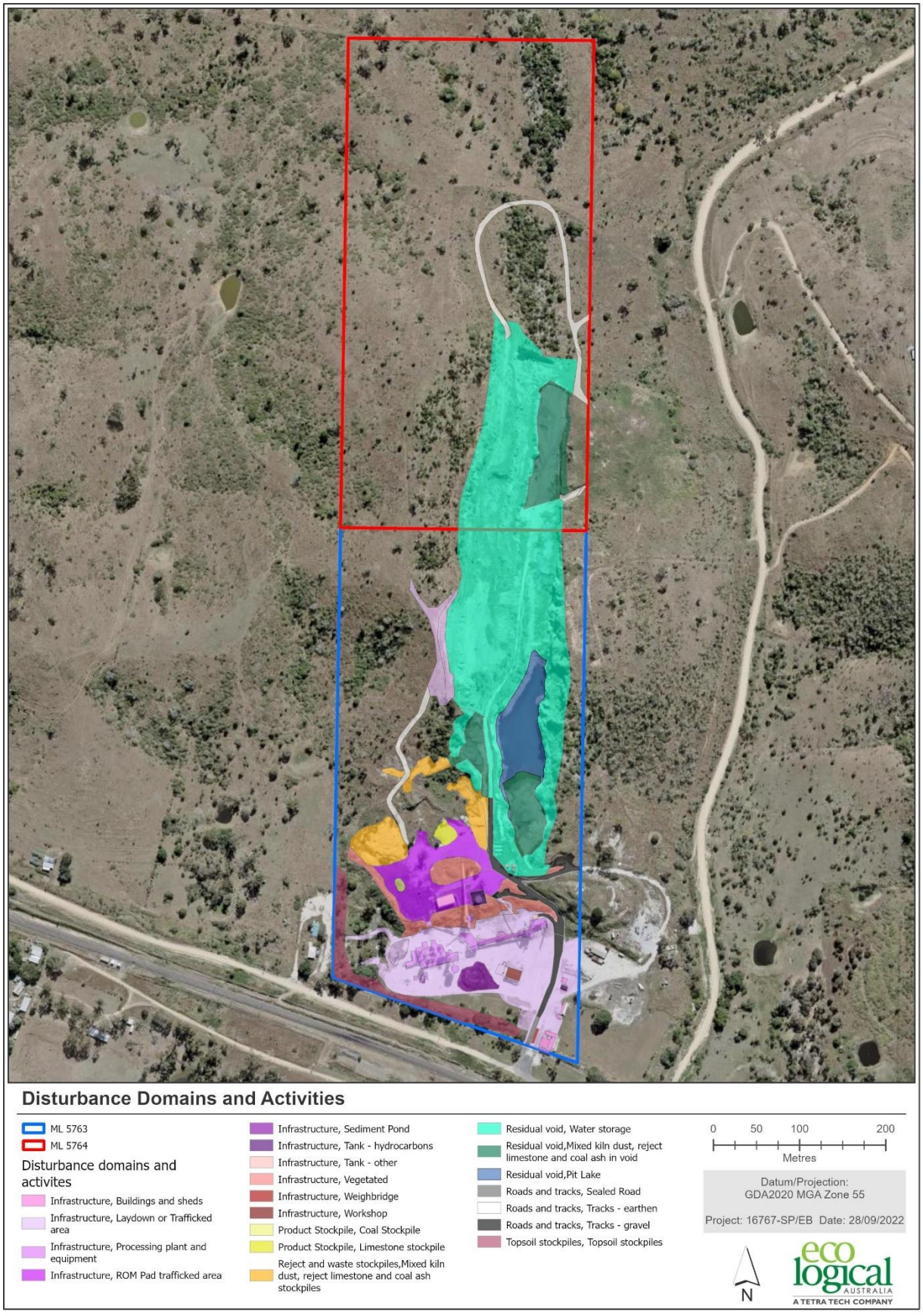


Figure 1: Locality, disturbance domains and within the current area of disturbance at Marmor Operations

2. Regulatory context

Rehabilitation at mining operations is regulated under the EP Act and its subordinate legislation including the *Environmental Protection Regulation 2019*. It is Queensland Government policy that land disturbed by mining activities will be rehabilitated progressively as it becomes available, to minimise the risk of environmental impacts and to reduce cumulative areas of disturbed land.

2.1 Queensland rehabilitation regulatory framework

Under amendments to the EP Act resulting from the passing of the *Mineral and Energy Resources (Financial Provisioning) Act 2018* (MERFP Act), all new and existing EA holders for a mining activity relating to a mining lease approved through a site-specific application (DES 2021) are required to prepare a PRCP following receipt of a Notice from DES.

For existing operations, the transitional arrangements mean that existing "land outcomes" (Post Mine Land Uses (PMLU) and associated milestone criteria) secured in a "land outcome document" (LOD) received by DES (and not rejected) before December 2018 can be carried forward (and do not need community consultation or stakeholder agreement). According to Section 750 of the EP Act a 'land outcome document' can be:

'a) an EA

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

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

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

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

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

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

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

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

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

e) an EIS assessment report

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

The PRCP guideline (DES 2021) states that the land outcome document list is hierarchical and if there are inconsistencies between these documents on either the final outcomes or details of the outcome, then the document appearing first in the above list will prevail to the extent of the inconsistency.

For Marmor, the land outcome document that is relevant is the EA (EPML00319713 dated 14 February 2020). The EA contains no conditions requiring the preparation of any other rehabilitation management documents.

The EA for Marmor Operations includes specific conditions relating to rehabilitation outcomes, including the PMLU. These specific conditions are provided in Table 1.

Table 1: EA conditions relevant to rehabilitation

Condition No.	Condition
D1-1	All areas significantly disturbed by mining activities must be rehabilitated to a stable landform with a self-sustaining vegetation cover in accordance with final land use and landform design in Schedule D – Table 1.*
D1-2	Progressive rehabilitation must commence when areas become available within the operational land.
D2-1	All infrastructure, constructed by or for the environmental authority holder during the mining activities including water storage structures, must be removed from the site prior to mining lease surrender, except where agreed in writing by the post mining landowner/holder.

** See Table 11 for PMLU requirements as provided in Condition D1-1.*

3. Project Planning Section

3.1 Project Planning

This section will include background information, site location details, a description of the project and information on rehabilitation planning at Marmor.

Given the age of the site and the operation, no baseline (pre-mining) information or Environmental Impact Statement is available.

3.1.1 Site location, regional context and topography

The Marmor Operation is located approximately 40 km south of Rockhampton in Central Queensland adjacent to the small town of Marmor, within the Rockhampton Regional Local Government Area. The site covers approximately 31.1 hectares within a group of steep sided hills called the Redan Range. The site is located at the southern end of a small limestone ridge. The gradient of the natural slopes around the site ranges from 14 to 27 degrees with an average of 15 degrees (27%) (Rocktest 2022). The land has been extensively cleared for grazing although small areas of remnant native vegetation are present.

3.1.2 Climate

The Marmor Operation is located within Queensland's sub-tropical climatic zone which is characterised by high summer temperatures, warm dry winters, and distinct wet and dry seasons. It lies within the southeast trade wind belt but is too far south to experience monsoonal influence from the northwest and too far north to benefit from higher altitude cold fronts (BoM 2020a).

Climate data for the region has been captured by the Rockhampton Aero BoM weather station (station no. 039083) from August 1939 to present. Based on the climate data collected from this weather station, the region experiences an annual mean maximum temperature of 28.5°C, a mean minimum temperature of 16.8°C and a mean total annual rainfall of 815.1 mm. The long-term mean temperature is provided in Table 2 and the mean monthly rainfall is presented in Figure 2.

Rainfall data displays distinct wet and dry seasons, with high rainfall from December to March and low rainfall from June to September. Winds are primarily south-easterly; however, during the warmer months there is often a north-easterly sea breeze. The region is subject to the effects of tropical cyclones and tropical lows during the summer months which can produce wind and rainfall events that are typically short-lived and intense. The resulting run-off can cause localised flooding in the region (BoM 2020a).

Table 2: Long-term mean temperature since 1939 (BoM weather station 039083; Rockhampton Aero)

Temp (mean; °C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Min	22.2	22.2	20.9	18	14.3	11.1	9.7	10.8	13.8	17.1	19.6	21.3	16.8
Max	32	31.4	30.6	28.8	26.1	23.6	23.3	24.9	27.5	29.7	31.3	32.2	28.5

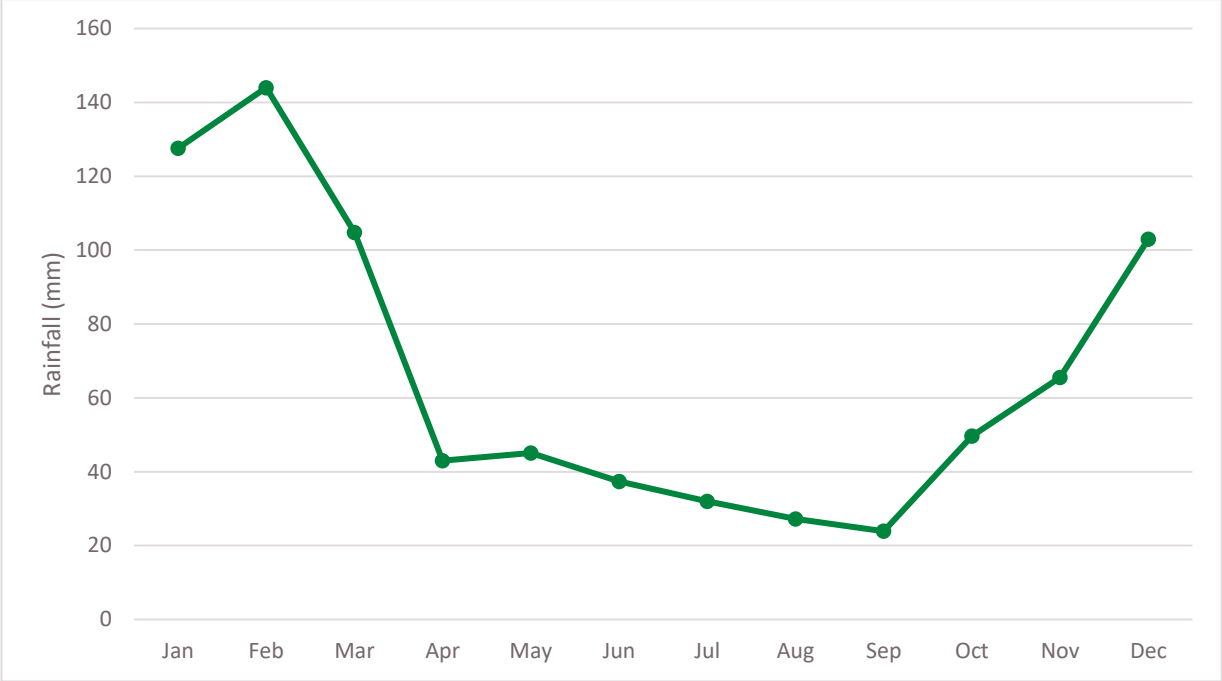


Figure 2: Mean monthly rainfall (BoM weather station 039083; Rockhampton Aero)

3.1.3 Geology and overburden geochemistry

The lithology comprises a shallow cover of soil underlain by thinly interbedded limestone, sandstone, and siltstone and thick beds of conglomerate. It also comprises volcanics, including rhyolitic and dacitic tuff, rhyolite, and andesite. Prior to 1997, these rocks were classified as being within the Mount Holly beds, which were considered to underlie the Mount Alma Formation (347-361 Ma). Since 1997, the beds have been included in the latter formation rather than being considered to be a separate lithology. In the area around the mine, the beds within the Alma Formation strike north-south and dip steep to the west. The limestone beds forming the orebody dip west at 65° to 80°. They occur as an elongate lens, 1,200 m long and 100 m thick. To the west, the limestone is overlain by low to medium strength calcareous sandstone, siltstone, and mudstone. To the east, the limestone is underlain by sandstone and volcanics (Rocktest 2022 and provided in Appendix F). Further details of the stratigraphy are provided in Section 3.1.5.

In general, the upper beds tend to be dark grey containing buff mottling with grades ranging from 74% to 97% calcium carbonate ($CaCO_3$). The underlying beds, ranging with depth from mottled light-grey to buff, have high grades averaging approximately 98% $CaCO_3$. As the limestone is of higher strength compared to the overlying and underlying features, the limestone has been subject to less weathering than the surrounding rock. This has led to cavities and joints within the limestone being infilled with primarily silty clay (Meyers 2005).

The target resource is limestone and the exposed rocks in the void are not considered to pose a risk in terms of the development of acid, metalliferous or saline drainage. In places, the void walls have been exposed for over 100 years and the void is internally draining (Rocktest 2022). Any acid, metalliferous or saline drainage would be evident in the quality of the water in the pit lake. No such evidence exists.

The results from the analysis of pit lake water samples collected between 2013 and 2021 have been reviewed. The pH ranged from 5.9 to 8.1 with an average pH of 6.7 and the EC ranged from 245 to

966 µS/cm with an average of as 497 µS/cm. These values are not indicative of acid, metalliferous or saline drainage. Sampling undertaken in September 2021 showed cadmium, chromium, copper, nickel lead and zinc concentrations in the void were below the limit of detection. Arsenic was detected at 0.002 mg/L but this is below the freshwater ecosystems default guideline value and the stock water guidelines (ANZECC and ARMCANC 2000). None of the water quality results to date would prevent the void from being used for water storage to support the surrounding post mine land use of cattle grazing or pose a threat to wildlife.

3.1.4 Regional and local catchment hydrology

Marmor is located within the Fitzroy River Sub-basin, in the freshwater catchment zone for the Fitzroy River.

The Marmor lease boundaries are located outside the Fitzroy River catchment floodplain according to mapping provided by the *Queensland Floodplain Assessment Overlay (QFAO[1])* which represents an estimate of areas potentially at threat of inundation by flooding. It is outside the Floodplain Investigation Area on the Floodplain Investigation Area Overlay Map OM-8B-29 (Marmor) of the *Rockhampton Region Planning Scheme (2015) - Version 2.2* (Rockhampton Planning Scheme) (Rockhampton Regional Council 2015) (see also a full assessment of flooding hazard in Section 3.5.1).

There are no major watercourses within the immediate vicinity of the site; and none of the neighbouring waterways are identified as High Ecological Value waters.

A number of minor watercourses / drainage features of the Fitzroy sub-basin occur around the site, the closest of which begins approximately 50 m from the southeast border of ML 5764. This drainage feature flows in a north-easterly direction towards Inkerman Creek (a perennial creek) which flows into Raglan Creek approximately 15 km northeast of the site.

Specific environmental values and water quality objectives are provided for the Fitzroy River Sub-basin in the *Environmental Protection (Water) Policy 2009 – Fitzroy River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Fitzroy River Sub-basin* (DEHP 2011a). These values and objectives cover all fresh and estuarine surface waters and groundwaters of the Fitzroy River Sub-basin.

Both the Fitzroy River and Raglan Creek discharge downstream into Keppel Bay and support a number of significant environmental values for the region including (DEHP 2011a):

- High ecological value aquatic ecosystems
- Irrigation
- Farm water supply
- Stock water
- Aquaculture
- Human consumer

[1] http://qldspatial.information.qld.gov.au/catalogue/custom/search.page?q=%22Queensland%20floodplain%20assessment%20overlay%22, accessed March 2021

- Primary, secondary and visual recreation
- Drinking water (freshwater and groundwater)
- Industrial use
- Cultural and spiritual values.

3.1.5 Groundwater

3.1.5.1 Hydrostratigraphy

OVERVIEW

The Marmor site lies within a region dominated by two types of aquifer systems: alluvial and fractured rock (Figure 3). The aquifers that comprise the unconfined alluvial system include surficial sediments and floodplain alluvium. The aquifers that make up the confined fractured rock aquifer system include Mount Alma Formation and Mount Holly Formation/Erebus Beds.

ALLUVIAL (QUATERNARY)

The formation is composed of a lithology that includes clay, silt, sand, and gravel (Department of Resources 2021).

MOUNT ALMA FORMATION (LATE DEVONIAN – EARLY CARBONIFEROUS)

The formation is described as thinly interbedded fine-grained sandstone and siltstone and thick beds of conglomerate with andesitic to dacitic clasts and siltstone rip-up-clasts. It has also been described to include fossiliferous limestone and dolomite. The dominant rock unit within this formation is arenite-mudrock (Geoscience Australia 2020; Department of Resources 2021).

MOUNT HOLLY FORMATION/EREBUS BEDS[2] (LATE SILURIAN – MIDDLE DEVONIAN)

The formation is comprised of acid or intermediate ash-flow tuff, ash-fall tuff, acid or basic flows, volcanic arenite, siltstone, mudstone, conglomerate, crinoidal and coralline limestone. The dominant rock type is predominately volcanic (Australian Geological Survey Organisation 2000, Geoscience Australia 2020).

3.1.5.2 Geological structures

Two regional faults are present to the east and west to the mine site (Figure 3). They are characterised as being part of the Queenslander Fault system that extends 47 km southeast from the site. These faults are defined as eastward dipping thrust faults that strike north-west to south-east and dated from the Late Permian to Late Triassic (Withnall & Cranfield 2013; Maxwell 2019). The fault system predates the deposition of quaternary surficial sediments and establishment of the alluvial aquifer system (Department of Resources 2021).

[2] Mount Holly Formation is historical nomenclature for Erebus Beds

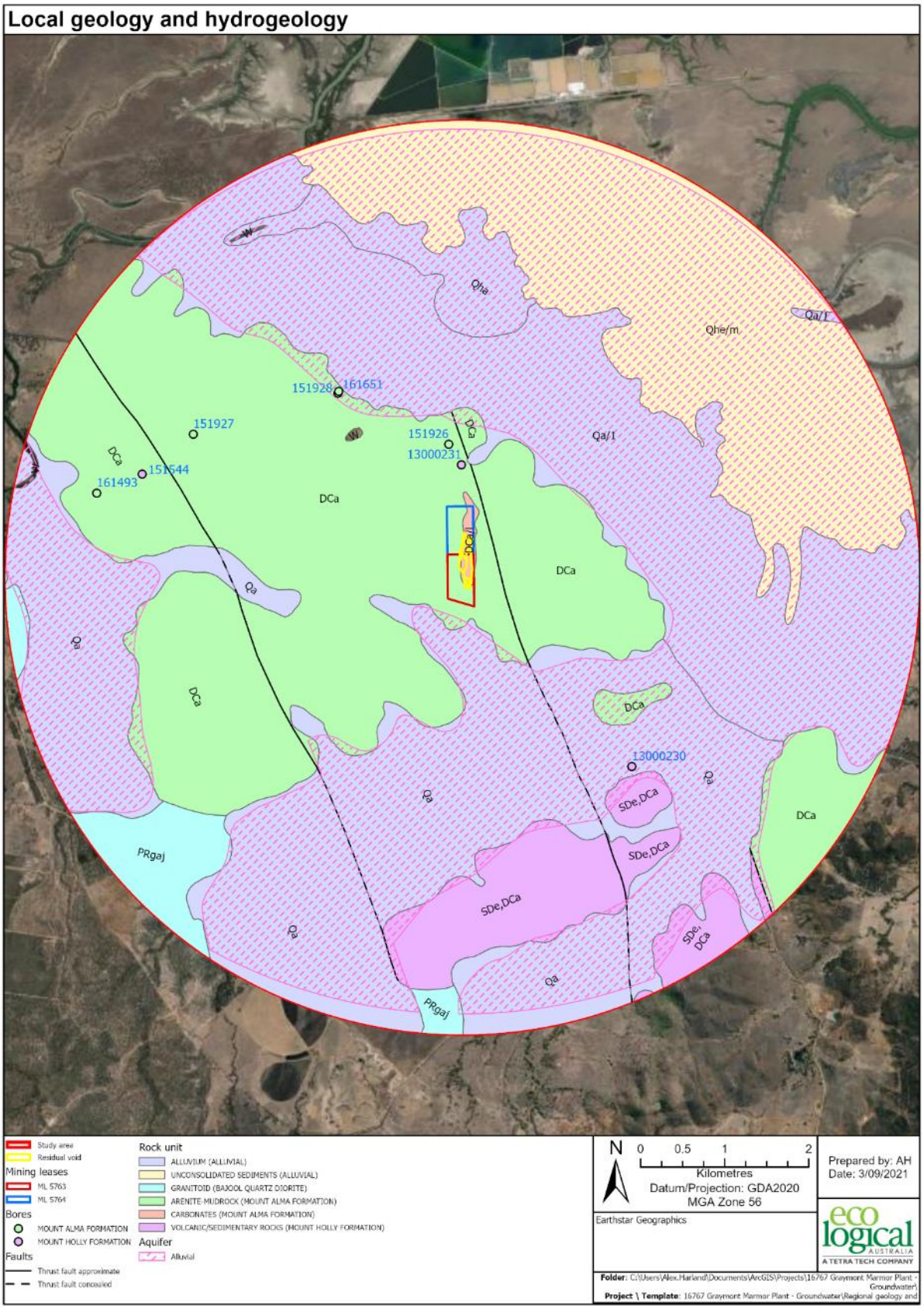


Figure 3: Local geology and hydrogeology with bores drilled between 2011-2021 and formation that they were screened in

3.1.5.3 Registered bores

Interrogation of the Bureau of Meteorology (BoM) Groundwater Explorer online database (BOM 2020b) identified 118 bores that were within a 5 km radial extent of the Operation (Figure 4). Each of these bores had an assigned number and associated bore report (Business Queensland 2021). The following sections summarise the information contained in these bore reports.

There is one licensed groundwater bore within the Marmor MLs (Water Licence 190342 for Bore 136274), which provides potable water to the amenities. This bore extracts water from the underlying Mount Alma Formation.

3.1.5.4 Regional groundwater level

Water level data are available from the BoM Groundwater Explorer database for 80 of the 118 bores. Eight of the 80 bore records presented data collected within the past 10 years and there is recent site data available for the bore on the Marmor site (136274). Table 3 presents details of the nine bores, and a summary of water levels. Figure 4 presents their locations.

Table 3: Registered bores with water level data within study area

Bore ID	SWL (mbgl)	Bore depth (m)	RSWL (mAHD)	Top of aquifer (mAHD)	Measured date	Formation name	Aquifer lithology
151544	5.2	18.3	20.8	27.2	20/07/2011	Mount Holly Formation/Erebus Beds	Siltstone
151926	21.0	49	23.0	-2.5	6/07/2013	Mount Alma Formation	Siltstone
151927	10.6	29	33.4	25.5	8/07/2013	Mount Alma Formation	Siltstone
151928	6.0	33.5	19.0	4.5	13/07/2013	Mount Alma Formation	Siltstone
161493	15.8	33.5	12.2	8.2	29/06/2016	Mount Alma Formation	Siltstone
161651	5.9	56.7	30.1	18.0	3/07/2017	Mount Alma Formation	Siltstone
13000230	0.6	19.8	10.4	1.0	14/06/2012	Mount Holly Formation/Erebus Beds	Shale
13000231	4.0	6.4	24.2	25.2	20/07/2011	Mount Holly Formation/Erebus Beds	Shale
136274	18.0	unknown	12.0	unknown	23/09/2021	Mount Alma Formation	Siltstone

The depth of the bores with recent depth readings ranged from 6.4 to 56.7 (mbgl). All bores were screened within the Mount Alma Formation and Mount Holly Formation/Erebus Bed fractured rock aquifers and were either primarily drilled for water supply, stock use or monitoring.

Groundwater level readings taken from the fractured rock aquifer system show a range between:

- 12.0 and 33.4 mAHD within the Mount Alma Formation; and
- 10.4 and 30.8 mAHD within the Mount Holly Formation.

There are no recent water level readings available taken from the alluvial aquifer system.

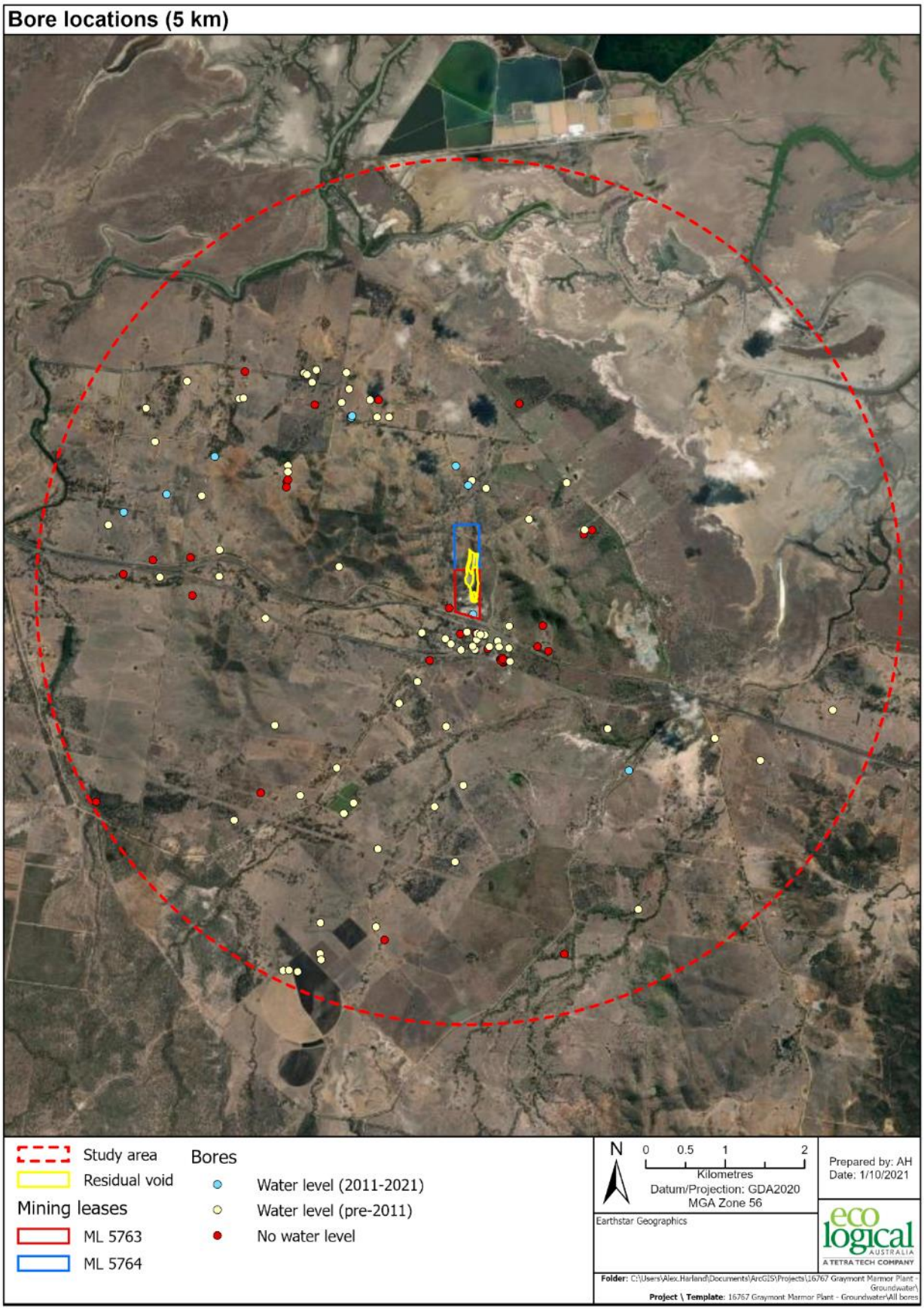


Figure 4: All bores found within the study area and information about availability of bore depth data (no water level data (red), water level data pre-2011 (yellow) and water level data between 2011-2021 (blue)).

3.1.5.5 Groundwater quality

The BoM groundwater explorer (BoM 2020b) identified 28 bores within the study area screened into the Mount Alma Formation and Mount Holly Formation/Erebus Beds that had available water quality data. Groundwater salinity (EC) ranges between 560 – 12,500 (µS/cm) and pH ranges between 7.5 – 8.5. No water quality data was available for alluvial aquifers.

Water quality measurements taken from Bore 136274, situated approximately 300 m south-east from the mine void, are summarized in Table 4.

3.1.5.6 Environmental values and water quality objectives

Environmental Protection (Water) Policy (EPP) 2009 and DEHP (2011a) outlines water quality objectives (WQOs) for environmental values (EVs) for waters within the Fitzroy River Sub-basin. WQOs for Fitzroy River Sub-basin groundwaters are provided according to their chemistry zone and depth category (DEHP 2011b). However, the study area is not included in any currently defined groundwater chemistry zone. DEHP (2011a) defers to DEHP (2009) in this case. Fitzroy River Sub-basin groundwaters EVs are provided in DEHP (2011a). These EVs include:

- aquatic ecosystem[3]
- irrigation
- farm supply / use
- stock water
- primary recreation
- drinking water
- cultural and spiritual values.

Groundwater WQOs available for the nominated EV are outlined in Table 5. The data available for Bore 136274 (Table 4), was compared to these WQOs.

[3] According to DEHP (2009): "*The aquatic ecosystem EV is a default applying to all waters, and therefore the WQOs for aquatic ecosystems form the minimum WQOs for all waters. Where no human use [i.e., irrigation, farm supply, stock water etc.] EVs are identified, the WQOs identified for aquatic ecosystem protection remain applicable.*"

Table 4: Water quality data for Bore 136274

Date	pH	EC (µS/cm)	Total Alkalinity as $CaCO_3$ (mg/L)	Sulfate as SO_4 (mg/L)	Chloride (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	As (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Ni (mg/L)	Pb (mg/L	Zn (mg/L)
Sep-2021	7.10	35	7	2	4	3	<1	2	<1	<0.001	<0.0001	<0.001	0.077	<0.001	<0.001	0.588
June-2020	7.69	699	-	-	-	-	-	-	-	-	-	-	-	-	-	-
June-2015	6.84	473	-	-	-	-	-	-	-	-	-	-	-	-	-	-
June-2013	-	602	-	31	46	65	3	36	1	-	-	-	-	-	-	-

Recent water quality data (2021) from Bore 136274 indicates that general physicochemical and major ions concentrations in groundwater within the mining lease meets all WQO's. This is significant given the close proximity of the bore to the mine void. However, data for Bore 136274 shows the EC was between ~400-700 µS/cm prior to 2021. This range marginally exceeds the WQO for irrigation water for sensitive crops (650 µS/cm). However, it is well within the recommended limit for moderately sensitive crops (1,300 µS/cm) and is not considered to significantly affect the use of groundwater for this EV. Although not unusual for regional groundwater, the EC at the high end of the range exceeds the WQOs for aquatic ecosystems. However, given the mixing that occurs when groundwater discharges into surface water systems, local groundwater quality is not expected to diminish aquatic ecosystem EVs. The sodium concentration (up to 36 mg/L) has also been above the WQO for raw water supply (30 mg/L). However, NHMRC (2011) (the Australian Drinking Water Guidelines or ADWG) notes that 50 mg/L is a '*typical value*' in reticulated supplies. The ADWG value for sodium is 180 mg/L (based on level at which taste become appreciable).

The recent change in EC may indicate that local groundwater maybe becoming fresher with time or it may reflect recent to high rainfall/recharge or seasonable variability in the groundwater system.

The analysis conducted in September 2021 suggest elevated copper and zinc concentrations in the groundwater. These concentrations would exceed the WQO for freshwater ecosystems, but the concentrations do not exceed the WQO for other EVs. This was investigated and is believed to due to cross contamination. The contamination is not related to water quality in the void (where no elevated metals have been recorded). The affected bore is a production bore and it appears the apparently elevated metals may have come from the infrastructure associated with the bore. The bore pump will be removed during future monitoring events to prevent potential sample contamination.

Table 5: WQOs applicable to Fitzroy groundwater EVs nominated in DEHP (2011a)

Environmental value and WQO source	pH	EC (µS/cm)	Total Alkalinity as $CaCO_3$ (mg/L)	Sulfate as SO_4 (mg/L)	Chloride (mg/L)	Calc(mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Copper (mg/L)	Zinc (mg/L)
Aquatic ecosystem (fresh waters, moderately disturbed (DEHP 2011a)	6.5 – 8.5	<250	ng*	<15	ng	ng	ng	ng	ng	0.0014	0.008
Irrigation and general use (DEHP 2011a and ARCANZ & ANZECC 2000)#	ng	<650	ng	ng	<175	ng	ng	<115	ng	0.2	2
Stock water (cattle) (DEHP 2011a and ARCANZ & ANZECC 2000)	ng	<5,970	ng	<1,000	ng	<1,000	ng	ng	ng	1.0	20
Primary recreation (DEHP 2011a)	6.5 – 8.5	ng	ng	ng	ng	ng	ng	ng	ng	ng	ng
Drinking water (before treatment) (DEHP 2011a)	6.5 – 8.5	<2,400+	ng	<200	ng	ng	ng	<30	ng	2	3 (aesthetic) only

** ng = no guideline value available*

 # The values are for sensitive crops

+ Value taken from NHMRC (2011), page 977

Note there are no WQOs available for the cultural use EV.

3.1.6 Pre-mining and current surrounding land use

As operations at the site began in 1904, there are no records of former land use at the site prior to mining disturbance. The soils and topography in the area are generally not suitable for cultivation but pasture establishment is common. Published land use information has been reviewed to provide the likely baseline land use associated with the site pre-mining. This has been based on current and recent land uses in the surrounding areas on similar landforms.

A number of land-uses have been mapped within and surrounding the project area as shown in Figure 5. This shows that the dominant land uses in the surrounding areas are production from relatively natural environments (grazing on unimproved native pastures) or conservation land-uses (Queensland Government 2019). These were likely the pre-mining land use for the Marmor Operation.

The site is fenced and livestock are currently prevented from accessing the lease areas.

3.1.7 Soil properties and productivity

Given the age of the site, there is no pre-mining soil survey data available for the site. Published soils and land resources information has been reviewed to provide the necessary baseline information.

The *Land Systems of the Dawson-Fitzroy area, Queensland* (CSIRO 1968) mapped the area as part of the Toonda Land System (Figure 6; Queensland Government 2018). This comprises mostly hills and slopes on gently dipping Upper Palaeozoic volcanics and extensive colluvial-alluvial slopes under softwood and/or brigalow scrub.

The soils are described as 'dark brown and grey-brown clays'. The soils of this group have uniform or gradational, medium to fine textures on parent materials that have been affected only slightly or indirectly by deep weathering. In undisturbed scrubs these soils have a granular, highly organic, surface mulch that has sub-plastic properties and strong, medium to coarse angular blocky structure in the subsoils. The friable surface soils are prone to erosion after land clearing.

Given the background geology of the project area, the uniform or gradational clay loams to clays would be classified as Red or Brown Dermosols under the current Australian Soil Classification (ASC) system (see the soil profiles exposed above the pit walls in Figure 7). It is possible that deeper clay rich soils (Grey or Brown Vertosols under the ASC) occur in flatter areas outside the main area of disturbance. Where topsoil depths have been provided in *Land Systems of the Dawson-Fitzroy area, Queensland* (CSIRO 1968), they are generally 100 to 150 mm deep. This has guided the proposed topsoil depth to be used in site rehabilitation.

The soil types present (even when shallow) have moderate to high fertility and are used widely and successfully for the establishment of exotic pastures.

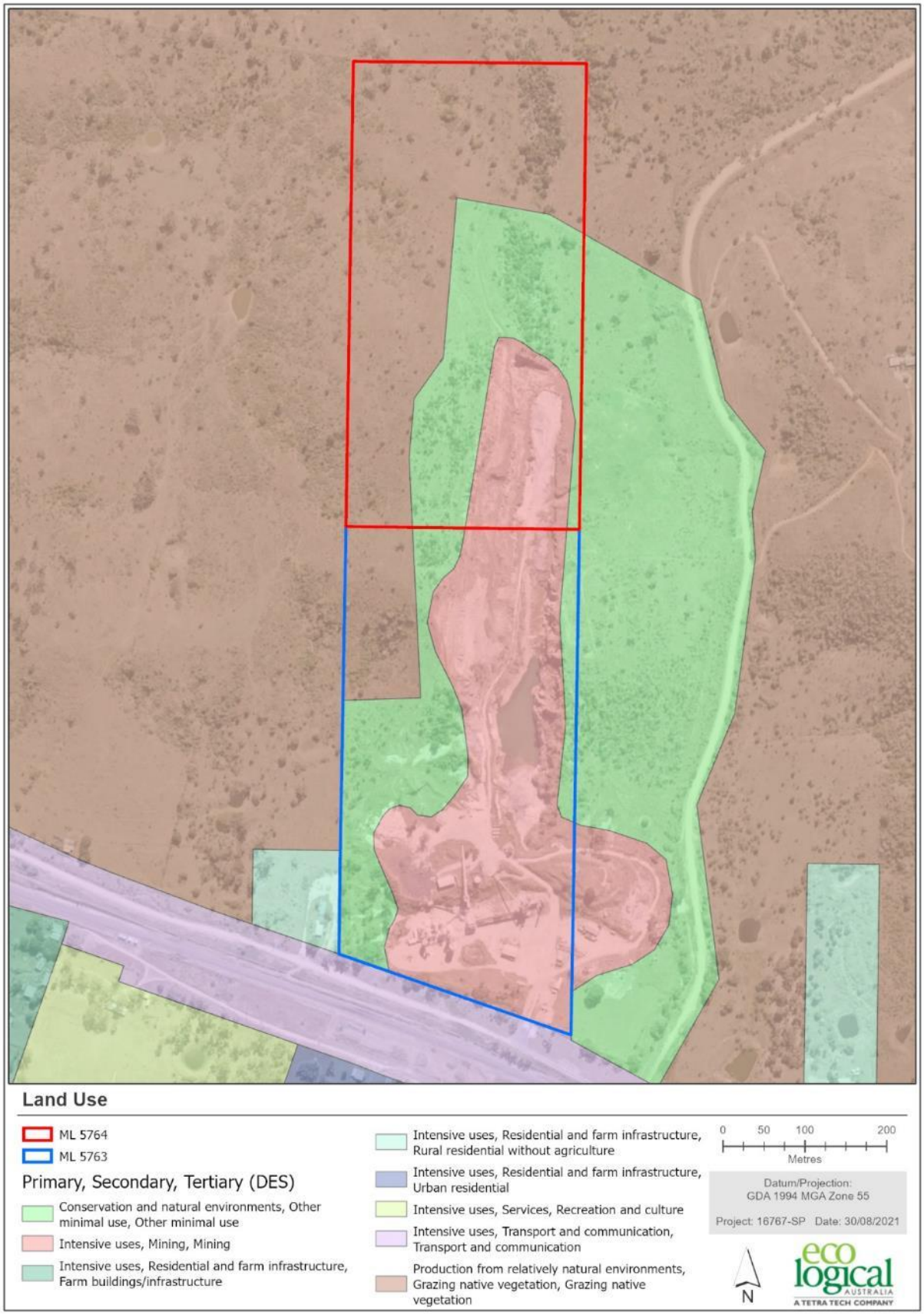


Figure 5: The land use classes within the project area (source: Queensland Government 2019)

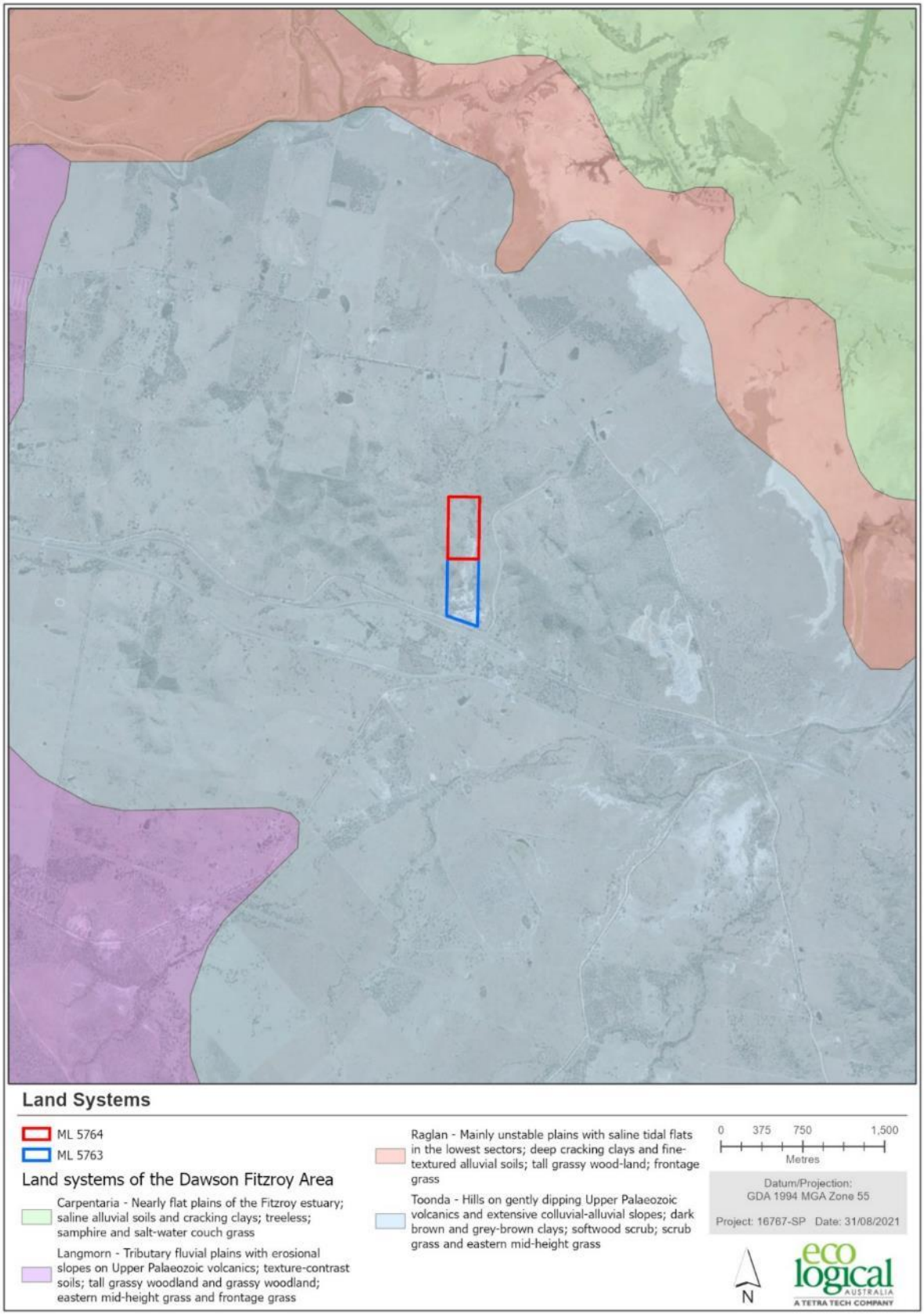


Figure 6: The land systems and associated soil types within the project area (source: CSIRO 1968 and Queensland Government 2018)

Figure 7: Photograph of the Marmor pit showing a cross section of the shallow red-brown clay soil profile over partially weathered parent material

The lease areas are outside the area below 20 m AHD and the acid sulfate soil overlay of the Rockhampton Planning Scheme (Rockhampton Regional Council 2015) and above the elevation where acid sulfate soils would be expected to occur.

3.1.7.1 Land stability

Although the published soils mapping indicates the potential for erosion following land clearing, there is no evidence of significant pre-existing land degradation/erosion in the undisturbed land within the lease areas even on steeply sloping land. Soil analysis of the stored topsoils shows that local soils have a good clay content, >90% calcium saturation (and very low sodium saturation) and are non-sodic (See Section 3.5.3). Therefore, the soils do not have characteristics that would make them pre-disposed to ongoing stability issues.

3.1.7.2 Agricultural potential and productivity

According to the Rockhampton Planning Scheme (Rockhampton Regional Council 2015), the project area is outside areas mapped as Agricultural Land Classification (ALC) Class A and B. The land is therefore not suited to high intensity land uses like cropping. The Land Systems mapping in the *Lands of the Dawson-Fitzroy Area, Queensland* (CSIRO 1968) characterises land within the project area as agricultural land class C1. Land class C1 is 'pasture land' defined as sown pastures and native pasture on high fertility soils.

Land quality with reference to the development of PMLUs is further discussed in a local, regional and state context in Section 3.3.1.1.

3.1.8 Ecological values

The site is located in an area that has been extensively cleared for agricultural activities. The surrounding landscape (outside the mining leases) is predominantly non-remnant vegetation with small, scattered patches of remnant vegetation.

According to the Queensland Government Regional Ecosystem (RE) mapping (Queensland Herbarium 2019), there are no areas of mapped remnant vegetation on ML 5763; however, there is one small patch of Category B remnant vegetation on ML 5764. The remnant vegetation on ML 5764 is a combination of REs:

- RE 11.11.16 (of concern) - *Eucalyptus cambageana*, *Acacia harpophylla* woodland on old sedimentary rocks with varying degrees of metamorphism and folding
- RE 11.3.26 (least concern) - *Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains (least concern).

This patch of remnant vegetation is approximately 2.53 ha in size and is located in the north and northeast corner of the mining lease, outside of the disturbance footprint. This will be retained as part of the rehabilitation and closure planning.

No regrowth vegetation is present within either of the MLs; however, a small patch of Category C high value regrowth (REs 11.11.16/11.3.26/11.3.1/11.3.25) occurs approximately 40 m to the east of ML 5763. Additionally, a larger patch of Category R watercourse and drainage regrowth borders the southeast corner of ML 5763 extending to the northeast away from the site (Figure 8).

Lantana and rubber vine have been recorded on the mine site. These species are considered Category 3 restricted invasive plants under the *Biosecurity Act 2014*. An eradication program for declared weeds began in 2003 in which basal spraying was carried out on infested areas in approximately 40% of the mine lease. Graymont undertakes regular maintenance weed control by engaging a local contractor to spray the weeds as required (typically three to four times per year).

A desktop fauna assessment was conducted within 3 km of the project area using the WildNet database (Appendix A; Queensland Government 2021). WildNet searches determined species or species habitat which may be present within the area. Results returned the potential presence of 10 amphibians, 93 birds, 10 ray-finned fishes, and 4 reptiles. Of these species, only 3 were listed as threatened under State or Federal legislation. Atlas of Living Australia searches (Atlas of Living Australia 2021) found occurrence records for an additional 6 bird species, one of which (squatter pigeon; southern population) is a threatened species. Likelihood of occurrence assessments were conducted for threatened species, as shown below in Table 6. Only the squatter pigeon is likely to occur close to the project area. The proposed rehabilitation has the potential to increase the availability of suitable habitat for the species (refer to habitat preferences in Table 6).

Table 6: Threatened fauna that are known to occur, or potentially occur, in or around the project area

Scientific Name	Common Name	EPBC Act Status	NC Act Status	Habitat description	Likelihood	Justification
Calidris ferruginea	Curlew sandpiper	CE	CE	Mainly occur in both fresh and brackish waters on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms but are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. Curlew Sandpipers forage on mudflats and nearby shallow water and generally roost on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh.	Unlikely	No ALA records within proximity of the project area. No suitable habitat occurs within the project area.
Limosa lapponica baueri	Western Alaskan bar-tailed godwit	V	V	Inhabits mainly in coastal areas such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays, around beds of seagrass, saltmarsh, coastal sewage farms and saltworks, salt lakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats. Rarely found on inland wetlands or in areas of short grass, such as farmland, paddocks and airstrips.	Unlikely	No ALA records within proximity of the project area. No suitable habitat occurs within the project area.
Numenius madagascariensis	Eastern curlew	CE	E	Associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sand flats.	Unlikely	No ALA records within proximity of the project area. No suitable habitat occurs within the project area.
Geophaps scripta	Squatter pigeon (southern population)	V	V	The Squatter Pigeon (southern) occurs mainly in grassy woodlands and open forests that are dominated by eucalypts. It has also been recorded in sown grasslands with scattered remnant trees, disturbed habitats (i.e., around stockyards, along roads and railways, and around settlements, in scrub and acacia growth, and remains common in heavily-grazed country north of the Tropic of Capricorn. The species is commonly observed in habitats that are located close to bodies of water.	Known	ALA species records occur within proximity to the project area.

CE = Critically Endangered, E = Endangered, V = Vulnerable

3.1.9 Project description

3.1.9.1 Underlying landholders

ML 5763 and ML5764 lie within Lot 3 on Survey Plan 252980 Rockhampton Regional Council Local Government Area. Graymont (NSW) Pty Ltd became the registered owner of Lot 3 on SP 252980 -on 24 December 2019. The tenure is Freehold.

3.1.9.2 Mining tenure

Details of the granted mining leases for the Marmor operation are provided in Table 7.

Table 7: Details of mining tenure for Marmor

Mining Lease number	Lease holder	Date granted	Expiry date	Areas (ha)	Activity
ML 5763	Graymont (NSW) Pty Ltd	01/04/1974	31/03/2031	15.4	Mining Limestone
ML5764	Graymont (NSW) Pty Ltd	01/04/1974	31/03/2031	16.1	Mining Limestone

3.1.9.3 Mining operation and activities

Marmor Operation comprises of Mining Leases (MLs) ML5763 and ML5764 (both were granted 1/04/1974 and expire 31/03/2031), covering 15.4 and 16.1 ha respectively.

Mining has been undertaken using open cut methods. No underground mining has occurred or is planned. Limestone was mined at Marmor for use as flux at the nearby Mount Morgan mine from the late 1800s until approximately 1923. From the 1980s until 2004, Unimin (the name formally used by Sibelco) extracted small tonnages of white limestone from the north wall and from the floor at the north end of the pit for use as decorative stone and for landscaping. Sibelco had planned to recommence operations on the 2010s and conducted works to stabilise the void (see Section 3.1.11.2). However no mining was undertaken.

Sibelco also ceased calcination operations prior to Graymont's acquisition of the operation. Until the site was put into care and maintenance limestone was purchased from the Sibelco site at Calliope near Gladstone and transferred to the Marmor site where it was processed at a yearly rate of approximately 70,000 tonnes per annum. When the plant was operating, the limestone was fired on the site in a rotary kiln powered by coal as part of the calcination process to produce burnt-lime. The burnt limestone was then milled to produce quick-lime, which is sold in bulk or diverted to the hydrator where it is hydrated and sold as either bulk or bagged product.

Waste lime from the kiln baghouse was stored in a storage bin. It was mixed with reject or waste limestone and coal ash and placed in stockpiles within the mined out sections of the void and outside the void near the ROM.

The site does not have a tailings storage facility.

As the site is in care and maintenance, current activities undertaken by Graymont are limited to site maintenance, environmental monitoring and implementation of environmental management to prevent/mitigate environmental harm.

Graymont is considering its options to restart operations at the site when favourable economic conditions exist. The site is still considered to have materials that are suitable for use as road base. However, a planned closure date of 2030 is being considered and rehabilitation planning has been undertaken on that basis.

3.1.9.4 Mine features and disturbance types

The disturbance types and areas have been approved in the Marmor EA together with the PMLU and other post-mine land requirements.

Table 8 provides a description of each disturbance type and the activities or assets associated with it. This has been used as the basis for the development of the Rehabilitation Areas (RAs) described in Section 3.1.11.1. The extent of the disturbance types and activities is shown in Figure 1.

Table 8: Description of the disturbance types and associated activities at Marmor

Disturbance type (as defined in the EA)	Details of activities or assets within each disturbance type
Product stockpiles	Limestone stockpiles Coal stockpiles ROM pad trafficked areas (gravelled areas surrounding limestone and coal stockpiles)
Infrastructure	Buildings and sheds (general and portable structures including administration, crib rooms, sheds, ablutions) Workshop Processing plant/equipment (inclusive of concrete pads, silos, bins and hoppers, conveyors) Tanks – hydrocarbons (and associated concrete bunds) Tanks – other Sediment pond Weighbridge Laydown or trafficked areas (gravelled areas surrounding processing plant, workshop administration and work areas that may include sections of gravel roads/access tracks) Vegetated (areas of minimal disturbance adjacent to other activities where vegetation has been retained or has passively regenerated)
Roads and tracks	Unsealed tracks Gravel roads (that may include access to ROM and void areas) Sealed road (bitumen sealed site entrance)
Topsoil stockpiles	Topsoil stockpile
Residual voids	Pit Lake Pit Lake catchment Mixed coal ash, lime kiln dust and reject limestone stored in the void
Rejects & waste stockpiles	Mixed coal ash, lime kiln dust and reject limestone stockpiles

3.1.9.5 Notifiable activities

Notifiable activities as prescribed by Schedule 3 (29)(b)(ii) of the EP Act are undertaken at Marmor Operations, on ML 5764:

- 21 - Lime burner—manufacturing cement or lime from limestone material using a kiln and storing wastes from the manufacturing process.
- 29 - Petroleum product or oil storage (for petroleum products or oil in class 3 in packaging groups 3 of the dangerous goods code— more than 5,000L capacity).

A 10,000 L diesel fuel tank on a low stand surrounded by a concrete bund with a capacity of 25,000 L and a shut-off valve is present on the site but is no longer utilised. Fuel is stored in a 2,000L self-bunded tank that is filled on demand.

Land is required to be listed on the Environmental Management Register where notifiable activities have been or are being carried out on the land.

3.1.9.6 Environmentally relevant activities

The Environmentally Relevant Activities (ERAs), as described in the *Environmental Protection Regulations 2019*, carried out at Marmor Operations are listed in Table 9. These are included in the EA.

Table 9: Marmor ERAs

Environmentally relevant activity/activities	Location
Schedule 3 21: A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20	ML5764
Schedule 3 20: A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20	ML5763
Ancillary 41 - Cement manufacturing 2: Calcining 200t or more of limestone in a year	ML5764
Ancillary 41 - Cement manufacturing 2: Calcining 200t or more of limestone in a year	ML5763

3.1.10 Design for closure

The operation was developed at a time when consideration of rehabilitation and closure was not built into the mine design or layout of operational areas. However, the site is not in a floodplain and the residual void is not expected to overtop (see also Section 3.5.11.3), there are no watercourses on site and ecologically significant vegetation occurs outside of the main disturbance area (Sensitive receptors have been identified in Figure 8 and the spatial data for this provided separately).

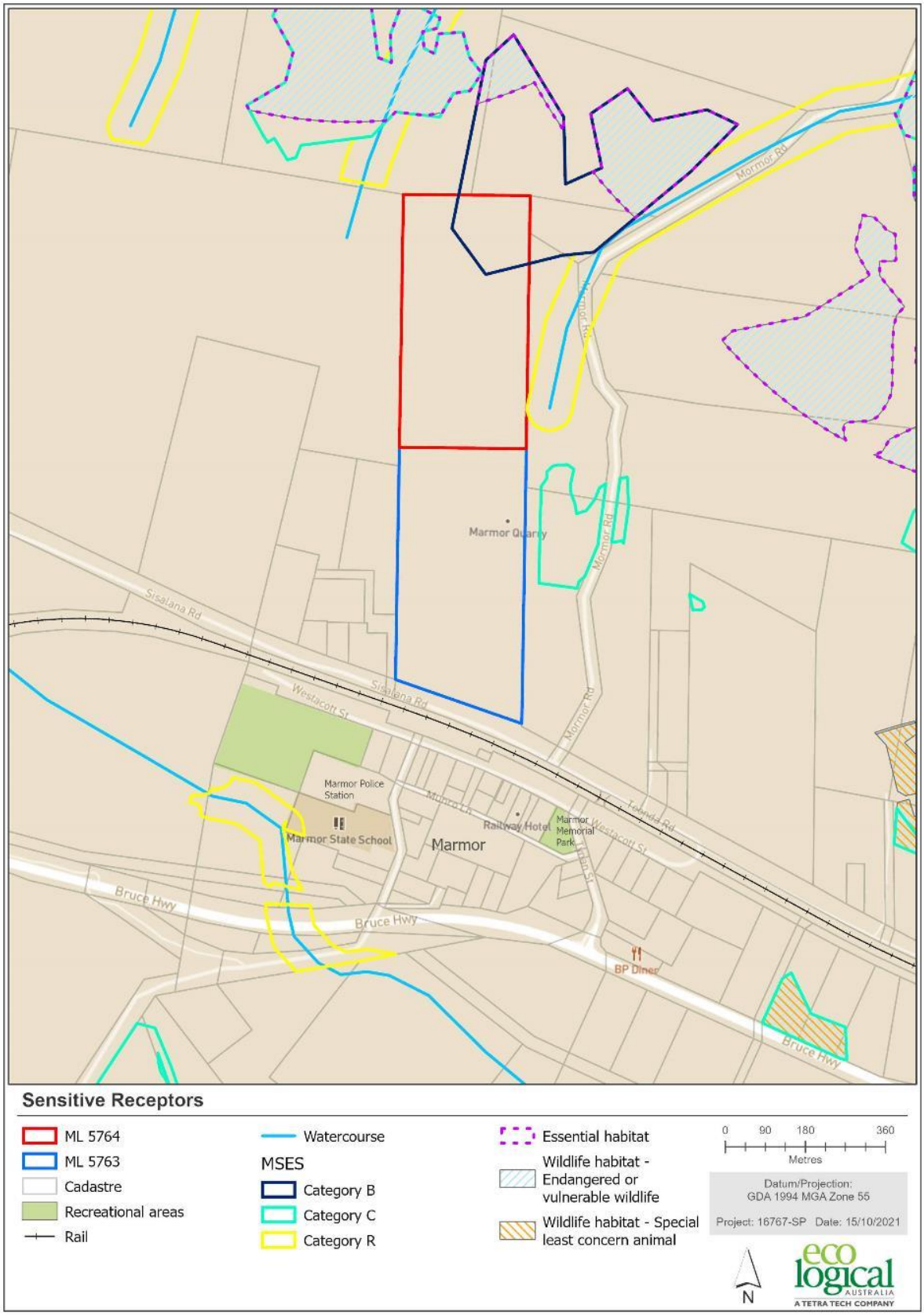


Figure 8: Sensitive receptors including Matters of State Environmental Significance (MSES) surrounding the Marmor lease areas

There are also no geochemically reactive or acid forming wastes at Marmor, neither are there any waste rock or overburden dumps, tailings dams, heap leach pads, or waste tyre stockpiles that would require selective placement.

Therefore, due to the simple mining methods used, the inert nature of the mined resource and the small scale of disturbance and the absence of significant flooding or void overtopping risk, the specific lack of documented decision making regarding the optimal location of infrastructure and facilities will not hinder the safe and successful rehabilitation of mine-affected areas to a stable condition.

3.1.11 Rehabilitation planning

3.1.11.1 Rehabilitation areas

The disturbance types and relevant activities shown in Figure 1 have been consolidated into RAs with similar rehabilitation requirements. Table 10 provides details of the RAs and they are shown in Figure 9. The RAs do not necessarily align exactly with the outline of disturbance types as listed in EA. This is particularly so for areas to areas that may have been designated as tracks (that run through infrastructure areas or may have been associated with void access), and stockpile footprints that are no longer used for this purpose and have been incorporated into the infrastructure area (as parking/trafficked or laydown areas) for the purposes of rehabilitation planning. However, the overall disturbance footprint of 12.37 ha is within that approved in the EA (14.25 ha).

Table 10 Disturbance types and RAs at Marmor Operations

Disturbance Type	Rehabilitation Area	Area (ha)[2]
Product Stockpiles & Infrastructure	RA1 – ROM Pad, Laydown Area and Product Stockpiles	1.09
	RA2 – Infrastructure (Buildings/Water Tanks)	0.07
	RA3 – Infrastructure (Process Plant/Hydrocarbon Storage)	0.28
	RA4 – Sediment Dam	0.11
	RA5 – Laydown Area (surrounding offices and Process Plant)	1.68
	RA6 – Vegetation Disturbance Area[1]	0.54
	Total	*3.78*
Roads and Tracks	RA7 – Unsealed Tracks	0.40
	RA8 – Site Entrance Tracks	0.34
	Total	*0.74*
Topsoil Stockpiles	RA9 – Topsoil Stockpiles	0.46
Residual Void	RA10 – Residual Void (Pit Lake)	0.69
	RA11 – Residual Void (Catchment)	5.25
	RA12 – Waste Stockpiles (In Void)	0.90
	Total	*6.85*
Waste Stockpiles	RA13 – Waste Stockpiles (Ex Void)	0.55
Total Site Disturbance		**12.37**

1. This includes areas that are within the disturbance envelope that are either remnant vegetation or have passively regenerated.
2. Rounding of areas of individual RAs may mean the sum for each disturbance type may not match exactly.

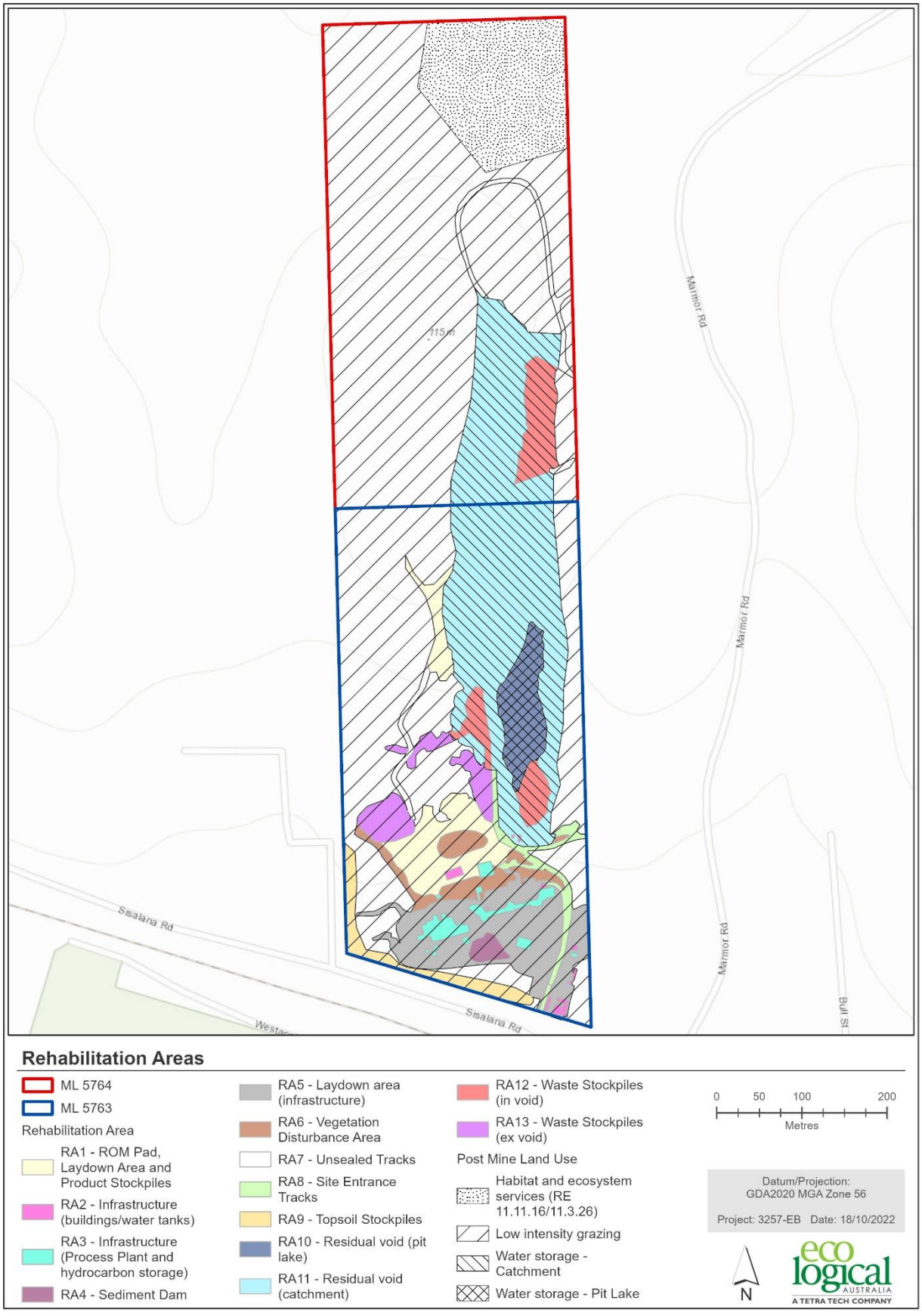


Figure 9: Rehabilitation Areas and final PMLU at Marmor

3.1.11.2 Rehabilitation works previously carried out

Although no areas have been fully rehabilitated, the previous owners of the site (Sibelco) conducted a lot of work in the void as part of planning to recommence operations. This involved stabilisation of the void walls according to recommendations provided by a geotechnical consultant (Rocktest 2014). These works were completed in 2014 and are documented in Rocktest (2022). They included the following:

- Limestone and sandstone protruding from the middle section of the west wall were excavated and the section of the wall was benched and scaled (loose/dangerous material removed from highwalls) to reduce the hazards applicable to vehicles accessing the haul road through the pit. This also resulted in the sealing of a small adit in the west wall.
- The crest of the east wall was cut back to ensure the risks applicable to operations on the floor would be acceptable.
- The east wall was scaled after rocks pushed over the crest during the cutback triggered falls of individual rocks and masses of rocks that previously had marginal capacities.
- The north wall was scaled.

Although this work was largely undertaken for operational safety, the works have provided long-term stability that is acceptable for closure. No other rehabilitation has been conducted to date at Marmor. Land can only be released for rehabilitation when it is no longer required for operations. Prior to acquisition by Graymont, the Plant had been operational and all of the disturbed areas were used as part of the on-going operation of the site including the void, for access to the resource and waste stockpiling, and the pit lake, as a water supply for process make-up water.

3.1.11.3 Progressive rehabilitation

Condition D1-2 of the EA states that, "*Progressive rehabilitation must commence when areas become available within the operational land*". Graymont recognises the importance of progressive rehabilitation in the overall production cycle as it allows for the disturbance area to be minimised as much as practicable. The site is in care and maintenance and as all areas may be used if operations recommence, none of the disturbance areas are currently available for further rehabilitation. When operations cease completely (currently planned for 2030), progressive rehabilitation of the RAs can commence.

The Rehabilitation Milestones for Marmor are presented in Section 3.3.2). The implementation timeframe is discussed in 3.3.2.9 and the PRCP schedule is presented in Appendix B.

3.2 Community consultation

The previous operators (Sibelco) implemented a detailed community engagement plan and identified stakeholders including regulatory agencies, Rockhampton Regional Council, Community Leaders (from the local police, Marmor State School, QCW, business community) and Marmor residents. Several engagement methods were employed to inform stakeholders of blasting events, changes in operations that may cause disruption and new developments on site. A register of engagement was maintained.

The local community was advised by Sibelco through a Marmor Community Advisory Group meeting on 18 May 2016, that the Marmor Operation would be going into care and maintenance and that Community Advisory Group meetings would be suspended. The site has not been re-opened by

Graymont and as no further development or changes to operational plans have been made, no further community meetings have been held to date.

PMLUs have been previously approved through an existing LOD (the EA, Appendix C) and under transitional arrangements have been included in the PRCP. There has been no change to the proposed PMLU for any of the disturbance types. Graymont has developed a Community Engagement Plan for the Marmor Operation (presented in Appendix D). This included a commitment to conduct a community 'Town Hall' style event in November 2021 to discuss Graymont's plans for the site including PMLUs nominated in the PRCP.

The Community Engagement Plan presented in Appendix D includes:

- Consultation objectives
- Consultation approach and community engagement methods (how the community will be engaged)
- The proposed frequency of engagement (depending on the trigger)
- The types of information that will be shared and the methods/media through which this will be achieved
- Monitoring and reporting schedule to
    - record outcomes of engagement and comments received
    - document all commitments and agreements made with key stakeholders and the progress of these commitments and agreements.

Graymont has maintained the Community Engagement Register established by Sibelco (Appendix D). Although previous discussions with the community have included operational matters and the transition to care and maintenance, there were no records of specific discussion about PMLUs in the register prior to 2021.

The most recent community meeting was held on 25 November 2021 at the nearby Bajool School of Arts Hall. This was the first community meeting since Graymont acquired the Marmor Operation from Sibelco in August 2019. It included a presentation by Simon Havis, the Site Manager for Marmor, with the following agenda items:

- An introduction to Graymont
- Marmor operations (including care and maintenance activities)
- Rehabilitation plans (including the PRCP and PMLUs)
- Questions – floor opened to questions from attendees.

The meeting was attended by approximately 20 people including residents, local businesses owners and former staff. Local government stakeholders were invited but did not attend. Most of the questions received from attendees were in relation to future mining plans, future mill operation plans and employment opportunities. No concerns were raised about site management, rehabilitation activities or the PMLUs.

3.3 Post Mine Land Use

3.3.1 Selection of PMLUs

The PMLUs for Marmor have previously been approved through an existing LOD (the EA). Condition D1-1 of the EA require that, "*All areas significantly disturbed by mining activities must be rehabilitated to a stable landform with a self-sustaining vegetation cover in accordance with final land use and landform design in Schedule D – Table 1*". The applicable LOD is presented in Appendix C and the PMLUs and criteria that are to be carried over from the EA for each disturbance type are provided in Table 11 (updated to reflect the remaining MLs that are relevant to the current EA).

With the exception of the mine void, the PMLU for the entire site will be low intensity grazing. Ultimately the aim is to create grazing land that requires no more management than would be expected for surrounding land under a similar land use. The species mix selected is specifically suited to the location and the species are adapted to low fertility soils (i.e., they will not require high rates of fertiliser/maintenance). The milestone criteria developed include minimum standards to be achieved for land condition and referential targets for pasture productivity.

The void will be retained for water storage through accumulation of surface water. The water storage has been split into the pit lake (the likely extent of the stored surface water in the void – RA10) and the void catchment (the inward draining component of the void above the surface water line that directs surface water to the pit lake – RA11 and RA12 (currently covered by stockpiled rejects and waste)). The void catchment as part of the water storage PMLU will not only function to harvest rainfall and run-off for the pit lake, but rehabilitation activities will facilitate further vegetation regeneration that, once established, will reduce sediment input into the water prior to entry into the void.

Table 11: PMLUs nominated for disturbance types in the Marmor EA

	Disturbance type and rehabilitation areas					
	Product stockpiles	**Residual voids**	**Infrastructure**	**Roads and tracks**	**Rejects & waste stockpiles**	**Topsoil stockpiles**
Equivalent rehabilitation area in this PRCP	RA1 (part)	RA10 to RA12 inclusive*	RA1 (part) – RA6 inclusive	RA7 & RA8	RA13*	RA9
Tenure ID[4]	ML5763	ML5763 ML5764	ML5763	ML5763 ML5764	ML5763 ML5764	ML5763
Post mine land use	Low intensity grazing	Water storage	Low intensity grazing	Low intensity grazing	Low intensity grazing	Low intensity grazing
Foliage projective cover range (%)	50	N/A	50	50	50	50

** Some reject and waste is currently stockpiled in the void and rehabilitation of these areas will be treated separately. However, the PMLU only applies to Rejects & waste stockpiles outside of the residual void.*

[4] The EA Schedule D – Table 1 still includes reference to ML 3614 (Ambrose) that has been deamalgamated from the Marmor Operation and is excluded from this Table.

As discussed in Section 3.1.3, the water in the residual void has a slightly acid to alkaline pH and low total dissolved solids (c. 340 mg/L) and the background geology is inert. Although no limitations are expected in terms of water quality for stock use, monitoring will continue until closure to ensure that water stored in the residual void remains suitable for supporting the surrounding grazing PMLU.

Areas of existing grazing land and remnant vegetation within the leases areas not affected by mining will be retained as part of the final PMLU at completion.

3.3.1.1 Consistency between the proposed PMLUs and any strategies or plans for the land

The land is zoned L1 - Rural under the Rockhampton Planning Scheme (Rockhampton Regional Council 2015).

Section 6.7.4 (Rural zone code) of the Rockhampton Planning Scheme states that the purpose of the rural zone code is to:

- ensure that land with productive capacity is maintained for a range of existing and emerging rural uses that are significant to the economy of the planning scheme area
- recognise that different types of rural land are suited to specific uses such as animal industries, horticulture, cropping, intensive animal industries, intensive grazing and extractive industries
- prevent the establishment of development which may limit the productive capacity of the land
- provide for diversification of rural industries where impacts can be managed
- maintain the environmental values of all rural land.

The purpose of the zone will be achieved through development in the zone that accommodates predominantly rural uses. The return of mine impacted land to a pasture PMLU for agricultural use is therefore consistent with the current zoning.

The planning scheme also states that non-rural uses may be appropriate where they do not detract from the productivity and can demonstrate a direct relationship with the rural use in the immediate locality; or the potential to make a contribution to primary production or the diversification of rural industries. Therefore, the PMLU of the residual void for the creation of a water storage (for primary industry use such as stock watering) is also consistent with the planning scheme.

Regional interests (relating to agricultural land) are designated in the *Regional Planning Interests Act 2014* (RPI Act) and include Strategic Cropping Land. The project area is outside mapped areas of Strategic Cropping Land.

State interests, relating to land areas requiring protection for sustainable agriculture, are recognised by the *State Planning Policy – July 2017* (DILGP 2017). They include Important Agricultural Areas (IAAs) as identified by the Queensland Agricultural Land Audit (DAFF 2013). Designation of land as an IAA is based on Agricultural Land Classification (ALC) (DILGP 2017) with ALC Class A and ALC Class B land protected for sustainable agricultural use. The project area is outside mapped areas of IAAs and areas recognised as ALC Class A and B. Therefore, the designation of a PMLU of grazing is consistent with the quality of the land at Marmor and also consistent with State and Regional Interests with respect to the protection of valuable productive agricultural land.

Plans for the rehabilitated areas are compatible with the surrounding land use (see Figure 5) and broader regional economic priorities. The importance of continued growth in agricultural production is recognised in the Rockhampton Region Economic Development Strategy Summary Report (RPS 2015). Rockhampton is the beef capital in Australia and the Fitzroy Natural Resource Management (NRM) region is home to one of the largest concentrations of beef capital in the country. In 2012/13, there were almost 3 million head of cattle in the NRM region, or some 23.4% of the State herd.

The designation of a PMLU of grazing is therefore consistent with Local Government Planning Scheme zoning, State Government State and Regional Planning Interests as well as Regional Economic and Development Strategies.

The final land use for all areas within the lease boundaries, including rehabilitation areas as well as un-mined pasture and remnant vegetation areas, is shown in Figure 10.

3.3.2 Rehabilitation milestones

The PRCP guideline requires the development of rehabilitation milestones and milestone criteria for all rehabilitation areas that have a PMLU (DES 2021). Milestones identify significant events or steps in the rehabilitation process and will be legally enforceable commitments once the PRCP Schedule is approved. These milestones apply to areas when they become available for rehabilitation. In accordance with the PRCP guideline, for Marmor, Graymont have developed milestone criteria that are SMART (Specific, Measurable, Achievable, Relevant and Timebound). The milestone criteria have been developed to ensure the EA approval conditions for rehabilitation are met (see Table 1) and that they address the risks identified in the risk assessment (Section 3.6 and Table 18).

They also address the overall rehabilitation aim of providing rehabilitated land that is in a stable condition according to the definition in Section 111A of the EP Act.

Rehabilitation milestones and milestone criteria for Marmor Operations are presented in Table 12. The activities to be conducted for each milestone and the basis for some of the site specific milestone criteria are described in the following sub-sections.

3.3.2.1 Rehabilitation milestone 1 - Infrastructure decommissioning and removal

No buildings, sheds or fixed assets will be retained and all existing infrastructure will be decommissioned. This milestone will include the identification and, as necessary, removal of hazardous building materials (such as asbestos). All decommissioned assets will be demolished and demolition waste removed from site for recycling or disposal at an appropriately licenced facility.

3.3.2.2 Rehabilitation milestone 2 - Stockpiled reject and waste material removal

The EA does not currently provide approval for waste disposal on site. Therefore, all stockpiled mixed lime kiln dust, coal ash and reject limestone will be removed from the lease areas. The waste will be classified and appropriately disposed of at a waste management facility licenced to receive such waste. Validation sampling by an appropriately qualified person (AQP) will be used to verify that the waste has been removed.

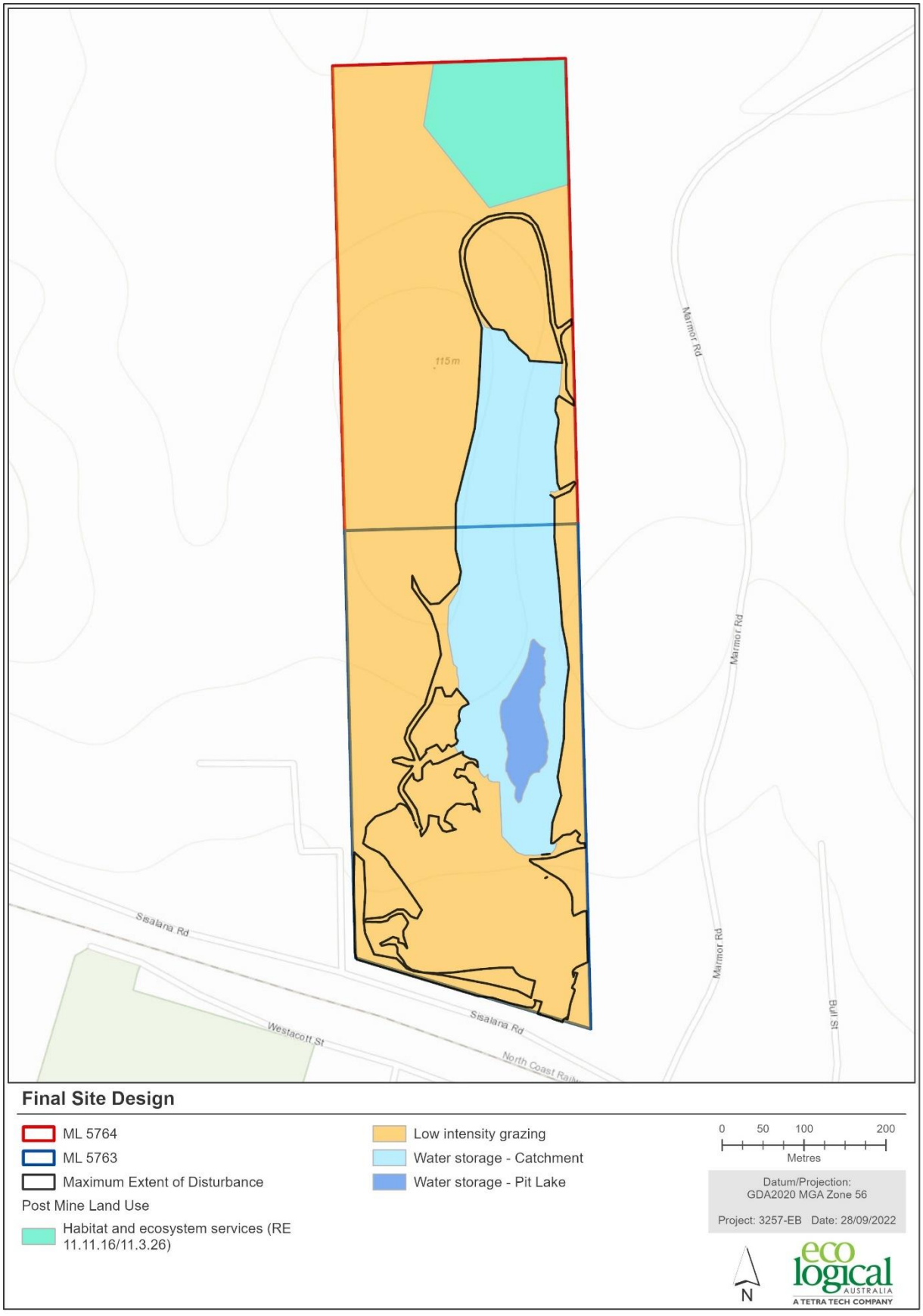


Figure 10: Final site design showing PMLUs

Table 12: Marmor Operations Rehabilitation Milestones and Milestone Criteria

Milestone ID	Reference Milestone	Milestone Criteria	Relevant RAs
RM1	Infrastructure decommissioning and removal	a) All services disconnected. b) All hazardous building materials removed by appropriately licensed contractors. c) All infrastructure assets demolished, and demolition waste removed to an appropriately licensed facility. d) All limestone feed stock not to be used for surface water management structures removed from stockpiles in RA1 and placed in the void. e) All coal removed from stockpiles in RA1 and disposed of an at appropriately licensed facility. f) All bitumen in RA8 removed and disposed of at appropriately licensed facility. g) Sediment dam (RA4) dewatered.	RA1, RA2, RA3, RA4, RA5, RA8
RM2	Stockpiled reject and waste material removal	a) Mixed lime kiln dust, coal ash and reject limestone waste stockpiles removed. b) Validation sampling by an AQP[1] confirms waste removed to virgin ground. c) Waste classified and disposed off-site at an appropriately licensed facility.	RA10 (part) RA12, RA13
RM3	Contaminated land assessment and remediation	a) Contaminated land investigation undertaken by an AQP. b) All contamination is remediated or removed from site. c) Contaminated material removed from site has been removed in accordance with relevant regulations. d) A contaminated land investigation document has been prepared by an AQP, containing a site suitability statement that states that land is not contaminated and is suitable for the proposed PMLU.	RA3, RA4
RM4	Landform development	a) An AQP has confirmed that geotechnical stability of the residual void walls (i.e., a factor of safety value of ≥1.3) has been achieved. b) Surface aggregate in RA1 and RA5 removed to a depth of 300 mm and placed in the floor of the residual void. c) All temporary and permanent Erosion and Sediment Control Structures have been designed and installed with reference to *Best Practice Erosion & Sediment Control* series (IECA 2008). d) Average slope of areas to be revegetated does not exceed 15% (RA1 – RA5, RA8, RA9, RA13). e) Unsealed tracks (RA7) graded to conform to the surrounding landform. f) Sediment dam bund pushed onto dam and levelled (RA4). g) All bores decommissioned.	RA1, RA2, RA3, RA4, RA5, RA7, RA9, RA11, RA12, RA13
RM5	Surface preparation	a) All areas to be revegetated ripped to a depth of 500 mm at 500-800 mm spacings (RA1-RA5, RA7-RA9, RA13). b) Haul roads/access tracks within the residual void (RA11) ripped to a depth of 500 mm at 500-800 mm spacings. The exposed void floor (RA12) has been scarified. c) Prior to application, stockpiled topsoil or imported topsoil has been assessed by an AQP to confirm it is suitable for target vegetation establishment. d) Topsoil placed to an average depth of 150 mm (RA1-RA5, RA7-RA9, RA13). e) Any fertilisers/ameliorants recommended as a result of the soil assessment have been applied at the rate recommended by the AQP (RA1-RA5, RA7-RA9, RA13).	RA1, RA2, RA3, RA4, RA5, RA7, RA8, RA9, RA11, RA12,-RA13

Milestone ID	Reference Milestone	Milestone Criteria	Relevant RAs
RM6	Revegetation	a) Seeding with Black Spear Grass (*Heteropogon contortus*), Forest Bluegrass (*Bothriochloa bladhii ssp. glabra*) and Shrubby Stylo (*Stylosanthes scabra*) at a rate of 2 kg/ha each has been completed (RA1-RA5, RA7-RA9, RA13). b) An AQP has assessed the condition of existing vegetation (RA6) in relation to the nominated PMLU and any recommendations provided as a result of the assessment have been implemented.	RA1-RA9, RA13
RM7	Establishment of post-mining land use vegetation and surface conditions (grazing)	a) The rehabilitation monitoring program has been implemented. b) Bare ground % is equivalent to at least a "fair" condition as defined by Future Beef (Land condition - FutureBeef). c) Native or introduced desirable palatable and productive species cover trending towards at least 50% of the vegetative ground cover or at least 75% of the average desirable palatable and productive species cover % recorded at reference areas whichever is lower. d) Pasture standing biomass is >45% and trending towards 75% of average standing biomass of reference areas. e) The cover of declared plant pest species will be no more than one rating[2] greater than the average cover class recorded in reference areas. f) No active[3] gullies >1.0 m depth. g) Any gullies <1.0 m >0.3m have shown progressive stabilisation (i.e., have become partly stabilised or stabilised[4]) over successive annual monitoring events. h) Temporary Erosion and Sediment Control Structures removed.	RA1-RA9, RA13
RM8	Establishment of post-mining land use surface conditions (water storage)	a) Monitoring of the void crests and walls by an AQP shows that they have achieved long-term stabilities. b) Vegetation cover is increasing in areas of the Water Storage - Catchment PMLU that have been scarified or received recovered aggregate to enhance Pit Lake water quality (RA11, RA12). c) Pit Lake water quality physico chemical indicators do not exceed the trigger values for livestock (beef cattle) drinking water defined in Australian and New Zealand Guidelines for Fresh and Marine Water Quality – Volume 3 Primary Industries — Rationale and Background Information Sections 9.3.4 & 9.3.5 (ANZECC and ARMCANZ 2000) (RA10).	RA10, RA11, RA12
RM9	Achievement of post-mining land use to stable condition (grazing)	a) An assessment of carrying capacity by an AQP demonstrates a sustainable grazing outcome has been achieved. b) No active[3] gullies >0.3 m depth. c) Bare ground % is equivalent to at least a "fair" condition as defined by Future Beef (Land condition - FutureBeef). d) Native or introduced desirable palatable and productive species cover trending towards at least 50% of the vegetative ground cover or at least 75% of the average desirable palatable and productive species cover % recorded at reference areas, whichever is lower. e) Pasture standing biomass is ≥ 75% of reference areas. f) The cover of declared plant pest species will be no more than one rating[2] greater than the average cover class recorded in reference areas.	RA1-9, RA13

Milestone ID	Reference Milestone	Milestone Criteria	Relevant RAs
RM10	Achievement of post-mining land use to stable condition (water storage)	a) An AQP has confirmed that geotechnical stability of the residual void walls (i.e., a factor of safety value of ≥1.3) has been achieved. b) Access to the residual void is limited by the installation of an appropriate abandonment barrier (bund and/or fence) located at least 10 m beyond the area potentially affected by void wall instability as specified in the *Marmor Mine PRCP: Pit Geotechnical* Report prepared for Graymont v1.1 prepared by Rocktest Consulting October 2022. c) Safety signage designed in accordance with relevant Australian Standards erected at a minimum of 100 m intervals. d) An AQP confirms that the residual void walls drain internally to the residual void. e) Pit Lake water quality physico chemical indicators do not exceed the trigger values for livestock (beef cattle) drinking water defined in Australian and New Zealand Guidelines for Fresh and Marine Water Quality – Volume 3 Primary Industries — Rationale and Background Information Sections 9.3.4 & 9.3.5 (ANZECC and ARMCANZ 2000) (RA10).	RA10, RA11, RA12

1. AQP (appropriately qualified person) means a person who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis on performance relative to the subject matter using the relevant protocols, standards, methods or literature.
2. Where Ratings are defined in the *State Rural Leasehold Land Strategy: Guidelines for determining land condition* prepared by the Department of Natural Resources and Mines (DNRM). Version 3.0 July 2013.
3. Active as defined in *the Australian Soil and Land Survey Field Handbook* (3rd Edition), The National Committee on Soil and Terrain published by CSIRO Publishing 2009.
4. Partly stabilised and stabilised as defined in the *Australian Soil and Land Survey Field Handbook* (3rd Edition), The National Committee on Soil and Terrain published by CSIRO Publishing 2009.

3.3.2.3 Rehabilitation milestone 3 - Contaminated land assessment and remediation

The extent and nature of land contamination associated with notifiable activities identified and the risk it poses to human or ecological receptors in terrestrial or aquatic environments will be assessed by an AQP according to State regulations or nationally recognised guidelines (National Environment Protection Measure 1999) (NEPC 2013). Any unacceptable contamination will be remediated on-site or removed to an appropriately licenced waste facility and a site suitability statement will be prepared by an AQP stating that land is not contaminated and is suitable for the proposed PMLU. As required, the site will be removed from the Contaminated Land Register.

3.3.2.4 Rehabilitation milestone 4 - Landform development

The landform milestone criteria for the residual void have been based on the geotechnical assessment and acceptable stability characteristics as presented in Rocktest (2022).

Operations and closure at Marmor will not result in the creation of out of pit post-mine landforms commonly found at many operations. Therefore, no significant earthworks or recontouring will be required and most rehabilitated areas outside the void (with a grazing PMLU) are approximately at their final grade. Some disturbance areas adjacent to the void (within RA1) are on naturally elevated and more steeply sloping land, whereas the majority of the disturbance at the southern end of the site is generally slightly inclined. In developing the milestone criteria, appropriate land evaluation and post-mine planning guidelines have been reviewed to determine minimum slopes requirements that allow for a sustainable grazing land use.

The *Guidelines for agricultural land evaluation in Queensland* (DSITI & DNRM 2015) do not provide maximum slopes for the Land Capability Classes originally approved in the EA and the Land Suitability Framework for the Central Queensland Coast area, which includes Marmor, does not provide land quality requirements for native or improved pasture (DNRM & DSITIA 2013). Therefore, the requirements for other parts of Qld have been reviewed and used as the basis for the milestone criteria developed. Maximum slopes (based on land stability or erosion hazard) for land classified as suitable for grazing (i.e., classes 1 to 3 inclusive) range from 15 to 20% (for rigid, non-sodic soils) for rainfed pasture in the subtropics (DME 1995, DNRM & DSITIA 2013). This has formed the basis for maximum slope angles that can be safely used for establishing the grazing PMLU before significant management intervention is required to prevent stability, erosion or land degradation issues.

As roads and tracks are either surrounded by or adjacent to other RAs or areas of existing pasture and are of limited spatial extent, these areas will be graded to conform to the surrounding landforms.

3.3.2.5 Rehabilitation milestone 5 - Surface preparation

STOCKPILED TOPSOIL DEPTH AND SUITABILITY

The depth of topsoil used needs to be suitable for the adequate establishment of the target vegetation. In general, a depth of between 150 mm and 300 mm is acceptable (DME 1995), with shallower depths being adequate where soils are expected to have good water holding capacity and inherent fertility. The assessment of topsoil in stockpiles at Marmor has shown that the soils have good nutrient holding capacity and soil textures (both indicators of relative clay content) that infer good water holding capacity. Where topsoil depths have been recorded for soils that occur in the region, they are generally 100 to 150 mm deep (CSIRO (1968).

A topsoil depth of 150 mm is considered suitable for the establishment and maintenance of pasture at Marmor.

The quality of the stockpiled topsoil will need to be assessed by an AQP to confirm it is suitable for the target vegetation establishment and intended PMLU. Any fertilisers/ameliorants recommended as a result of the soil assessment will need to be included in the site preparation. Appropriate record keeping/ Inspection and Test Plans (ITPs) will be used to validate that they have been applied at the rate recommended by the AQP (see Section 3.5.10 and Appendix E).

The quality of stockpiled topsoil has already been assessed by an AQP as being of good quality, inherently stable and suitable (with amelioration) for the nominated PMLU (Section 3.5.3).

IMPORTED TOPSOIL QUALITY

When the volume of topsoil required to meet rehabilitation needs was compared to the available stockpiled volume, a shortfall of available topsoil was identified. Therefore, topsoil will be imported to make up for the shortfall. To ensure that all soils used for rehabilitation at Marmor are stable and of suitable quality, minimum standards for pH, salinity (measured as saturated paste electrical conductivity or ECe), stoniness and stability/erosion risk have been established to reflect the PMLU and species mix selected. The quality of imported topsoil will be assessed by an AQP (such as a Certified Professional Soil Scientist) prior to use and will have the following properties:

- stone content does not exceed 20% by volume
- electrical conductivity (salinity as saturated paste electrical conductivity or ECe) <4 dS/m
- pH range 5.5 to 8.0
- exchangeable sodium percentage (ESP) <6%
- Emerson Aggregate Test class of 3 (2), 3 (1), 4, 5, 6, 7 or 8 (Hazelton and Murphy 2007).

3.3.2.6 Rehabilitation milestone 6 – Revegetation

The species mix selected for the grazing PMLU at Marmor has been developed based on the advice of Stuart Buck, an Agronomist with Department of Agriculture and Fisheries (DAF) Extension Service in Rockhampton. Further justification for the selection of these species, and the inclusion of the exotic pasture legume Shrubby Stylo (*Stylosanthes scabra*), is provided in Section 3.5.9. Any remedial revegetation works for RA6 will also be conducted following a condition assessment and the implementation of recommendations provided by and AQP.

3.3.2.7 Rehabilitation milestone 7 - Establishment of post-mining land use vegetation and surface conditions (grazing) & Rehabilitation milestone 9 - Achievement of post-mining land use to stable condition (grazing)

These two milestones have been developed for the grazing PMLU to allow for:

- A period of vegetation establishment with milestone criteria that reflect progression toward the ultimate rehabilitation completion criteria. This period allows for timely corrective action to be undertaken should the rehabilitation not be on the desired trajectory (Rehabilitation milestone 7).
- A period to allow for the final achievement and maintenance of post-mining land use to a stable condition. The rehabilitation will be complete and suitable for certification application at the end of this milestone.

PROVISION OF FOLIAGE PROJECTIVE COVER FOR MINIMISING EROSION AND PROTECT LAND QUALITY AND LONG-TERM SUSTAINIBILITY FOR THE GRAZING PMLU

The Land Condition assessment developed by Future Beef (2021) (similar to that used in software packages such as Stocktake) provides a measure of the health of grazing lands. It relies on the monitoring of two main attributes:

- Soil condition. This is a measure of the capacity of the soil to absorb and store rainfall, to store and cycle nutrients, to provide habitat for seed germination and plant growth, and to resist erosion.
- Pasture condition. This is a measure of the capacity of the pasture to capture sunlight and convert its energy into palatable green leaf, to use rainfall efficiently, to conserve soil condition and to cycle nutrients.

The Land Condition assessment has four classes in order of decreasing condition or ascending degradation; good (or "A"), fair ("B"), poor ("C) and very poor ("D").

Rehabilitation should aim to provide soil and pasture conditions that are capable of resisting degradation and sustaining grazing in the long-term. The milestone criteria have been based on the equivalent of maintaining at least "fair" land condition. This requires the maintenance of at least 50% ground cover. Pasture condition carrying capacity requirements have been benchmarked to reference site productivity as a surrogate for carry capacity. Additional criteria have been added for pasture species composition to favour productive species.

Similar critical minimum ground cover requirements have been recommended by the Queensland Government (2013) (40% at the end of the dry season). Research work on post-mine landforms in central and southern Queensland shows that groundcover of at least 50% is required to significantly reduce soil erosion rates (Loch 2000, NRA 2000, So et al. 2018), with reductions in erosion rates becoming diminishingly smaller as cover increases beyond this value. This corresponds to the foliage projective cover already nominated in the Marmor EA and is considered appropriate for ensuring land stability under the grazing PMLU at Marmor.

GULLYING

Some erosion may occur on newly established landforms in the period before protective vegetation cover has been established. Unless this is severe enough to indicate an inherent landform design issue that has the potential to affect the post mine land use (i.e., has gullies >1m in depth), it will not necessarily affect long-term stability provided it stabilises quickly. On-going (active) gully erosion (i.e., features >0.3m deep) indicates that the site will not be stable in the long-term.

All gullying milestone criteria have been standardised to refer to the definitions and classification in *Australian Soil and Land Survey Field Handbook* (3rd Edition) (NCST 2009).

PEST PLANTS

The main objective is for rehabilitated land to have similar land management requirements to surrounding land under the same land use. Therefore the condition rating of the rehabilitated pasture with respect to pest plants (as defined in DNRM 2013) will be benchmarked to the condition rating of appropriate reference areas.

3.3.2.8 Rehabilitation milestone 8 - Establishment of post-mining land use surface conditions (water storage) & Rehabilitation milestone 10 - Achievement of post-mining land use to stable condition (water storage)

These two milestones have been developed for the water storage PMLU that allow for:

- A period of ongoing stabilisation in wall stability and water quality improvement that reflect progression toward the ultimate rehabilitation completion criteria. This period allows for timely corrective action to be undertaken should the rehabilitation not be on the desired trajectory (Rehabilitation milestone 8).
- A period to allow for the final achievement and maintenance of post-mining land use to stable condition with respect to the void geotechnical stability and pit lake water quality. The rehabilitation will be complete and suitable for certification application at the end of this milestone (Rehabilitation milestone 10).

3.3.2.9 Rehabilitation timeline and implementation of rehabilitation milestones

The timeline for implementing the rehabilitation milestones has had to take into account the linear nature of the site and the need to continued access through the site required to achieve rehabilitation objectives. This means that site access (RA8) will be the last part of the site to made available for rehabilitation.

The initial activity will focus on the removal of infrastructure, site decontamination and waste removal. To make this most efficient and allow similar activities across RAs to occur at the same time, the timing of completion of RM1, RM2 and RM3 has been aligned. This allows for the removal and disposal of residual coal (RM1 for part of RA1), any contaminated material (RM3 for RA3 and RA4) and mixed mine waste stockpiles (RM2 for RA10, RA12 and RA13). This will allow the earthworks and topsoiling to be conducted within the same timeframe over all relevant RAs (except RA8). Similarly, revegetation works can be conducted over all relevant RAs (except RA8) at the same time.

The timeframes for the establishment of post-mining land use surface conditions (RM7 for the grazing PMLU and RM8 for the water storage PMLU) and the achievement of post-mining land use to stable condition (RM9 for the grazing PMLU and RM10 for the water storage PMLU) have been developed with due consideration to the risks identified in Section 3.6 and Table 18 and the potential occurrence of unforeseen events. Sufficient time has been allowed to allow for the repair of rehabilitated areas during early establishment of the PMLU (five years) and to gather the data required to validate the final achievement of the intended PMLU to a stable and satisfactory condition for certification (up to ten years). It may be possible that to achieve the required rehabilitation outcomes before the end of the nominated timeframe.

The important dates and milestones are summarised below and the full PRCP Schedule is presented in Appendix B.

- 2030
  - RA1 – RA5 become available for rehabilitation
- 2032
  - RM1 completed on RA3 and RA4
  - RA10-RA13 become available for rehabilitation

- 2034
  - RM1 completed on RA1, RA2 and RA5
  - RM2 completed on RA10, RA12 and RA13
  - RM3 completed on RA3 and RA4
  - RA7 becomes available for rehabilitation
- 2036
  - RM4 and RM5 completed on RA1-RA5, RA7, RA9 and RA11-RA13
  - RA6 becomes available for rehabilitation
- 2038
  - RM6 completed on RA1-RA7, RA9 and RA13
  - RA8 becomes available for rehabilitation
- 2040
  - RM4 and RM5 completed on RA8
- 2042
  - RM6 completed on RA8
- 2043
  - RM7 completed on RA1-RA7, RA9 and RA13
  - RM8 completed on RA10-RA12
- 2047
  - RM7 completed on RA8
- 2053
  - RM9 completed on RA1-RA9 and RA13
  - RM10 completed on RA10-RA12.

3.4 Non-Use Management Areas

At closure, no non-use management areas (NUMAs) will be present at Marmor. NUMAs have not been considered during the preparation of this PRCP.

3.5 Rehabilitation Management Methodology

The following Sections contain the information required by the PRCP Guidelines. Some of the information relates to matters and strategies that may affect all PMLUs whilst others are more relevant to specific rehabilitation areas or rehabilitation activities.

3.5.1 Hydrogeological assessment

The groundwater setting and information of groundwater depth and characteristics is provided in Section 3.1.5. The following sections provide a hydrological assessment as it relates to the interaction of the void with groundwater resources and the potential for impact on groundwater quality and groundwater levels.

3.5.1.1 Regional groundwater flow

Based on groundwater elevations recorded in the region (Section 3.1.5.4), regional groundwater flow within the fractured rock aquifer system appears to flow from outcropping areas in the northwest to

lower lying elevations in the southeast (Figure 11). It is unknown if groundwater flow is constrained by the presence of the Queenslander fault system due to the absence of water level data from bores within close proximity of the faults. However, regionally, data from Bores 151927, 151544 and 161493 suggest groundwater is able to flow across the fault system.

The fractured rock aquifer is likely to be recharged at outcropping areas from direct rainfall and surface water flows, along with seepage in areas where the alluvial sediments overlay the formation. No groundwater springs or other potential discharge locations are reported within the study area.

Groundwater flow in the alluvial system likely follows topography, draining from the higher topographic elevations to lower lying regions. Recharge of the alluvial aquifer system is likely to occur via direct rainfall and lateral flows from estuaries and watercourses. Discharge from the alluvial system would likely be towards lower lying areas or into nearby perennial watercourses or drainage features (Inkerman Creek) (Figure 12). Discharge of alluvial flows may also occur to the two aquatic GDEs that are registered in the study area which are artificial water storages (i.e., dams).

3.5.1.2 Mine void groundwater interaction and water quality

The Marmor resource is situated within a lens of limestone and dolomite (Mount Alma Formation). Groundwater discharge / seepage into the void has not been observed/recorded to date (Meyers 2005; Rocktest Consulting 2014; Sibelco 2014; Rocktest Consulting 2022). The base of the void is situated at a maximum depth of approximately 30 mAHD while RSWL values from bore (136274) closest to the void is 12 mAHD. The lack of observed seepage is likely due to a hydraulic disconnection between the void and local groundwater table.

Void water samples were collected between 2013 and 2021. The pH ranged from 5.9 to 8.1 with an average pH of 6.7 and the EC ranged from 245 to 966 µS/cm with an average of as 497 µS/cm. These values suggest that that any present pit lake water is likely derived from rainfall and site surface water run-off. The most recent water quality results and trends in EC and pH for samples taken from the pit lake and the bore within the lease boundary show no similarity. Therefore, the data supports the view that it is unlikely, due to hydraulic disconnection, the groundwater quality is significantly affected by the surface water within the pit lake.

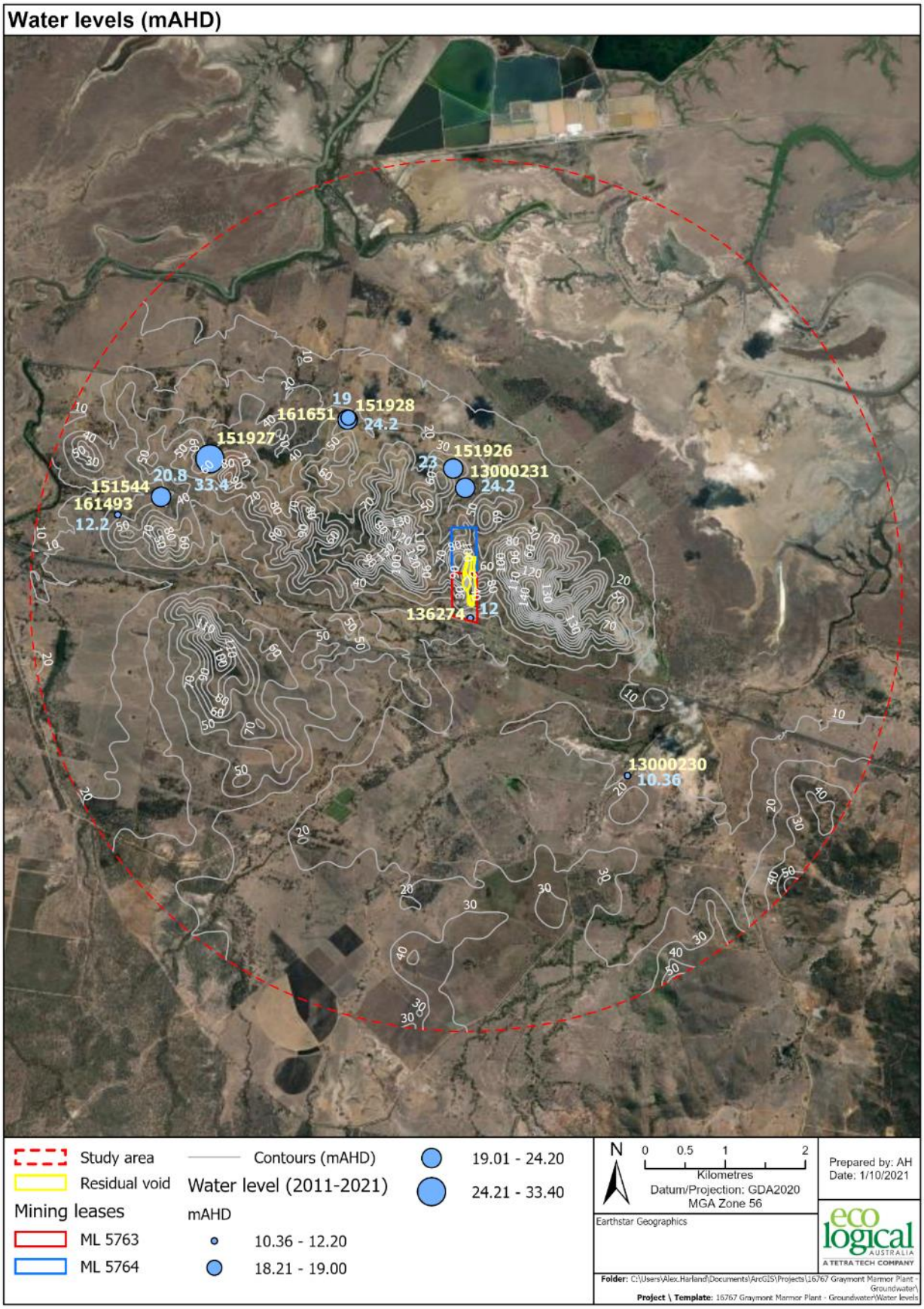


Figure 11: Topographical contours and bore water levels within the study area

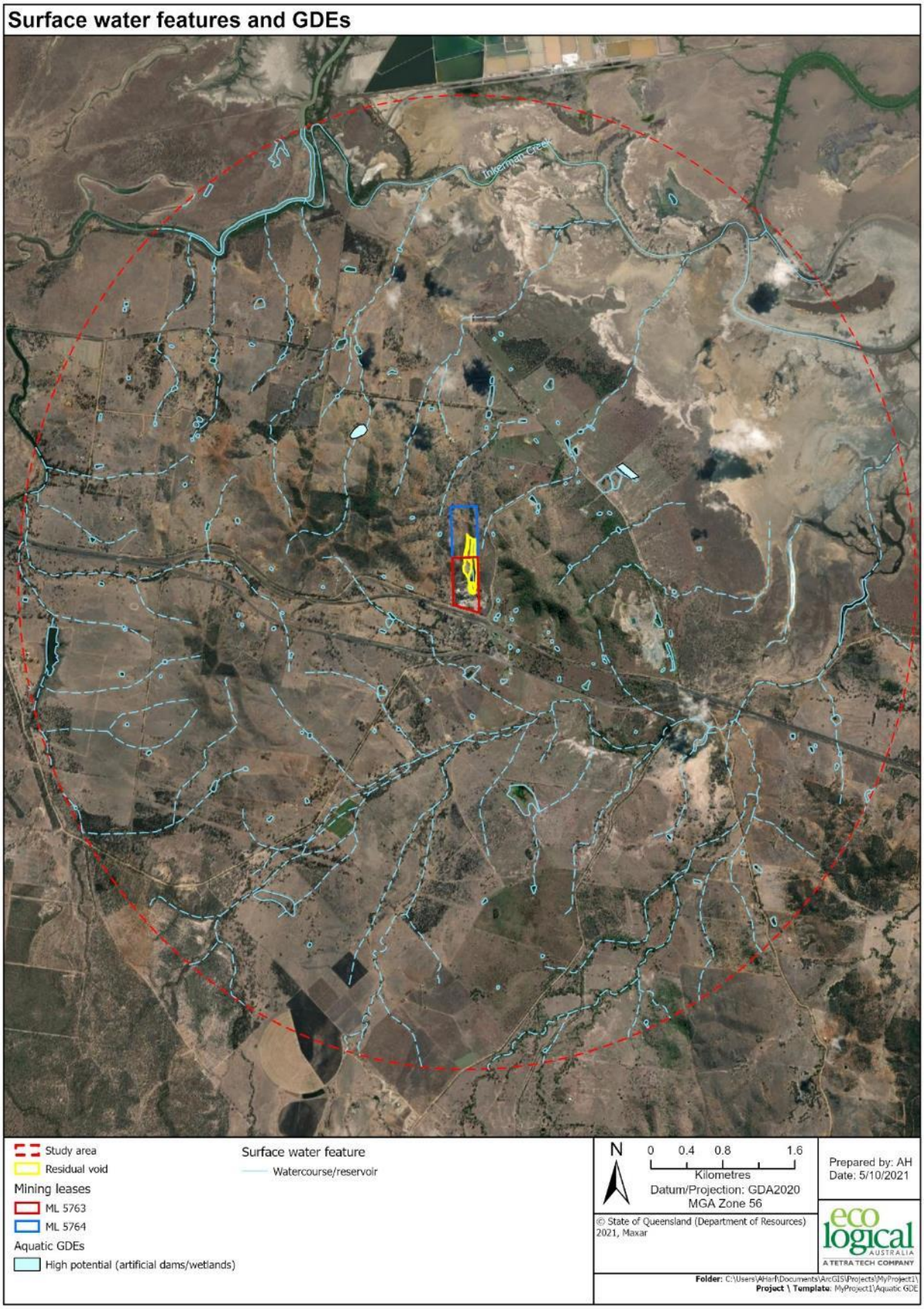


Figure 12: Location of surface water features and GDEs

3.5.1.3 Groundwater dependent ecosystems (GDEs)

AQUATIC

Two high potential aquatic GDEs exist in the study area (Figure 12). Both exist to the north-east and north-west of the study area and are characterised as artificial/highly modified wetlands. Groundwater flow into these GDEs is considered intermediate (BoM 2020c).

TERRESTRIAL

No high potential terrestrial GDEs exist in the study area.

SUBTERRANEAN

No high potential subterranean GDEs exist in the study area (BoM 2020c). However, the limestone rock of the Mount Alma Formation, in which the void is located, is registered as an unclassified subterranean GDE. The geological feature is considered to be a potential GDE within the BoM GDE Atlas due to the possibility of cavernous karstic features. These features may provide an environment for subterranean ecosystems to exist. The void, however, does not intersect the groundwater table at its current level and therefore does not directly interact with the potential ecosystem.

3.5.1.4 Groundwater conceptualisation and hydrological summary

The two main aquifer systems within the study area are the shallow, alluvial system and fractured rock. The fractured rock aquifer is utilised for water supply and comprises two main geological formations: Mount Alma Formation and Mount Holly Formation/Erebus Beds. Based on regional bore reports, the fractured rock aquifer lithology is mainly fractured siltstone and shale (Figure 3).

Two thrust faults exist to the east and west of the site, that may influence regional groundwater flow. However, water levels from bores to the east and west of the western most fault indicate a flow path down gradient following topography. RSWL (mAHD) values locally follow this trend, being influenced by topography, flowing in a general north to south-east direction (Figure 11).

Groundwater salinity (EC) ranges from 560-12,500 µS/cm within a 2 km area, with pH ranging between circum-neutral to mildly alkaline (pH 7.5 to 8.5). Recent water quality sampling from the bore within the mining lease (summarised in Table 4) shows groundwater at the site currently meets WQOs (Table 5) for groundwater EVs for the Fitzroy River Sub-basin.

The fractured rock aquifer system is likely to be predominately recharged at outcropping areas through direct rainfall or surface water flows. In areas where the alluvial sediments overlay the fractured rock may induce recharge through seepage.

There are two high potential aquatic GDEs located to the northwest and north east of the site. These are understood to be artificial water storage areas (dams) that are likely supplied by surface water run off via the ephemeral creeks and from throughflow from the alluvial sediments.

The limestone rock in which the quarry is located is referenced as an unclassified subterranean GDE. It is likely registered in this manner due to the potential for the karstic rock to be an environment for stygofauna to exist. The quarry does not intersect the groundwater table and is located in the unsaturated zone of the limestone rock and is therefore unlikely to be a point of recharge for the unclassified subterranean GDE.

There have been no observations of groundwater seepage into the mine void. This is consistent with observed groundwater levels which are measured to be 12 mAHD, locally, within the mining lease. The view that the void is disconnected from the local groundwater table is further supported by the dissimilarity in recent trends in water quality between the void and the groundwater.

The outcomes from the groundwater conceptualisation have allowed conclusions to be drawn about the potential impacts to groundwater water level and water quality due to the presence of the Marmor quarry. It was found that there is a 'low risk' of impact to groundwater resources, primarily due to the base of the mine void being located above the groundwater table and there is a hydraulic discontinuity.

As the void does not intersect the groundwater, there is no risk of the void creating localised drawdown of the water table.

3.5.2 Flooding

The EA has a pre-approved land outcome for a void. As such floodplain modelling is not specifically required for the PRCP. The likelihood of flooding connecting the void with surrounding waterways and of overtopping has been examined.

The site does not sit within a defined floodplain, however, a review of publicly available flood assessments that cover the site was undertaken to assess the flood susceptibility of the site, specifically:

- Queensland Globe (https://qldglobe.information.qld.gov.au/)
- Queensland Department of Resources Flood Check Queensland (https://floodcheck.information.qld.gov.au/)
- Australian Flood Risk Information Portal (https://afrip.ga.gov.au/flood-study-web/#/search)

There are no major watercourses within the site and surrounding areas. Some minor watercourses of the Fitzroy sub-basin exist around the site (Figure 13) that flow in a north-easterly direction away from the site.

Available flood information showed that there is the potential for some flooding on site during a 1% Annual Exceedance Probability (AEP) flood event (Figure 14) and during more extreme events (Figure 15) that approximate the probable maximum flood (PMF). These results show that some isolated flooding may occur during the 1% AEP event with more broadscale flooding occurring only in more extreme events. Combining the flood information with the contours of the site (Figure 16) indicates that the localised flooding identified would largely drain into the residual void. The potential flooding even for the PMF does not result in the whole of the void being flooded and there is no direct connection between flooding in the void and surrounding water courses, there is no direct continuity between flooding within the void. Therefore, flooding is not anticipated to impact the surrounding users or the environment. The likelihood of water spilling from the former mining pit is discussed in Section 3.5.11.3.

The nominated post mining land uses (PMLUs) of grazing (on either undisturbed or rehabilitated land) and water storage are not anticipated to change the likelihood of flooding. The areas potentially affected by minor flooding under extreme events will not contain any mine waste landforms after the site has been fully rehabilitated. There are no significant constructed post-mine landforms in the potentially affected area. The species chosen for pasture establishment are tolerant of short periods of waterlogging.

Minor localised and short-term flooding in extreme events will not affect either final landform stability, or the establishment and sustainability of nominated PMLUs at Marmor.

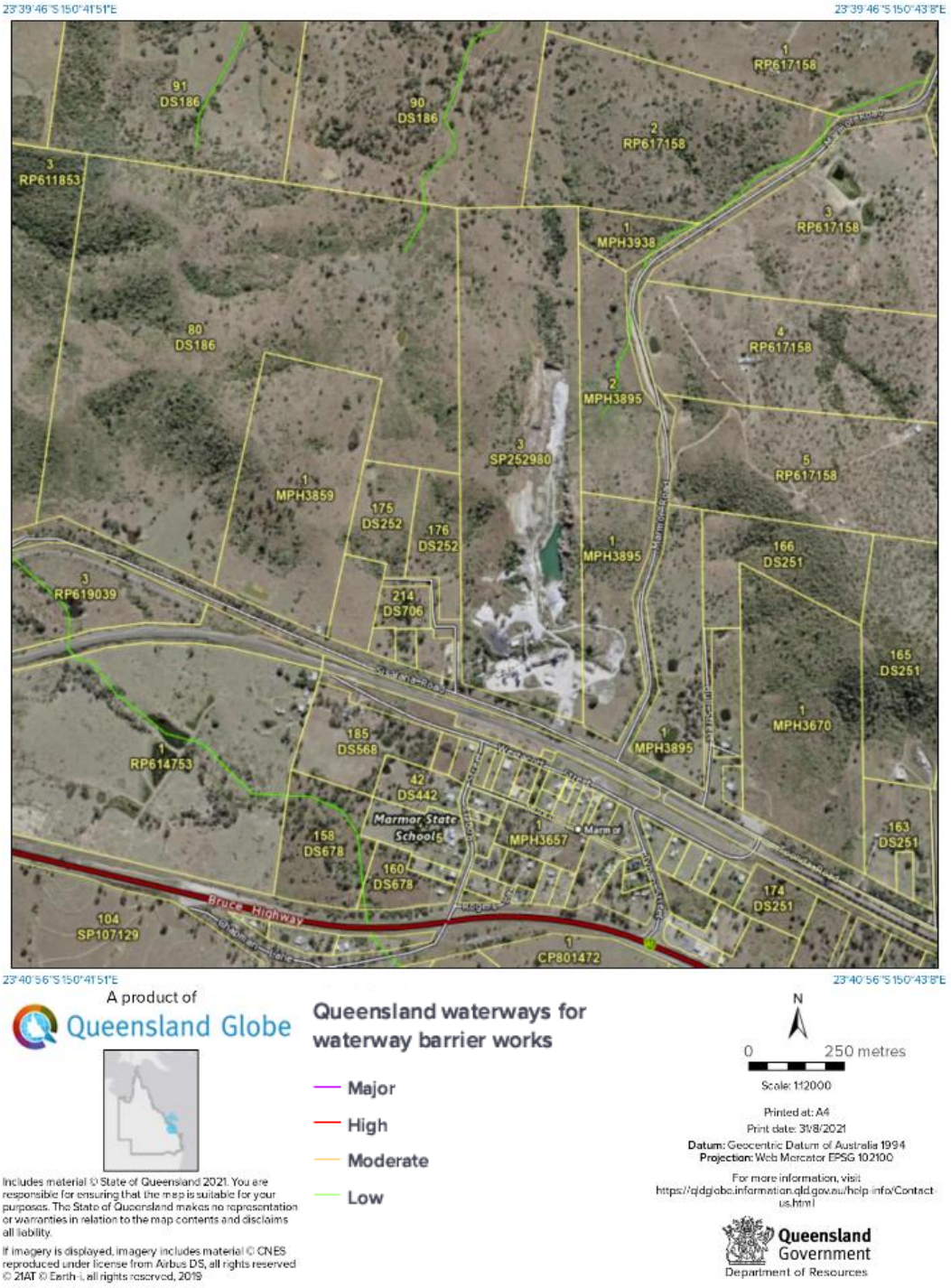


Figure 13: Waterways around the Marmor Operations (note: the Marmor MLs lie totally within Lot 3/SP252980)[5]

[5] https://qldglobe.information.qld.gov.au/qldglobe/print/H10fX8iZt, access August 2021

Figure 14: 1% AEP flood extent around the Marmor Operations6 where variants of blue blocks on the map indicate depth of water

[6] https://spatial-gis.information.qld.gov.au/arcgis/rest/directories/arcgisoutput/FloodCheck/FloodCheck_Print_GPServer/_ags_83e3e8ab83dd416084bfcea0f2a8a3a7.pdf, accessed August 2021

Figure 15: Extreme events (approximation of the PMF) flood extent around the Marmor Operations7 where variants of blue blocks on the map indicate depth of water

[7] https://spatial-gis.information.qld.gov.au/arcgis/rest/directories/arcgisoutput/FloodCheck/FloodCheck_Print_GPServer/_ags_29939c4c227d445f8c240c9491138b14.pdf, accessed August 2021

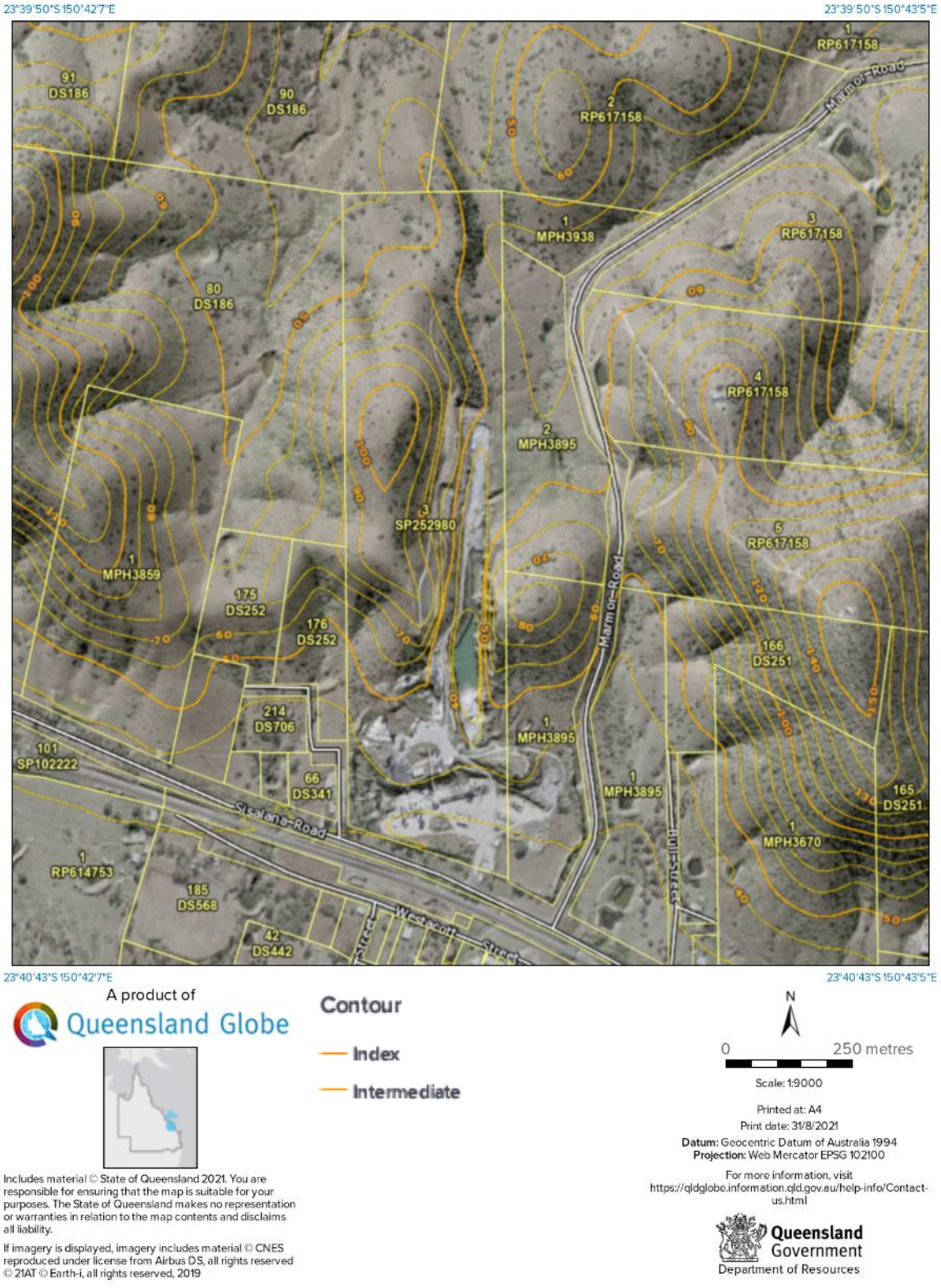


Figure 16: Ten metre contour lines around the Marmor Operations8

[8] https://qldglobe.information.qld.gov.au/qldglobe/print/rJ-m58obF, accessed August 2021

3.5.3 Soil and capping material assessment

3.5.3.1 Topsoil

The topsoil stockpile is located to the south of site and contains 5,300 m^3 of material for use during rehabilitation. The total topsoil requirement for closure has been estimated as 7,494 m^3. There is an estimated material deficit of 2,194 m^3 and an allowance for the importation of topsoil from an offsite location has been provided in the ERC.

No additional disturbance is planned at Marmor and no further topsoil stripping will be undertaken. All existing stripped topsoil has been placed in low stockpiles awaiting re-spreading. The stockpile is currently well vegetated and supports mature trees which will have assisted in maintaining biological activity (Figure 17).

Figure 17: View of the well vegetated topsoil stockpile at the Marmor Operations

Graymont commissioned a soil analysis of the stockpiled topsoil in October 2020. A summary of the results is provided in Table 13. The results have been reviewed for this PRCP by Dr. Andrew Butler, a Certified Professional Soil Scientist. Overall, the soils were found to have slightly to moderately basic pH (in $CaCl_2$). The effective cation exchange capacity of the soils (a measure of inherent fertility) was high to very high. Not surprisingly, the background geology the cation exchange complex is dominated by calcium (>90% saturation) and exchangeable sodium percentage is <0.5%. Therefore, the soils are non-sodic. This property and the high calcium saturation will prevent dispersion and will promote stability and structure formation. The soils have low chloride content and low to moderate electrical conductivity. Some of the electrical conductivity measured will be due to the presence of sparingly soluble 'salts' other than sodium chloride (that are released into the dilute soil extract used for routine EC screening analysis). When the EC is adjusted to reflect the chloride content, the salinity ratings are low to very low.

Table 13: Soil quality analysis from the soil stockpiles

Analyte	Units	Sample number					
		1	2	3	4	5	Average
pH (in $CaCl_2$)	Units	7.68	7.82	7.66	7.84	7.87	7.77
Electrical Conductivity	(dS/m)	0.18	0.12	0.23	0.12	0.12	0.15
Estimated chloride EC	(dS/m)	0.01	0.01	0.01	0.01	0.01	0.01
Textural Class		Sandy clay loam/silty clay loam	Sandy clay loam/silty clay loam	Sandy clay loam/silty clay loam	Sandy clay loam/silty clay loam	Sandy clay loam/silty clay loam	Sandy clay loam/silty clay loam
Approximate clay content based on texture class (DNR 1997)	%	32	32	32	32	32	32
Salinity rating (DNR 1997)	NA	Low	Low	Very low*	Low	Low	Low
Exchangeable calcium	cmol+/kg	38	86	33	118	154	86
Exchangeable magnesium	cmol+/kg	1.97	2.03	2.37	2.17	2.32	2.17
Exchangeable potassium	cmol+/kg	0.19	0.15	0.35	0.54	0.29	0.30
Exchangeable sodium	cmol+/kg	0.09	0.12	0.14	0.05	0.03	0.09
Effective Cation Exchange Capacity (ECEC)	cmol+/kg	41	89	35	121	156	88
Exchangeable sodium percentage (ESP)	%	0.22	0.14	0.40	0.04	0.02	0.16
Sodicity rating (DNR 1997)	NA	Non-sodic	Non-sodic	Non-sodic	Non-sodic	Non-sodic	Non-sodic
Chloride	mg/kg	13.2	< 10	19.3	17	< 10	16.5
Mehlich 3 extractable Nitrate-N	mg N/kg	33	21	61	6.4	15	27.3
Mehlich 3 extractable Phosphorus (P)	mg P/kg	34.1	14.1	51.8	42.4	21.8	32.8

*When adjusted for chloride content and estimated chloride EC (= ([Chloride] mg/kg)/10000)*6.64) (DNR 1997).

Available nitrogen concentrations were found to be generally adequate and likely reflect the ongoing litter inputs, organic matter accumulation and nutrient cycling occurring in the surface of the well vegetated stockpile. Although the available phosphorus levels were adequate for native species, for productive pasture establishment inclusive of legumes (as selected for Marmor in Section 3.5.9) an additional phosphatic fertiliser application would be beneficial. Some samples were low in available potassium and establishment fertiliser applications will be required.

The source of the imported topsoil required to complete rehabilitation works has yet to be identified, but the milestone criteria contain minimum standards for the quality of the material to be imported to ensure that it is suitable for the achievement of the nominated PMLU (Section 3.3.1).

3.5.3.2 Capping requirements

No reactive wastes or geochemically unstable materials that require the placement of an engineered capping layer will remain on-site at Marmor post-closure. No engineered capping is required and therefore no capping material assessment is necessary.

3.5.4 Waste characterisation and waste stockpile removal

Lime kiln dust, coal ash and reject limestone has been stored in stockpiles adjacent to the ROM area and at three locations within the residual void footprint. The material has been mixed during collection, storage and stockpiling.

This material is viewed as waste by the DES and the EA does not currently allow for disposal of mine wastes on-site. Therefore, the current rehabilitation strategy is to remove this material back to virgin ground using excavators and trucks. Following appropriate landfill waste characterisation, it will be disposed of at a suitably licenced off-site waste management facility. No mine waste will remain on site under the current strategy and no waste characterisation (other than to support off-site disposal) is necessary to support the rehabilitation strategy.

A validation sampling plan will be developed and implemented by an AQP to verify that all waste material has been removed to virgin ground.

Graymont believes that given its nature and the weathering that has already occurred, the mixed lime kiln dust, coal ash and reject limestone could be successfully rehabilitated on-site. Although the material has been stored within the residual void, it has not adversely affected water quality or compromised the planned PMLU for the void. Therefore, Graymont will investigate options to amend the EA to allow this material to be retained on site as part of site rehabilitation and closure and undertake supporting research. If this is successful, the PRCP will be amended.

There are no other waste rock dumps, overburden dumps, tailings dams, heap leach pads, or waste tyre stockpiles at Marmor for which waste characterisation is required.

3.5.5 Cover design

No reactive wastes or geochemically unstable materials that require the placement of an engineered capping layer will remain on-site at Marmor at relinquishment. No engineered capping or cover design is required.

3.5.6 Landform design

This section relates to the landform development of the areas outside the Residual Void (largely within ML 5763 apart from some unsealed tracks in RA7). The areas include all disturbance associated with the RAs in Table 14. The Landform design for the Residual Void RAs is provided in Section 3.5.11 and Appendix F.

Table 14: RAs outside the Residual Void

Disturbance Type	Rehabilitation Area
Product Stockpiles & Infrastructure	RA1 – ROM Pad, Laydown Area and Product Stockpiles
	RA2 – Infrastructure (Buildings/Water Tanks)
	RA3 – Infrastructure (Process Plant/Hydrocarbon Storage)
	RA4 – Sediment Dam
	RA5 – Laydown Area (surrounding offices and Process Plant)
	RA6 – Vegetation Disturbance Area[1]
Roads and Tracks	RA7 – Unsealed Tracks
	RA8 – Site Entrance Tracks
Topsoil Stockpiles	RA9 – Topsoil Stockpiles
Waste Stockpiles	RA13 – Waste Stockpiles (Ex Void)

3.5.6.1 Existing landform

The majority of the mining landform for this part of the site drains to the west or south of the project area. The existing landform within the disturbance area is dominated by:

- the slightly elevated cut and fill area adjacent to the southern access to the void where the Product stockpiles and trafficked ROM area (The majority of RA1) as well as the rejects & waste stockpiles (RA13) are located (referred to as the 'upper area' below) and
- the southern part of the site, adjacent to Sisalana Road where the bulk of the infrastructure (RA2, RA3 and RA5), sediment dam (RA4), bitumen road (RA8) and topsoil stockpiles (RA9) are located.

These two areas are separated by the slopes of the upper area that have spontaneously revegetated (RA6) and are connected by gravel tracks (part of RA7).

The balance of the existing disturbed landform is a small laydown area (part of RA1) adjacent to the void (RA11) and earthen tracks (the bulk of RA7) that largely conform to the existing surrounding land surface.

3.5.6.2 Final landform design requirements

There are no significant reconstructed landforms at Marmor. All product, waste & reject and topsoil stockpiles will be removed to surrounding ground level during site rehabilitation. No mine waste landforms (such as overburden, reactive waste or tailings dams) will present at closure.

Therefore, there will be no significant post-mine landforms that require detailed engineering design to achieve landform stability, encapsulation hazardous mine waste.

The nominated minimum slope requirements are consistent with the soils present on (or to be imported to) Marmor and the nominated grazing PMLU as discussed in Section 3.3.2. The objective it to provide final landforms and surface water management that minimises the risk of erosion on rehabilitated areas.

3.5.6.3 Final landform concept design

A concept final landform for ML 5763 (including cross sections) is shown in Figure 18. Following removal of existing stockpiles and surface aggregate from the upper area occupied by RA1, minor earthworks will ensure the landform is graded to drain toward the western boundary with an average grade of 0.5-1%. This is to minimise flows over the slope between the upper to the lower areas during earthworks and vegetation establishment. Additional temporary drainage controls will also be used (see Section 3.5.7). Cross section C-C' in Figure 18 shows the upper area.

Following the removal of waste & reject stockpiles from RA13 and minor earthworks, the small section of the upper area adjacent to the void will be graded to drain towards the residual void (is it does currently) with an average grade of 0.5-1%. The remaining minor earthen tracks (in ML 5764) will be graded to conform to the surrounding landform.

The lower area is largely occupied by RA2, RA3, RA4, RA5 and RA8. After the decommissioning and removal of all infrastructure, backfilling of the sediment dam according to the methods outlined in Section 3.5.13 and removal of surface aggregate and bitumen, minor earthworks will reshape the landform to direct surface flows to the existing outlet for this catchment adjacent to the front gate. Final grades will average 3-5% (cross section D-D' Figure 18).

The topsoil stockpiles (RA9) will be gradually removed during rehabilitation works. The area will be graded to conform to the surrounding ground level, but a small catch drain will be retained to the west and south of the lease boundary for surface water management (see Section 3.5.7).

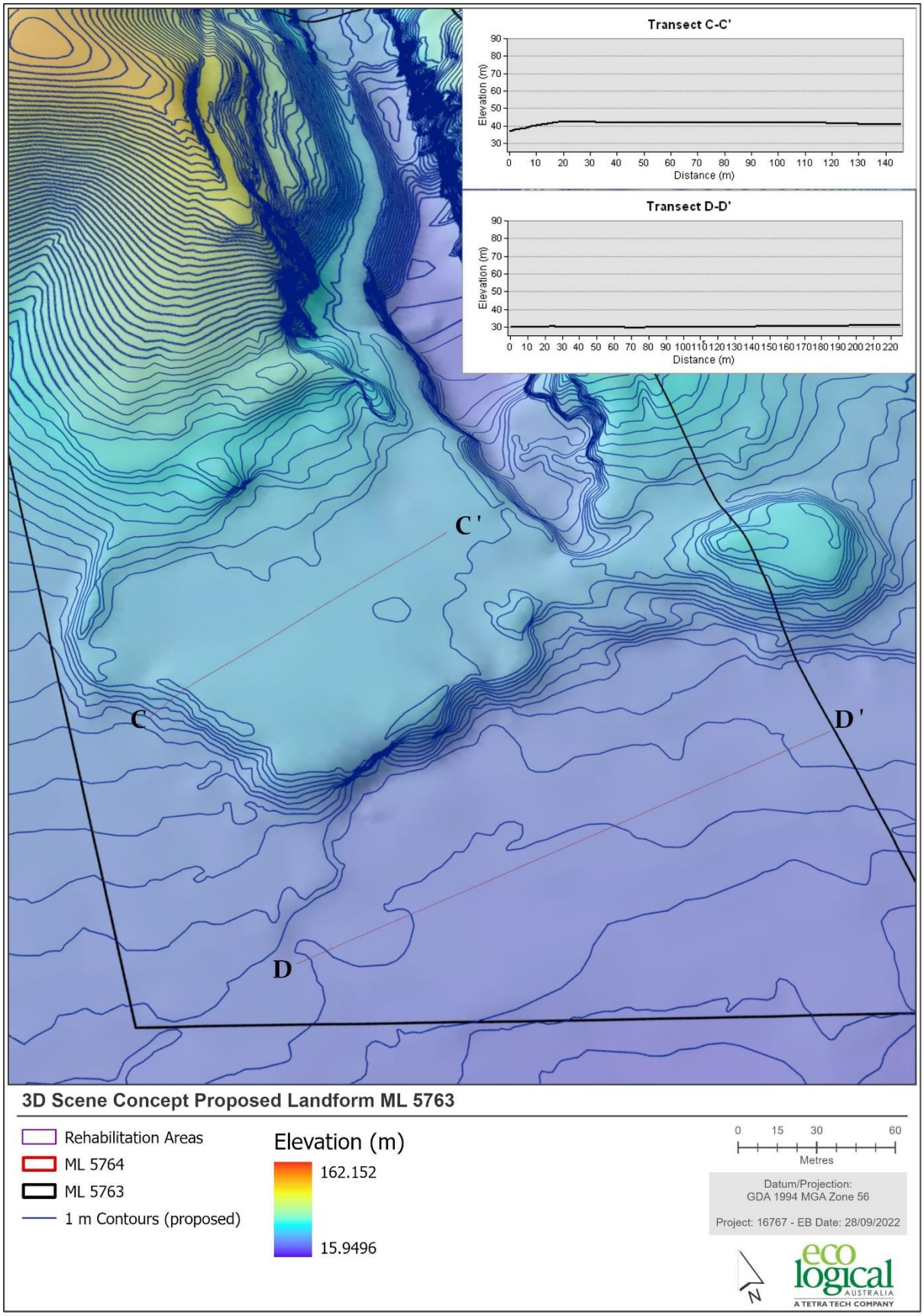


Figure 18: Concept final landform for areas within ML 5763 (1 m contours)

3.5.7 Water management

The main potential sources of contamination at Marmor include:

- Stored or waste petroleum hydrocarbons (from fuel storage, the workshop and minor spills)
- Lime products and kiln dust (potentially alkali solids such as quick lime and hydrated lime)
- Coal and coal ash (metals, salts and potentially minor amounts of PAHs).

A conceptual site model (CSM - Figure 19) shows the source, likely significant pathways and environmental and sensitive receptors.

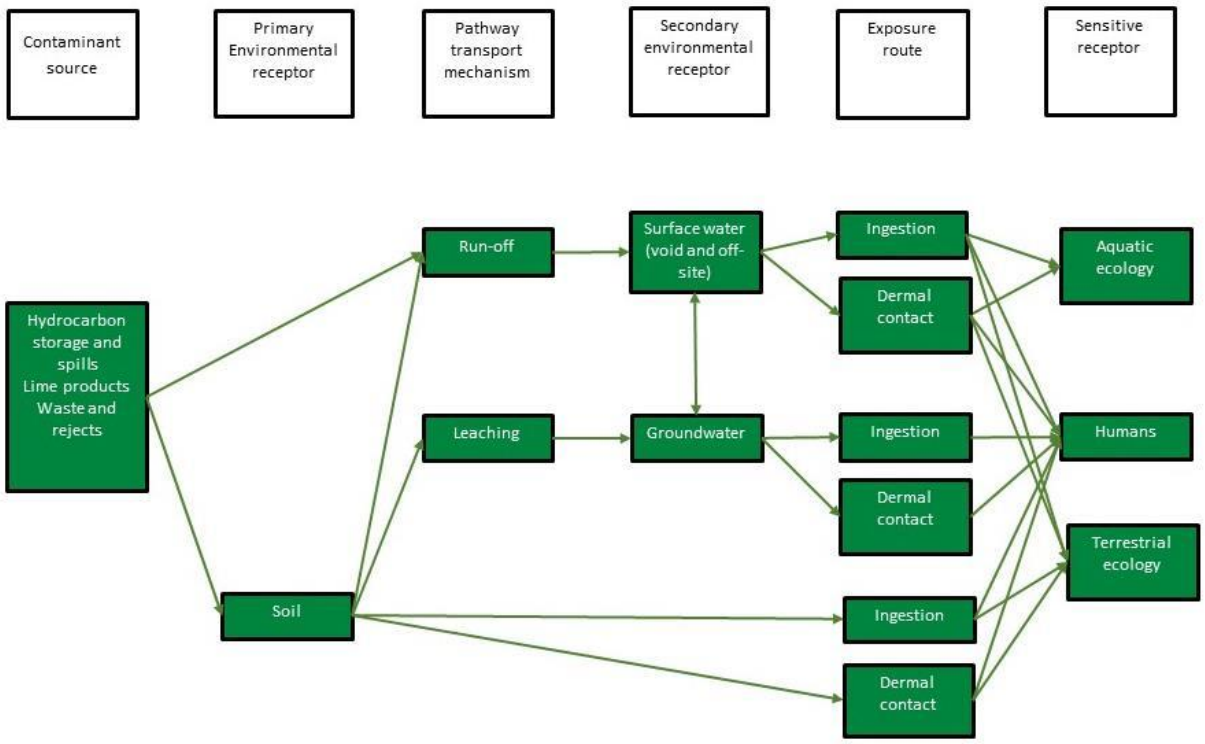


Figure 19: Conceptual site model

A void water balance is provided in a Section 3.5.11.3.

3.5.7.1 Operational water management

The site water management plan developed by the previous owners (Sibelco 2014) and is still relevant to the layout of the site and will be fully implemented by Graymont when site operations re-commence. The operational site water management plan is summarised below. During the care and maintenance period, the monitoring and performance assessment requires presented below will still be undertaken.

OBJECTIVES

The objectives are:

- To ensure access to secure and sufficient water resources to service operations
- To minimising impacts to offsite environmental value. This is achieved through:
  - Identifying, separating and controlling clean and dirty waters
  - Ensuring the appropriate containment or treatment of waters affected by site operations.

TARGETS AND PERFORMANCE INDICATORS

The target is compliance with EA conditions:

- C1-1 - Contaminants must not be released from site to any waters or the bed and banks of any waters.
- C2-1 - All reasonable and practicable erosion protection measures and sediment control measures must be implemented and maintained to minimise erosion and the release of sediment.

The performance indicators are:

- No contaminants are released from site.
- Erosion and sediment controls are in place, maintained and monitored during rainfall for effectiveness.

CONTROLS

Appropriate water management controls are provided below. Although some fixed measures apply to the site in care and maintenance, others will be applied when operations resume.

- The extent of disturbed / exposed areas is to be kept to the minimum area necessary for works.
- Disturbed land will be rehabilitated as soon as it is available.
- Vehicle wash-down will be carried out in a designated area so that washings (including concrete washings) will not enter waterways or stormwater drains.
- Earth flow diversion banks and catch drains are installed upslope of excavations to prevent surface water entering these areas.
- Sediment controls (sediment traps, the sediment dam and dams) are regularly maintained.
- All runoff from the coal storage and feed line handling area and limestone stockpiles is directed into a sediment trap before being directed to the void.
- Stormwater runoff from building roof areas is harvested directly into tanks for re-use on site.
- Mechanical sweepers are used to collect spilt product and thus minimise the potential to be mobilised in run off.
- Stormwater from the main processing plant is directed to a sediment dam on the trafficked / laydown area to the south of the main plant. Any overflow from this and stormwater from other parts of the main infrastructure area is directed (in some areas by the topsoil stockpile bund) through rock filter dams to off-site table drains along Sisalana Road which borders the southern lease boundary.
- All hydrocarbons are stored in above ground tanks contained within bunds (to AS 1940).
- Any stormwater captured within the bund is checked to make sure it is free from contaminants or wastes prior being released through the lockable value.
- Spill control equipment is stocked at specific locations around the site for spill response.
- Vehicles are to be well maintained to avoid fuel and oil leakages.
- Re-fuelling of trucks on site will take place away from drainage lines and in isolated/bunded areas to minimise the risk of environmental contamination and to contain spills.

- Fuels, oils and chemicals required for construction and operation will be stored appropriately. Any spillages will be immediately contained and absorbed with a suitable material and disposed in an approved manner.
- All staff to be appropriately trained in procedures for the management of fuel and chemical spills and the location and use of spill kits.

MONITORING AND PERFORMANCE

The following operational monitoring of erosion and sediment control measures is conducted:

- Visual inspection of the sedimentation dam ensure basin is free of weeds (six monthly as required)
- Visual inspection of sediment dam freeboard (six monthly and after rainfall)
- Cleaning and removal of sediment from sediment traps and dam (prior to 1 November annually as required)
- Dewatering of sediment dam prior to the wet season (prior to 1 November annually as required).

No water quality monitoring is required as a conditions of the EA. Water quality monitoring of the void and groundwater has been infrequent during care and maintenance, but it has been restarted and has been formalised in this PRCP to address potential contaminants of concern at Marmor (Section 3.7.3). Any adverse results will be investigated and action taken as required.

Although coal and mixed coal ash, kiln dust and rejects has been stored within the void catchment, there is no indication that this has led to significant contamination of the water in the void (Sections 3.1.3). The void is not connected to the underlying groundwater (Section 3.5.1.2).

No complaints have been received regarding run off from site.

3.5.7.2 Rehabilitation and closure water management

The objective will be to use Best Practice site management procedures to control the severity and extent of soil erosion and pollutant transport during rehabilitation and provide long-term stability for closure.

CONTAMINANT MANAGEMENT

The rehabilitation strategy for the Marmor Operations ensures that all known sources of potential contaminants that pose a risk to environmental values of the receiving environment will be removed. A contaminated land site investigation will be undertaken at closure and the site remediated to a safe condition (including, where necessary, affected groundwater).

At closure, it is not expected that water stored in the void will require any additional treatment to reduce contaminants.

REHABILITATION CONSTRUCTION EROSION AND SEDIMENT CONTROL

During rehabilitation works, contractors engaged to undertake rehabilitation earthworks will be required to provide a detailed Erosion and Sediment Control Plan (ESCP) to Graymont as part of the contract deliverables. The ESCP must be approved by Graymont prior to site establishment and commencement of ground disturbance. The ESCP, including the designs specifications of temporary features, should be consistent with the *Best Practice Erosion & Sediment Control* series (IECA 2008). The intent is to adhere to the core principals of erosion and sediment control (ESC) relevant to the main risks

associated with site rehabilitation works. The main risk related to the earthworks and the period prior to vegetation establishment on RA1-RA5ated. Therefore, where ever reasonable and practicable, up-slope stormwater runoff – whether dirty or clean needs to be diverted around soil disturbances and unstable slopes in a manner that minimises soil erosion and the saturation of soils within active work areas. Therefore temporary flow diversion banks (that can be made from a variety of material including but not limited to straw bales or site-won compacted earthen materials) and a permanent catch drain (with bank) will be required at Marmor.

As well as the operational water management measures, the following erosion and sediment control (ESC) measures and principals would be expected as a minimum:

- Where possible, works will be scheduled to occur outside the main wet season.
- Work will be scheduled to minimise the extent of disturbed / exposed areas as much as possible.
- Disturbed land will be revegetated as soon as possible following earthworks.
- Upslope temporary flow diversion banks to be used to direct clean water away from areas under rehabilitation until vegetation establishment. Existing well vegetated areas can be used to safely convey water away from the structures using level spreaders (slopes up to 10%). Temporary flow division banks or catch drains will be used to divide the catchment of the upper and lower areas within ML 5763 so that waters can be directed to separate sediment control structures prior to release. One permanent catch drain will be required to manage site water post-closure (see below). The construction of temporary and permanent features will be scheduled to occur prior to major works being undertaken in affected areas.
- The bitumen road at the entrance to be retained for as long as possible.
- A temporary rock pad rumble strip to be established at the site entry / exit to reduce loose soil material being moved off site and onto the roads servicing the site.
- Temporary sediment controls to be implemented to minimise off site sediment transport including the use of sediment fencing (or equivalent) or temporary covers for any earthen material temporarily stockpiled onsite.
- Additional temporary sediment controls to be constructed where stormwater leaves the site. Based on the success of operational controls, rock filter dams would be appropriate. The concept design incudes two possible exist points in the southwestern and south eastern corners of the site.

Erosion and sediment control (ESC) measures to be inspected daily by the construction manager (or nominated representative) during periods of runoff-producing rainfall, and de-silted, repaired and amended as appropriate to maintain the ESCP WQOs. This should include:

- Daily site inspections during periods of runoff-producing rainfall including all drainage, erosion and sediment control measures; occurrences of excessive sediment deposition (whether on-site or off-site); all site discharge points.
- Weekly site inspections including all drainage, erosion and sediment control measures; occurrences of excessive sediment deposition (whether on-site or off-site); occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements; litter and waste receptors; oil, fuel and chemical storage facilities.

- Site inspections immediately prior to anticipated runoff-producing rainfall including all drainage, erosion and sediment control measures; all temporary (e.g. over-night) flow diversion and drainage works.
- Site inspections immediately following runoff-producing rainfall including treatment and de-watering requirements of sediment control structures basins and the need for its removal; all drainage, erosion and sediment control measures; occurrences of excessive sediment deposition (whether on-site or off-site); occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements; occurrences of excessive erosion, sedimentation, or mud generation around the site office, car park and material storage areas.
- In addition, monthly site inspections including proposed staging of future site clearing, earthworks and site/soil stabilisation.
- Water quality monitoring must be carried out on any controlled off-site release points, including water pH and suspended solids.
- Water quality monitoring at the nominated monitoring stations to be carried out monthly and following significant rainfall (>25mm in 72hrs) (additional water quality monitoring maybe required if the WQOs are not being met).

The minimum WQOs for water leaving site are:

- Water pH released from a controlled sediment structure outflow must be within the range 6.5 to 8.5.
- Suspended Solids released from controlled sediment structure outflows must be no greater than 50mg/L.
- No visible films or odour.
- No visible litter washed from the site.

Poor performance of control measures will be identified by the following with investigation and corrective action undertaken as required:

- Visual inspections revealing:
  - a build-up of sediment off the site
  - excessive sediment build-up on the site
  - excessive erosion on the site
  - release of construction material from the site
  - poor vegetation establishment
  - poorly maintained, damaged or failed ESC devices.
- Poor water quality outside of the ESCP WQOs or complaints received.

All temporary ESC measures will be removed when vegetation is established in areas with a grazing PMLU and the risk of erosion and sediment generation has been minimised (during RM7).

PERMANENT FEATURES FOR CLOSURE

Given the stability of the existing void crests (Rocktest 2022) and the lack of erosion features, no specific management of overland flow to the void crest is required to provide acceptable crest stability for closure (Tony Meyers pers. comm. 30 May 2022).

As described in the subsections above, at present, surface water run-off from disturbed areas is directed to the void or via topsoil stockpiles (functioning as flow diversion banks) to established vegetation and rock filter dams and thence to off-site table drains along Sisalana Road which borders the southern lease boundary. This approach has proved successful in managing surface water run-off from the site to date, with no scour observed in site and no complaints received from the public. The southern half of the site naturally drains to the south. Therefore the same approach has been adopted for the management of surface water run-off during rehabilitation and closure.

At present, the topsoil stockpile (RA9) along the western boundary of ML 5763 prevents surface water run-off from the site affecting the neighbouring property. During rehabilitation, the topsoil stockpile will be removed, but a catch drain (with bank) will be constructed within the disturbance footprint of RA that retains the same function. During rehabilitation all stockpiled topsoil will be removed to virgin ground. The native topsoil from this area will be stripped and the subsoil pushed up to form the bank of the catch drain. The stripped topsoil will be placed on the constructed catch drain, ameliorated and revegetated according to the methods in Sections 3.5.8 and 3.5.9.

During rehabilitation, run-on from the largely well vegetated areas upslope of RA1 will be temporarily directed away from the disturbance area to the western boundary via a flow diversion bank. Water will be safely discharged to the existing stable vegetated area via a level spreader. As described in the previous subsection, similar temporary structures will temporarily divert run-on water away from rehabilitation activities on RA5 (and other RAs bound by it). The reinstated permanent western catch drain described above, will prevent diverted run-off from affecting the neighbouring property.

All permanent structures will be designed and constructed according to the *Best Practice Erosion & Sediment Control* series (IECA 2008) with the intent of retaining the protection that operation site water management currently offers to adjacent properties.

3.5.8 Site preparation and topsoiling

All compacted areas will be ripped to a depth of 500 mm at 500 – 800 mm spacings.

Based on the baseline soils information, topsoil will be placed to a depth of 150 mm for all areas with a nominated PMLU of grazing (see further justification in Section 3.3.2.5).

Based on the soil test results, soil characteristics and crop requirements, where site-won topsoil is used, an establishment dressing of a compound fertiliser containing N, P (low), K and S (such as Crop King 88 or equivalent) will be applied at a rate of 300 kg/ha (3 kg/100 sq m). Fertiliser application rates for imported topsoils will be provided by an AQP following the assessment of imported topsoil quality against the standards nominated in Section 3.3.2.5. As rehabilitation progresses, fertiliser rates will be adjusted based on monitoring of the performance of revegetation works (refer to maintenance and contingency measures in Section 3.7.6). After incorporation of fertiliser, a seedbed will be preparation using harrows.

Fertiliser will only be applied to areas of existing vegetation (RA6) if vegetation appears to be deficient or ground cover is low based on the advice of an AQP.

3.5.9 Revegetation

On the advice of Stuart Buck, an Agronomist with Department of Agriculture and Fisheries (DAF) Extension Service in Rockhampton, the following species mix, suited to the Marmor area, has been selected for pasture establishment in areas with a grazing PMLU:

- Black Spear Grass (*Heteropogon contortus*). This native species is useful for providing erosion control for slopes up to 20°. It grows on a wide variety of well-drained soils, with surface textures ranging from loamy sand to clay loam, and uniform or texture contrast soils, as well as on very fertile clay loams. While well-adapted to low fertility, it is not tolerant of extremely low fertility, nor poor drainage or high levels of salinity. It is most abundant where the average annual rainfall is 600–1,000 mm, and where there are marked wet and dry seasons. It does tolerate short periods of inundation on otherwise well-drained soils but is not tolerant of prolonged flooding or waterlogging (Cook et al. 2020).
- Forest Bluegrass (*Bothriochloa bladhii ssp. glabra*) – Swann Forest cultivar. This hardy naturalised species grows on moderately fertile or infertile soils, with a wide range of textures from sandy loam to clays (including hard-setting clay loams) provided exchangeable aluminium levels are fairly low (they are zero at this site) and pH is 5.5 to 8.4. A drought-hardy species, particularly if well grazed to reduce the amount of foliage and hence, water use. Cultivars have been successful mostly in areas with rainfall >750 mm, although can tolerate as low as 600 mm/yr. It can stand temporary waterlogging and flooding, but not tolerant of permanently wet conditions. The species is not fertility demanding, but may respond to moderate inputs of applied nitrogen on infertile soils. It is tolerant of heavy grazing by cattle and sheep, adjusting growth habit to prostrate to accommodate pressure (Cook et al. 2020).
- Shrubby Stylo (*Stylosanthes scabra*) - Siran cultivar. This exotic perennial forage legume is well adapted to infertile, friable or hard-setting, sandy-surfaced soil, though less well adapted to heavier textured alkaline soils. It is an extremely drought-hardy species, occurring in areas with rainfall as low as 350 mm/yr although it has mainly been used in areas with an annual rainfall of 600–900 (but has been successful in areas with up to 2,000 mm). Some types at least are not very tolerant of waterlogging (Cook et al. 2020).

Although Shrubby Stylo is sometimes regarded as an environmental weed, it is not listed in the *Rockhampton Regional Council Biosecurity Plan for Pest Management 2017-2021* (Rockhampton Regional Council 2017) and was not listed as an environmental pest plant in the *Rockhampton Regional Council Pest Management Plan 2012-2016* (V2) (Rockhampton Regional Council 2012). It is also not regarded as an environmental weed by pasture agronomists and graziers. DAF advised that from their perspective, collectively stylos are regarded as a pasture plant that can provide beef production gains and so should be considered by graziers in suitable situations. They referred to a new stylo identification guide that has just been released by the Queensland Government (DAF) for beef industry advisors and graziers (Walker et al. 2022) which indicates that Shrubby Stylo is a suitable companion plant for native grass pasture systems in Coastal northern Queensland (as proposed for Marmor). DAF advised that Shrubby Stylo is the preferred companion legume for Marmor and that all other potential tropical legume species alternatives are also non-native.

DAF also advised that Stylos are commonly found in the Marmor area of central Queensland and that their existing local presence means that the use of this plant at Marmor would pose a low risk of negatively impacting the surrounding environment. Shrubby Stylo (unlike other legume ground covers), so it does not appear to be a concern locally.

Seeding rates will be 2 kg/ha of each species in the mix. Seeding will occur in the late dry season or early wet season to make the best use of summer rains and high temperatures. Press wheels or harrows will be used after sowing to optimise soil-to-seed contact. As areas are progressively rehabilitated, seeding rates may be adjusted based on monitoring of the performance of revegetation works (refer to maintenance and contingency measures in Section 3.7.6) .

Germination should be visible two to six weeks after seeding (or after the first wetting rains). If germination has failed, attempts will be made to re-seed while there is a probability of follow-up wet season rain (refer to maintenance and contingency measures in Section 3.7.6). Long range weather forecasts will be used to assist in making this decision. Where required the water stored in the void can be used to assist in early vegetation establishment if there is a period of drought following seeding or germination. Re-seeding and any associated earthworks and soil preparation should not be undertaken later than 1 April. However, cultivation/reseeded should be avoided if the soil is too wet as it could be damaged through trafficking. If repair works cannot be conducted before 1 April, re-treatment should be scheduled for the following wet season. Some minor earthworks/seed bed preparation may be required prior to re-seeding.

3.5.10 Rehabilitation implementation quality control

Inspection and Test Plans (ITPs) that include specific witness or hold points have been developed for rehabilitation milestones at Marmor. They will ensure that records are maintained for verification of the completion of critical rehabilitation milestones nominated in Section 3.3.2. These ITPs are provided in Appendix E.

3.5.11 Void closure

The following sections describe the design considerations and rehabilitation strategy for the residual void to ensure the establishment and maintenance of a stable condition with respect to the agreed PMLU of Water Storage.

3.5.11.1 Void dimensions

The residual void final landform will have the following dimensions:

- 6.85 ha in size
- maximum length at the crest of 620 m
- average width at the crest of 137 m
- maximum height of walls (west wall) 64 m and
- height of benches 10-23 m
- maximum overall slope angles 21°, 10°, 54° and 28° for north, south, east, west respectively.

The final landform for the void and cross sections profiles are shown in Figure 20 and Figure 21[9].

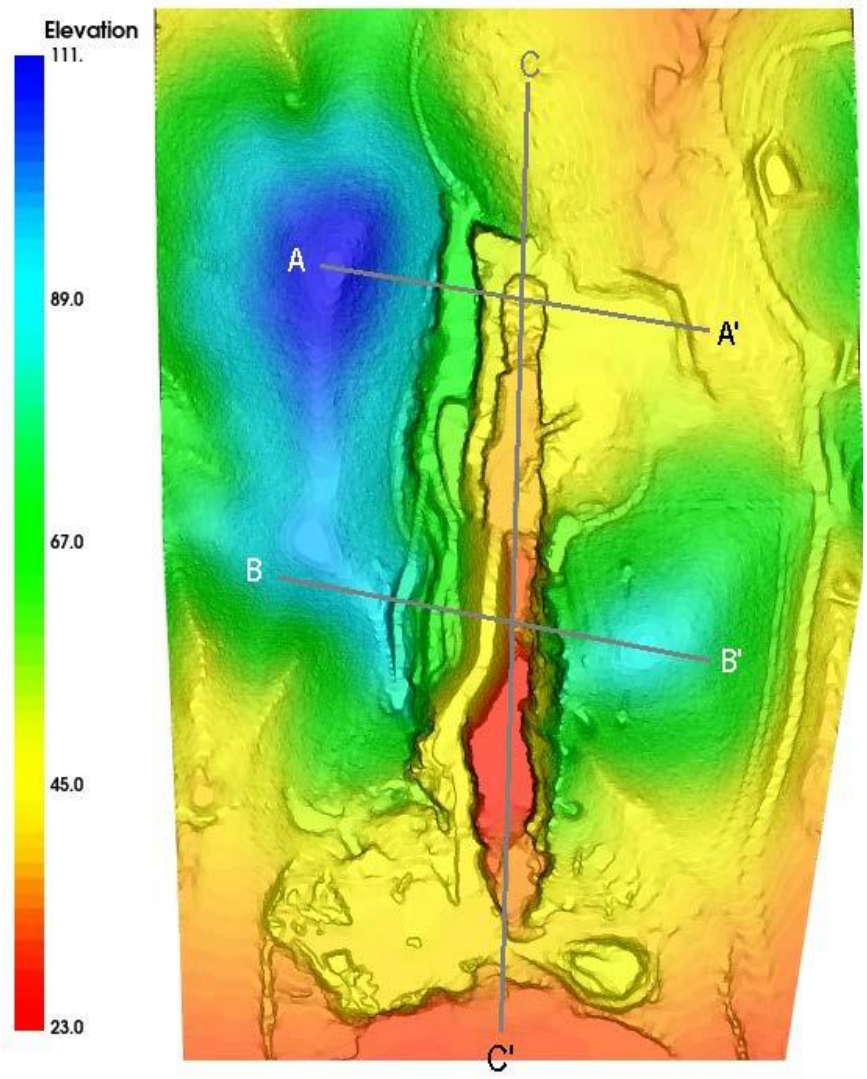


Figure 20: Concept final landform for the residual void (including the location of cross sections below) (from Rocktest 2022)

[9] The reprofiled landform for the area of the product stockpiles and infrastructure areas within ML 5763 are shown separately in Figure 18.

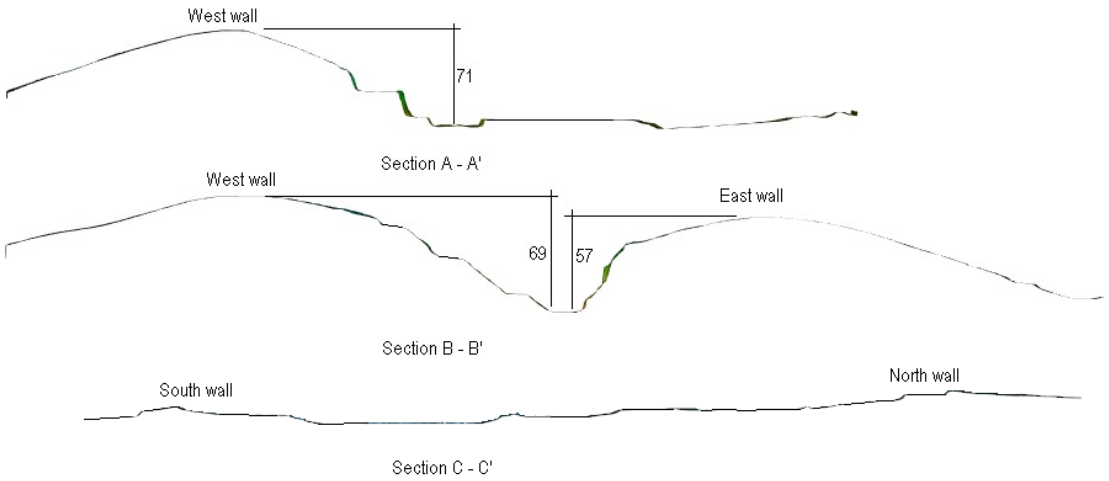


Figure 21: Concept final landform in cross section for the residual void (from Rocktest 2022)

3.5.11.2 Function of void areas in achieving the PMLU

The area nominated as having a Water Storage PMLU includes the Residual Void (Pit Lake) (RA10) and the Residual Void (Catchment) (RA11 and RA12) which functions as the main catchment for delivering surface water to the Pit Lake.

The rehabilitation strategy for RA11 and RA12 has the objective of enhancing the quality surface water run-off from the void catchment to ensure the establishment and maintenance of the water quality in the Pit Lake (RA10) of a standard that achieves the nominated PMLU.

The observations of the rapid regeneration of vegetation within the void (particularly between 2014 and 2022), as shown in Rocktest (2022) and examples reproduced in Figure 22 and Figure 23, is consistent with the benign nature of the limestone parent material and the recognised ability of vegetation to passively regenerate in limestone pits in many other parts of the world under varying climatic conditions (Davis 1979, Thompson & Green 2010, Tropek et al. 2010, Gilardelli et al. 2015).

The primary objective of rehabilitation works in the void will be to facilitate, where possible, natural regeneration to provide the vegetative cover that will reduce sediment delivery from the areas to be disturbed during removal of the waste stockpiles located in the north of the void catchment (RA12). This will be achieved through the scarification of the void floor and the strategic placement of aggregate recovered from trafficked infrastructure and ROM areas (RA1 and RA5). This soil forming material will improve water availability and physical growing conditions for root development. This material will be loose tipped to provide a hummocked surface to provide a range of relief and microclimates to promote diverse vegetation establishment.

Other remaining tracks and exposed void floor areas within RA11 will be deep ripped and or scarified to reduce the soil physical barriers to natural regeneration.

Figure 22: High vegetation cover on the floor of the Marmor void adjacent to the Pit Lake with good cover on the east wall in the background

Figure 23: Good vegetation in disturbance areas at the crest of the west wall of the Marmor void with groundcover, shrub and tree establishment on benches and good groundcover establishment in areas reworked in 2014 to the left

3.5.11.3 Achievement of a stable condition

STABILITY

A geotechnical assessment of the stability of the void has been undertaken by Rocktest (2022) (presented in full in Appendix F). The following provides a summary of the outcomes.

Inter-ramp (IR) scale instabilities, involving failure surfaces extending over multiple benches, were assessed for the main east and west walls. The applicable criteria are a maximum probability of failure

(Pf) of 10% to 20% where the likelihood of the consequence is medium to high and 20% to 25% when it is low to medium. The following results were obtained:

- The Pf for the west wall (Pf = 8%) is within the ranges of acceptability for all likelihood categories.
- The Pf for the east wall (Pf = 22%) is within the low to medium likelihood category. This category is appropriate and the value is acceptable, because:
  - IR scale events have not occurred for decades unless triggered by external forces e.g., impact by falling rocks when the east wall crest was cut back in 2014.
  - The presence of the pit lake prevents persons from being closer than 30 m to the 250 m long toe of the highest section of the wall. Dense vegetation that has naturally regenerated on the pit floor provides additional hinderance to access.
  - If an instability occurs in the future, the risk mitigation strategies included in the void closure plan mean that the likelihood is low that a person will be within the trajectory of falling rocks at the time.

An overall scale instability involves a failure surfaces extending from the crest of a wall to its toe. No such instability is known to, or appears to, have occurred on the west wall at any time. These instabilities have occurred on the east wall, likely at the time or soon after the wall was excavated many decades ago. One or more of the events contributed to the sawtooth profile of the wall and the backbreak along the crest. The applicable criteria are a maximum factor of safety (FoS) of 1.3 to 1.5, where the likelihood of the consequence of failure is medium to high, and 1.2 to 1.3 where it is low to medium. The FoS for both walls is ≥ 1.3and within the range of acceptability for all likelihood categories.

SAFETY

The final landform will be made safe through the installation of an abandonment barrier behind the crest of each wall to prevent inadvertent access to the crests by vehicles and restrict access by motorbikes and persons on foot. In lieu of a Queensland specific guideline on barriers, the recommendations in the Western Australian guideline (DIR 1997) have been adopted.

The barrier will be offset from the crest of the residual void to reflect the likely zone of instability in the long-term. Rocktest (2022) considered the minimum recommendation in the WA guideline (DIR 1997), site characteristics and the performance of the walls to date to provide recommended minimum offset distances. The default minimum of 10 m offset is acceptable for the north and south walls, but the offset has been increased to up to 40 m for the west wall and 16 m for the east wall (Figure 24).

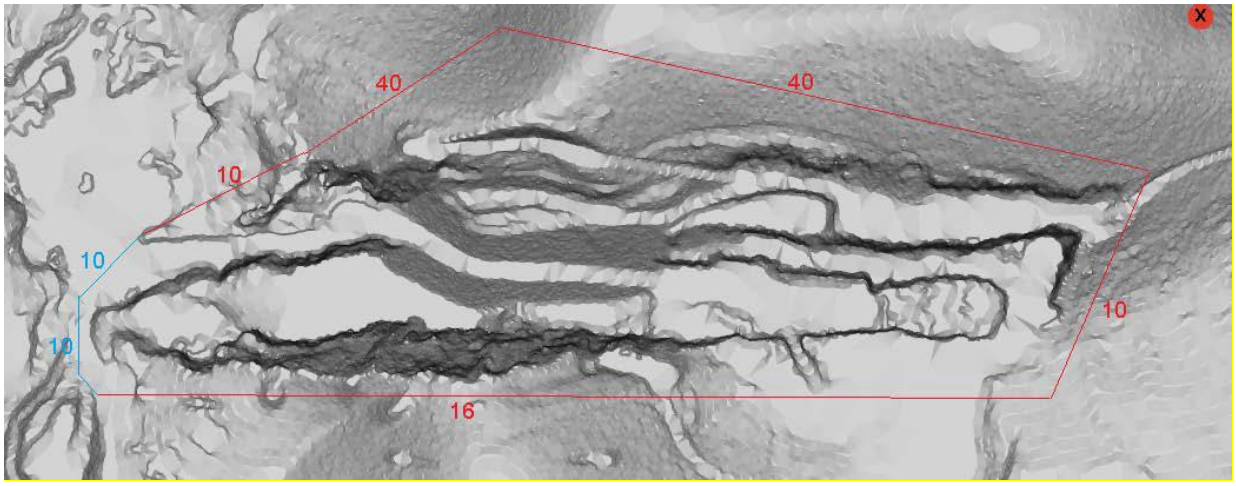


Figure 24: Location of the abandonment bund (in blue) and fence (in red) and offset distances from the crest (Rocktest 2022)

The abandonment barrier will be 1.9 km long and as shown in Figure 24 will include:

- a 1.5 m high rock bund along only the 115 m long section of the barrier footprint across the existing southern access to the void to prevent vehicles accessing the principal route to the mine workings
- a 1.5m high, 10 kJ capacity, proprietary rockfall barrier fence along the remainder of the footprint.

Signage will be erected outside the safety bund or on the fence that include warnings of the safety risk and prohibiting unauthorised access. Signs will be erected every 100 m of length of the barrier and will comply with *AS 1319-1994 Safety signs for the occupational environment.*

Tracks within the void will be deep ripped to make them unusable as an additional strategy to prevent unintentional access to the void.

POTENTIAL FOR ENVIRONMENTAL HARM (NON-POLLUTING)

The information presented in Section 3.1.5 and Section 3.5.2 has already demonstrated that the void does not intersect local groundwater aquifers and there is no indication that local groundwater quality has been affected by seepage through the void. The void will not act as a permanent groundwater sink and will not adversely affect groundwater levels in the surrounding area.

The residual void is internally draining and water falling in the void catchment and stored in the pit lake will not be connected to surrounding surface waters even during PMF event. This is further supported by an assessment of the water balance in the residual void developed using hydrologic modelling. A water balance model was created by considering rainfall, evaporation, contributing catchment area and hydrogeologic characteristics of the area. Conceptually, the residual void was considered as a localised sink as per Figure 25.

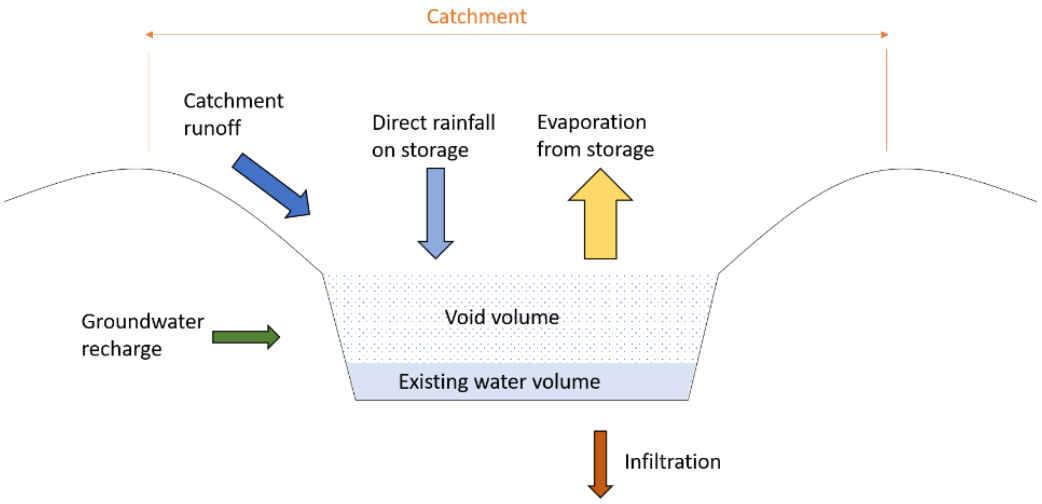


Figure 25: Water balance model representation

Based on the conceptual model, a water balance model was developed using the following inputs:

- Daily rainfall and evaporation from SILO[10] at latitude -23.65° and longitude 150.70° from 01/01/2010 - 02/09/2021
- Void contributing catchment area – 10.79 ha (calculated based on available contour information), including:
  - Grazing area – 4.03 ha
  - Void walls area – 6.35 ha
  - Void lake area – 0.41 ha
- Groundwater recharge & filtration – None (no groundwater interaction with the pit lake (ELA, 2021))
- Runoff coefficient for surface waters for catchment area under grazing – 0.61 (Engineers Australia (2014) and DSITI (2015)) based on:
  - 10-year Average Recurrence Interval (ARI), 1 hour rainfall intensity of 63.5 mm[11] (at latitude -23.68° and longitude 150.71°)
  - Fraction impervious – 0% (due to the post mining land use of grazing)
- Runoff coefficient for surface waters for catchment areas within the void – 0.76 (Engineers Australia (2014) and DSITI (2015)) based on:
  - 10-year Average Recurrence Interval (ARI), 1 hour rainfall intensity of 63.5 mm[11] (at latitude -23.68° and longitude 150.71°)
  - Fraction impervious – 50% (assuming a mixture of hard rock, blasted scree slopes and aggregate equivalent to unsealed roads).

The water balance model operated on a difference calculation (i.e., at the start of the simulation it has a net zero water level that represents the initial water level within the pit lake). The simulation then

[10] https://www.longpaddock.qld.gov.au/silo/

[11] http://www.bom.gov.au/water/designRainfalls/revised-ifd/

runs to observe the change in water level over time. The results are presented in Figure 26. Over the period modelled, the water level generally fluctuated within a band of approximately +/- 2 m from initial level. However, in the last 2 years of the simulation, there was a downward trend in water level with evaporation rate significantly greater than the rainfall rate, such that the inflows were lower than losses from the system.

For any one rainfall event that occurred during the simulation, the maximum increase in water level was 1.93 m. The model showed that 811 mm rainfall across approximately four days (24/1/2013-27/1/2013) (approximately equivalent to the average annual rainfall total) caused the water level to increase. This is comparable to between a 0.5% and 0.2% Annual Exceedance Probability (AEP) four-day event.

A sensitivity analysis was undertaken by altering the fraction of impervious surface within the void area. The assumed value of 50% was replaced with values of between 20% and 90%, resulting in a runoff coefficient of 0.67 and 0.87, respectively. This change produced no significant effect on the results. The maximum modelled increase to water level was between 1.89 m and 1.95 m under the range of runoff coefficients and the overall trend in water level was unaffected.

Therefore, based on the modelled behaviour of the void the freeboard of approximately 10 m is anticipated to be adequate to prevent overtopping.

The apparent decline in water level from 2018 is due to three consecutive years with annual rainfall substantially below average (450, mm, 245 mm, and 612 mm for 2018, 2019 and 2020 respectively compared to an average of 815 mm) coupled with high evaporation rates (particularly in 2018 and 2019). This is in line with site observations.

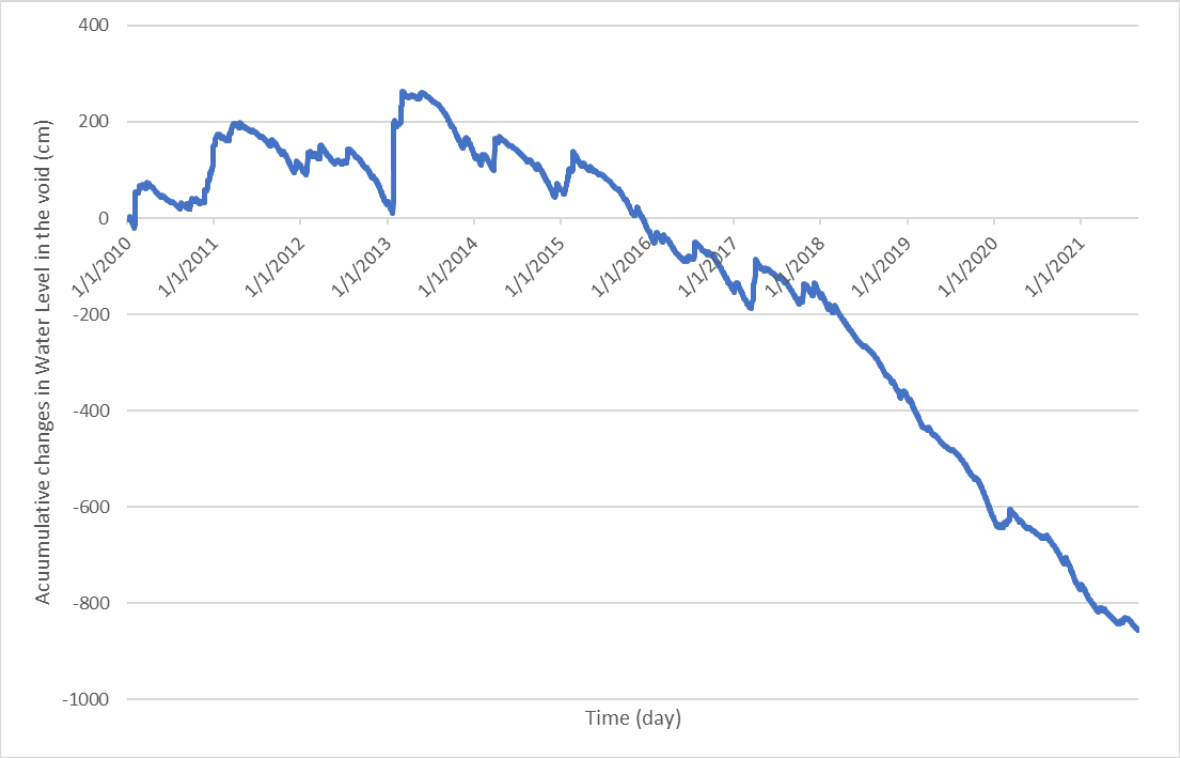


Figure 26: Water balance simulation for the void

None of the pit lake water quality results to date would prevent the void from being used for water storage to support the surrounding PMLU of cattle grazing and the quality of the pit lake does not pose a threat to wildlife (data presented in Section 3.1.3).

Rehabilitation efforts will further enhance water quality though improvements in vegetation cover and removal of waste materials as a potential source of pollutants. Given current water quality conditions (developed over many years of inactive mining), the nature of the exposed geology and void wall geochemistry, specific long-term geochemical modelling is not warranted.

There is no significant geochemical risk that would prevent the achievement of a stable condition in the long-term. Routine monitoring of void water quality will be undertaken (Section 3.7.3) and mitigation measures developed if water quality trends indicate that it will not be suitable for stock use as is currently expected (Section 3.7.6).

3.5.12 Underground mining

The mine is operated by open cut mining methods. No significant underground workings have been developed nor are any planned for the life of mine. A small adit with a 3 m wide portal that opened into a 50 m long adit was present in the west wall, but the stabilisation works carried out in 2014 have sealed this off and it is no longer visible or accessible.

3.5.13 Built infrastructure and services decommissioning

No infrastructure will remain at the completion of rehabilitation.

3.5.13.1 Services

All service connections (electricity, water and wastewater) will be disconnected in coordination with service providers and all associated service infrastructure (such as poles and wires, pipework) will be removed from site.

3.5.13.2 Bores

The water licence associated with the on-site bore will be surrendered and the bore decommissioned in consultation with the Queensland Department of Resources according to the preferred practices nominated in the Minimum Construction Requirements for Water Bores in Australia (National Uniform Drillers Licensing Committee 2020). The bore casing will be cut off at least 0.5 m below the surface and decommissioned by fully grouting from the bottom of the bore to the surface.

To allow for on-going groundwater quality data collection, the decommissioning of bores will not occur until the decontamination assessment has been completed (i.e., after RM3).

3.5.13.3 Buildings, plant and equipment

Existing management plans and registers will be reviewed for the presence of hazardous substances on site (such as equipment containing PCB, lead paint or asbestos building materials). Where information is not available, additional surveys for hazardous materials will be undertaken to identify any materials that require specialist contractors for removal and disposal. All other works will be undertaken once the site has been cleared of any hazardous materials (managed through the use of ITPs).

Where possible, serviceable demountable buildings will be sold or provided for community use. Those that cannot be re-used along with all other general buildings, sheds and tanks used to store non-

hazardous materials will be emptied, decommissioned, demolished and all waste materials removed from site. All concrete slabs and footings that are less than 0.5 m deep will be broken up and removed. Footings below 0.5 m will not interfere with rehabilitation operations or the nominated PMLU and will remain in situ.

All conveyors and gantries will be dismantled and their associated waste removed from site.

Fuel storage tanks will be emptied and decommissioned with the remaining fuel removed by a licenced contractor. Plant and infrastructure used for processing (including the kiln), workshop and fuel storage (including bunds and slabs) will be decommissioned and demolished and all waste materials removed from site. All concrete slabs and footings that are less than 0.5 m deep will be broken up and removed.

Areas that may have been affected by notifiable activities (hydrocarbon storage, lime burning), the workshop area or areas potentially contaminated through the operation of the plant and equipment (RA3 and the sediment in RA4) will undergo a contaminated site investigation and a Site Investigation Report will be prepared by an appropriately qualified person. If the investigation demonstrates that on-site remediation or removal of contaminated material is required, these works will be undertaken and validation sampling has been completed. Where appropriate, an application will then be made to remove the site from Contaminated Land Register. Where the Site Investigation Report determines that contamination can safely remain in-situ (under appropriate management), a Site Management Plan will be prepared by an appropriately qualified person that will include a statement by the underlying landholder (Graymont (NSW) Pty Ltd) accepting responsibility to implement the Site Management Plan.

3.5.13.4 Roads, tracks and hardstands

The site access (RA8) will be retained as long as possible to allow vehicles involved in the rehabilitation and revegetation works to readily access work areas. Rehabilitation will comments in RA8 once the revegetation works have been completed on the remainder of the site.

All bitumen removed from the site entrance (part of RA8) will be removed and disposed of at appropriately licensed facility.

The aggregate used to create the trafficable surfaces around the administration, plant and stockpile areas and on unsealed (gravel) roads (remainder of RA8) will be removed to 300 mm and used to create the abandonment bund at the void main access (see Section 3.5.11.3). A materials balance has confirmed that there is sufficient material available from the 0.32 ha of RA8 from which material can be salvaged.

Following the removal of surface aggregate and bitumen, these areas will be reshaped to create the final landforms and surface drainage pattern as described in Section 3.5.6, before site preparation, topsoiling (Section 3.5.8) and revegetation (Section 3.5.9).

Unsealed tracks that remain within the RA11(in the residual void) will not be stripped of aggregate during rehabilitation, but they will be deep ripped to break them up as a safety measure to prevent them from being used should there be any unauthorised access. This will also promote natural regeneration that will ultimately improve the quality of surface water run-off to the void.

3.5.13.5 General

Vehicle hygiene controls will be implemented to minimise the risk of weeds being transported to site.

3.6 Risk Assessment

The overall objective of the closure and rehabilitation risk assessment (the risk assessment) is to identify risks of a stable condition for land not being achieved and to document how Graymont has or intends to manage or mitigate the risks identified in accordance with Section 126C(1)(f) of the EP Act. As defined in Section 111A of the EP Act, *Land is in a stable condition if —*

a) the land is safe and structurally stable; and
b) there is no environmental harm being caused by anything on or in the land; and
c) the land can sustain a post-mining land use.

Potential environmental risks associated with not achieving a stable condition have been assessed with risk treatment measures identified. The residual risk after treatment has been assessed according to the criteria presented in Table 15 to Table 17. The risk assessment outcomes are presented in Table 18.

All treatment measures identified have been incorporated into the rehabilitation and closure planning outlined in this PRCP. This includes rehabilitation strategies, milestone criteria, the PRCP Schedule and implementation timeframe, ITP validation, monitoring requirements and corrective actions. The rehabilitation milestone criteria that reflect the implementation of risk treatments/mitigating actions are identified in Table 18. Where treatments/controls are discussed and detailed elsewhere in the PRCP Planning part, cross-references are provided in Table 18.

Table 15: Likelihood measures

Level	Rating	Description	Frequency
5	Almost certain	The event is expected to occur in most circumstances	More than once a year
4	Likely	The event will probably occur in most circumstances	At least once per year
3	Possible	The event should occur at some time	At least once in 3 years
2	Unlikely	The event could occur at some time	At least once in 10 years
1	Rare	The event may only occur in exceptional circumstances	Less than once in 15 years

Table 16: Consequence measures

Rating (level)	Health	Financial Impact	Environment
Insignificant (1)	Minor injuries not requiring first aid or near miss. No psychological stress	Less than $10,000	Contained, reversible impact managed by on site response
Minor (2)	First Aid treatment and/or one off counselling	$10,000 to $100,000	Contained, reversible impact managed by internal response
Moderate (3)	Medical treatment required and/or psychological intervention/treatment required	$100,000 to $1,000,000	Contained, reversible impact managed by external agencies
Major (4)	Serious or extensive injuries and/or significant and long-term psychological stress	$1,000,000 to $10,000,000	Uncontained, reversible impact managed by a coordinated response from external agencies
Catastrophic (5)	Death or severe permanent physical and/or psychological disablements	Greater than $10,000,000	Uncontained, irreversible impact

Table 17: Risk assessment matrix

	Consequence				
Likelihood	**Insignificant (1)**	**Minor (2)**	**Moderate (3)**	**Major (4)**	**Catastrophic (5)**
Almost certain (5)	**Moderate (5)**	**High (10)**	**High (15)**	**Extreme (20)**	**Extreme (25)**
Likely (4)	**Low (4)**	**Moderate (8)**	**High (12)**	**High (16)**	**Extreme (20)**
Possible (3)	**Low (3)**	**Moderate (6)**	**Moderate (9)**	**High (12)**	**High (15)**
Unlikely (2)	**Low (2)**	**Low (4)**	**Moderate (6)**	**Moderate (8)**	**High (10)**
Rare (1)	**Low (1)**	**Low (2)**	**Low (3)**	**Low (4)**	**Moderate (5)**

Table 18: Risk assessment outcomes according to each PMLU

Risk event	Potential impact on achievement of stable condition	Proposed mitigations strategy and risk treatment	Justification	Performance Assessment and Reporting	Monitoring and reporting	Residual Risk (L / M / H / E)
Low Intensity Grazing PMLU						
Incomplete or inadequate removal of infrastructure.	**Land is safe** Remaining infrastructure or hazardous building materials pose a risk to human, fauna or stock safety. **Potential for environmental harm** Hazardous building materials debris impact on soil quality. Hazardous building materials debris impact on surface water runoff and offsite EVs. **Sustaining PMLU** Surface or buried debris prevents soil seedbed preparation.	• The rehabilitation management methodology relevant to this risk is contained in Section 3.5.13. • Hazardous building materials will be identified, managed and removed by appropriately licenced contractors prior to demolition. • All infrastructure will be removed from the site, including hazardous building materials. • Adequate time allowed in the PRCP Schedule. • ITPs have been developed to include hold points for milestone criteria RM1 b. and c. (related to removal of hazardous materials and infrastructure) that will prevent subsequent rehabilitation actions from being implemented until these criteria had been satisfied.	• The removal of infrastructure and hazardous materials is adequately managed through the rehabilitation strategy presented in the PRCP Planning part. • The PRCP Schedule has been prepared mindful of site size, complexity, and nature of the task and likelihood of the risk. • The ITPs provide adequate QA/QC control of the rehabilitation process relevant to this risk.	Refer to the completion criteria relevant to this risk in Table 12 as listed below: • RM1 a, b, c, f • RM4 j	Performance validated and documented in ITPs for RM1 and RM4 (bores) (see Appendix E) including sources of documentary or photographic evidence.	1 / 2 / L
Incomplete removal of mine waste (ex-void)	**Land is safe** Remaining waste presents a risk to human, fauna or stock safety. **Potential for environmental harm** Remaining waste impacts on soil quality. Remaining waste building materials debris impact on surface water runoff and offsite EVs. **Sustaining PMLU** Residual waste adversely affects growing conditions.	• The rehabilitation management methodology relevant to this risk is contained in Section 3.5.4and 3.5.13. • Waste will be removed and disposed off-site at an appropriately licensed facility. • Validation sampling will be conducted by an AQP to confirm waste removed to virgin ground. • Adequate time allowed in the PRCP Schedule. • ITPs have been developed to include a hold point for milestone criterion RM2 b. (validation sampling by AQP has occurred) that will prevent subsequent rehabilitation actions from being implemented until this criterion criteria had been satisfied.	• The removal of mine waste is adequately managed through the rehabilitation strategy presented in the PRCP Planning part. • The PRCP Schedule has been prepared mindful of volume of waste and number of locations affected. • The ITPs provide adequate QA/QC control of the rehabilitation process relevant to this risk.	Refer to the completion criteria relevant to this risk in Table 12 as listed below: • RM2 a, b, c	Performance validated and documented in ITPs for RM2 (see Appendix E) including sources of documentary or photographic evidence.	2 / 2/ L
Adverse groundwater quality identified.	**Potential for environmental harm** Impacts to downstream and off-site EVs.	• Ongoing monitoring program documented in this PRCP (Section 3.7) to assess groundwater quality samples at Bore 136274 against appropriate WQOs (see Section 3.1.5.6) until all potential sources of contamination have been removed and a contaminated land investigation and any subsequent remediation has been completed. • Conceptual site model (CSM) developed to understand sources of contamination (Section 3.5.7). • ITPs have been developed to include a hold point for milestone criterion RM3 d. (receipt of a suitability statement that states that land is not contaminated and is suitable for the proposed PMLU) that will prevent subsequent rehabilitation actions (including monitoring more removal) from being implemented until this criterion had been satisfied.	• WQOs have been adopted based on Fitzroy River Sub-basin (see Section 3.1.5.6). • Potential sources of contamination understood and current groundwater quality is generally good. • Void is not connected to groundwater and is not a potential source of contamination (Section 3.5.1.2). • The monitoring program is based on the CSM and potential sources of contamination.	Refer to the completion criteria relevant to this risk in Table 12 as listed below: • RM4 g (Note this RM is after completion of contaminated land management activities in RM3).	Monitoring program presented in Section 3.7. Groundwater quality monitoring ongoing until completion of RM3. Performance to be documented in reports after each monitoring event and annually. Water quality reports to be used to inform contamination assessment in RM3. Performance validated for precursor RM3 validated in ITPs (see Appendix E) including sources of documentary or photographic evidence.	2 / 2 / L

Risk event	Potential impact on achievement of stable condition	Proposed mitigations strategy and risk treatment	Justification	Performance Assessment and Reporting	Monitoring and reporting	Residual Risk (L / M / H / E)
Incomplete removal of site contamination.	**Land is safe** Remaining contamination presents a risk to human, fauna or stock safety. **Potential for environmental harm** Impacts to downstream and off-site EVs **Sustaining PMLU** Contamination adversely affects growing conditions.	• When the site is operational, runoff from the process plant footprint is directed through the onsite sediment dam (Section 3.5.7.1). • The rehabilitation management methodology relevant to this risk is contained in Section 3.5.13.3. • All stockpiled waste materials which could provide a source of ongoing contaminants and sediment will be removed (see previous risk). • Validation sampling will be conducted by an AQP to confirm that the material has been removed to virgin ground. • Areas that may have been affected by notifiable activities (hydrocarbon storage, lime burning), the workshop area, areas potentially contaminated through plant and equipment operation (within RA3), and the sediment dam (within RA4) will undergo a contaminated land investigation by an AQP. • A contaminated land investigation document will be prepared by an AQP. • Site remediation (including groundwater) will be undertaken on the advice of an AQP. • Adequate time allowed in the PRCP Schedule. • ITPs have been developed to include a hold point for milestone criterion RM3 d. (receipt of a suitability statement that states that land is not contaminated and is suitable for the proposed PMLU) that will prevent subsequent rehabilitation actions (including monitoring more removal) from being implemented until this criterion had been satisfied.	• The removal of site contamination is adequately managed through the rehabilitation strategy presented in the PRCP Planning part. • Potential sources of contamination understood and current groundwater quality is generally good. • The PRCP Schedule has been prepared mindful of site size, complexity potential sources of contamination and nature of the task. Time has been allowed for remediation of sources of contamination not reasonably foreseen. • The ITPs provide adequate QA/QC control of the rehabilitation process relevant to this risk.	Refer to the completion criteria relevant to this risk in Table 12 as listed below: • RM3 a, b, c, d	Performance validated and documented in ITPs for RM3 (see Appendix E) including sources of documentary or photographic evidence.	2 / 2 / L
Final landform design does not provide for the creation of a stable condition.	**Land is safe and stable** landform is unstable. **Potential for environmental harm** Sedimentation impacts to downstream and off-site EVs **Sustaining PMLU** Slope is not suitable for long-term sustainability of the nominated PMLU.	• The rehabilitation management methodology relevant to this risk is contained in Section 3.5.6 • Operations and closure at Marmor will not result in the creation of out of pit post-mine landforms commonly found at many operations. • There will be no significant earthworks or recontouring required at closure • Most RAs outside the void to be returned to a grazing PMLU are approximately at their final grade. • Average slope of areas to be revegetated does not exceed 15% (RA1 – RA5, RA8, RA9 and RA13). • Unsealed tracks (RA7) graded to conform to the surrounding un-mined landform previously used for grazing. • Adequate time allowed in the PRCP Schedule for landform development. • ITPs have been developed to include a hold point for milestone criterion RM4 c. (relating to final landform slope for the largest RAs) that will prevent subsequent rehabilitation actions (including topsoil placement) from being implemented until this criterion had been satisfied. • Monitoring for mass stability (slumping) is included in the nominated monitoring program (Section 3.7.1.2).	• The selection of the maximum slope has been selected based on the site, soil characteristics and the nominated PMLU and is justified in Section 3.3.2.3. • Most final landforms will be at current grade. • The PRCP Schedule has been prepared mindful of site size, complexity and nature of earthworks required. • The ITPs provide adequate QA/QC control of the rehabilitation process relevant to this risk.	Refer to the completion criteria relevant to this risk in Table 12 as listed below: • RM4 d, e	Performance validated and documented in ITPs for RM4 (see Appendix E) including sources of documentary or photographic evidence.	2 / 2 / L

Risk event	Potential impact on achievement of stable condition	Proposed mitigations strategy and risk treatment	Justification	Performance Assessment and Reporting	Monitoring and reporting	Residual Risk (L / M / H / E)
Topsoils used in rehabilitation are susceptible to erosion or of unsuitable quality.	**Land is safe and stable** Landform is unstable. **Potential for environmental harm** Sedimentation impacts to downstream and off-site EVs **Sustaining PMLU** Topsoil lost through erosion prevents sustained vegetation growth Poor quality topsoil does not provide suitable growing conditions for proposed PMLU.	• The rehabilitation management methodology relevant to this risk is contained in Sections 3.5.3 and 3.5.7.2. • Topsoil in stockpiles to be used for rehabilitation has been assessed and results reviewed by a Certified Professional Soil Scientist (see Section 3.5.3). • To address the topsoil shortfall identified, a minimum standard of soil quality (including stability criteria) has been documented in the PRCP and a milestone criterion has been included to ensure that prior to use, any topsoil imported for rehabilitation works has been assessed and results reviewed by a AQP (outlined in Section 3.3.2.5 and RM5 c). • Topsoil will be ameliorated according to the recommendations of AQP (section 3.5.8). • An adequate depth of topsoil is provided in the rehabilitation methodology. • Temporary and permanent Erosion and Sediment Control Structures have been designed and installed with reference to Best Practice Erosion & Sediment Control series (IECA 2008). • A period of vegetation establishment has been included in rehabilitation milestones with milestone criteria that reflect progression toward the ultimate rehabilitation completion criteria. This period allows for corrective action to be undertaken should the rehabilitation not be on the desired trajectory (Rehabilitation milestone 7). • ITPs have been developed to include hold points for milestone criteria RM5 c, d and e (relating to soil quality and topsoil depth) that will prevent subsequent rehabilitation actions (including topsoil placement) from being implemented until each criterion had been satisfied. • Monitoring for soil erosion is included in the nominated monitoring program (Section 3.7.1.2). • Monitoring of water management structures included in the nominated monitoring program (Section 3.7.1.4). • Corrective actions in response to adverse erosion nominated in Section (3.7.6).	• Slopes have been adopted that are suitable for according the erosion risks associated with the nominated PMLU (Section 3.3.2.3). • The stockpiled topsoil available for rehabilitation has been analysed and shown to be non-sodic and has properties that provide inherent erosion resistance. • There is no evidence of land on the lease areas being prone to instability in the previously disturbed areas around the crest of the void have stabilised following vegetation establishment (Section 3.5.7.2). • The PRCP Schedule has been prepared mindful of risk and to allow adequate time to provide corrective actions. • The ITPs provide adequate QA/QC control of the rehabilitation process relevant to this risk.	Refer to the completion criteria relevant to this risk in Table 12 as listed below: • RM4 c • RM5 c, d, e • RM7 a, b, f, g • RM9 b, c	Routine monitoring program presented in Section 3.7. Additional site inspections in first year of establishment and following adverse events (Sections 3.7.6.1 and 3.7.6.2). Performance validated and documented in ITPs for RM4, RM5, RM7 and RM9 (see Appendix E) including sources of documentary or photographic evidence.	2 / 2 / L
Ground compacted by previous land use prevents adequate vegetation establishment or sustained ground cover.	**Sustaining PMLU** Compaction leads to poor water holding capacity, poor drainage and water logging and poor vegetation establishment and poor pasture productivity.	• The rehabilitation management methodology relevant to this risk is contained in Section 3.5.8. • ITPs have been developed to include a hold point for milestone criterion RM5 a (relating to deep ripping) that will prevent subsequent rehabilitation actions (including topsoil placement) from being implemented until this criterion had been satisfied. • Monitoring for water ponding (that may indicate the presence of subsoil compaction) is included in the nominated monitoring program (Section 3.7.1.2). • Monitoring of ground conditions and vegetation (Section 3.7.1.1).	• The relieving of ground compaction through deep ripping is adequately managed through the rehabilitation strategy presented in the PRCP Planning part. • The ITPs provide adequate QA/QC control of the rehabilitation process relevant to this risk.	Refer to the completion criteria relevant to this risk in Table 12 as listed below: • RM5 a • RM7 b	Routine monitoring program presented in Section 3.7. Additional site inspections in first year of establishment and following adverse events (Sections 3.7.6.1 and 3.7.6.2). Performance validated and documented in ITPs for RM5 and RM7 (see Appendix E) including sources of documentary or photographic evidence.	2 / 1 / L

Risk event	Potential impact on achievement of stable condition	Proposed mitigations strategy and risk treatment	Justification	Performance Assessment and Reporting	Monitoring and reporting	Residual Risk (L / M / H / E)
Vegetations fails to establish due to inappropriate species mix.	**Land is safe and stable** Poor cover leads to accelerated erosion. **Potential for environmental harm** Sedimentation impacts to downstream and off-site EVs **Sustaining PMLU** Unable to achieve the relevant vegetation milestones in the PRCP schedule.	• The rehabilitation management methodology relevant to this risk is contained in Section and 3.5.9. • The rehabilitation management methodology relevant to this risk is contained in Section 3.5.9. The specific treatment controls are detailed below. • Pasture seeding mix that is suited to the available soil resources and site conditions has been recommended by an independent agronomist (see Section 3.5.9). • The plant species selected are tolerant of a wide range of soil conditions and drought (see Section 3.5.9). • The plant species selected are adapted to low fertility soils (i.e., they do not require high rates of fertiliser/maintenance) (see Section 3.5.9). • The revegetation strategy considered optimum timing for planning to maximise potential for follow up rains (see Section 3.5.9). • A period of vegetation establishment has been included in rehabilitation milestones with milestone criteria that reflect progression toward the ultimate rehabilitation completion criteria. This period allows for corrective action to be undertaken should the rehabilitation not be on the desired trajectory (Rehabilitation milestone 7) • Vegetation and land condition monitoring program developed (Section 3.7). • Corrective actions in response to poor vegetation establishment and undesirable pasture species composition nominated in Section 3.7.6. This includes conducting a review rehabilitation strategy and species lists (in consultation with local DAF officers). • The TRCP Schedule (Appendix B) has allowed for sufficient time for vegetation establishment period (RM7) and for the achievement of the final stable condition (RM9).	• Justification for the selection of the pasture seed mix is provided in Section 3.5.9. • The revegetation strategy and species selection is adequately managed through the rehabilitation strategy presented in the PRCP Planning part. • The ITPs provide adequate QA/QC control of the rehabilitation process relevant to this risk. • Milestones RM7 and RM9 are justified in Section 3.3.2.7. • Appropriate triggers and corrective actions have been established to managed poor vegetation outcomes.	Refer to the completion criteria relevant to this risk in Table 12 as listed below: • RM6 a, b • RM7 a, b, c, d, e • RM9 a, c, d, e, f	Routine monitoring program presented in Section 3.7. Additional site inspections in first year of establishment and following adverse events (Sections 3.7.6.1 and 3.7.6.2). Performance validated and documented in ITPs for RM6, RM7 and RM9 (see Appendix E) including sources of documentary or photographic evidence.	1 / 1 / L
Pests, disease and/or weeds adequate vegetation establishment or sustained pasture quality and productivity.	**Sustaining PMLU** Decrease in pasture quality and unable to achieve vegetation milestones. Risk of spread to neighbouring properties.	• The site is fenced and during operations, stock are prevented from using the land within the lease areas (Section 3.1.6). • Vehicle hygiene controls will be implemented to minimise the risk of weeds being transported to the site (Section 3.5.13.5). • A period of vegetation establishment has been included in rehabilitation milestones with milestone criteria that reflect progression toward the ultimate rehabilitation completion criteria. This period allows for corrective action to be undertaken should the rehabilitation not be on the desired trajectory (Rehabilitation milestone 7). • Vegetation (including cover, condition and biomass) condition monitoring program developed (Section 3.7). • Weed management will be implemented in response to monitoring of vegetation composition and weed cover (monitoring program in Section 3.7). • Corrective actions in response to poor vegetation establishment and undesirable pasture species composition nominated in Section 3.7.6. This includes the installation of temporary fencing if due to excessive	• The revegetation strategy and species selection is adequately managed through the rehabilitation strategy presented in the PRCP Planning part. • The ITPs provide adequate QA/QC control of the rehabilitation process relevant to this risk. • Milestones RM7 and RM9 are justified in Section 3.3.2.7. • Appropriate triggers and corrective actions have been established to managed poor vegetation outcomes.	Refer to the completion criteria relevant to this risk in Table 12 as listed below: • RM7 a, b, d, e, f • RM9 a, d, e, f	Routine monitoring program presented in Section 3.7. Additional site inspections in first year of establishment and following adverse events (Sections 3.7.6.1 and 3.7.6.2). Performance validated and documented in ITPs for RM7 and RM9 (see Appendix E) including sources of documentary or photographic evidence.	3 / 2 / M

Risk event	Potential impact on achievement of stable condition	Proposed mitigations strategy and risk treatment	Justification	Performance Assessment and Reporting	Monitoring and reporting	Residual Risk (L / M / H / E)
		herbivory from native animals (macropods) and conducting pest and/or disease control measures as determined by monitoring. • Additional site inspections in addition to routine monitoring will be triggered by serious pest invasions and disease outbreaks (Section 3.7.6.2). • The PRCP Schedule (Appendix B) has allowed for sufficient time for vegetation establishment period (RM7) and for the achievement of the final stable condition (RM9).				
Pasture die-off or damage due to adverse weather.	**Sustaining PMLU** Decrease in pasture cover, quality and productivity unable to achieve vegetation milestones.	• The plant species are tolerant of drought conditions (see Section 3.5.9). • A period of vegetation establishment has been included in rehabilitation milestones with milestone criteria that reflect progression toward the ultimate rehabilitation completion criteria. This period allows for corrective action to be undertaken should the rehabilitation not be on the desired trajectory (Rehabilitation milestone 7) • Vegetation and land condition monitoring program developed (Section 3.7). • Corrective actions in response to poor vegetation cover establishment nominated in Section 3.7.6. This includes the provision of additional irrigation (from water stored in the void) if rainfall is inadequate and reseeding damaged areas. • Additional site inspections in addition to routine monitoring will be triggered by adverse weather events (Section 3.7.6.2). • No controls required for flooding management as the site will be largely unaffected by flooding even under a PMF (Section 3.5.2) and the pasture mix is tolerant of short term waterlogging (Section 3.5.9). • The PRCP Schedule (Appendix B) has allowed for sufficient time for vegetation establishment period (RM7) and for the achievement of the final stable condition (RM9).	• The site is not in a floodplain and flooding assessment has determined that landforms or PMLU unlikely to be affected even under extreme events (see Section 3.5.2). • The void water is available and of a suitable quality for use in irrigation purposes. • The ITPs provide adequate QA/QC control of the rehabilitation process relevant to this risk. • Milestones RM7 and RM9 are justified in Section 3.3.2.7. • Appropriate triggers and corrective actions have been established to manage poor vegetation outcomes associated with adverse weather events.	Refer to the completion criteria relevant to this risk in Table 12 as listed below: • RM7 a, b, d, e • RM9 a, d, e, f	Routine monitoring program presented in Section 3.7. Additional site inspections in first year of establishment and following adverse events (Sections 3.7.6.1 and 3.7.6.2). Performance validated and documented in ITPs for RM7 and RM9 (see Appendix E) including sources of documentary or photographic evidence.	3 / 2 / M
Unforeseen conditions affect achievement of stable condition.	**Sustaining PMLU** Decrease in pasture quality and unable to achieve vegetation milestones. Risk of spread to neighbouring properties.	• A period of vegetation establishment has been included in rehabilitation milestones with milestone criteria that reflect progression toward the ultimate rehabilitation completion criteria. This period allows for corrective action to be undertaken should the rehabilitation not be on the desired trajectory (Rehabilitation milestone 7) • Vegetation and land condition monitoring program developed (Section 3.7). • Corrective actions in response to poor vegetation cover establishment nominated in Section 3.7.6. • Additional site inspections in addition to routine monitoring will be triggered by previously unforeseen events (Section 3.7.6.2). • The PRCP Schedule (Appendix B) has allowed for sufficient time for vegetation establishment period (RM7) and for the achievement of the final stable condition (RM9).	• Milestones RM7 and RM9 are justified in Section 3.3.2.7. • Appropriate triggers and corrective actions have been established to manage poor vegetation outcomes associated with adverse weather events.	Refer to the completion criteria relevant to this risk in Table 12 as listed below: • RM7 a to g • RM9 a to f	Routine monitoring program presented in Section 3.7. Additional site inspections in first year of establishment and following unforeseen events (Sections 3.7.6.1 and 3.7.6.2). Performance validated and documented in ITPs for RM7 and RM9 (see Appendix E) including sources of documentary or photographic evidence.	1 / 2 / L

Risk event	Potential impact on achievement of stable condition	Proposed mitigations strategy and risk treatment	Justification	Performance Assessment and Reporting	Monitoring and reporting	Residual Risk (L / M / H / E)
Water Storage PMLU						
Insufficient prevention of access to the residual void.	**Land is safe** Accidental access to void poses a risk to human safety (falls and drowning).	• The rehabilitation management methodology relevant to this risk is contained in Section 3.5.11. • Retention and, during operations, regular inspection of the secure fence and locked gate along the property boundary on Sisalana Road. • Installation of safety bund and fencing around the residual void in accordance with recommendations in Rocktest (2022) (Appendix F). • Installation of warning signage around the bund and fence compliant with *AS 1319-1994* and placed at maximum 100m spacings (Section 3.5.11). • Deep ripping of the haul road and access tracks within the residual void (Section 3.5.11) further prevent accidental access.	• The closure strategy for the void is adequately managed through the rehabilitation strategy presented in the PRCP Planning part. • The proposed mitigation strategies recommended and detailed in the Pit Geotechnical Report (Rocktest 2022) and have been adopted. • The safety bund and fencing will physically restrict accidental access to the site and the deep excavation. • The ITPs provide adequate QA/QC control of the rehabilitation process relevant to this risk.	Refer to the completion criteria relevant to this risk in Table 12 as listed below: • RM5 b • RM10 b. c	Performance validated and documented in ITPs for RM5 and RM10 (see Appendix E) including sources of documentary or photographic evidence.	1 / 5 / M
Adverse water quality in the pit lake.	**Land is safe** Accidental access to void and contact with the or ingestion of pit lake water poses a risk to humans, livestock and fauna. **Potential for environmental harm** Adverse water quality affects off-site EVs. **Sustaining PMLU** Unable to achieve the relevant water quality milestones in the PRCP schedule.	• The site information and rehabilitation management methodology relevant to this risk is contained in Sections 3.5.1, 3.5.2, 3.5.4 and 3.5.11. • The void is internally draining. There is no risk of void overtopping even during a PMF event. • Water quality already meets stock water quality (and by inference suitability for fauna use) and no additional sources of contamination will be introduced. This is prior to additional controls that will be undertaken during rehabilitation. • All stockpiled waste materials which could provide a source of ongoing sediment or contaminants within the area with a Water Storage PMLU area will be removed. Validation sampling by an AQP to confirm that the material has been removed to virgin ground. • Rehabilitation management will further facilitate vegetation regeneration within the void to improve water quality draining to the pit lake. • Ongoing monitoring program to assess water quality in the pit lake with respect to the standards in ARMCANZ & ANZECC (2000) guidelines for stock water (monitoring program presented in Section 3.7.2). • A period of water quality establishment has been included in the rehabilitation milestones with milestone criteria that reflect progression toward the ultimate rehabilitation completion criteria. This period allows for corrective action to be undertaken should the rehabilitation not be on the desired trajectory (Rehabilitation milestone 8). • Corrective actions in response to poor water quality nominated in Section 3.7.6. This includes investigating quality of drainage or seepage inputs or remediation/treatment options for the void (based on inputs from specialist input from an AQP). • Retention and, during operations, regular inspection of the secure fence and locked gate along the property boundary on Sisalana Road prevent unauthorised access (including livestock).	• The closure strategy for the void is adequately managed through the rehabilitation strategy presented in the PRCP Planning part. This includes measures to remove sources of contamination and further enhance water quality. • Reviews in the PRCP has determined that the void poses no risk to groundwater or off-site EVs. • The safety bund and fencing will physically restrict accidental access to the pit lake. • The ITPs provide adequate QA/QC control of the rehabilitation process relevant to this risk.	Refer to the completion criteria relevant to this risk in Table 12 as listed below: • RM2 a, b • RM5 b • RM8 b, c • RM10 b, c, d, e	Routine monitoring program presented in Section 3.7. Additional site inspections following unforeseen events that may affect water quality (Section 3.7.6.2). Performance validated and documented in ITPs for RM2, RM5, RM8 and RM10 (see Appendix E) including sources of documentary or photographic evidence.	1 / 3 / L

Risk event	Potential impact on achievement of stable condition	Proposed mitigations strategy and risk treatment	Justification	Performance Assessment and Reporting	Monitoring and reporting	Residual Risk (L / M / H / E)
		• Installation of safety bund and fencing around the residual void in accordance with recommended strategy in the Pit Geotechnical Report (Rocktest 2022) (Appendix F). • Installation of warning signage around the bund and fence compliant with *AS 1319-1994* and placed at maximum 100m spacings (Section 3.5.11). • Deep ripping of the haul road and access tracks within the residual void (Section 3.5.11) prevent accidental access to the pit lake.				
Failure to establish groundcover in the void.	**Sustaining PMLU** Natural regeneration does not increase the ground cover and intended to further polish surface water draining to the pit lake. Water quality milestone criteria are not met.	• The rehabilitation management methodology relevant to this risk is contained in Section 3.5.11. This includes measures presented below. • Deep ripping of the haul road and access tracks within the residual void and scarification of the void floor to remove soil physical barriers to revegetation. • Placement of recovered surface aggregate in the void floor to improve substrate and provide soil forming materials. • Annual monitoring of vegetation cover establishment in the Residual Void (Catchment) during RM8 using Unmanned Aerial Vehicles (UAVs) (Sections 3.7.2.1 and 3.7.4). • Ongoing monitoring program to assess water quality in the pit lake with respect to the standards in ARMCANZ & ANZECC (2000) guidelines for stock water (Monitoring program presented in Section 3.7.2). • Corrective actions in response to poor water quality nominated in Section 3.7.6. This includes investigating whether poor vegetation regeneration in the floor of the void could have contributed to adverse water quality and, as required, remedial action such as aerial seeding to improve vegetation cover. • Additional site inspections following unforeseen events that may affect water quality (Section 3.7.6.2).	• The closure strategy for the void is adequately managed through the rehabilitation strategy presented in the PRCP Planning part. This includes measures to improve growing conditions that will facilitate natural regeneration. • The ITPs provide adequate QA/QC control of the rehabilitation process relevant to this risk.	Refer to the completion criteria relevant to this risk in Table 12 as listed below: • RM4 b • RM5 b • RM8 b, c • RM10 e	Routine monitoring program presented in Section 3.7. Additional site inspections following unforeseen events that may affect water quality (Section 3.7.6.2). Performance validated and documented in ITPs for RM4, RM5, RM8 and RM10 (see Appendix E) including sources of documentary or photographic evidence.	3 / 2 / M
Void wall geotechnical instability or failure.	**Land is safe and stable** Wall instability caused risk to Remaining contamination presents a risk to human, fauna or stock safety.	• The site information and rehabilitation management methodology relevant to this risk is contained in Section 3.5.11. • Works have already been undertaken in the void to provide safe and stable conditions. • An assessment by a geotechnical engineer has confirmed that that long-term geotechnical stability of the final void walls has been achieved (Rocktest 2022) (Appendix F). • Installation of safety bund and fencing around the residual void in accordance with recommendations in Rocktest (2022) (Appendix F). • Installation of warning signage around the bund and fence compliant with *AS 1319-1994* and placed at maximum 100m spacings (Section 3.5.11). • Deep ripping of the haul road and access tracks within the residual void (Section 3.5.11) prevent accidental access to the pit lake. • Ongoing audits of geotechnical risk by an AQP occurring at 18-month intervals until rehabilitation sign-off (Section 3.7). • Additional site inspections following unforeseen events that may affect void wall stability (Section 3.7.6.2).	• Geotechnical stabilisation works were completed in 2014 in accordance with advice from a AQP to ensure the void was operationally safe (Rocktest 2014). • In 2022, a geotechnical assessment by an AQP confirmed that the void walls had achieved long term stability (Rocktest 2022). • The closure strategy for the void is adequately managed through the rehabilitation strategy presented in the PRCP Planning part. • The ITPs provide adequate QA/QC control of the rehabilitation process relevant to this risk.	Refer to the completion criteria relevant to this risk in Table 12 as listed below: • RM 4 a • RM5 b • RM8 a • RM10 a, b, c	Routine monitoring program presented in Section 3.7. Additional site inspections following unforeseen events that may affect void wall stability (Section 3.7.6.2). Performance validated and documented in ITPs for RM4, RM5, RM8 and RM10 (see Appendix E) including sources of documentary or photographic evidence.	1 / 5 / M

3.6.1 Rehabilitation trials

The rehabilitation strategy at Marmor is not complex or on a large scale and no specific trials are required.

3.7 Monitoring and Maintenance

Section 3.3.2 contains information on the milestone criteria against which the completion of rehabilitation milestone and the successful achievement of a stable condition.

Validation and supporting evidence of the achievement of milestone criteria will be captured in the QA/QC procedures outlined in the ITPs (Section 3.5.10 and Appendix E).

The following sections provide the routine monitoring requirements to determine rehabilitation progress against milestones for the achievement of agreed PMLUs to stable a condition. The data will be used to determine maintenance requirements. All routine monitoring will be undertaken by appropriately qualified professionals.

As outlined in Section 3.7.6 additional inspections will be required after:

- the revegetation seeding has been conducted in RM6 to ensure adequate vegetation establishment
- adverse weather events (drought, cyclones or unusual rainfall events exceeding 10% AEP of 207 mm in 24 hours)
- bushfires
- serious pest invasions and disease outbreaks
- other unforeseen events that may affect vegetation and or water quality or void wall stability not accounted for in the risk assessment.

The response to these events is discussed in Section 3.7.6.

3.7.1 Areas with a low intensity grazing PMLU

3.7.1.1 Vegetation monitoring

MONITORING PLOT ESTABLISHMENT

The central 50 m transect of the plot should be aligned across the slope and placed no closer than 10 m from the outer perimeter of the rehabilitation area to avoid possible edge effects. Both ends of each transect should be permanently marked with labelled star pickets and GPS co-ordinates (including the map datum and zone) at the end markers recorded.

The plot layout is illustrated in Figure 27. The assessment plot constitutes a 50 x 10 m area within which the vegetation attributes are assessed as described in the following sections.

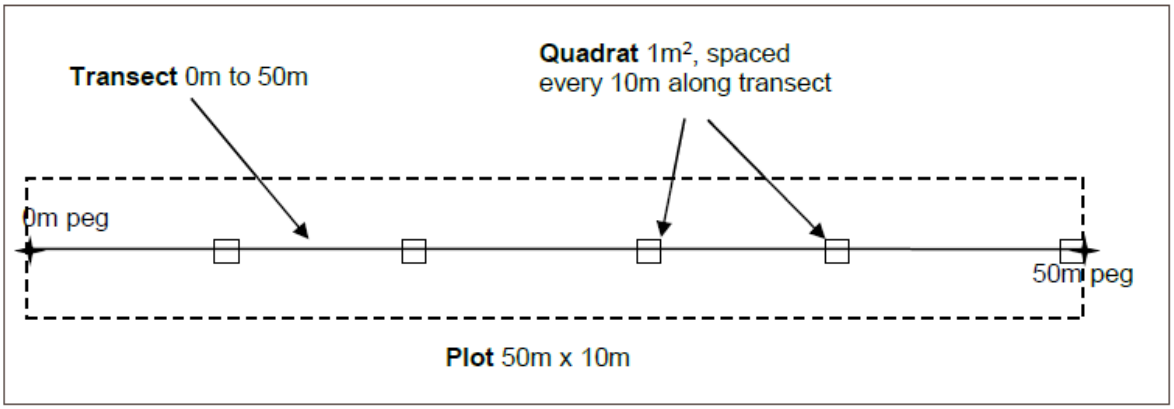


Figure 27: Pasture vegetation monitoring plot layout

PHOTOGRAPHIC RECORDS

Photographs should be taken from each end of the transect on each monitoring occasion as a permanent visual record of the development of the rehabilitation.

GROUND COVER

Observations of the type of cover (limited to the cover present below 0.5 m above ground level) are made at point intercepts along the centre line of the 50 m transect at 0.5 m intervals. Cover types are: vegetation (including all live vegetation and standing senescent vegetation that is still attached to the main plant and is not in intimate contact with the soil); litter; rock or bare ground. The cover type that is intercepted directly below each point is recorded. A total of 100 observations are made per transect and the data recorded on a standard proforma. At the end of each transect before moving on to the next location, a quality assurance (QA) check of the data will be made. The sum of all counts for each cover type and will be checked to ensure it adds up to 100. If it does not, the proforma will be reviewed to check for counting errors or the assessment repeated as required. Ground cover % is calculated as 100 minus bare ground counts.

VEGETATION COMPOSITION (INCLUDING DECLARED WEEDS)

Within each of the 5 x 1 m^2 quadrats along the transect

- Projective cover (%) of declared plant pests to the nearest 1%.
- All species observed and % groundcover to the nearest 5%. Species are to be classified according to lifeform (e.g., perennial grass, annual grass, herb, shrub etc).
- Species assessed as to whether they are desirable palatable and productive (based on resources such as desirable pasture species for land types in Qld https://futurebeef.com.au/knowledge-centre/land-types-in-grazing-land-management/, https://ausgrass2.myspecies.info/ and Cook et al. 2020 or other appropriate literature sources).

Plot average declared weed ground cover and pasture/palatable species richness and cover should be calculated form the data from individual quadrats. This should be converted to the rating (1-4) according to the rating classes in DNRM (2013); namely, Class 1 = 0%, Class 2 = <10%, Class 3= 10-30%, Class 4 = >30%.

STANDING BIOMASS

Photographs will be taken of the standing biomass with an appropriate height marker. Standing pasture will be cut with battery or hand shears close to ground in 5 x 1m^2 quadrats outside each fixed monitoring plot within the area photographed. Cut pasture will be collected into large plastic bags and weighed to the nearest gram. The following method will be used to calculate standing biomass:

1. Sub-sample each of the 'wet' sample quadrats and combine into one sub-sample.
2. Measure the wet weight of the combined sub-sample
3. Oven dry the sub-sample. This can be done by a commercial laboratory or can be done using a microwave oven. For the latter:
    a. Place the combined sample in a suitable container and reweigh.
    b. Microwave on high for about 30 seconds to 1 minute.
    c. Take out, let moisture steam off, then reweigh.
    d. Repeat until the sample no longer loses weight.
    e. Reweigh the dry pasture on its own and record.
2. Calculate dry matter percentage of the sub-sample (100 x (dry weight/wet weight))
3. Use this dry matter percentage (DM%) to determine the dry matter weight of each 1 m^2 quadrat (quadrat wet weight x (DM%/100))
4. Calculate the equivalent dry matter weight for each quadrat for one hectare (kg DM/ha) (quadrat dry weight x 10).

Once this has been done several times, it should be possible to establish a series of photo standards (like the one in using the plot photos and the standing biomass measurements to be used for future estimates of standing biomass.

Figure 28: Example of a photo standard of Black Speargrass with a pasture yield of 2,450 kg DM/ha

ESTABLISHMENT OF SUSTAINABLE CARRYING CAPACITY

Over-stocking causes pasture and soil degradation in the long-term. It is therefore necessary to estimate the sustainable carrying capacity for the rehabilitated land particularly through the dry season to inform sustainable stocking rates for relinquishment.

For sown pastures, approximately 40% of the standing biomass can be sustainably grazed. Cattle of approximately 450 kg can consume approximately 8 kg DM per day to maintain body weight (or 1,700 kg DM/head for a 210 day dry season).

To calculate carrying capacity divide demand / head (in kg) by the supply (standing biomass in kg x 0.4) to derive area (ha) required per head of cattle.

SAMPLING INTENSITY AND REPLICATION FOR MONITORING AND REFERENCE SITES

The total area to be rehabilitated to the low intensity grazing PMLU is only 5.53 ha in total. Usually a sampling intensity of one plot per 9 ha is adequate. However, to provide robust data that can be used for statistical analysis, monitoring will be conducted at a minimum of four representatives locations within the rehabilitated areas (with a focus on larger areas former infrastructure and waste stockpile areas) and three reference locations in unmined areas to the north and west of the void.

3.7.1.2 Erosion and stability

As areas are relatively small, the whole area returned to grazing will be traversed to look for signs of active erosion and the development of rills and gullies. This can be conducted as a wandering transect with the observer meandering the full width of the rehabilitation area across the slope to maximise the likelihood of encountering erosion features. Active erosion as defined in the *Australian Soil and Land Survey Field Handbook* 3rd Edition (The National Committee on Soil and Terrain, 2009).

Active erosion features, slumping and ponded areas will be photographed and logged with a GPS. This will be provided to Graymont to allow follow up repairs as required.

3.7.1.3 Land management

The wandering transect used to examine erosion and stability will also be used to identify any areas of poor cover and significant declared weed infestations. These will be logged with a GPS and provided to Graymont to allow follow up repairs as required.

3.7.1.4 Water management structures

Section 3.5.7 provides the recommended monitoring for water management structures.

3.7.2 Areas with a water storage PMLU

3.7.2.1 Vegetation cover monitoring

The progressive establishment of vegetation cover in the Residual Void (Catchment) will be assessed using UAVs and photographic records.

3.7.2.2 Void stability

An AQP will monitor the profiles of the walls of the residual void, the area around the void and the abandonment barriers using drone based photogrammetry. This will involve the creation of surfaces from the point clouds which will be compared to the surfaces measured on previous occasions to identify any significant changes. Evidence of excessive deformation (i.e.,> 0.5 m) of a section of a wall,

that may indicate triggering of a multi-bench or overall scale failure will be recorded. Evidence of sections of a wall failure will be recorded.

3.7.3 Water quality

Surface water quality sampling will be undertaken according to the methods presented in the *Monitoring and Sampling Manual: Environmental Protection (Water) Policy* (DES 2018). Samples will be collected into appropriate containers supplied by the laboratory and chilled. Holding times specified in the manual (or as advised by the receiving laboratory) will be adhered to and samples will be analysed by a NATA accredited laboratory. Appropriate duplicates and sampling blanks should be taken for assessment of reproducibility and cross-contamination control.

The following analytical suites apply

- Suite A: pH, EC, total suspended solids and major ions (Ca, Mg, K, Na, Cl, F, SO_4 and alkalinity)
- Suite B: Total metals/metalloids (As, Cd, Cr, Cu, Ni, Pb, Se, Zn) and PAHs.

Results will be compared to ARMCANZ & ANZECC (2000) guidelines for stock water (cattle).

Groundwater sampling will be undertaken according to the same methods and for the same suite of as above (for dissolved fraction) with the addition of total petroleum hydrocarbons (TPH). The data will be used to inform the contaminated land investigation to be undertaken during RM3.

Results will be compared the WQOs identified in Section 3.1.5.6.

3.7.4 Monitoring schedule and frequency

Table 19 provides the proposed monitoring schedule and frequency for Marmor.

Table 19: Monitoring schedule

PMLU	Indicator	Monitoring initiated	Preferred time of year	Frequency and duration
Grazing	Photographs	In the year after revegetation has been undertaken	Between February and May	Annually during RM7 and RM9
	Pasture groundcover and standing biomass %	In the year after revegetation has been undertaken	In the dry season (between May and November)	Annually during RM7 and RM9
	Pasture vegetation composition (desirable species)	In the year after revegetation has been undertaken	Between February and May to provide the best opportunities for grass identification	Annually during RM7 and RM9
	Pasture dry season carrying capacity	Within at least 5 years after vegetation establishment	In the dry season (between May and November)	At least once during RM9
	Erosion	In the year after revegetation has been undertaken	Between February and May	Annually during RM7 and RM9
	Land management	In the year after revegetation has been undertaken	Between February and May	Annually during RM7 and RM9

PMLU	Indicator	Monitoring initiated	Preferred time of year	Frequency and duration
Water storage	Void vegetation cover	After completion of RM5	Between February and May	Annually during RM8
	Void water quality	Within 6 months of the finalisation and approval of the PRCP	Wet season and dry season	Every 6 months for suite A Every 12 months for Suite B Until completion of RM10
	Groundwater quality	Within 6 months of the finalisation and approval of the PRCP	Wet season and dry season	Every 6 months for suite A Every 12 months for Suite B and TPH Until completion of RM3 (contamination assessment) after which the bore will be decommissioned.

3.7.5 Reporting

A short report will be prepared after of each monitoring event, to record the results obtained. Any immediate performance or land management issues identified will be documented after each event.

An annual report will be prepared after completion of each full round of annual sampling. This will contain details of the methods used, the data collected and quality assurance data. The data will be analysed against the milestone criteria and an assessment made of rehabilitation performance. It will also include an assessment of trends (both positive and negative). The report will provide recommendations for repairs or additional management action and any changes required to the monitoring methods or frequency. It will also include a statement regarding the achievement of each RA to a stable condition.

3.7.6 Maintenance and contingency measures

Monitoring or site observations may indicate that rehabilitation is not meeting the desired rehabilitation outcomes and management intervention may be required as identified in Table 20. RM7 (for the Grazing PMLU) and RM8 (for the water storage PMLU) provided a period of establishment and early intervention.

Table 20: Contingency measures

Issue	Maintenance treatment
Poor vegetation cover establishment	• Review ITPs to ensure all necessary RM5 & RM6 milestone requirements were signed off • Reseed are areas >25m^2 during appropriate seasonal conditions • Install temporary fencing if due to excessive herbivory from native animals (macropods) • Provide additional irrigation (from water stored in the void) if rainfall is inadequate • Conduct pest and/or disease control measures as required • If measures above do not resolve the issue, conduct additional soil sampling and seek input from an AQP • Adjust fertiliser / soil ameliorant inputs and reseed any large bare areas during appropriate seasonal conditions

Issue	Maintenance treatment
Pasture species inconsistent with PMLU	• Review rehabilitation strategy and species lists (in consultation with local DAF officers) • Review weed control measures or control frequency • Conduct overseeding or reseed during appropriate seasonal conditions
Erosion	• Fill erosion features, provide soil surface protection and reseed during appropriate seasonal conditions. • Review temporary ESCP and water management controls and amend as required
Water quality does not meet requirements for the PMLU	• Review ITPs to ensure all necessary RM2 & RM3 milestone requirements were signed off, in particular waste removal from the void • Review whether poor vegetation regeneration in the floor of the void could have contributed to adverse water quality and consider aerial seeding (using drones) with a range of locally relevant native grass species including *Bothriochloa bladhii subsp. bladhii* and /or *subsp. glabra*, *Chrysopogon fallax* and *Heteropogon contortus* • Investigate quality of drainage or seepage inputs and address as required • Consider remediation or treatment options for the void and seek specialist input from an AQP • Consider alternative PMLU if quality issues cannot be resolved

In addition to the routine monitoring program addition inspections will be required as outlined in the following sub-sections.

3.7.6.1 Additional establishment monitoring in Year 1 after seeding

As outlined in Section 3.5.9, revegetation seed germination should be visible two to six weeks after seeding (or after the first wetting rains). A follow up inspection will be required within the first three months after seeding to confirm that germination is satisfactory. As per Table 20, if germination has failed, attempts will be made to re-seed while there is a probability of follow-up wet season rain. Long range weather forecasts will be used to assist in making this decision. Where required the water stored in the void can be used to assist in early vegetation establishment if there is a period of drought following seeding or germination. Re-seeding and any associated earthworks and soil preparation should not be undertaken later than 1 April. In such an event, re-treatment should be scheduled for the following wet season. Some minor earthworks/seed bed preparation may be required prior to re-seeding.

3.7.6.2 Additional inspections following adverse events

Additional site inspections will also be required should any of the following events occur outside of the routine monitoring cycle:

- adverse weather events (drought, cyclones or unusual rainfall events exceeding 10% AEP of 207 mm in 24 hours)
- bushfires
- serious pest invasions and disease outbreaks
- other unforeseen events that may affect vegetation and or water quality or void wall stability not accounted for in the risk assessment.

The treatments in Table 20 should be reviewed and implemented as required or amended to suit the circumstances of the event.

4. References

ANZECC & ARMCANZ 2000. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality Volume 3 Primary Industries*. Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand.

Atlas of Living Australia, 2021. *Atlas of Living Australia*. Available from: https://www.ala.org.au.

Australian Geological Survey Organisation (ASGO) 2000. *Geology of the Rockhampton 1:250k*. Available at: https://ecat.ga.gov.au/geonetwork/srv/eng/catalog.search#/metadata/34685. Geoscience Australia.

Bureau of Meteorology (BoM) 2020a. Rockhampton Area Climate of Rockhampton. Available at: http://www.bom.gov.au/qld/rockhampton/climate.shtml. Australian Government.

Bureau of Meteorology (BoM) 2020b. Australian Groundwater Explorer. Available at: http://www.bom.gov.au/water/groundwater/explorer/index.shtml. Australian Government.

Bureau of Meteorology (BoM) 2020c. *GDE Atlas*. Available at: http://www.bom.gov.au/water/groundwater/gde . Australian Government.

Business Queensland 2021. *Bore reports*. Available at: https://www.business.qld.gov.au/industries/mining-energy-water/water/bores-and-groundwater/bore-reports. Queensland Government

Cook, B., Pengelly, B., Schultze-Kraft, R., Taylor, M., Burkart, S., Cardoso Arango, J-A., González Guzmán, J-J., Cox, K., Jones, C., Peters, M. 2020. *Tropical Forages: an interactive selection tool*. https://www.tropicalforages.info/text/intro/index.html. Last accessed 24 August 2021.

CSIRO 1968. *Lands of the Dawson-Fitzroy Area, Queensland*. Land Research Series NO. 21, Commonwealth Scientific and Industrial Research Organization, Australia 1968.

DAFF 2013. *Queensland Agricultural Land Audit*. Department of Agriculture, Fisheries and Forestry published by the State of Queensland 2013.

Davis, B. 1979. 'Chalk and limestone quarries as wildlife habitats'. *Environmental Geochemistry and Health*. 1. 48-56.

Department of Environment and Heritage Protection (DEHP) 2009. *Queensland Water Quality Guidelines, Version 3, ISBN 978-0-9806986-0-2.*

Department of Environment and Heritage Protection (DEHP) 2011a. *Environmental Protection (Water) Policy 2009 – Fitzroy River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Fitzroy River Sub-basin*. Queensland Government.

Department of Environment and Heritage Protection (DEHP) 2011b. *WQ1310 – Fitzroy Basin Groundwater Zones, Central Queensland Map Series*. Geoscience Australia.

Department of Environment and Science (DES) 2018. *Monitoring and Sampling Manual: Environmental Protection (Water) Policy*. Brisbane: Department of Environment and Science Government.

Department of Environment and Science (DES) 2021. *Progressive Rehabilitation and Closure Plans (PRC Plans) Guideline (ESR/2019/4964)*. Version 2.00 effective 17 March 2021.

Department of Industry and Resources (WA) 1997. *Safety Bund Walls Around Abandoned Open Pit Mines: Guideline*. MOSHAB Approved. Document No: ZMA048HA.

Department of Minerals and Energy (DME) 1995. *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland*. Department of Minerals and Energy.

Department Natural Resources (DNR) 1997. *Salinity Management Handbook*. Department Natural Resources, Queensland.

DILGP 2017. *State Planning Policy – July 2017.* Department of Infrastructure, Local Government and Planning, Brisbane. July 2017.

Department of Natural Resources and Mines (DNRM) 2013. *State Rural Leasehold Land Strategy: Guidelines for determining land condition*. Prepared by the Department of Natural Resources and Mines Version 3.0 July 2013.

Department of Natural Resources and Mines & Department of Science Information Technology and Innovation and Arts (DNRM &DSITIA) 2013. *Regional Land Suitability Frameworks for Queensland*. Department of Natural Resources and Mines and the Department of Science, Information Technology, Innovation and the Arts, 2013.

Department of Resources (DoR) 2021. *Geology detailed 1:100k*. Available at: http://qldspatial.information.qld.gov.au/catalogue/custom/search.page?q=%22Queensland%20geology%20detailed%20web%20map%20service%22. Queensland Government.

Department of Science Information Technology and Innovation (DSITI) 2015. *Soil conservation guidelines for Queensland. Chapter 4. The Empirical version of the Rational Method*.

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

Engineers Australia 2014. *Australian Rainfall & Runoff - Project 13 (Rational Method Developments)*.

Future Beef 2021. *Land Condition*. Web resource published: September 20, 2011 and last reviewed: February 22 2022 Land condition - FutureBeef Last accessed 13 October 2022.

Geoscience Australia. 2020. *Australian Stratigraphic Units Database*. Australian Government.

Gilardelli, F., Sgorbati, S., Armiraglio, S., Citterio, S. and Gentili R. 2015. 'Assigning plant communities to a successional phase: Time trends in abandoned limestone quarries'. Plant Biosystems, 2015.

Hazelton P.A. and Murphy, B.W. 2007. *Interpreting soil test results : what do all the numbers mean?*. Second Edition. CSIRO Publishing.

International Erosion and Sediment Control Association (IECA) 2008. *Best Practice Erosion and Sediment Control*. Document series, International Erosion and Sediment Control Association Australasia Chapter.

Loch, R. J. 2000. Effects of vegetation cover on runoff and erosion under simulated rain and overland flow on a rehabilitated site on the Meandu Mine, Tarong, Queensland. *Australian Journal of Soil Research* 38 299 – 312.

Maxwell, L. 2019. EPC 2616 *Biloela East, Queensland. Final Activity Report for the period 27 June 2014 – 19 June 2019.* Blackwatch Pty Ltd.

Meyers, T. 2005. *Rehabilitation of the Marmor Pit*. Memorandum to Unimin, April 2005.

National Committee on Soil and Terrain (NCST) 2009. *Australian Soil and Land Survey Field Handbook.* Third Edition. CSIRO Publishing.

National Uniform Drillers Licensing Committee 2020. *Minimum Construction Requirements for Water Bores in Australia*. Fourth edition.

National Environment Protection Council (NEPC) 2013. National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended in May 2013). Schedule B (1) Guideline on the Investigation Levels for Soil and Groundwater. National Environment Protection Council.

NRA 2000. *Soil Erosion Rates and Fertility Studies, Burton Coal Project*. Report prepared by NRA Environmental Consultants for Thiess Pty Ltd. September 2000.

NRMMC 2011. *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy*. National Health and Medical Research Council, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra.

Queensland Herbarium 2019. *Regional Ecosystem Description Database (REDD) - Version 11.1 (April 2019)*. Queensland Department of Environment and Science: Brisbane.

Queensland Government 2013. *Erosion control in grazing lands*. Science notes Land series 91. Queensland Government July 2013.

Queensland Government, 2018. *Land Systems of Dawson-Fitzroy area, Queensland ZDD3*. Spatial dataset. Available from: https://www.publications.qld.gov.au/dataset/land-system-dawson-fitzroy-zdd3.

Queensland Government, 2019. *Land use mapping – 1999 to Current – Queensland*. Spatial dataset. Available from: https://www.qld.gov.au/environment/land/management/mapping/statewide-monitoring/qlump/qlump-datasets.

Queensland Government, 2021. *WildNet database*. Available from: www.qldhttps://www.qld.gov.au/environment/plants-animals/species-information/wildnet.gov.au.

Rocktest Consulting 2014. *Marmor Mine Site Visit Report*. For Sibelco.

Rocktest Consulting 2022. *Marmor Mine PRCP: Pit Geotechnical*. Report prepared for Graymont (v1.1 dated October 2022).

Rockhampton Regional Council 2015. *Rockhampton Planning Scheme*. Version 2.2 (as amended 2021).

Rockhampton Regional Council 2017. *Biosecurity Plan for Pest Management 2017-2021*. Rockhampton Regional Council Pest Management Unit.

Rockhampton Regional Council 2012. *Rockhampton Regional Council Pest Management Plan 2012-2016*. Version 2, Rockhampton Regional Council Pest Management Services.

RPS 2015 *Rockhampton Region Economic Development Strategy Summary Report*. Prepared by RPS Australia East Pty Ltd for Rockhampton Regional Council.

Thompson, R.L. and Green, S.R. 2010. *Vascular Plants of an Abandoned Limestone Quarry in Garrard County, Kentucky*. *Castanea*. 75. 245-258.

Tropek, R., Kadlec, T., Karesova P., Spitzer, L., Kocarek, P., Malenovsky, I., Banar, P., Tuf, I.H., Hejda, M. and Konvicka, M. 2010 'Spontaneous succession in limestone quarries as an effective restoration tool for endangered arthropods and plants'. *Journal of Applied Ecology* 47, 139–147.

Sibelco 2014. *Environmental Management Plan. Marmor*. Version 1, dated 15 May 2014.

So, H.B., Khalifa, A.M., Yu, B., Caroll, C., Burger, P. and Mulligan, D. 2018. MINErosion 3: Using measurements on a tilting flume-rainfall simulator facility to predict erosion rates from post-mining landscapes in Central Queensland, Australia. *PLoS ONE* 13(3) https://doi.org/10.1371/journal.pone.0194230

Walker, L.K., Peck, G.A., Mace, G. & Buck, S. 2022. *Stylos in Queensland: an identification and suitability guide for graziers and advisers*. Queensland Government, Brisbane.

Withnall, I. & Cranfield, L. 2013. *Geological framework.* Queensland Minerals.

Appendix A Wildnet species list

Queensland Government

WildNet species list

Search Criteria: Species List for a Specified Point
Species: Animals
Type: Native
Queensland status: All
Records: All
Date: Since 1980
Latitude: -23.6718
Longitude: 150.7091
Distance: 3
Email: adam.garthwaite@ecoaus.com.au
Date submitted: Monday 30 Aug 2021 11:47:53
Date extracted: Monday 30 Aug 2021 11:50:01

The number of records retrieved = 117

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	amphibians	Hylidae	*Cyclorana alboguttata*	greenstripe frog		C		3
animals	amphibians	Hylidae	*Cyclorana brevipes*	superb collared frog		C		2
animals	amphibians	Hylidae	*Litoria caerulea*	common green treefrog		C		2
animals	amphibians	Hylidae	*Litoria fallax*	eastern sedgefrog		C		5
animals	amphibians	Hylidae	*Litoria gracilenta*	graceful treefrog		C		1
animals	amphibians	Hylidae	*Litoria nasuta*	striped rocketfrog		C		1
animals	amphibians	Hylidae	*Litoria rothii*	northern laughing treefrog		C		1
animals	amphibians	Hylidae	*Litoria rubella*	ruddy treefrog		C		3
animals	amphibians	Limnodynastidae	*Limnodynastes peronii*	striped marshfrog		C		1
animals	amphibians	Limnodynastidae	*Limnodynastes salmini*	salmon striped frog		C		2
animals	birds	Acanthizidae	*Gerygone olivacea*	white-throated gerygone		C		1
animals	birds	Accipitridae	*Aquila audax*	wedge-tailed eagle		C		1
animals	birds	Accipitridae	*Haliastur sphenurus*	whistling kite		C		3
animals	birds	Anatidae	*Anas gracilis*	grey teal		C		1
animals	birds	Anatidae	*Anas superciliosa*	Pacific black duck		C		5
animals	birds	Anatidae	*Aythya australis*	hardhead		C		2
animals	birds	Anatidae	*Chenonetta jubata*	Australian wood duck		C		1
animals	birds	Anatidae	*Cygnus atratus*	black swan		C		3
animals	birds	Anatidae	*Dendrocygna eytoni*	plumed whistling-duck		C		2
animals	birds	Anatidae	*Nettapus coromandelianus*	cotton pygmy-goose		C		1
animals	birds	Anatidae	*Oxyura australis*	blue-billed duck		C		1
animals	birds	Anhingidae	*Anhinga novaehollandiae*	Australasian darter		C		2
animals	birds	Anseranatidae	*Anseranas semipalmata*	magpie goose		C		1
animals	birds	Ardeidae	*Ardea alba modesta*	eastern great egret		C		2
animals	birds	Ardeidae	*Ardea intermedia*	intermediate egret		C		3
animals	birds	Ardeidae	*Bubulcus ibis*	cattle egret		C		2
animals	birds	Ardeidae	*Egretta garzetta*	little egret		C		1
animals	birds	Ardeidae	*Egretta novaehollandiae*	white-faced heron		C		2
animals	birds	Artamidae	*Cracticus nigrogularis*	pied butcherbird		C		1
animals	birds	Artamidae	*Gymnorhina tibicen*	Australian magpie		C		3
animals	birds	Cacatuidae	*Eolophus roseicapilla*	galah		C		1
animals	birds	Cacatuidae	*Nymphicus hollandicus*	cockatiel		C		2
animals	birds	Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike		C		1
animals	birds	Charadriidae	*Charadrius ruficapillus*	red-capped plover		C		1
animals	birds	Charadriidae	*Elseyornis melanops*	black-fronted dotterel		C		2
animals	birds	Charadriidae	*Vanellus miles*	masked lapwing		C		1
animals	birds	Charadriidae	*Vanellus miles novaehollandiae*	masked lapwing (southern subspecies)		C		3
animals	birds	Ciconiidae	*Ephippiorhynchus asiaticus*	black-necked stork		C		1
animals	birds	Cisticolidae	*Cisticola exilis*	golden-headed cisticola		C		1
animals	birds	Columbidae	*Geopelia humeralis*	bar-shouldered dove		C		2
animals	birds	Columbidae	*Geopelia striata*	peaceful dove		C		3
animals	birds	Columbidae	*Ocyphaps lophotes*	crested pigeon		C		1
animals	birds	Corvidae	*Corvus orru*	Torresian crow		C		3
animals	birds	Cuculidae	*Centropus phasianinus*	pheasant coucal		C		1
animals	birds	Cuculidae	*Chalcites minutillus barnardi*	Eastern little bronze-cuckoo		C		1
animals	birds	Estrildidae	*Taeniopygia bichenovii*	double-barred finch		C		3

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Falconidae	*Falco berigora*	brown falcon		C		1
animals	birds	Gruidae	*Antigone rubicunda*	brolga		C		2
animals	birds	Halcyonidae	*Dacelo novaeguineae*	laughing kookaburra		C		2
animals	birds	Halcyonidae	*Todiramphus macleayii*	forest kingfisher		C		1
animals	birds	Hirundinidae	*Cheramoeca leucosterna*	white-backed swallow		C		1
animals	birds	Hirundinidae	*Petrochelidon ariel*	fairy martin		C		2
animals	birds	Jacanidae	*Irediparra gallinacea*	comb-crested jacana		C		1
animals	birds	Laridae	*Chroicocephalus novaehollandiae*	silver gull		C		1
animals	birds	Laridae	*Hydroprogne caspia*	Caspian tern		SL		1
animals	birds	Laridae	*Sternula albifrons*	little tern		SL		1
animals	birds	Maluridae	*Malurus cyaneus*	superb fairy-wren		C		1
animals	birds	Maluridae	*Malurus melanocephalus*	red-backed fairy-wren		C		2
animals	birds	Megapodiidae	*Alectura lathami*	Australian brush-turkey		C		1
animals	birds	Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater		C		1
animals	birds	Meliphagidae	*Lichmera indistincta*	brown honeyeater		C		4
animals	birds	Meliphagidae	*Meliphaga lewinii*	Lewin's honeyeater		C		1
animals	birds	Meliphagidae	*Melithreptus gularis*	black-chinned honeyeater		C		1
animals	birds	Meliphagidae	*Philemon citreogularis*	little friarbird		C		2
animals	birds	Meliphagidae	*Philemon corniculatus*	noisy friarbird		C		1
animals	birds	Meliphagidae	*Ramsayornis fasciatus*	bar-breasted honeyeater		C		1
animals	birds	Monarchidae	*Grallina cyanoleuca*	magpie-lark		C		2
animals	birds	Monarchidae	*Myiagra rubecula*	leaden flycatcher		C		1
animals	birds	Nectariniidae	*Dicaeum hirundinaceum*	mistletoebird		C		2
animals	birds	Oriolidae	*Sphecotheres vieilloti*	Australasian figbird		C		2
animals	birds	Otididae	*Ardeotis australis*	Australian bustard		C		1
animals	birds	Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush		C		1
animals	birds	Pachycephalidae	*Pachycephala rufiventris*	rufous whistler		C		3
animals	birds	Pardalotidae	*Pardalotus striatus*	striated pardalote		C		2
animals	birds	Pelecanidae	*Pelecanus conspicillatus*	Australian pelican		C		4
animals	birds	Phalacrocoracidae	*Microcarbo melanoleucos*	little pied cormorant		C		2
animals	birds	Phalacrocoracidae	*Phalacrocorax sulcirostris*	little black cormorant		C		2
animals	birds	Podargidae	*Podargus strigoides*	tawny frogmouth		C		1
animals	birds	Podicipedidae	*Poliocephalus poliocephalus*	hoary-headed grebe		C		1
animals	birds	Podicipedidae	*Tachybaptus novaehollandiae*	Australasian grebe		C		3
animals	birds	Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler		C		2
animals	birds	Psittacidae	*Aprosmictus erythropterus*	red-winged parrot		C		3
animals	birds	Psittacidae	*Platycercus adscitus*	pale-headed rosella		C		2
animals	birds	Psittacidae	*Trichoglossus chlorolepidotus*	scaly-breasted lorikeet		C		2
animals	birds	Psittacidae	*Trichoglossus moluccanus*	rainbow lorikeet		C		2
animals	birds	Rallidae	*Gallinula tenebrosa*	dusky moorhen		C		2
animals	birds	Rallidae	*Porphyrio melanotus*	purple swamphen		C		3
animals	birds	Recurvirostridae	*Himantopus himantopus*	black-winged stilt		C		2
animals	birds	Rhipiduridae	*Rhipidura leucophrys*	willie wagtail		C		1
animals	birds	Scolopacidae	*Arenaria interpres*	ruddy turnstone		SL		1
animals	birds	Scolopacidae	*Calidris ferruginea*	curlew sandpiper		CR	CE	1
animals	birds	Scolopacidae	*Calidris ruficollis*	red-necked stint		SL		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Scolopacidae	*Limosa lapponica baueri*	Western Alaskan bar-tailed godwit		V	V	1
animals	birds	Scolopacidae	*Numenius madagascariensis*	eastern curlew		E	CE	1
animals	birds	Scolopacidae	*Numenius phaeopus*	whimbrel		SL		1
animals	birds	Scolopacidae	*Tringa incana*	wandering tattler		SL		1
animals	birds	Scolopacidae	*Tringa nebularia*	common greenshank		SL		1
animals	birds	Scolopacidae	*Tringa stagnatilis*	marsh sandpiper		SL		1
animals	birds	Threskiornithidae	*Platalea flavipes*	yellow-billed spoonbill		C		1
animals	birds	Threskiornithidae	*Platalea regia*	royal spoonbill		C		1
animals	birds	Threskiornithidae	*Plegadis falcinellus*	glossy ibis		SL		1
animals	birds	Threskiornithidae	*Threskiornis molucca*	Australian white ibis		C		3
animals	birds	Threskiornithidae	*Threskiornis spinicollis*	straw-necked ibis		C		1
animals	ray-finned fishes	Ambassidae	*Ambassis agassizii*	Agassiz's glassfish				1
animals	ray-finned fishes	Anguillidae	*Anguilla reinhardtii*	longfin eel				2
animals	ray-finned fishes	Apogonidae	*Glossamia aprion*	mouth almighty				1
animals	ray-finned fishes	Atherinidae	*Craterocephalus stercusmuscarum*	flyspecked hardyhead				2
animals	ray-finned fishes	Clupeidae	*Nematalosa erebi*	bony bream				2
animals	ray-finned fishes	Eleotridae	*Hypseleotris compressa*	empire gudgeon				1
animals	ray-finned fishes	Eleotridae	*Hypseleotris klunzingeri*	western carp gudgeon				1
animals	ray-finned fishes	Megalopidae	*Megalops cyprinoides*	oxeye herring				2
animals	ray-finned fishes	Melanotaeniidae	*Melanotaenia splendida splendida*	eastern rainbowfish				1
animals	ray-finned fishes	Mugilidae	*Mugil cephalus*	sea mullet				1
animals	reptiles	Chelidae	*Emydura macquarii krefftii*	Krefft's river turtle		C		1
animals	reptiles	Chelidae	*Wollumbinia latisternum*	saw-shelled turtle		C		1
animals	reptiles	Colubridae	*Tropidonophis mairii*	freshwater snake		C		3
animals	reptiles	Elapidae	*Furina diadema*	red-naped snake		C		1

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992.*
The codes are Extinct (EX), Extinct in the Wild (PE), Critically Endangered (CR), Endangered (E), Vulnerable (V), Near Threatened (NT), Special Least Concern (SL) and Least Concern (C).

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999.*
The values of EPBC are Extinct (EX), Extinct in the Wild (XW), Critically Endangered (CE), Endangered (E), Vulnerable (V) and Conservation Dependent (CD).

Records - The first number indicates the total number of records of the taxon (wildlife records and species listings for selected areas).
This number is output as 99999 if it equals or exceeds this value. A second number located after a / indicates the number of specimen records for the taxon.
This number is output as 999 if it equals or exceeds this value.

Appendix B PRCP Schedule

Also provided separately as original Excel table

Post-mining land uses (PMLU)										
Rehabilitation area	RA1									
Relevant activities	ROM Pad, Laydown Area and Product Stockpiles									
Total rehabilitation area size (ha)	1.09									
Commencement of first milestone: RM1	10/12/2030									
PMLU	Low Intensity Grazing									
Date area is available	10/12/30	10/12/34								
Cumulative area available (ha)	0.06	1.09								
Milestone completed by	10/12/34	10/12/36	10/12/38	11/12/43	12/12/53					
Milestone Reference	**Cumulative area achieved (ha)**									
RM1*	0.06									
RM4		1.09								
RM5		1.09								
RM6			1.09							
RM7				1.09						
RM9					1.09					
***Only applies to a portion of RA1 occupied by limestone and coal stockpiles**										

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
2) Insert new columns to the blue table to match rehabilitation milestone dates.
3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA2									
Relevant activities	Infrastructure (Buildings/Water Tanks)									
Total rehabilitation area size (ha)	0.07									
Commencement of first milestone: RM1	10/12/2030									
PMLU	Low Intensity Grazing									
Date area is available	10/12/30									
Cumulative area available (ha)	0.07									
Milestone completed by	10/12/34	10/12/36	10/12/38	11/12/43	12/12/53					
Milestone Reference	**Cumulative area achieved (ha)**									
RM1	0.07									
RM4		0.07								
RM5		0.07								
RM6			0.07							
RM7				0.07						
RM9					0.07					

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
2) Insert new columns to the blue table to match rehabilitation milestone dates.
3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA3									
Relevant activities	Infrastructure (Process Plant/Hydrocarbon Storage)									
Total rehabilitation area size (ha)	0.28									
Commencement of first milestone: RM1	10/12/2030									
PMLU	Low Intensity Grazing									
Date area is available	10/12/30									
Cumulative area available (ha)	0.28									
Milestone completed by	10/12/32	10/12/34	10/12/36	10/12/38	11/12/43	12/12/53				
Milestone Reference	**Cumulative area achieved (ha)**									
RM1	0.28									
RM3		0.28								
RM4			0.28							
RM5			0.28							
RM6				0.28						
RM7					0.28					
RM9						0.28				

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
2) Insert new columns to the blue table to match rehabilitation milestone dates.
3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA4									
Relevant activities	Sediment Dam									
Total rehabilitation area size (ha)	0.11									
Commencement of first milestone: RM1	10/12/2030									
PMLU	Low Intensity Grazing									
Date area is available	10/12/30									
Cumulative area available (ha)	0.11									
Milestone completed by	10/12/32	10/12/34	10/12/36	10/12/38	11/12/43	12/12/53				
Milestone Reference	**Cumulative area achieved (ha)**									
RM1	0.11									
RM3		0.11								
RM4			0.11							
RM5			0.11							
RM6				0.11						
RM7					0.11					
RM9						0.11				

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
2) Insert new columns to the blue table to match rehabilitation milestone dates.
3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA5									
Relevant activities	Laydown Area (surrounding offices and Process Plant)									
Total rehabilitation area size (ha)	1.68									
Commencement of first milestone: RM1	10/12/2030									
PMLU	Low Intensity Grazing									
Date area is available	10/12/30									
Cumulative area available (ha)	1.68									
Milestone completed by	10/12/34	10/12/36	10/12/38	11/12/43	12/12/53					
Milestone Reference	**Cumulative area achieved (ha)**									
RM1	1.68									
RM4		1.68								
RM5		1.68								
RM6			1.68							
RM7				1.68						
RM9					1.68					

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
2) Insert new columns to the blue table to match rehabilitation milestone dates.
3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA6									
Relevant activities	Vegetation Disturbance Area									
Total rehabilitation area size (ha)	0.54									
Commencement of first milestone: RM7	10/12/2036									
PMLU	Low Intensity Grazing									
Date area is available	10/12/36									
Cumulative area available (ha)	0.54									
Milestone completed by	10/12/38	11/12/43	12/12/53							
Milestone Reference	**Cumulative area achieved (ha)**									
RM6	0.54									
RM7		0.54								
RM9			0.54							

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
2) Insert new columns to the blue table to match rehabilitation milestone dates.
3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA7									
Relevant activities	Unsealed Tracks									
Total rehabilitation area size (ha)	0.4									
Commencement of first milestone: RM4	10/12/2034									
PMLU	Low Intensity Grazing									
Date area is available	10/12/34									
Cumulative area available (ha)	0.40									
Milestone completed by	10/12/36	10/12/38	11/12/43	12/12/53						
Milestone Reference	**Cumulative area achieved (ha)**									
RM4	0.40									
RM5	0.40									
RM6		0.40								
RM7			0.40							
RM9				0.40						

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
2) Insert new columns to the blue table to match rehabilitation milestone dates.
3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA8									
Relevant activities	Site Entrance Tracks									
Total rehabilitation area size (ha)	0.34									
Commencement of first milestone: RM1	10/12/2038									
PMLU	Low Intensity Grazing									
Date area is available	10/12/38									
Cumulative area available (ha)	0.34									
Milestone completed by	10/12/40	10/12/42	10/12/47	10/12/53						
Milestone Reference	**Cumulative area achieved (ha)**									
RM1	0.34									
RM4	0.34									
RM5	0.34									
RM6		0.34								
RM7			0.34							
RM9				0.37						

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
2) Insert new columns to the blue table to match rehabilitation milestone dates.
3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA9									
Relevant activities	Topsoil Stockpiles									
Total rehabilitation area size (ha)	0.46									
Commencement of first milestone: RM4	10/12/2034									
PMLU	Low Intensity Grazing									
Date area is available	10/12/34									
Cumulative area available (ha)	0.46									
Milestone completed by	10/12/36	10/12/38	11/12/43	12/12/53						
Milestone Reference	**Cumulative area achieved (ha)**									
RM4	0.46									
RM5	0.46									
RM6		0.46								
RM7			0.46							
RM9				0.46						

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
2) Insert new columns to the blue table to match rehabilitation milestone dates.
3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA10									
Relevant activities	Residual Void (Pit Lake)									
Total rehabilitation area size (ha)	0.69									
Commencement of first milestone: RM2	10/12/2032									
PMLU	Water Storage - Pit lake									
Date area is available	10/12/32	10/12/34								
Cumulative area available (ha)	0.12	0.69								
Milestone completed by	10/12/34	10/12/43	12/12/53							
Milestone Reference	**Cumulative area achieved (ha)**									
RM2*	0.12									
RM8		0.69								
RM10			0.69							
***Only applies to the portion of RA10 occupied by mixed lime kiln dust, coal ash and reject limestone waste stockpiles**										
1) Insert new columns to the yellow table to include further rehabilitation milestone dates.										
2) Insert new columns to the blue table to match rehabilitation milestone dates.										
3) Insert new rows to the blue table to include additional rehabilitation milestone references.										
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).										

Post-mining land uses (PMLU)										
Rehabilitation area	RA11									
Relevant activities	Residual Void (Catchment)									
Total rehabilitation area size (ha)	5.25									
Commencement of first milestone: RM4	10/12/2032									
PMLU	Water Storage - Catchment									
Date area is available	10/12/32									
Cumulative area available (ha)	5.25									
Milestone completed by	10/12/36	11/12/43	12/12/53							
Milestone Reference	**Cumulative area achieved (ha)**									
RM4	5.25									
RM5	5.25									
RM8		5.25								
RM10			5.25							

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
2) Insert new columns to the blue table to match rehabilitation milestone dates.
3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA12									
Relevant activities	Waste Stockpiles (In Void)									
Total rehabilitation area size (ha)	0.90									
Commencement of first milestone: RM2	10/12/2032									
PMLU	Water Storage - Catchment									
Date area is available	10/12/32									
Cumulative area available (ha)	0.90									
Milestone completed by	10/12/34	10/12/36	11/12/43	12/12/53						
Milestone Reference	**Cumulative area achieved (ha)**									
RM2	0.90									
RM4		0.90								
RM5		0.90								
RM8			0.90							
RM10				0.90						

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
2) Insert new columns to the blue table to match rehabilitation milestone dates.
3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA13									
Relevant activities	Waste Stockpiles (Ex Void)									
Total rehabilitation area size (ha)	0.55									
Commencement of first milestone: RM2	10/12/2032									
PMLU	Low Intensity Grazing									
Date area is available	10/12/32									
Cumulative area available (ha)	0.55									
Milestone completed by	10/12/34	10/12/36	10/12/38	11/12/43	12/12/53					
Milestone Reference	**Cumulative area achieved (ha)**									
RM2	0.55									
RM4		0.55								
RM5		0.55								
RM6			0.55							
RM7				0.55						
RM9					0.55					

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
2) Insert new columns to the blue table to match rehabilitation milestone dates.
3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Milestone reference	Rehabilitation milestone	Milestone criteria
RM1	Infrastructure decommissioning and removal	a) All services disconnected. b) All hazardous building materials removed by appropriately licensed contractors. c) All infrastructure assets demolished, and demolition waste removed to an appropriately licensed facility. d) All limestone feed stock not to be used for surface water management structures removed from stockpiles in RA1 and placed in the void. e) All coal removed from stockpiles in RA1 and disposed of an at appropriately licensed facility. f) All bitumen in RA8 removed and disposed of at appropriately licensed facility. g) Sediment dam (RA4) dewatered.
RM2	Stockpiled reject and waste material removal	a) Mixed lime kiln dust, coal ash and reject limestone waste stockpiles removed. b) Validation sampling by an AQP[1] confirms waste removed to virgin ground. c) Waste classified and disposed off-site at an appropriately licensed facility.
RM3	Contaminated land assessment and remediation	a) Contaminated land investigation undertaken by an AQP. b) All contamination is remediated or removed from site. c) Contaminated material removed from site has been removed in accordance with relevant regulations. d) A contaminated land investigation document has been prepared by an AQP, containing a site suitability statement that states that land is not contaminated and is suitable for the proposed PMLU.
RM4	Landform development	a) An AQP has confirmed that geotechnical stability of the residual void walls (i.e., a factor of safety value of ≥1.3) has been achieved. b) Surface aggregate in RA1 and RA5 removed to a depth of 300 mm and placed in the floor of the residual void. c) All temporary and permanent Erosion and Sediment Control Structures have been designed and installed with reference to Best Practice Erosion & Sediment Control series (IECA 2008). d) Average slope of areas to be revegetated does not exceed 15% (RA1 - RA5, RA8, RA9, RA13). e) Unsealed tracks (RA7) graded to conform to the surrounding landform. f) Sediment dam bund pushed onto dam and levelled (RA4). g) All bores decommissioned.
RM5	Surface preparation	a) All areas to be revegetated ripped to a depth of 500 mm at 500-800 mm spacings (RA1 - RA5 , RA7 - RA9, RA13). b) Haul roads/access tracks within the residual void (RA11) ripped to a depth of 500 mm at 500-800 mm spacings. The exposed void floor (RA12) has been scarified. c) Prior to application, stockpiled topsoil or imported topsoil has been assessed by an AQP to confirm it is suitable for target vegetation establishment. d) Topsoil placed to an average depth of 150 mm (RA1 - RA5, RA7 - RA9, RA13). e) Any fertilisers/ameliorants recommended as a result of the soil assessment have been applied at the rate recommended by the AQP (RA1 - RA5, RA7 - RA9, RA13).
RM6	Revegetation	a) Seeding with Black Spear Grass (*Heteropogon contortus*), Forest Bluegrass (*Bothriochloa bladhii ssp. glabra*) and Shrubby Stylo (*Stylosanthes scabra*) at a rate of 2 kg/ha each has been completed (RA1 - RA5, RA7 - RA9, RA13). b) An AQP has assessed the condition of existing vegetation (RA6) in relation to the nominated PMLU and any recommendations provided as a result of the assessment have been implemented.
RM7	Establishment of post-mining land use vegetation and surface conditions (grazing)	a) The rehabilitation monitoring program has been implemented. b) Bare ground % is equivalent to at least a "fair" condition as defined by Future Beef (https://futurebeef.com.au/resources/land-condition/). c) Native or introduced desirable palatable and productive species cover trending towards at least 50% of the vegetative ground cover or at least 75% of the average desirable palatable and productive species cover % recorded at reference areas whichever is lower. d) Pasture standing biomass is >45% and trending towards 75% of average standing biomass of reference areas. e) The cover of declared plant pest species will be no more than one rating[2] greater than the average cover class recorded in reference areas. f) No active[3] gullies >1.0 m depth. g) Any gullies <1.0 m >0.3m have shown progressive stabilisation (i.e., have become partly stabilised or stabilised[4]) over successive annual monitoring events. h) Temporary Erosion and Sediment Control Structures removed.
RM8	Establishment of post-mining land use surface conditions (water storage)	a) Monitoring of the void crests and walls by an AQP shows that they have achieved long-term stabilities. b) Vegetation cover is increasing in areas of the Water Storage - Catchment PMLU that have been scarified or received recovered aggregate to enhance Pit Lake water quality (RA11, RA12). c) Pit Lake water quality physico chemical indicators do not exceed the trigger values for livestock (beef cattle) drinking water defined in Australian and New Zealand Guidelines for Fresh and Marine Water Quality – Volume 3 Primary Industries — Rationale and Background Information Sections 9.3.4 & 9.3.5 (ANZECC and ARMCANZ 2000) (RA10).
RM9	Achievement of post-mining land use to stable condition (grazing)	a) An assessment of carrying capacity by an AQP demonstrates a sustainable grazing outcome has been achieved. b) No active gullies >0.3 m depth. c) Bare ground % is equivalent to at least a "fair" condition as defined by Future Beef (Land condition - https://futurebeef.com.au/resources/land-condition/). d) Native or introduced desirable palatable and productive species cover trending towards at least 50% of the vegetative ground cover or at least 75% of the average desirable palatable and productive species cover % recorded at reference areas, whichever is lower. e) Pasture standing biomass is ≥ 75% of reference areas. f) The cover of declared plant pest species will be no more than one rating greater than the average cover class recorded in reference areas.
RM10	Achievement of post-mining land use to stable condition (water storage)	a) An AQP has confirmed that geotechnical stability of the residual void walls (i.e., a factor of safety value of ≥1.3) has been achieved. b) Access to the residual void is limited by the installation of an appropriate abandonment barrier (bund and/or fence) located at least 10 m beyond the area potentially affected by void wall instability as specified in the Marmor Mine PRCP: Pit Geotechnical Report prepared for Graymont v1.1 prepared by Rocktest Consulting October 2022. c) Safety signage designed in accordance with relevant Australian Standards erected at a minimum of 100 m intervals. d) An AQP confirms that the residual void walls drain internally to the residual void. e) Pit Lake water quality physico chemical indicators do not exceed the trigger values for livestock (beef cattle) drinking water defined in Australian and New Zealand Guidelines for Fresh and Marine Water Quality – Volume 3 Primary Industries — Rationale and Background Information Sections 9.3.4 & 9.3.5 (ANZECC and ARMCANZ 2000) (RA10).

1. AQP (appropriately qualified person) means a person who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis on performance relative to the subject matter using the relevant protocols, standards, methods or literature.		
2. Where Ratings are defined in the *State Rural Leasehold Land Strategy: Guidelines for determining land condition* prepared by the Department of Natural Resources and Mines (DNRM). Version 3.0 July 2013.		
3. Active as defined in *the Australian Soil and Land Survey Field Handbook* (3rd Edition), The National Committee on Soil and Terrain published by CSIRO Publishing 2009.		
4. Partly stabilised and stabilised as defined in the *Australian Soil and Land Survey Field Handbook* (3rd Edition), The National Committee on Soil and Terrain published by CSIRO Publishing 2009.		
1) Insert new rows below the table to record more Rehabilitation Area Milestones for the project **2) Ensure all Rehabilitation Milestones recorded in this table align with those included in the RA sheets in this form.** **3) See the PRCP guideline before developing site-specific Rehabilitation Area Milestones**		

Appendix C Marmor EA

Permit

Environmental Protection Act 1994

Environmental authority EPML00319713

This environmental authority is issued by the administering authority under Chapter 5 of the Environmental Protection Act 1994.

Environmental authority number: EPML00319713

Environmental authority takes effect on 14 February 2020

Environmental authority holder(s)

Name(s)	Registered address
GRAYMONT (NSW) PTY LTD	Level 16, 111 Pacific Highway NORTH SYDNEY NSW 2060 Australia

Environmentally relevant activity and location details

Environmentally relevant activity/activities	Location(s)
Schedule 3 21: A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20	ML5764
Schedule 3 21: A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20	ML5763
Ancillary 41 - Cement manufacturing 2: Calcining 200t or more of limestone in a year	ML5764
Ancillary 41 - Cement manufacturing 2: Calcining 200t or more of limestone in a year	ML5763

Additional information for applicants

Environmentally relevant activities

The description of any environmentally relevant activity (ERA) for which an environmental authority (EA) is issued is a restatement of the ERA as defined by legislation at the time the EA is issued. Where there is any inconsistency between that description of an ERA and the conditions stated by an EA as to the scale, intensity or manner of carrying out an ERA, the conditions prevail to the extent of the inconsistency.

An EA authorises the carrying out of an ERA and does not authorise any environmental harm unless a condition stated by the EA specifically authorises environmental harm.

A person carrying out an ERA must also be a registered suitable operator under the *Environmental Protection Act 1994* (EP Act).

Contaminated land

It is a requirement of the EP Act that an owner or occupier of contaminated land give written notice to the administering authority if they become aware of the following:

- the happening of an event involving a hazardous contaminant on the contaminated land (notice must be given within 24 hours); or
- a change in the condition of the contaminated land (notice must be given within 24 hours); or
- a notifiable activity (as defined in Schedule 3) having been carried out, or is being carried out, on the contaminated land (notice must be given within 20 business days);

that is causing, or is reasonably likely to cause, serious or material environmental harm.

For further information, including the form for giving written notice, refer to the Queensland Government website www.qld.gov.au, using the search term 'duty to notify'.

Take effect

Please note that, in accordance with section 200 of the EP Act, an EA has effect:

a) if the authority is for a prescribed ERA and it states that it takes effect on the day nominated by the holder of the authority in a written notice given to the administering authority-on the nominated day; or

b) if the authority states a day or an event for it to take effect-on the stated day or when the stated event happens; or

c) otherwise-on the day the authority is issued.

However, if the EA is authorising an activity that requires an additional authorisation (a relevant tenure for a resource activity, a development permit under the *Sustainable Planning Act 2009* or an SDA Approval under the *State Development and Public Works Organisation Act 1971*), this EA will not take effect until the additional authorisation has taken effect.

If this EA takes effect when the additional authorisation takes effect, you must provide the administering authority written notice within 5 business days of receiving notification of the related additional authorisation taking effect.

If you have incorrectly claimed that an additional authorisation is not required, carrying out the ERA without the additional authorisation is not legal and could result in your prosecution for providing false or misleading information or operating without a valid environmental authority.

Filiz Tansley
Department of Environment and Science
Delegate of the administering authority
Environmental Protection Act 1994

Date issued: 14 February 2020

Enquiries:
Minerals Business Centre
Department of Environment and Science

Phone: 07 4222 5352
Email: ESCairns@des.qld.gov.au

It is noted that on 5 June 2019, mining lease (ML) 3614 was de-amalgamated to a new environmental authority, as such this environmental authority no longer has authorisation to those tenures and associated activities.

Obligations under the *Environmental Protection Act 1994*

In addition to the requirements found in the conditions of this environmental authority, the holder must also meet their obligations under the EP Act, and the regulations made under the EP Act. For example, the holder must comply with the following provisions of the Act:

- general environmental duty (section 319)
- duty to notify environmental harm (section 320-320G)
- offence of causing serious or material environmental harm (sections 437-439)
- offence of causing environmental nuisance (section 440)
- offence of depositing prescribed water contaminants in waters and related matters (section 440ZG)
- offence to place contaminant where environmental harm or nuisance may be caused (section 443)

Other permits required

This permit only provides an approval under the *Environmental Protection Act 1994*. In order to lawfully operate you may also require permits / approvals from your local government authority, other business units within the department and other State Government agencies prior to commencing any activity at the site. For example, this may include permits / approvals with your local Council (for planning approval), the Department of Transport and Main Roads (to access state controlled roads), the Department of Natural Resources, Mines and Energy (to clear vegetation), and the Department of Agriculture and Fisheries (to clear marine plants or to obtain a quarry material allocation).

Schedule of Conditions

The aforementioned description of the ERA for which this authority is issued is simply a restatement of the activity as prescribed in the legislation at the time of issuing this authority. Where there is conflict between the above description of the ERA for which this authority is issued and the conditions as specified in this authority as to the scale, intensity or manner of carrying out of the ERA, then such conditions prevail to the extent of the inconsistency.

This authority incorporates the following schedule of conditions relevant to various issues.

Schedule 3A – General Financial Assurance

A1-1 Provide a financial assurance in the amount and form required by the administering authority prior to the commencement of activities proposed under this environmental authority.

Note: The calculation of financial assurance for condition (A1-1) must be in accordance with Guideline 17 and may include a performance discount. The amount is defined as the maximum total rehabilitation cost for complete rehabilitation of all disturbed areas, which may vary on an annual basis due to progressive rehabilitation. The amount required for financial assurance must be the highest Total Rehabiltiation Cost calculated for any year of the Plan of Operations and calculated using the formula: (Financial Assurance = Highest Total Annual Rehabiliation Cost x Percentage Required)

A1-2 The financial assurance is to remain in force until the administering authority is satisfied that no claim on the assurance is likely.

Note: Where progressive rehabilitation is completed and acceptable to the administering authority, progressive reductions to the amount of financial assurance will be applicable where rehabilitation has been completed in accordance with the acceptance criteria defined within this environmental authority.

Maintenance of measures, plant and equipment

A2-1 The environmental authority holder must ensure:

a) that all measures, plant and equipment necessary to ensure compliance with the conditions of this environmental authority are installed; and

b) that such measures, plant and equipment are maintained in a proper condition; and

c) that such measures, plant and equipment are operated in a proper manner.

Monitoring

A3-1 Record, compile and keep all monitoring results required by this environmental authority and make available for inspection all or any of these records upon request by the administering authority.

A3-2 Where monitoring is a requirement of this environmental authority, ensure that a competent person(s) conducts all monitoring.

Storage and handling of flammable and combustible liquids

A4-1 Spillage of all flammable and combustible liquids must be contained within an on-site containment system and controlled in a manner that prevents environmental harm (other than trivial harm) and maintained in accordance with Section 5.9 of AS 1940 – Storage and Handling of Flammable and Combustible Liquids of 1993.

END OF CONDITIONS FOR SCHEDULE 3A

Schedule 3B – Air Quality

B1-2 The release of noxious or offensive odours or any other noxious or offensive airborne contaminants resulting from the activity must not cause a nuisance at any odour sensitive place.

Dust Nuisance

B2-1 The release of dust and/or particulate matter resulting from the activity must not cause an environmental nuisance at any dust sensitive place.

B2-2 Excedence of any of the following levels when measured at any dust sensitive place is an environmental nuisance for the purposes of condition B2-1.

- Dust deposition of 120 milligrams per square metre per day, when monitored in accordance with Australian Standard AS 3580.10 of 1991; OR
- A concentration of particulate matter with an aerodynamic diameter of less than 10 micrometre (µm) (PM10) suspended in the atmosphere of 150 micrgrams per cubic metre over a 24 hour averaging time, at a dust sensitive place downwind of the site, when monitored in accordance with:
- Australian Standard AS 3580.9.6 'Ambient air – Particulate matter – Determination of suspended particulate PM10 high-volume sampler with size-selective inlet – Gravimetric method', or
- Any alternative method of monitoring PM10 which may be permitted by the 'Air Quality Sampling Manual' as published from time to time by the administering authority.

B2-3 When requested by the Administering Authority, dust and particulate monitoring must be undertaken to investigate any complaint of environmental nuisance caused by dust and/or particulate matter, and the results notified with 14 days to the administering authority following completion of monitoring. Monitoring must be carried out at a place(s) relevant to the potentially affected dust sensitive place and at upwind control sites and must include:

- For a complaint alleging dust nuisance, dust deposition; and
- For a complaint alleging adverse health effects caused by dust, the concentration per cubic metre of particulate matter with an aerodynamic diameter of less than 10 micrometre (µm) (PM10) suspended in the atmosphere over a 24hr averaging time.

The release of contaminants to the atmosphere

B3-1 Contaminants must not be released to the atmosphere from a release point shown in Schedule B – Table 1 other than:

a) In accordance with the criteria shown in Schedule B – Table 1; and

b) Directed vertically upwards, with no impedance.

B3-2 Contaminants must be released to the atmosphere from a release point at a height and a flow rate not less than the corresponding height and velocity stated for that release point in Schedule B – Table 1.

Contaminants must not be released to the atmosphere from a release point at a concentration, as measured at a monitoring point, in excess of that stated in Schedule B – Table 1 and must be monitored not less frequently than stated in Schedule B – Table 1.

Schedule B – Table 1 (Release of Contaminants)

Release point number	Minimum release height (metres)	Minimum velocity (m/sec)	Contaminant release	Maximum release limit	Sampling frequency
RP1 Rotary Kiln Exhaust	25	--	Particulates	100mg/Nm^3 dry 12% CO_2	Annually

B3-4 When requested by the Administering Authority, contaminant monitoring and recording must be undertaken to investigate any complaint of air contamination, and the results notified within 14 days to the administering authority. If you can provide evidence through monitoring that the limits in Schedule B Table 1 are not being exceeded then you shall not be in break of condition B2-1 with regards to any release of the contaminants listed in Schedule B Table 1. When monitoring is requested the following must be complied with:

- Monitoring provisions for the release points listed in Schedule B – Table 1 must comply with the Austrlaian Standard AS 4323.1 – 1995 'Stationary source emissions Method 1: Selection of sampling positions'.
- The following tests must be performed for each required determination specified in Schedule B – Table 1:
- Gas velocity and volume flow rate;
- Gas temperature
- Water vapour concentration (moisture content),
- Where practicable samples must be taken when emissions are expected to be at maximum rates.
- During the sampling period the following additional information must be gathered:
- Production rate at the time of sampling;
- Pressure drop across fabric filter dust collector;
- Raw materials used;
- Number of equipment and mixing vessels operating;
- Operating or mixing temperature;
- Product made; and
- Reference to the actual test methods and accuracies.

B3-5 If monitoring indicates exceedance of the relevant limits in Schedule B Table 1, then the environmental authority holder must:

- Address the complaint including the use of appropriate dispute resolution if required or;
- Immediately implement dust abatement measures so that emissions of dust from the activity do not result in further environmental nuisance.

Fabric Filter Dust Collector (FFDC)

B4-1 All collected material removed from the FFDC must be handled or disposed of in a manner that minimises dust emissions.

B4-2 All contaminant emissions from Release Point 1 in Schedule B Table 1 must be treated via the FFDC emission control system except during emergency shut-down.

Fuel Burning

B5-1 The sulphur content of any fuel burned in industrial fuel burning equipment is not to exceed 3 percent by weight.

B5-2 The fuels that may be burned in industrial fuel burning equipment are coal and fuel oil.

B5-3 Reclaimed fuel oil must only be sourced from an oil recycler who is the holder of a current registration certificate for a development approval for that activity under the Environmental Protection Act 1994.

END OF CONDITIONS FOR SCHEDULE 3B

Schedule 3C – Water Management

Release to waters

C1-1 Contaminants must not be released from the site to any waters or the bed and banks of any waters.

Erosion protection measures and sediment controls

C2-1 All reasonable and practicable erosion protection measures and sediment control measures must be implemented and maintained to minimise erosion and the release of sediment.

Bunding

C3-1 All petroleum storage tanks must be bunded according to the Australian Standards for The Storage and Handling of Flammable and Combustible Liquids (Section 5.9 AS 1940).

C3-2 Where it is impractical to completely roof a bunded area the holder of this environmental authority must ensure that any stormwater captured within the bund is free from contaminants or wastes prior to any release.

END OF CONDITIONS FOR SCHEDULE 3C

Schedule 3D – Land Management

Rehabilitation landform criteria

D1-1 All areas significantly disturbed by mining activities must be rehabilitated to a stable landform with a self-sustaining vegetation cover in accordance with final land use and landform design in Schedule D – Table 1.

Schedule D – Table 1 (Final Land Use and Rehabilitation Approval Schedule)

	DISTURBANCE TYPE					
	Product stockpiles	**Residual voids**	**Infrastructure**	**Roads and tracks**	**Rejects & waste stockpiles**	**Topsoil stockpiles**
Tenure ID	ML3614 ML5763 Lot 1 MPH3895	ML3614 ML5763 ML5764	ML3614 ML5763 Lot 1 MPH3895	ML3614 ML5763 ML5764 Lot 1 MPH3895	ML3614 ML5763 ML5764	ML5763
Projective surface area	0.5ha	8ha	3ha	0.7ha	2ha	0.05ha
Post mine land use	Low intensity grazing	Water storage	Low intensity grazing	Low intensity grazing	Low intensity grazing	Low intensity grazing
Post mine land description	Flat vegetated land	Open void	Flat revegetated land	Flat revegetated land	Slightly elevated with slopes <6:1	Flat revegetated land
Post mine land capability classification	VII	Class VIII	VII	VII	VII	VII
Projective cover range (%)	50%	N/A	50%	50%	50%	50%
Species Mix	Rhodes grass		Rhodes grass	Rhodes grass	Rhodes grass	Rhodes grass

D1-2 Progressive rehabilitation must commence when areas become available within the operational land.

Infrastructure

D2-1 All infrastructure, constructed by or for the environmental authority holder during the mining activities including water storage structures, must be removed from the site prior to mining lease surrender, except where agreed in writing by the post mining land owner/holder.

Note: this is not applicable where the landowner/holder is also the environmental authority holder.

END OF CONDITIONS FOR SCHEDULE 3D

Schedule 3E – Noise and Vibration

Noise nuisance

E1-1 Subject to Conditions (E1-2) and (E1-3) noise from the mining activity must not cause an environmental nuisance, at any sensitive or commercial place.

E1-2 When requested by the administering authority, noise monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolour nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any sensitive or commercial place, and the results must be notified within 14 days to the administering authority following completion of monitoring.

E1-3 If the environmental authority holder can provide evidence through monitoring that the limits defined in Schedule E – Table 1 and 2 inclusive, are not being exceeded then the holder is not in breach of Condition (E1-1). Monitoring must include:

- LA, max adj, T; and
- The level and frequency of occurrence or impulsive or tonal noise; and
- Atmospheric conditions including wind speed and direction; and
- Location, date and time of recording.

E1-4 If monitoring indicates exceedance of the limits in Schedule E – Table 1 and 2, then the environmental authority holder must:

- Address the complaint including the use of appropriate dispute resolution if required; or
- Immediately implement noise abatement measrues so that emission of noise from the activity do not result in further environmental nuisance.

E1-5 The method of measurement and reporting of noise levels must comply with the latest edition of the Environmental Protection Agency's Nosie Measurement Manual.

Schedule E – Table 1 (Noise Limits)

Noise level dB(A) measured as	Monday to Saturday			Sundays and public holidays		
	7am-6pm	6pm-10pm	10pm-7am	9am-6pm	6pm-10pm	10pm-9am
	Noise measured at a 'Noise sensitive place'					
L_{A10}, adj, 10 mins	b/g+5	b/g+5	b/g+5	b/g+5	b/g+5	b/g+0
L_{A1}, adj, 10 mins	b/g+10	b/g+10	b/g+5	b/g+10	b/g+10	b/g+5
	Noise measured at a 'Commercial place'					
L_{A10}, adj, 10 mins	b/g+10	b/g+10	b/g+5	b/g+10	b/g+10	b/g+5
L_{A1}, adj, 10 mins	b/g+15	b/g+15	b/g+10	b/g+15	b/g+15	b/g+10

Vibration nuisance

E2-1 Subject to Conditions (E2-2) and (E2-3) must not cause an environmental nuisance at any sensitive or commercial place.

E2-2 When requested by the administering authority, vibration monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolour nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any sensitive or commercial place, and the results must be notified within 14 days to the administering authority following completion of monitoring.

E2-3 If the environmental authority holder can provide evidence through monitoring that the limits defined in Schedule E – Table 3 are not being exceeded then the holder is not in breach of (E2-1). Monitoring must include:

- Location of the blast(s) within the mining area (including which bench level); and
- Atmospheric conditions including temperature, relative humidity and wind speed and direction; and
- Location, date and time of recording.

E2-4 If monitoring indicates exceedance of the relevant limits in Schedule E – Table 3, then the environmental authority holder must:

- Address the complaint including the use of appropriate dispute resolution if required; or
- Immediately implement vibration abatement measures so that vibration from the activity does not result in further environmental nuisance.

Schedule E – Table 3 (Vibration Limits)

Location	**Vibration Measured**	
	Monday to Friday 9am – 3pm	**Saturday, Sundays and public holidays**
Sensitive or commercial place	5mm/s peak particle velocity for nine (9) out of ten (10) consecutive blasts and not greater than 10mm/s peak particle velocity at any time	**No blasting to occur**

Note: The method of measurement and reporting of vibration levels must comply with the latest edition of the Department of Environment and Resource Management vibration and air blast overpressure monitoring guideline.

END OF CONDITIONS FOR SCHEDULE 3E

Schedule 3F – Waste Management

Waste Handling

F1-1 All regulated waste removed from the site must be removed by a person who holds a current environmental authority to transport such as waste under the provisions of the *Environmental Protection Act 1994.*

END OF CONDITIONS FOR SCHEDULE 3F

Schedule 3G – Community

Complaint response

G1-1 All complaints received must be recorded including details of complainant, reasons for the complaining, investigations undertaken, conclusions formed and actions taken. This information must be made available for inspection by the administering authority on request.

END OF CONDITIONS FOR SCHEDULE 3G

END OF PART 3

Definitions

"acceptance criteria" means the measures by which the actions implemented to rehabilitate the land are deemed to be complete. The acceptance criteria indicate the success of the rehabilitation outcome or remediation of areas which have been significantly been disturbed by the mining activities. Acceptance criteria may include information regarding:

- vegetation establishment, survival and succession;
- vegetation productivity, sustained growth and structure development;
- fauna colonisation and habitat development;
- ecosystem processes such as soil development and nutrient cycling, and the recolonisation of specific fauna groups such as collembola, mites and termites which are involved in these processes;
- microbiological studies including recolonisation by mycorrhizal fungi, microbial biomass and respiration;
- effects of various establishment treatments such as deep ripping, topsoil handling, seeding and fertiliser application on vegetation growth and development;
- resilience of vegetation to disease, insect attack, drought and fire;
- vegetation water use and effects on ground water levels and catchment yields.

'airblast overpressure' means energy transmitted from the blast site within the atmosphere in the form of pressure waves. The maximum excess pressure in this wave, above ambient pressure is the peak airblast overpressure measured in decibels linear (dB).

'ambient (or total) noise' at a place, means the level of noise at the place from all sources (near and far), measured as the Leq for an appropriate time interval.

'competent person' means a person with the demonstrated skill and knowledge required to carry out the task to a standard necessary for the reliance upon collected data or protection of the environment.

'authority' means an environmental authority (mining activities) under the *Environmental Protection Act 1994*.

'blasting' means the use of explosive materials to fracture:

a) rock, coal and other minerals for later recovery, or

b) structural components or other items to facilitate removal from a site or for reuse.

'commercial place' means a work place used as an office or for business or commercial purposes, which is not part of the mining activity and does not include employees' accommodation or public roads.

'dam' means a containment or proposed containment whether permanent or temporary, which is designed to contain, divert or control flowable substances. However this does not include a fabricated or manufactured tank or container designed to a recognised standard.

'dust sensitive place' means-

- a dwelling, mobile home or caravan park, residential marina or other residential place;

- a motel, hotel or hostel;
- a kindergarten, school, university or other educational institution;
- a medical centre or hospital;
- a protected area;
- a public park or gardens;
- a place used as an office for business or commercial purposes and includes the curtilage of any such place.

'environmental authority holder' means the holder of this environmental authority.

'hazardous waste' means any substance, whether liquid, solid or gaseous, derived by or resulting from, the processing of minerals that tends to destroy life or impair or endanger health.

'infrastructure' means water storage dams, roads and tracks, buildings and other structures built for the purpose of the mining activities but does not include facilities required for the long term management of mining impacts or the impacts or the protection of potential resources. Such facilities include dams containing hazardous waste, waste rock dumps, voids, or ore stockpiles and building or other structures whose ownership can be transferred and which have a residual beneficial use for the next owner of the operational land or the background land owner.

"L_{A10}, adj, 10 mins" means the A-weighted sound pressure level, *(adjusted for tonal character and impulsiveness of the sound)* exceeded for 10% of any 10-minute measurement period, using Fast response.

"L_{A1}, adj, 10 mins" means the A-weighted sound pressure level, *(adjusted for tonal character and impulsiveness of the sound)* exceeded for 1% of any 10-minute measurement period, using Fast response.

"L_A, max adj, T" means the average maximum A-weighted sound pressure level, adjusted for noise character and measured over any 10 minute period, using Fast response.

'land' in the 'land schedule' of this document means land excluding waters and the atmosphere.

'land capability' as defined in the DME 1995 Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland.

'land suitability' as defined in the DME 1995 Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland.

'land use' term to describe the selected post mining use of the land, which is planned to occur after the cessation of mining operations.

'mandatory reporting level' means the volume below the spillway crest, equivalent to the lower of the AEP, 72 hour storm or the AEP wave allowance (AEP is the annual exceedance probability).

'mineral' means a substance which normally occurs naturally as a part of the earth's crust or is dissolved or suspended in water within or upon the earth's crust and includes a substance which may be extracted from such a substance, and includes-

a) clay if mined for its ceramic properties, kaolin and bentonite;

b) foundry sand;

c) hydrocarbons and other substance or matter occurring in association with shale or coal and necessarily mined, extracted, produced or released by or in connection with mining for shale or coal or for the purpose of enhancing the safety or current or future mining operations for coal or the extraction or proxuction of mineral oil therefrom;

d) limestone if mined for use for its chemical properties;

e) marble;

f) mineral oil or gas extracted or produced from shale or coal by in situ processes;

g) peat;

h) salt including brine;

i) shale from which mineral oil may be extracted or produced;

j) silica, including silica sand, if mined for use for its chemical properties;

k) rock mined in rock or slab form for building or monumental purposes;

but does not include –

l) living matter;

m) petroleum within the meaning of the Petroleum Act 1923;

n) soil, sand, gravel or rock (other than rock mined in block or slab form for building or monumental purposes) to be used or to be supplied for use as such, whether intact or in broken form;

o) water.

'noxious' means harmful or injurious to health or physical well being, other than trivial harm.

'non-standard' means a mining operation that if in the opinion of the administering authority does not have a low risk of serious environmental harm and the activities can not comply with the criteria for standard mining activities prescribed in schedule 1A of the *Environmental Protection Regulation 1998*. The standard mining activity trigger criteria are as follows;

- the mining activities do not or will not cause more than 10ha of land to be significantly disturbed at any one time;

- the mining activities do not or will not cause more than 5ha of land to be significantly disturbed at any one time;

a) in a riverine area;

b) because of mine workings;

- the mining activities are not or will not be carried out in, or within 2km of a category A *Environmentally Sensitive Area;*
- the mining activities are not or will not be carried out in, or within 1km of a category B *Environmentally Sensitive Area;*
- the mining activities do not include a level 1 environmentally relevant activity
- no more than 20 persons are carrying out or will, at any one time, carry out the mining activities;

'offensive' means causing reasonable offence or displeasure; is disagreeable to the sense; disgusting, nauseous or repulsive, other than trivial harm.

'peak particle velocity (ppv)' means a measure of ground vibration magnitude which is the maximum rate of change of ground displacement with time, usually measured in millimetres/second (mms^{-1}).

'protected area' means – a protected area under the *Nature Conservation Act 1992*, or

a) a marine park under the *Marine Parks Act 1992*, or

b) a World Heritage Area.

'progressive rehabilitation' means rehabilitation (defined below) undertaken progressively or a staged approach to rehabilitation as mining activities are ongoing.

'reference site' (or analogue site) may reflect the original location adjacent area or another area where rehabilitation success has been completed for a similar biodiversity. Details of the reference site may be as photographs, computer generated impages and vegetation models etc.

'rehabilitation' the process of reshaping and revegetating land to restore it to a stable landform and in accordance with the acceptance criteria set out in this environmental authority and, where relevant, includes remediation of contaminated land.

'representative' means a sample set which covers the variance in monitoring or other data either due to natural changes or operational phases of the mining activities.

'residual void' means an open pit resulting from the removal of ore and/or waste rock which will remain following the cessation of all mining activities and completion of rehabilitation processes.

'self sustaining' means an area of land which has been rehabilitatied and has maintained the required acceptance criteria without human intervention for a period nominated by the administering authority.

'sensitive place' means:

a) a dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises, or

b) a motel, hotel or hostel, or

c) an educational institution, or

d) a medical centre or hospital, or

e) a protected area under the *Nature Conservation Act 1992*, the *Marine Parks Act 1992* or a World Heritage Area, or

f) a public park or gardens.

'significant disturbance' – includes land

a) if it is contaminated land; or

b) it has been disturbed and human intervention is needed to rehabilitate it

   i. to a state required under the relevant environmental authority; or

if the environmental authority holder does not require the land to be rehabilitated to a particular state – to its state immediately before the disturbance.

Some examples of disturbed land include:

- areas where soil has been compacted, removed, covered, exposed or stockpiled;
- areas where revegetation has been removed or destroyed to an extent where the land has been made susceptible to erosion; (vegetation & topsoil)
- areas where the land use suitability or capability has been diminished;
- areas within a watercourse, waterway, wetland or lake where mining activities occur;
- areas submerged by tailings or hazardous contaminant storage and dam walls in all cases;
- areas under temporary infrastructure. Temporary infrastructure includes any infrastructure (roads, tracks, bridges, culverts, dams, bores, buildings, fixed machinery, hardstand areas, airstrips, helipads etc) which is to be removed after mining activities have ceased; or
- areas where land has been contaminated and a suitability statement has not been issued.

However the following areas are not included:

- areas off lease (e.g. roads or tracks which provide access to the mining lease);
- areas previously significantly disturbed which have achieved the rehabilitation outcomes;

- by agreement with the EPA, areas previously significantly disturbed which have not achieved the rehabilitation objective(s) due to circumstances beyond the control of the mine operator (such as climatic conditions);

- areas under permanent infrastructure. Permanent infrastructure includes any infrastructure (roads, tracks, bridges, culverts, dams, bores, buildings, fixed machinery, hardstand areas, airstrups, helipads etc) which is to be left with agreement with the landowner. The agreement to leave permanent infrastructure must be recorded in the Landowner Agreement and lodged with the EPA.

- Disturbances that pre-existed the grant of tenure unless those areas are disturbed during the term of tenure.

'waters' includes a river, stream, lake, lagoon, pond, swamp, wetland, unconfined surface water, bed and bank of any waters, dams, non-tidal or tidal waters (including the sea) and any part thereof.

END OF DEFINITIONS

END OF ENVIRONMENTAL AUTHORITY

Appendix D Graymont Community Engagement Plan and Community Engagement Register

GRAYMONT

MARMOR COMMUNITY ENGAGEMENT PLAN

GRAYMONT

Consultation Objectives

Key objectives have been defined as follows:

› Ensure factual information about the project, including operational, rehabilitation and closure plans, is widely available to those stakeholders with an interest

› Provide stakeholders with an opportunity to ask questions

› Identify areas of concern with respect to the facility and respond to these within a timely manner

› Build relationships with stakeholder groups within the area

› Demonstrate how community feedback is being used in the development and operation of the facility. Following the focus group sessions, these were confirmed. A number of participants highlighted the need for Graymont to ensure that better transparency and balance transpired in the consultation provided and the information disseminated.

Targets and Key Performance Indicators

Target	Key Performance Indicator
Zero verified community complaints received regarding site operations	Number of community complaints received and the timeframes/response in resolving issues
Initiate at least one community based meeting/forum regarding site operations	Record of meeting in diary If formal meeting, record meeting minutes
Site operations to engage in or provide support to at least one community based project	Number of community project involvements

Consultation Approach

Designed to identify a consultation approach that aims to achieve the objectives

It is also designed to identify a consultation approach somewhat determined by types of issues and level of perceived impacts on the community and stakeholders

- It will include:
  - Identifying stakeholders
  - Developing factual information about the project and development
  - Conducting awareness raising events to inform and engage stakeholders about the project, and seek their input
  - Providing community updates as the site progresses
  - Providing feedback mechanisms and how comments will be considered/actions taken
  - Providing timely, and accurate responses
  - Providing documented concerns, enquiries and feedback
  - Providing ongoing and meaningful consultation

Key Stakeholders

All stakeholders to Graymont's operations have varying degrees of interest or concern with our operations and as a result varying needs for information and engagement. Stakeholders also change from time to time, depending on issue or circumstance. Therefore it is essential to identify not only the stakeholder but the key issues that group may have with our operations.

The following list details some key stakeholders identified by the Marmor site which are the focus of this community and stakeholder engagement plan for site operations.

- Department of Environment and Science

- Department of Resources
- Rockhampton Regional Council
- Marmor Fire Brigade
- Marmor Police
- Community Members
  - Heather Clark
  - Peter Volling
  - Mark Sherwood
  - Emma Leach
  - Tony Rutherford
  - Merv Hillier
  - James Wetzlar

As the site is still in care and maintenance, the Marmor Community Engagement Plan remains suspended until such time as there are plans to renew operations. At that time, Graymont will review the list of stakeholder and implement the Plan in full

Stakeholders

- The stakeholder list is dynamic and people will move in and out of the consultation processes depending on their personal interest at any given time
- Consultation program is designed to facilitate this process
- The stakeholders and areas of interest help Graymont to recognise and adequately respond to the various key interests of the stakeholders

Stakeholder engagement processes .

- Preferences for active/personal engagement processes include:
  - Group meetings
  - Information sessions
  - Community forums

» Facility briefings

› Preferences for passive / support engagement include:

» Facility newsletter / community update

» Fact sheets

» Letters

» Complaints register

Suspension of Community Engagement during Care and Maintenance

› The site has been in care and maintenance since May 2016 hence there hasn't been any community engagement events over the past 6 years. However, a community townhall event is being planned for the 18th November 2021 to discuss the progressive rehabilitation plan of the site.

Community Engagement Methods

Proactive			
Engagement methods	**Rationale/ Current Situation – Desired Outcome Target**	**Frequency**	**Responsibility**
Conduct local community based projects	• Portray a positive image to key stakeholders that Graymont is a caring corporate citizen, considers stakeholders concerns and is a "Good Neighbour".	One per year	Site Manager
Advise neighbours of a blast 24 hours in advance	• Allow neighbours to be aware of risk • Build rapport with neighbour – site aware of potential impact of activities on neighbours	In accordance with blast schedule	Site Manager
Advise key stakeholders via letter or other means prior to	• Provide community awareness of	As required	Site Manager

Proactive			
Engagement methods	**Rationale/ Current Situation – Desired Outcome Target**	**Frequency**	**Responsibility**
a change in standard operations that may cause disruption to the local community	ongoing site operations		
Consultation with relevant government agencies shall be conducted for all new developments proposed onsite. Consultation will be sought at the concept phase to determine approval processes and key stakeholder issues associated with the proposal.	• Prevent more stringent conditions on operations • Build community and stakeholder confidence in site operations by clearly communicating the environmental management and performance of site operations.	When required	QLD Environmental Advisor
Reactive			
Engagement methods	**Rationale/ Current Situation – Desired Outcome Target**	**Frequency**	**Responsibility**
Complaints received shall be managed in accordance with the **EHS Incident Notification & Investigation Procedure**	• Ensure timely response to complaints	When received	QSE Coordinator after consultation with Operations Manager
Media enquiries received by the site shall be managed by the Corporate EHS Team.	• Ensure accurate and consistent information about site operations is delivered to media outlets	When received	Corporate EHS Team
Government agency enquiries shall be responded to by the QSE coordinator or the Corporate EHS Team	• Ensure accurate and consistent information about site operations is delivered to government agencies.	When received	Corporate EHS Team

Communication protocols

A number of communication protocols will be developed to enhance engagement processes overall. These include:

» Timing and distribution of communication material

» Traffic change notifications

» Enquiries and complaints management

»Progressive rehabilitation status

» Unresolved complaints / disputes

» Media protocols.

Monitoring and reporting

This has been included to facilitate the monitoring, checking and reporting on potential issues and measuring the effectiveness of the stakeholder engagement program. Reporting will include:

› Quarterly sustainability reporting to the Graymont Board that incorporates

» Stakeholder engagement – including economic and social benefits reporting

» Environmental reporting

» Rehabilitation progress

› Complaints, breaches and incidents.

Monitoring and Reporting Schedule

Description of monitoring	Timing/ Frequency	Report to:	Follow up action:
Record of all meeting minutes at all stakeholder related meetings and forums	When required	Forward meeting minutes to key stakeholders	Operations Manager/QSE Coordinator

Record and file all correspondence with key stakeholders	Ongoing	Maintain site diary entry.	QSE Coordinator
All complaints to be tracked, investigated and signed off	When required	Report in JDE and review annually with Corporate EHS team	QSE Coordinator
Track all commitments and agreements made with key stakeholders and the progress of these commitments and agreements	Ongoing	Corporate EHS team annually	Community Engagement Plan and Community Advisory Group Meetings (held quarterly)

Complaints

In the event of an environmental complaint, the receiver of the complaint shall document details from the complainant. As a minimum, the following information will be collected:

» the date and time of the complaint;
» the method by which the complaint was made;
» any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect; and
» the nature of the complaint.

Site personnel will conduct an initial investigation to verify the complaint. If the investigation has determined that the source of the complaint is from site activities, corrective actions will be developed and assigned to specified site personnel to rectify the cause of complaint or minimise any future events from occurring. Site personnel will respond to the complaint (if contact details are available) with the outcome of its investigation and advise of any actions that have or will be taken to prevent or minimise future impacts. The outcomes of the investigation and the close out of any corrective actions will be documented in JDE (JD Edwards Incident recording and tracking system).

Any environmental complaint will prompt a review of the sites legal compliance and environmental risk registers.

Management Review

Management review is to ensure that rigour is retained and systems and processes are continuously evaluated. The facility manager will chair a review of community engagement processes and performance every 12 months.

MARMOR COMMUNITY ENGAGEMENT REGISTER

Type of Engagement	Consultation Date	People Involved	Issues Raised / information provided	Outcomes of engagement and/or actions taken	Responsibility
Resident's Complaint	17 March 2014	M Hollier (complainant)	Dust on car	ICAM investigation to determine causes. Controls implemented	Site Manager
Marmor News (Newsletter)	1st April 2015	Site and Community	Refer to Newsletter	Information only.	Site Manager
Resident's Complaint	24 January 2015	Troy McMillan (Complainant)	Dust on car	ICAM investigation to determine causes. Controls implemented	Site Manager
Quarterly Marmor Community Advisory Group	16th March 2016	H Clark P Volling M Sherwood E Leach T Rutherford	Build up of dust on parked cars	Dust sent for analysis to check if it was from site. Refer to meeting minutes	Site Manager
Quarterly Marmor Community Advisory Group	18th May 2016	H Clark P Volling M Hollier E Leach J Wetzlar	Mine to go into care and maintenance	Site phones redirected to Calliope site Refer to meeting minutes	Site Manager
"Town Hall" Meeting	25 November 2021	Site personnel (Simon Havis and Emma Sharpe) and c. 20 Community members	Information and Q&A session including • An introduction to Graymont • Marmor operations (including care and maintenance activities)	Questions answered regarding future mining plans, future mill operation plans and employment opportunities. No concerns were raised about site management, rehabilitation activities or the PMLUs.	Site Manager

MARMOR COMMUNITY ENGAGEMENT REGISTER

			• Rehabilitation plans (including the PRCP and PMLUs) • Questions – floor opened to questions from attendees.	No Actions, but Graymont to provide periodic updates	

Appendix E Graymont Rehabilitation ITPs

Rehabilitation Inspection and Test Plan: Rehabilitation Milestone 1 – Marmor

Rehabilitation Area:_____

Reference Milestone	Milestone Criteria or action required	Applicable to this RA ?	Responsible party	Records or comment	Hold or witness point	Date	Hold/Witness Point Signature
Infrastructure decommissioning and removal	a. All services disconnected?				Witness		
	b. All hazardous building materials identified and removed by appropriately licensed contractors.				Hold		
	c. All infrastructure assets demolished, and demolition waste removed to an appropriately licensed facility.				Hold		
	d. All limestone feed stock not to be used for surface water management structures removed from stockpiles in RA1 and placed in the void.				Witness		
	e. All coal removed from stockpiles in RA1 and disposed of an at appropriately licensed facility.				Witness		
	f. All bitumen in RA8 removed and disposed of at appropriately licensed facility.				Witness		
	g. Sediment dam (RA4) dewatered.				Hold		

Rehabilitation Inspection and Test Plan: Rehabilitation Milestone 2 – Marmor

Rehabilitation Area:_____

Reference Milestone	Milestone Criteria or action required	Applicable to this RA ?	Responsible party	Records or comment	Hold or witness point	Date	Hold/Witness Point Signature
Stockpiled reject and waste material removal	a. Mixed lime kiln dust, coal ash and reject limestone waste stockpiles removed.				Witness		
	b. Validation sampling by an AQP confirms waste removed to virgin ground.				Hold		
	c. Waste classified and disposed off-site at an appropriately licensed facility.				Witness		

Rehabilitation Inspection and Test Plan: Rehabilitation Milestone 3 – Marmor

Rehabilitation Area:_____

Reference Milestone	Milestone Criteria or action required	Applicable to this RA ?	Responsible party	Records or comment	Hold or witness point	Date	Hold/Witness Point Signature
Contaminated land assessment and remediation	a. Contaminated land investigation undertaken by an AQP .				Witness		
	b. All contamination is remediated or removed from site.				Hold		
	c. Contaminated material removed from site has been removed in accordance with relevant regulations.				Witness		
	d. A contaminated land investigation document has been prepared by an AQP, containing a site suitability statement that states that land is not contaminated and is suitable for the proposed PMLU.				Hold		

Rehabilitation Inspection and Test Plan: Rehabilitation Milestone 4 – Marmor

Rehabilitation Area:_____

Reference Milestone	Milestone Criteria or action required	Applicable to this RA ?	Responsible party	Records or comment	Hold or witness point	Date	Hold/Witness Point Signature
Landform development	a. An AQP has confirmed that geotechnical stability of the residual void walls (i.e., a factor of safety value of ≥1.3) has been achieved.				Hold		
	b. Surface aggregate in RA1, RA5 and RA8 removed to a depth of 300 mm and placed in the floor of the residual void.				Hold		
	c. All temporary and permanent Erosion and Sediment Control Structures have been designed and installed with reference to Best Practice Erosion & Sediment Control series (IECA 2008).				Hold		
	d. Average slope of areas to be revegetated does not exceed 15% (RA1 – RA5, RA8, RA9 and RA13).				Hold		
	e. Unsealed tracks (RA7) graded to conform to the surrounding landform.				Witness		
	f. Sediment dam bund pushed onto dam and levelled (RA4).				Witness		

Reference Milestone	Milestone Criteria or action required	Applicable to this RA ?	Responsible party	Records or comment	Hold or witness point	Date	Hold/Witness Point Signature
	g. All bores decommissioned.				Witness		

Rehabilitation Inspection and Test Plan: Rehabilitation Milestone 5 – Marmor

Rehabilitation Area:_____

Reference Milestone	Milestone Criteria or action required	Applicable to this RA ?	Responsible party	Records or comment	Hold or witness point	Date	Hold/Witness Point Signature
Surface preparation	a. All areas to be revegetated ripped to a depth of 500 mm at 500-800 mm spacings.				Hold		
	b. Haul roads/access tracks within the residual void (RA11) ripped to a depth of 500 mm at 500-800 mm spacings. The exposed void floor (RA12) has been scarified.				Hold		
	c. Prior to application, stockpiled topsoil or imported topsoil has been assessed by an AQP to confirm it is suitable for target vegetation establishment.				Hold		
	d. Topsoil placed to an average depth of 150 mm.				Hold		
	e. Any fertilisers/ameliorants recommended as a result of the soil assessment have been applied at the rate recommended by the AQP.				Hold		

Rehabilitation Inspection and Test Plan: Rehabilitation Milestone 6 – Marmor

Rehabilitation Area:_____

Reference Milestone	Milestone Criteria or action required	Applicable to this RA ?	Responsible party	Records or comment	Hold or witness point	Date	Hold/Witness Point Signature
Revegetation	a. Seeding with Black Spear Grass (*Heteropogon contortus*), Forest Bluegrass (*Bothriochloa bladhii ssp. glabra*) and Shrubby Stylo (*Stylosanthes scabra*) at a rate of 2 kg/ha each has been completed.				Hold		
	b. An AQP has assessed the condition of existing vegetation (RA6) in relation to the nominated PMLU and any recommendations provided as a result of the assessment have been implemented.				Hold		

Rehabilitation Inspection and Test Plan: Rehabilitation Milestone 7 – Marmor

Rehabilitation Area:_____

Reference Milestone	Milestone Criteria or action required	Applicable to this RA ?	Responsible party	Records or comment	Hold or witness point	Date	Hold/Witness Point Signature
Establishment of post-mining land use vegetation and surface conditions (grazing)	a. The rehabilitation monitoring program has been implemented.				Hold		
	b. Monitoring has shown bare ground % is equivalent to at least a "fair" condition as defined by Future Beef by the end or RM7				Hold		
	c. Monitoring has shown native or introduced desirable palatable and productive species cover trending towards at least 50% of the vegetative ground cover or at least 75% of the average desirable palatable and productive species cover % recorded at reference areas whichever is lower by the end of RM7.				Hold		
	d. Monitoring has shown pasture standing biomass is >45% and trending towards 75% of average standing biomass of reference areas by the end of RM7.				Hold		
	e. Monitoring has shown the cover of declared plant pest species will be no more than one rating greater than the average cover class recorded in reference areas by the end of RM7.				Hold		
	f. Monitoring has shown no active gullies >1.0 m depth by the end of RM7.				Hold		

Reference Milestone	Milestone Criteria or action required	Applicable to this RA ?	Responsible party	Records or comment	Hold or witness point	Date	Hold/Witness Point Signature
	g. Monitoring has shown that any gullies <1.0 m >0.3m have shown progressive stabilisation (i.e., have become partly stabilised or stabilised) over at least 5 successive annual monitoring events.				Hold		
	h. Temporary Erosion and Sediment Control Structures removed.				Hold		

Rehabilitation Inspection and Test Plan: Rehabilitation Milestone 8 – Marmor

Rehabilitation Area:_____

Reference Milestone	Milestone Criteria or action required	Applicable to this RA ?	Responsible party	Records or comment	Hold or witness point	Date	Hold/Witness Point Signature
Establishment of post-mining land use surface conditions (water storage)	a. Monitoring of the void crests and walls by an AQP shows that they have achieved long-term stabilities by the end or RM8.				Hold		
	b. Monitoring has shown that vegetation cover is increasing in areas of the Water Storage Catchment that have been scarified or received recovered aggregate to enhance Pit Lake water quality by the end or RM8.				Hold		
	c. Monitoring has shown that Pit Lake water quality physico chemical indicators do not exceed the trigger values for livestock (beef cattle) drinking water defined in Australian and New Zealand Guidelines for Fresh and Marine Water Quality – Volume 3 Primary Industries — Rationale and Background Information Sections 9.3.4 & 9.3.5 (ANZECC and ARMCANZ 2000) by the end or RM8.				Witness		

Rehabilitation Inspection and Test Plan: Rehabilitation Milestone 9 – Marmor

Rehabilitation Area:_____

Reference Milestone	Milestone Criteria or action required	Applicable to this RA ?	Responsible party	Records or comment	Hold or witness point	Date	Hold/Witness Point Signature
Achievement of post-mining land use to stable condition (grazing) Surface preparation	a. An assessment of carrying capacity by an AQP demonstrates a sustainable grazing outcome has been achieved by the end or RM9.				Hold		
	b. Monitoring has shown that no active gullies >0.3 m depth by the end or RM9.				Hold		
	c. Monitoring has shown that bare ground % is equivalent to at least a “fair” condition as defined by Future Beef by the end or RM9.				Hold		
	d. Monitoring has shown that native or introduced desirable palatable and productive species cover trending towards at least 50% of the vegetative ground cover or at least 75% of the average desirable palatable and productive species cover % recorded at reference areas whichever is lower by the end or RM9.				Hold		
	e. Monitoring has shown that pasture standing biomass is ≥ 75% of reference area by the end or RM9s.				Hold		
	f. Monitoring has shown that the cover of declared plant pest species will be no more than one rating greater than the average				Hold		

Reference Milestone	Milestone Criteria or action required	Applicable to this RA ?	Responsible party	Records or comment	Hold or witness point	Date	Hold/Witness Point Signature
	cover class recorded in reference areas by the end or RM9.						

Rehabilitation Inspection and Test Plan: Rehabilitation Milestone 10 – Marmor

Rehabilitation Area:_____

Reference Milestone	Milestone Criteria or action required	Applicable to this RA ?	Responsible party	Result, comment or record details	Hold or witness point	Date	Hold/Witness Point Signature
Achievement of post-mining land use to stable condition (water storage)	a. An AQP has confirmed that geotechnical stability of the residual void walls (i.e., a factor of safety value of ≥1.3) has been achieved.				Hold		
	b. Access to the residual void is limited by the installation of an appropriate abandonment barrier (bund and/or fence) located at least 10 m beyond the area potentially affected by void wall instability as specified in the Marmor Mine PRCP: Pit Geotechnical Report prepared for Graymont v1.1 prepared by Rocktest Consulting October 2022.				Hold		
	c. Safety signage designed in accordance with relevant Australian Standards erected at a minimum of 100 m intervals.				Hold		
	d. An AQP confirms that the residual void walls drain internally to the residual void.				Hold		
	e. Monitoring has shown that Pit Lake water quality physico chemical do not exceed the trigger values for livestock (beef cattle) drinking water defined in Australian and New Zealand Guidelines for Fresh and				Hold		

Reference Milestone	Milestone Criteria or action required	Applicable to this RA ?	Responsible party	Result, comment or record details	Hold or witness point	Date	Hold/Witness Point Signature
	Marine Water Quality – Volume 3 Primary Industries — Rationale and Background Information Sections 9.3.4 & 9.3.5 (ANZECC and ARMCANZ 2000) by the end of RM10.						

Appendix F Marmor Mine PRPC Pit Geotechnical V1.1 (Rocktest 2022)

MARMOR MINE PRCP:
PIT GEOTECHNICAL
V1.1

for

GRAYMONT

Rocktest
Rock Engineering Consultants
ABN 51 760 370 906
46 Hastings Street
Glenelg South SA 5045
P +61 (0)412 903 222
E tony@rocktest.com.au
W **www.rocktest.com.au**

04 October 2022

Global Mine Engineering Lead
Graymont Australia Pty Ltd
9 Carlton Street
Port Adelaide SA 5015
emmanuel.ashong@graymont.com

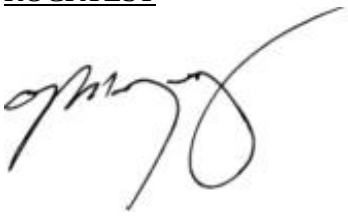
ATTENTION: EMMANUEL ASHONG

Dear Sir

Marmor Progressive Rehabilitation and Closure Plan (PRCP): Pit Geotechnical V1.1

This updated report addresses geotechnical issues relevant to the PRCP for the Marmor Mine. I trust it provides the information you require. Please contact this office if you wish to discuss any aspect of it or require further assistance.

For and on behalf of
ROCKTEST



Tony Meyers
BE (Mining) PhD (Rock Mechanics), MAusIMM CP(Mining Geotech), MIEAust CPEng (Civil), NER APEC Engineer IntPE(Aus) RPEQ (Mining, Civil)
Principal Rock Mechanics Engineer

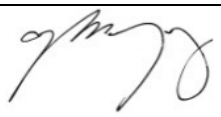
DOCUMENT CONTROL

Project	Marmor Mine PRCP
Client	Graymont Australia Pty Ltd
Report Title	Marmor Mine PRCP Pit Geotechnical
Version	1.1
Author(s)	Tony Meyers
Distribution	1. Graymont Australia Pty Ltd 2. Rocktest Consulting – Project File
Filename	PRCP - Geotechnical V1.1

DOCUMENT HISTORY

Version	Date	Status	Issued to	Comments
1.0	28/07/2022	Draft	E. Ashong of Graymont	
1.1	04/10/2022	Final	E. Ashong & M. Muir of Graymont	Updated following comments on draft report.

DOCUMENT APPROVAL

Signature	
Approval	Tony Meyers
Position	Principal Rock Mechanics Engineer
Date	28/07/2022

EXECUTIVE SUMMARY

This study concluded:

- The proposed landform design satisfies the geotechnical related requirements of the PRCP Guideline.
- The stabilities of the walls of the void are within the ranges typically considered acceptable in the mining industry.
- The water level in the void is expected to remain similar to its current level, fluctuating with the season. The water will not significantly reduce the performances of the walls of the void.

The principal strategies recommended to reduce the risks applicable to the walls of the void are:

- reducing to the greatest degree practical the likelihood of impact of persons by falling rocks
- reducing to the greatest degree practical the likelihood of falls-from-heights associated with the crests of the walls of the void and their berms
- facilitating, where possible, passive regeneration of vegetation to increase the stabilities of erodible areas and to minimise the aesthetic and visual impact of the void.

The presence of vegetation within the void will reduce the likelihood of the void being an attractant.

The geotechnical considerations will be achieved by:

- installing an abandonment bund across the south entrance to the void
- installing fences with signs elsewhere behind the crests of all of the walls of the void to restrict access to the crests (Section 5.1)
- restricting access to and around the site by rehabilitating access tracks and ramps, revegetation works and securing the front boundary fence (Section 5.2)
- minimising the area of ground disturbed by limiting clearing of vegetation to only that required for rehabilitation
- implementing a programme to visually monitor the outcomes of the closure plan (Section 5.3)
- assessing the outcomes of the closure plan against indicators and completion criteria to demonstrate the success of the plan (Section 6).

CONTENTS

1 INTRODUCTION

1.1 Background

This report considers geotechnical issues[1] applicable to the Progressive Rehabilitation and Closure Plan (PRCP) for the final landform at the Marmor Mine. The primary landform consists of the open-cut pit (i.e., void) and the area around the pit. The requirements of the PRCP, as outlined by the Guideline prepared by the Queensland Department of Environment and Science[2], are that it should provide details of how the landform will achieve post-closure stability. The project was undertaken by Rocktest at the request[3] of Graymont Australia Pty Ltd (Graymont).

1.2 Requirements in the PRCP

In regard to geotechnical issues associated with the pit, the PRCP requires discussion of the:

- locations and specifications i.e., depth, length, width, overall slope angles, bench specifications
- methods of construction with 3D design plans
- soil/rock characteristics
- geotechnical conditions (i.e., soil/rock characteristics)
- pit wall geotechnical stabilities, considering the effects of long-term erosion and weathering and the effects of significant hydrological events
- rehabilitation strategies.

1.3 Terminology

Time periods referred to in this report are:

- Short-term < Five years
- Medium-term Five years to 50 years
- Long-term > 50 years

[1] This report considers geotechnical issues only. Surface and subsurface hydrology issues are considered only where relevant.

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

[3] Phone call to T. Meyers of Rocktest from E. Ashong of Graymont, 13 May 2022.

2 GEOLOGY

2.1 Lithology

Figure 1 shows the footprint of the pit. It is located on the east side of a north-south striking ridge within a group of low-lying hills of the Redan Range. The average gradient[4] of the surrounding natural slopes is 15° (3.7H:1V).

The lithology comprises a shallow cover of soil underlain by thinly interbedded limestone, sandstone, and siltstone and thick beds of conglomerate. It also comprises volcanics, including rhyolitic and dacitic tuff, rhyolite, and andesite. Prior to 1997, these rocks were classified as being within the Mount Holly beds, which were considered to underlie the Mount Alma Formation (347-361 Ma). Since 1997[5], the beds have been included in the latter formation rather than being considered to be a separate lithology.

In the area around the mine, the beds within the Alma Formation strike north-south and dip steep to the west. The limestone beds forming the orebody dip west at 65° to 80°. They occur as an elongate lens, 1200 m long and 100 m thick. To the west, the limestone is overlain by low to medium strength calcareous sandstone, siltstone, and mudstone, collectively referred to in this report as "sandstone". To the east, the limestone is underlain by sandstone and volcanics. Lenses of sandstones within the limestone orebody and variable limestone grades make the limestone uneconomic to extract at the current time.

The east, north and south walls of the pit comprises limestone (Figure 2). The uppermost benches midway along the west wall comprise sandstone from surface to RL80: approximately 10 m. The sandstone is fine grained, predominantly light grey to dark grey and has high to very high-strength[6] even where weathered[7]. The benches below the sandstone are predominantly in limestone to the pit floor with some interbeds of sandstone. The sandstone does not contribute significantly to the overall performances of the pit walls.

2.2 Macro-Structures

Figure 3 highlights the approximate locations of some of the larger faults that traverse the site. North-south striking fault F1 (Figure 4) is parallel to two major regional thrust faults, 300 m east and 2.7 km west of the site. Northeast striking faults F2 to F6 (Figure 5) may be synthetic faults[8] associated with displacements along the more persistent faults. Localised shear zones and distorted beds (e.g., drag folds) resulting from displacements along the faults have not significantly reduced the performances of sections of the walls they intersect. These performances have been associated more with the characteristics of the discontinuities (i.e., bedding partings and joints) discussed in Section 2.6.3.

[4] The natural gradient is in the range 14° to 27°.

[5] Publ May 1997 in QGMJ 98 p11-25. Yarrol project. Rockhampton Subprovince, Yarrol Province. Considered Frasnian -Tournasian in Geology of Queensland 2013, p340.

[6] Uniaxial compressive strength classifications: 6MPa ≤ Medium ≤ 20MPa ≤ High ≤ 60MPa ≤ Very high ≤ 200MPa

[7] In this report, the term "weathered" refers to a rock that has a strength decreased by weathering. It includes the AS 1726:2017 classifications "highly weathered" and "extremely weathered". The term "unweathered" refers to a rock that has a strength that has not been decreased by weathering. It includes the classifications "fresh", "slightly weathered" and "moderately weathered".

[8] A synthetic fault is type of minor fault having a displacement similar to its associated major fault.

2.3 In-Situ Stress

Significant in-situ vertical and horizontal stress could contribute positively to the stabilities of the rocks exposed in the walls. However, they are unlikely to do so at any location in a wall:

1. The vertical stresses are functions of gravity and the masses of the overlying rocks. These masses are small as the benches and walls are not high hence neither are the stresses.
2. The horizontal stresses in all directions are low as both ends of the walls terminate in contour lows.

2.4 Soil

The average thickness of the soil is less than 1 m (Figure 4 to Figure 7). Being thin, it has negligible influence on the performances of the walls of the pit. Its main influence is to reduce the shear strengths of karst features and infilled dilated discontinuities[9] in the weathered limestone. These features occur predominantly to depths up to approximately 10 mBGL in the north, south and east walls.

The soil is silty CI CLAY with sand and sub angular gravels of limestone, sandstone and volcanics, red-brown, medium plasticity, firm to stiff and moist. Its average shear strength can be defined[10] in terms of an estimated friction angle of 25^{o} and a cohesion of 50 kPa.

2.5 Volcanics

The volcanics exposed in the walls of the pit are predominantly andesite. The andesite is fine grained and olive green. Where unweathered, it is of medium- to high-strength. When exposed in the walls, the moderate proportion of feldspar makes the rocks significantly more susceptible to weathering than is the limestone. When extremely weathered it has soil like strength.

The andesite occurs generally as steep dipping dykes (Figure 8) up to 2 m thick associated with vertical to sub-vertical bedding, faults, and joints within the limestone. It can occur as large irregular shaped lenses and sills (Figure 9).

The volcanics comprise less than 1% of the total rockmass. For this reasons, even when weathered, they have insignificant influence on the stabilities of the walls. Their influence is not therefore considered further in this report.

2.6 Limestone

2.6.1 Intact Limestone

The intact limestone is fine to coarse grained. Some (i.e., <40%) is recrystallised to marble. It is predominantly white to cream and light grey to dark grey. Less typical are other colours, including pink, purple, brown, and green. These colours can be banded or mottled, particularly in area where the rockmass has been sheared by movements along faults (Figure 5).

At depths less than ≈10 mBGL in the north, south and east walls, and adjacent to faults and karst structures, the surfaces of individual rocks are highly- to extremely-weathered (Figure 5 to Figure 7). At greater depths,

[9] The term “discontinuities” collectively refers to bedding partings, joints, and foliation)

[10] The shear strength of the soil is estimated, based on the characteristics of the materials.

the limestone is slightly- to moderately-weathered. Rocks of all weathering grades have high- to very high-strengths. The strengths progressively decrease as the depth of weathering into a rock increases. The rocks eventually become extremely weathered gravels of medium- to high-strength, then become residual sands and silts. The shear strength of the sediments can be defined in terms of a residual friction angle of ≈37°[11].

Most weathered, and all less weathered, limestone has sufficient strength and durability for it to be suitable for use in abandonment bunds (Section 5.1). Only extremely weathered limestone is unsuitable for this use; these rocks are non-typical and occur predominantly above 10mBGL.

2.6.2 Karst within Limestone

Karst features are extensive in the upper benches of all walls (Figure 10). They comprise predominantly cavities, sinkholes and solution widened discontinuities. All karst is clay filled. The features can extend to ≈10 mBGL although they are most prevalent at shallower depths. With depth, karst become less prevalent and the apertures of the discontinuities become tight and clean.

Karst has influenced the performances of the benches above 10 mBGL (Figure 11); bench scale instabilities have occurred below the crests of all walls. These events have had, and will continue to have, insignificant influence on the performances of the overall walls (i.e., crest to toe).

2.6.3 Discontinuity Orientations

Analysis of data obtained from areal mapping[12] 348 discontinuities (i.e., bedding partings and joints) within limestone exposed in all walls indicates that most discontinuities can be assigned to one of 7 sets (Figure 12). Set 1 contains bedding partings. Sets 2 to 7 contain joints. Based on the mean orientations of each set, discontinuities within:

- Set 1, dip steep[13], towards the west
- Set 2 dip shallow towards the west
- Set 3 dip steep towards the east
- Set 4 dip steep towards the southwest
- Set 5 dip moderate towards the northwest
- Set 6 dip moderate towards the southeast
- Set 7 dip moderate towards the northeast.

The number of sets is high which, if applicable[14], can be evidence of the rockmass having been significantly deformed. This observation is consistent with the tectonic history of the site, which includes significant faulting and micro-folding. However, the high average value for Fisher's constant[15] (i.e., F > 30) is typically

[11] The residual friction angle of the sediments is based on the minimum angle of repose of fines and gravels on the berms, which ranges from 36° to 43°. This value is likely to be slightly conservative. The residual friction angle is typically a few degrees greater than the angle of repose.

[12] Discontinuities were mapped using a photogrammetric technique.

[13] Dip terms: Very shallow 0-20°; Shallow 20-40°; Moderate 40-60°; Steep 60-75°; Very steep 75-90°.

[14] The apparently high number of sets may be the result of folding and may not be a characteristic of the sets. To be conservative, seven sets are assumed in subsequent stability analyses.

[15] Fisher's constant defines how tightly the orientation data within a group are clustered around the mean orientation of that group. Values near 100 imply parallelism. Values less than 20 imply a highly deviated set of data. Values exceeding 30 are rare.

indicative of a rockmass that is not significantly deformed. Understanding the inconsistency is beyond the requirement of this study[16].

Table 1. Characteristics of the sets of discontinuities in the limestone.

Set	Type	Dip Angle (0^o – 90^o)	Dip Direction (0^o – 360^o	Fisher's constant, F	Apparent mean spacing (m)	Maximum trace length (m)
1	Bedding partings	73	267	>30	1.6	24
2	joints	28	271	>30	1.9	32
3	joints	69	86	>30	1.7	17
4	joints	70	226	>30	1.2	11
5	joints	54	314	29	1.6	5
6	joints	44	140	27	1.3	6
7	joints	46	041	36	1.6	3

2.6.4 Discontinuity Spacings and Persistence

The spacings between adjacent discontinuities from the same set define the sizes of the individual rocks. These sizes contribute to the performances of the benches[17]. The spacings also contribute to the degree to which down-stepping between multiple adjacent discontinuities can occur, which can result in large failure surfaces developing.

Column 6 of Table 1 lists the apparent average spacings. These values are wide[18]. However, the actual values are likely to be smaller than those listed[19] although sufficiently wide for adjacent rocks to interlock, a characteristic favourable to the performances of the benches.

Column 7 of Table 1 lists the maximum length of the traces[20] of the discontinuities within each set. These lengths are functions of the persistences (i.e., areal extents or sizes) of the discontinuities. The persistences contribute to the volumes of rocks overlying discontinuities; the greater the average persistence, the greater the average volume involved in instabilities. Based on the trace lengths, the persistences range from low to very high[21].The larger discontinuities within each set have had a significant influence on the performance of each wall and the relative performances of the walls.

- Moderate to steep dipping discontinuities from Sets 1, 4 and 5 daylight on the east wall. Large discontinuities within these sets underlie large volumes of limestone. Instabilities involving masses of

[16] A possible contributor to the inconsistency is bias in the sampling method. A larger data set with samples obtained using a lineal sampling method would typically reduce the F values.

[17] Large rocks contribute to rockmass interlocking which can contribute positively to rock mass strength, weathering rates and the performances of the benches and walls. Several closely spaced sets can contribute to low rockmass strength.

[18] Spacings: 0.06 ≤ Close ≤ 0.2m ≤ Moderate ≤ 0.6m ≤ Wide ≤ 2m ≤ Very wide ≤ 6 m. Extremely wide >6m.

[19] The sampling method focuses on discontinuities with long trace lengths and tends not to include discontinuities with short traces. Doing so imposes a sampling bias. By ignoring small discontinuities, the apparent average spacings between multiple adjacent discontinuities and the average persistences are greater than the actual values.

[20] A discontinuity can be approximated as a 2D planar surface. The batter of a bench can also be approximated as a 2D surface. Intersection of the two surfaces results in a line along the batter referred to as the trace of the discontinuity.

[21] Persistence classification: 1-m ≤ Low ≤ 3-m ≤ Medium ≤ 10-m ≤ High ≤ 20 m, Very high >20 m.

overlying rocks displacing along these discontinuities have contributed to the sawtooth profiles of sections of the wall (Figure 13).

- Moderate to steep dipping discontinuities from Sets 3, 6 and 7 daylight on the west wall. Discontinuities within these sets are typically smaller than those in the sets that daylight on the other wall. The sizes of the discontinuities have contributed to instabilities on the west wall typically having been of bench or lesser scales. The moderate spacings between adjacent discontinuities have also limited the size of events by not being conducive to down-stepping; multiple small discontinuities have generally not combined to form very persistent surfaces.

2.6.5 Rock Sizes

The sizes of the individual rocks have contributed to the performances of the benches. The greater the proportion of large rocks within the distribution of rock sizes, the less deformable and more stable the benches have been. A numerical procedure was implemented to estimate[22] this distribution. The procedure assumes the characteristics of the discontinuities are those listed in Table 1. Table 2 lists relevant data generated from the distribution (Figure 14). It indicates the rocks have an average dimension of 16 cm and most rocks (95%) have a maximum length less than 50 cm. These characteristics classify most rocks as being of medium size[23]. This range is consistent with observation (Figure 15). Rocks in this range generally interlock to some degree and enhance the stability of a slope.

Table 2. Results from rock size simulations.

Parameter	*Mean*	*95th %tile*
Rock volume (m^3)	0.01	0.04
Average length of edges (cm)	16	40
Maximum length of edges (cm)	20	50
Mass (kg)	24	111

2.6.6 Discontinuity Shear Strengths

Instabilities from the walls occur when the driving forces applied to rocks exceed the shear strengths of the underlying discontinuities[24]. In this study, these strengths are quantified in terms of a degraded peak friction angle[25]. The discontinuities are assumed to have no cohesive strengths[26] due to the low in-situ stresses and the lack of cementation, damage to roughness features during blasting, creep of the walls as benches were excavated in the floor, and a history of tectonic activity.

The friction angles for the limestone and the sandstone were estimated using a non-linear shear strength criterion described in Appendix A1.3. The parameters quantified in Table 3 apply to the limestone. A similar procedure was applied for the sandstone; its characteristics are not significantly different to those of the

[22] The sizes of rocks within a rockmass cannot be measured directly. Disassembling a mass of rocks and measuring or weighing the individual rocks to obtain data required to define the distribution of rock sizes is impractical.

[23] Rock size based on maximum edge lengths: 0.1 ≤ Small ≤ 0.3 m ≤Medium ≤ 1 m ≤Large ≤ 3 m; Very large": > 3 m.

[24] Assuming a mass of rocks is free to move out of a batter.

[25] Any movement along a discontinuity destroys any cohesive bonds leaving a surface that is purely frictional.

[26] Cohesion is not considered as a component of the shear strength as it is not a constant component of a discontinuity's strength; it degrades prior to adjacent rocks displacing after which the shear strength becomes solely frictional. Assuming a cohesive strength could overestimate the peak strength and hence overestimate the stabilities of the rocks.

limestone. The decrease (44^o to 38^o) in the estimated friction angles[27] reflects the degradation of the surfaces of the discontinuities as they progressively weather.

Table 3. Estimated discontinuity shear strength parameters for limestone.

	Weathering period	
Characteristic	*Long term*	*Short term*
Mean Joint wall Compressive Strength, JCS (MPa)	36	68
Estimated residual friction angle, ϕ_b	20^o	23^o
Joint roughness coefficients, JRC	8	9
Density of intact rock (t/m^3)	2.61	2.65
Estimated peak friction angles based on B-B model.	38^o	44^o

2.7 Earthquake Characteristics

Geoscience Australia (2018)[28] places Marmor in a zone of low earthquake hazard. The estimated peak ground acceleration (PGA) having a 10% probability of being exceeded in a 50-year period is 0.006g ($0.06\ m/s^2$). The probability corresponds to a 1 in 500 annual return period. There is therefore a 10% probability that an acceleration (A_e) of 0.0012g ($100/500^{ths}$ of 0.006g) will be exceeded during the 100-year period considered in this study.

Several studies have reported on PGA values of 0.2g generating falls of individual rocks from pit walls[29] in low stress conditions as apply at this site. On this basis, PGA values of 0.0012g are unlikely to generate many rockfalls. On this basis, a 100-year event is unlikely to significantly increase the risk to persons within the pit or upon the crest of a wall at the moment an earthquake of this intensity occurs.

Wall scale instabilities being triggered by earthquakes within any pit are rare. Although they are unlikely to do so at this site, the influence of earthquake loading is considered in the stability analyses in Section 4.

[27] The analyses assume discontinuities are at an average depth of 5-m and dip at 60^o.

[28] Geoscience Australia (2018) The 2018 National Seismic Hazard Assessment for Australia. (Editor. Allen, T.) Page 10.

[29] Rockfalls have been reported for PGA values of 0.16g in pits where discontinuities contain significant joint pressures.

3 PIT CHARACTERITICS

3.1 Specifications

The major axis of the pit is parallel to the strikes of the beds of limestone. It takes the form of a relatively thin, long, steep sided, valley (Figure 16 and Figure 17) with a void within the floor. High east and west walls and low north and south walls define the extents of the valley. The specifications of the pit and its walls are listed in Table 4 and Table 5. These specifications will not change prior to the planned closure unless market conditions change.

Table 4. Specifications of the pit.

Dimension	*Specification*
Trend of major axis	180°
Length of major axis at crest	620m
Average length of minor axis at crest	137m
Maximum height of walls (i.e., west wall)	64m
Heights of benches	10 – 23m
Maximum number of benches	4
Widths of berms	10 – 16m
Batter angles in unweathered rocks	52° - 70°
Batter angles in weathered rocks	35° - 60°
Inter-ramp angles	20° - 60°
Maximum overall slope angles (north/south/east/west)	21° /10° /54° /28°
Ramp type	none

Table 5. Average dip directions of the walls.

North (South dip)	*South (North dip)*	*East (West dip)*	*West (East dip)*
180°	000°	275°	094°

3.2 Mining History

Limestone was mined at Marmor for use as flux at the nearby[30] Mount Morgan mine from the late 1800s until approximately 1923. From the 1980s until 2004, Unimin extracted small tonnages of white limestone from the north wall and from the floor at the north end of the pit for use as decorative stone and for landscaping. In 2014, then owner, Sibelco proposed undertaking a mining campaign to extract limestone from similar areas[31]. In preparation for doing so:

- limestone and sandstone protruding from the middle section of the west wall were excavated and the section of the wall was benched and scaled to reduce the hazards applicable to vehicles accessing the haulroad (Figure 18)

[30] The Mount Morgan mine is 63 km by road from Marmor.

[31] In 2014, this office prepared a report recommending risk management strategies to apply during mining and post mining to closure.

- the crest of the east wall was cut back to ensure the risks applicable to operations on the floor would be acceptable (Figure 19)
- the east wall was scaled after rocks pushed over the crest during the cutback triggered falls of individual rocks and masses of rocks that previously had marginal capacities (Figure 20)
- the north wall was scaled.

The proposed mining campaign did not occur. Hence Graymont, nor the previous owner Sibelco, did not undertake any mining at the site[32]. Most of the lengths of the east and west walls have therefore been exposed for nearly 100 years since mining of them last occurred.

3.3 Pit Water Management

A (<9,000 m^2) lake located from the south end of the pit to midway along the east wall has a base at ≈RL30. Its upper surface does not rise above ≈RL36, hence it has a maximum depth of ≈6 m. The upper surface of the water in the lake remains more than 2 m below the lowest point on the crest of the void, which occurs at its south end. The level of water stabilises at or below this level as losses due to outflows equate to inflows.

- Groundwater levels within 500 m of the lake are up to ≈ RL12. The base of the lake is therefore ≈18 m above the level of the groundwater, hence there is a hydraulic disconnect between the two. No seepage of water occurs above the toes of the walls except when rainfall has been extreme. Groundwater is not therefore a source of inflow to the lake and hence the pit is not a hydraulic sink. The pit is not within any major watercourse[33]. The source of inflows is therefore only runoff from the east and west walls and direct impact by rainfall.
- Loss of water through the underlying formation is not a significant source of outflow as the lake is within low permeability limestone with tight discontinuities. Evaporation is therefore the primary outflow.

Flood modelling indicates the whole of the void will not be inundated with water under an extreme flood event that approximates a probable maximum flood. Water within the void will not therefore significantly influence the stabilities of the walls as:

- the depth of water cannot increase sufficiently for it to provide support to, or remove support from, the base of the east wall
- excess joint water pressures are unlikely to develop within any wall as no evidence has been observed to indicate any permanent phreatic surface develops
- cycles of wetting and drying of the durable high-strength limestone at the toe of the east wall is unlikely to significantly reduce the ability of these rocks to support the walls during the long term.

The lake acts as a barrier, preventing persons from accessing closer than 30 m to the 250 m long toe of the highest section of the east wall.

[32] The kilns at Marmor burnt limestone imported from the Calliope mine until 2016. No limestone was mined on-site.

[33] The nearest water courses are Twelve Mile Creek, 3 km east of the site and Inkerman Creek which flows into Raglan Creek, 15 kms northeast of the site.

3.4 Pit Vegetation

Since 2014, the lack of significant earthworks in the pit or movements of vehicles around the haulroads and behind the crests of the walls have allowed vegetation to establish. Bushes and trees, including several species of Eucalyptus and Acacia, have germinated, and grown with vigour. The density of vegetation is generally:

- high behind the crests of all walls (Figure 21)
- moderate to high on the pit floor (Figure 22)
- sparse to moderate on the batters (Figure 23) and moderate to high on the berms on all walls (Figure 24) which reduces the visual impact of the batters.

4 LONG-TERM STABILITIES OF THE PIT WALLS

4.1 Inter-ramp (Multi-Bench) Scale Stabilities

No inter-ramp (IR) scale[34] instabilities are known to, or appear to, have occurred on the west wall at any time. They have occurred on the east wall, likely at the time or soon after the wall was excavated up to 100 years ago. They also occurred in 2014 triggered by earthworks at the crest of the wall. The likelihood for an event to occur during the long term is considered in this section.

IR scale instabilities typically involve masses of rocks sliding upon or toppling from underlying discontinuities. The events are controlled primarily by the characteristics of the discontinuities. A series of analyses, summarised in Appendix 2, were undertaken to quantify how conducive these characteristics are to these event and, if so, the modes of instabilities most likely to occur (i.e., sliding or toppling). The north and south walls are not considered as they comprise single low benches.

The results of the analyses indicate:

- On the west wall, toppling is the most likely mode of instability at IR and bench scales. Sliding modes are unlikely to occur at IR scale but are prevalent at bench scale. These modes are consistent with observation e.g., Figure 25.
- On the east wall, sliding and toppling modes are likely at IR and bench scales although toppling modes are twice as likely to occur than are sliding modes. These modes are also consistent with observation e.g., Figure 26.

The results of the analyses are quantified in terms of the likelihood for failure (P_f) values[35] listed in Appendix 2 and summarised in Column 2 of Table 6. The acceptabilities of these values are considered in Section 4.3.1.

The results indicate that on the east and west walls 22% and 8% respectively of discontinuities could have characteristics that enable them to underlie potentially unstable masses of rocks. Many of these masses would have detached at the time, or soon after, the walls were excavated up to 100 years ago. At the time, these events contributed to the crests of the walls breaking back. On the east and west walls, the maximum breakback was 6.3 m and 8.5 m respectively (Figure 27 and Figure 28). During the long-term, other masses of rocks could detach. However, the lack of events over the past decades indicates that these events are unlikely unless external triggers are applied.

[34] During the long term, loss of one or more benches may be a significant hazard. Loss of width from an individual berm is unlikely to be a significant hazard as most rocks that mobilise will be controlled by lower berms.

[35] The likelihood of failure quantifies the probability that a particular location on a wall will experience an IR scale instability.

Table 6. Results of stability analyses applicable during the long term.

	Inter-ramp scale (%)	*Overall scale*	
Wall	*Sliding and toppling modes (%)*	*Sliding modes (%*	*Rotational mode (FoS)*
East	22	4	4
West	8	0	1.3

4.2 Overall (Wall) Scale Stabilities

An overall scale instability involves a failure surfaces extending from the crest of a wall to its toe, No such instability is known to, or appears to, have occurred on the west wall at any time. These instabilities have however occurred on the east wall; likely at the time or soon after the wall was excavated. One or more of the events contributed to the sawtooth profile of the wall and the backbreak along the crest. The likelihood for an event of similar scale occurring during the long term is considered in this section.

4.2.1 Planar Sliding Modes

An overall scale instability can involve a mass of rocks sliding upon a surface comprising one or two individual discontinuities that have very high persistence, sufficient to extend from crest to toe. A mass of rocks can also slide upon a stepped surfaces having very high persistence that comprises multiple adjacent discontinuities, each having medium persistence. A series of analyses, summarised in Appendix 2, were undertaken to ascertain whether the discontinuities are conducive to these modes.

The results of the analyses indicate that overall scale sliding is unlikely to occur on the west wall. However, it may occur on the east wall; as evidenced by its sawtooth profile (Figure 13 and Figure 26). The results are quantified in terms of the likelihood for failure (P_f) values listed in Appendix 2 and summarised in Column 3 of Table 6. The acceptabilities of the values are considered in Section 4.3.1.

4.2.2 Rotational Sliding Modes

An overall scale instability can also involve a mass of rocks sliding upon a curvilinear surface that comprises multiple discontinuities and/or surfaces that develop through intact rocks. This scenario typically occurs in either, or a combination of, weak and/or extremely weathered rocks, highly discontinuous rocks where adjacent discontinuities are closely spaced, and/or in slopes where the ratio of height to rock size is large. None of these scenarios is applicable to the walls. Nor is there evidence of this mode occurring on any wall. It is therefore not generally relevant to this site. Analyses were undertaken to confirm these observations.

In addition to quantifying the stabilities of the walls, the analyses also provided an approximate offset distance behind the crests of the walls where surfaces having the lowest capacities daylight. These distances were used to inform decisions on the offsets for the abandonment bunds in Section 5.1.2) and the widths of the areas within which evidence of large scale instabilities are most likely to be observed.

Details of the analyses are discussed in Appendix 3. They were undertaken through cross section B-B’ in Figure 2 and Figure 17 along which,

- the east and west walls have their greater heights
- discontinuities dip towards the pit, possibly providing surfaces along which sliding can occur
- the lower RL44 bench that forms the haul road on the west wall comprises material excavated from the upper benches of that wall (Figure 18).

The results of the analyses are quantified in terms of Factor of Safety (FoS)[36] values for each of hundreds of surfaces assessed within each of the walls. The acceptabilities of the FoS values are considered in Section 4.3.2. The surfaces with the lowest capacities are highlighted in Figures A3.2 and A3.3 and summarised in Table 6. The results indicate:

- No overall scale surface in either wall has a FoS of less than 1.3. Hence, overall scale instabilities are unlikely. This result is consistent with the performances of the walls to date.
- The overall scale surfaces having the lowest capacities daylight 41 m and 16 m behind the crests of the west and east walls respectively. These values are within the lease boundaries.
- The benches on the west wall in limestone and sandstone are stable.
- The benches on the east wall are marginally stable. This result is consistent with the results from the planar sliding analyses in Section 4.2.1.
- The lowest bench on the west wall, comprising compacted materials, is marginally stable. This result is expected, its slope is at the angle of repose of the materials. Instability of the haul road on the bench will not be a hazard in the long-term as the haul road will be made inaccessible during rehabilitation.
- The water table does not have a significant influence on the stabilities of the walls.

4.3 Acceptability of Stabilities

The acceptabilities of the results from the analyses, summarised in Table 6, are assessed by comparing them to criteria listed by Read and Stacey (2009)[37].

4.3.1 Inter-Ramp Scale Instabilities

Inter-ramp (IR) scale instabilities, involving failure surfaces extending over multiple benches, can develop over days to weeks and the eventual collapse can trigger rapidly. Cracks may develop prior to a collapse although a collapse can occur without significant evidence of the pending event. An event is therefore a major hazard with a high consequence for persons who are within the trajectory of the displacing rocks at the time they release. The applicable criteria are a maximum probability of failure (P_f) of 10% to 20% if the likelihood of the consequence is medium to high[38] and 20% to 25% if the consequence is low to medium.

- The P_f for the west wall (i.e., P_f = 8%) is within the ranges of acceptability for all likelihood categories.
- The P_f for the east wall (i.e., P_f = 22%) is within the low to medium likelihood category. This category is appropriate, hence the value is acceptable, because:
  - IR scale events have not occurred for decades unless triggered by external forces e.g., impact by falling rocks when the crest was cut back in 2014.
  - The pit lake will prevent persons from being closer than 30 m to the 250 m long toe of the highest section of the wall. Progressive development of vegetation on the pit floor during the period until rehabilitation completion will create an additional hinderance to access to the toe of the east wall.

[36] The Factor of Safety (FoS) is the ratio of the average shear strength of a surface to the average shear stress applied to the surface. A FoS value of less than unity (1.0) indicates a 50% or greater likelihood for an unstable scenario.

[37] Read, J. and Stacey, P. (2009) Chapter 9: Acceptance Criteria. *Guidelines for Open Pit Slope Design*. CSIRO Publications.

[38] Risk classification terms are consistent with AS/NZS ISO 31000-2009 Risk Management— Principles and Guidelines. Standards Australia

- If an instability occurs, the likelihood is low that a person will be within the trajectory of rocks at the time they detach due to the implementation of the risk management strategies discussed in Sections 5.

4.3.2 Overall (Wall) Scale Instabilities.

Overall scale instabilities typically develop over weeks to years although an eventual collapse can trigger rapidly. A collapse rarely occurs without cracks and/or subsidence developing behind a crest days or weeks prior to the event. If evidence is not observed and strategies are not implemented to mitigate the risk, the collapse will be a major hazard for persons in the trajectory of the displacing rocks at the time the event occurs. It will be a major hazards with a high consequence for persons on the section of crest that collapses. The applicable criteria are a maximum factor of safety (FoS) of 1.3 to 1.5 where the likelihood of the consequence is medium to high and 1.2 to 1.3 when it is low to medium[39]. The FoS for both walls (i.e., FoS ≥ 1.3) is within the range of acceptability for all likelihood categories.

5 RISK MANAGEMENT STRATEGIES

The primary strategies to ensure the geotechnical related risks remain acceptable for the long-term aim to:

- reduce to the greatest degree practical the likelihood of impact of persons by falling rocks
- reduce to the greatest degree practical the likelihood of falls-from-heights associated with the crests of the walls and the berms
- facilitate, where possible, passive regeneration of vegetation to increase the stabilities of erodible areas and to minimise the aesthetic and visual impact of the pit.

The presence of vegetation within the void will reduce the likelihood of the pit being an attractant.

The geotechnical considerations will be achieved by:

- installing abandonment barriers behind the crests of all walls to restrict access to the crests (Section 5.1)
- restricting access to and around the site (Section 5.2)
- minimising the area of ground disturbed by limiting clearing of vegetation to only that required for rehabilitation
- implementing a programme to visually monitor the outcomes of the closure plan (Section 5.3)
- assessing the outcomes of the closure plan against indicators and completion criteria to demonstrate the success of the plan (Section 6).

[39] Although dynamic loading was assumed in the analyses, the criteria applicable to static loading are considered applicable as the dynamic loads are very low.

5.1 Install Abandonment Barriers

5.1.1 General Requirements

The final landform will include an abandonment barrier behind the crest of each wall to prevent inadvertent access to the crests by vehicles and restrict access by motorbikes and persons on foot. In lieu of a Queensland specific guideline on barriers, the recommendations in the Western Australian guideline (1997)[40] will be applied. The intentions of the guideline are for a barrier to:

- be installed behind the crest of each wall beyond potential failure zones
- encircle the pits with no gaps other than where locked gates provide restricted access through the barrier
- be obvious
- have sufficient height to restrict access
- have sufficient longevity to remain functional for the long-term.

5.1.2 Offsets from the Crests

The guideline recommends barriers be offset a minimum of 10 m behind the point at which a construction line from the toe of a wall intersects the natural ground surface behind the wall. The line is to be orientated at 45^{o} in unweathered rocks and 25^{o} in weathered rocks[41]. On this basis, the minimum recommended offsets are those listed in Column 6 of Table 7.

- The offsets recommended by the guideline exceed the maximum break-back distances experienced to date of 6.3 m on the east wall and 8.5 m on the west wall (Figure 27 and Figure 28).
- The maximum offset recommended by the guideline along the east wall is unrealistic as it exceeds significantly the 16 m distance at which the lowest strength overall scale surfaces daylights behind the crest (Figures A3.3). It is also inconsistent with the performance of the wall since mining ceased.
- The recommended offset applicable to west wall is less than the 41 m distance the lowest strength overall scale surfaces daylight behind the crest (Figures A3.2).

Based on these considerations, the suggested offsets for the barriers are those listed in Table 7 Column 7. These offsets are shown in Figure 29. They result in a barrier approximately 1.6 km long.

5.1.3 Type of Barriers

An intention of the guideline is that the barrier should have sufficient longevity to remain functional for the long-term. The guideline therefore prefers the use of a bund rather than a fence. A bund generally remains functional for the long-term with negligible maintenance whereas a fence can deteriorate within 10 to 15 years if not well maintained unless it is designed and installed to a standard that aims to achieve greater longevity.

In lieu of a bund, the guideline indicates “a fence of a suitable construction and appropriate height may be appropriate”. This allowance is appropriate for this site as a bund is unsuitable and/or impractical for most of the length of the barrier because:

[40] Government of Western Australia Department of Industry and Resources (1997) *Safety Bund Walls Around Abandoned Open Pit Mines: Guideline*. MOSHAB Approved. Document No: ZMA048HA. 14 pages.

[41] The procedure in the guideline can provide inappropriately large offsets when the wall comprises a single low bench with a steep batter. In these scenarios, this office considers a 10 m offset is appropriate.

- A 1.5 m high, 1.6 km long, bund will require approximately 7,000 m^3 (i.e., 11,800 tonnes) of loose rocks requiring 5,400 m^3 of in-situ rock[42]. This volume is unlikely to be available at closure.
- The footprint of the bund requires clearing vegetation from a minimum area of up to approximately 7,000 m^2 (i.e., 0.7 Ha). Providing roads of a width suitable and safe for trucks to access the footprint will require clearing a significantly greater area. Clearing vegetation safely will be challenging and will require considerable time. It will increase the overall area of disturbance and require additional rehabilitation.
- Providing safe access for trucks will require establishing roads in areas not previously having roads. Doing so will require significant cut and fill earthworks.

The recommended strategy to address the impracticality of a 1.6 km long bund is:

- Establish a bund along only the 115 m long section of the footprint highlighted in blue in Figure 29. The bund will prevent vehicles accessing the only practical route to the void.
- Establish fences along the remainder of the footprint.

Post and wire, farm style, fences require regular maintenance and/or replacement if they are to have long-term longevity. Provision for maintenance and replacement may require establishing an agreement with, and paying funds to, a third-party initially and implementing a strategy to reinforce a guarantee that the agreement will be honoured during the long term.

Alternatively, a proprietary rockfall barrier (i.e. fence) (e.g., Figure 30) can provide a 100 year design life without significant maintenance or the need for replacment. A suitable barrier would be 1.5 m high and have a 10 kJ capacity. Post spacings can be up to 5 m, which minimises the number of posts required compared to a farm style fence. The style of barrier is suitable for stock control. Sturdy locked gates should be installed within the barrier where access to the site is required.

Table 7. Minimum offsets from the crests for a barrier based on wall specifications.

Wall	*Section of wall*	*Maximum height of wall (m)*	*Overall slope angle of wall*	*Weathering depth on wall (m)*	*Offset recommended by guideline(m)*	*Suggested offset (m)*
North	All (single bench)	22	20^o	20	10	10
South	All (single bench)	8	45^o	8	10	10
East	Centre to south	52	61^o	20	56	16
	North (single bench)	8	70^o	8	10	10
West	Centre	62	29^o	20	10	40
	North	40	30^o	20	10	10
	South	34	30^o	20	10	10

[42] Assumes a 30% bulking factor, a broken rock density of 2.2 t/m^3 and a 35^o angle of repose

5.1.4 Signs

- Attach signs along each run of the fence and to gates. The signs should note “Danger. Deep Excavation” or similar words.
- Place signs at maximum 100-m spacings.
- The specifications of the signs should be consistent with those recommended in Australian Standard AS 1319-1994 *Safety Signs for the Occupational Environment*.
- Attach signs to the posts with secure galvanised fasteners.

5.2 Restrict Site Access

- Deep rip access routes into the void and to the crests of its walls, the haul road adjacent to the west wall and ramps to the floor of the void to:
  - reduce the visibilities of tracks
  - prevent vehicles from accessing tracks
  - reduce overland flows of water by creating paths for water to permeate into the ground rather than flow along tracks and cause erosion.
- Retain a secure fence with locked gate along the property boundary on Sisalana Road.

5.3 Undertake Regular Monitoring and Risk Management

- Facilitate audits of geotechnical risk issues by an appropriately qualified independent geotechnical consultant. Four inspections at 18 month intervals are recommended. The audits should be undertaken until the completion of certification of rehabilitation sign off.
- Visually inspect the walls of the void and the areas within and beyond the void. Note evidence of, and record, changes in the risk profiles including, but not limited to,:
  - sections of a wall having failed or potentially failing
  - excessive erosion beyond or within the void or over the crest of a wall
  - excessive cracking behind a crest of a wall or on any berm that is safely accessible
  - access to the void area by persons, use of ripped tracks or establishment of new tracks
  - damage to a section of the abandonment bund or fence (where safely accessible).
- Assess the profiles of the walls of the pit, the area around the pit and the abandonment barriers using drone based photogrammetry. Create surfaces from the point clouds. Compare the surfaces to previous surfaces to highlight significant changes. Note evidence of excessive deformation (i.e.,’ > 0.5 m) of a section of a wall, which may indicate multi-bench or overall scale failure may be triggering. Note evidence of sections of a wall having failed.
- Plan and implement a risk management strategy if the risk applicable to any hazard may become unacceptable.

6 COMPLETION CRITERIA

Table 8 lists the rehabilitation milestones and completion criteria relevant to the geotechnical risk applicable to the void.

Table 8. Rehabilitation milestones and completion criteria.

Rehabilitation Milestone	*Rehabilitation Completion Criteria*
Surface conditions	Visual monitoring indicates the crests and slopes of the walls of the final void have achieved acceptable long-term stabilities.
Achievement of Post Mine Land Use to a Stable Condition (Water Storage)	Safe Access to the final void is restricted by the installation of an appropriate abandonment barrier (bund and/or fence) that is located at least 10 m beyond the area potentially affected by instabilities of the walls of the final void. Safety signs have been designed in accordance with Australian Standard AS 1319-1994, alert people to the presence of the final void, are erected at maximum 100 m intervals and are visible. Stable An appropriately qualified independent geotechnical consultant has confirmed that the walls of the final void have likely achieved acceptably stabilities for the long-term on the basis of risk. Non-polluting The walls are confirmed to be draining internally to the final void.

7 SUMMARY

This study concluded:

- The proposed landform designs satisfy the geotechnical related requirements of the PRCP Guideline.
- The stabilities of the walls of the void are within the ranges typically considered acceptable in the mining industry.
- The water level in the void is expected to remain similar to its current level fluctuating with the season. The water will not significantly reduce the performances of the walls of the void.

The principal strategies recommended to reduce the risks applicable to the walls of the void are:

- reducing to the greatest degree practical the likelihood of impact of persons by falling rocks
- reducing to the greatest degree practical the likelihood of falls-from-heights associated with the crests of the walls and the berms
- facilitating, where possible, passive regeneration of vegetation to increase the stabilities of erodible areas and to minimise the aesthetic and visual impact of the void.

The presence of vegetation within the void will reduce the likelihood of the void being an attractant.

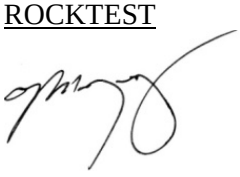
The geotechnical considerations will be achieved by:

- installing an abandonment bund across the south entrance to the pit
- installing fences with signs elsewhere behind the crests of all walls to restrict access to the crests (Section 5.1)
- restricting access to and around the site by rehabilitating access tracks and ramps, revegetation works and securing the front boundary fence (Section 5.2)
- minimising the area of ground disturbed by limiting clearing of vegetation to only that required for rehabilitation
- implementing a programme to visually monitor the outcomes of the closure plan (Section 5.3)
- assessing the outcomes of the closure plan against indicators and completion criteria to demonstrate the success of the plan (Section 6).

8 CLOSURE

This report addresses the geotechnical related issues required in a PRCP listed in Section 1. I trust that it provides the information you require. Please contact the undersigned if you have any queries on any matter discussed within it or wish to discuss any aspect of the report in more detail.

For and on behalf of
ROCKTEST



Tony Meyers
Principal Rock Mechanics Engineer

FIGURES

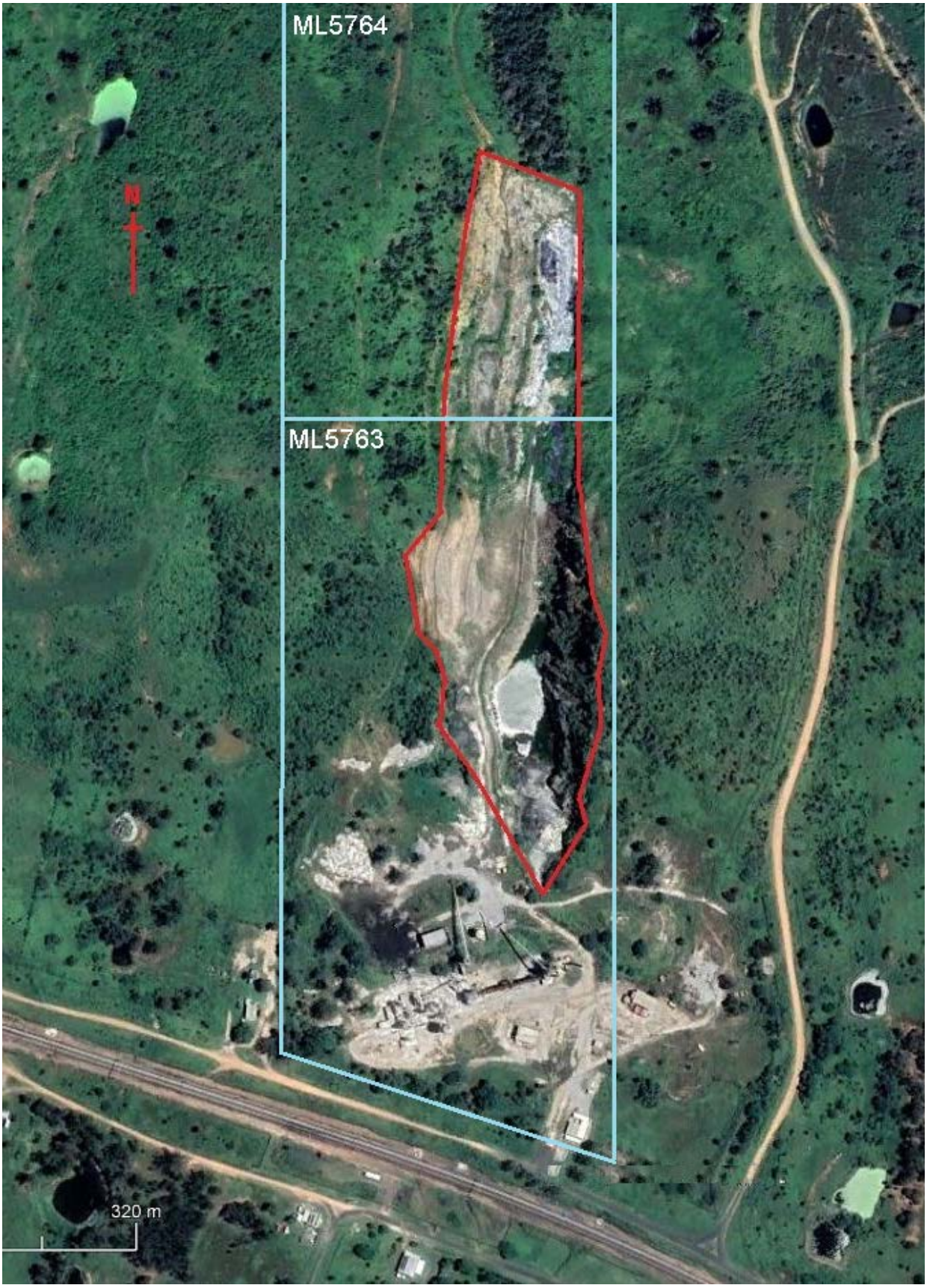


Figure 1. Highlighted (red) is the footprint of the pit. The town of Marmor is located 500 m to the south.

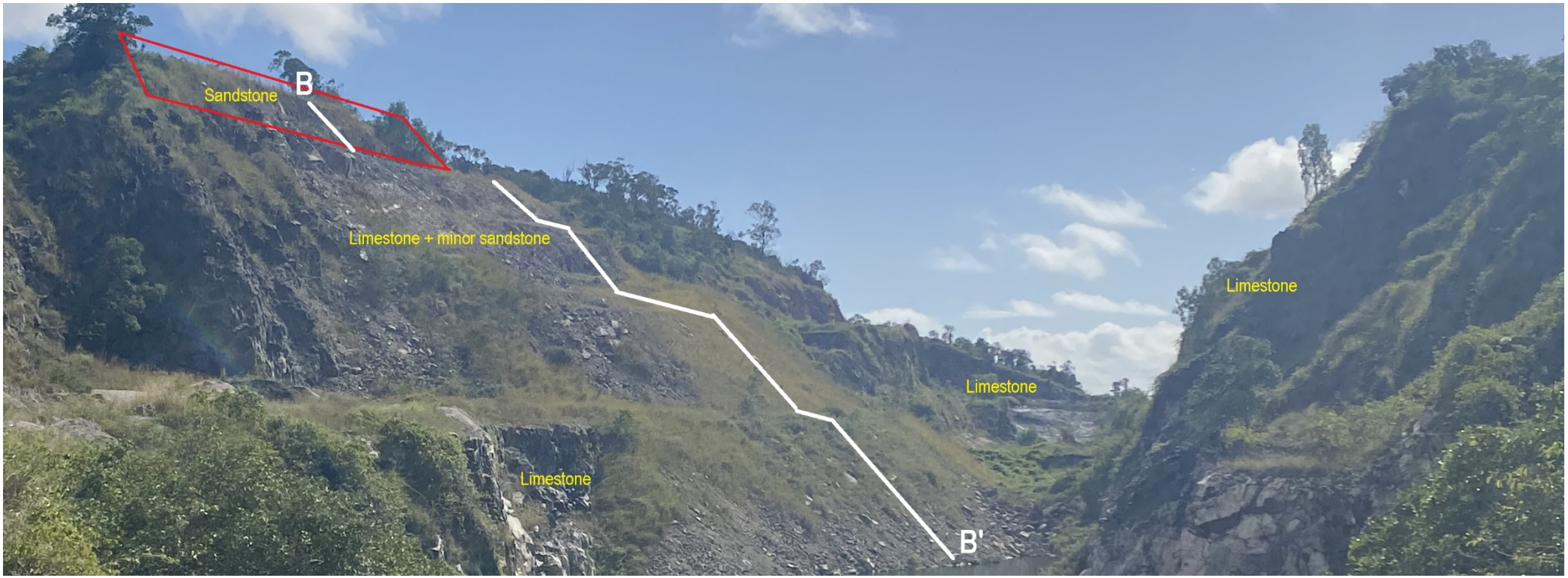


Figure 2. General rock types exposed in the pit walls. Vegetation density is high behind the crests and sparse to moderate on the walls and the pit floor. The stabilities of the east and west walls along cross-section B-B' is considered in Section 4.2.2.

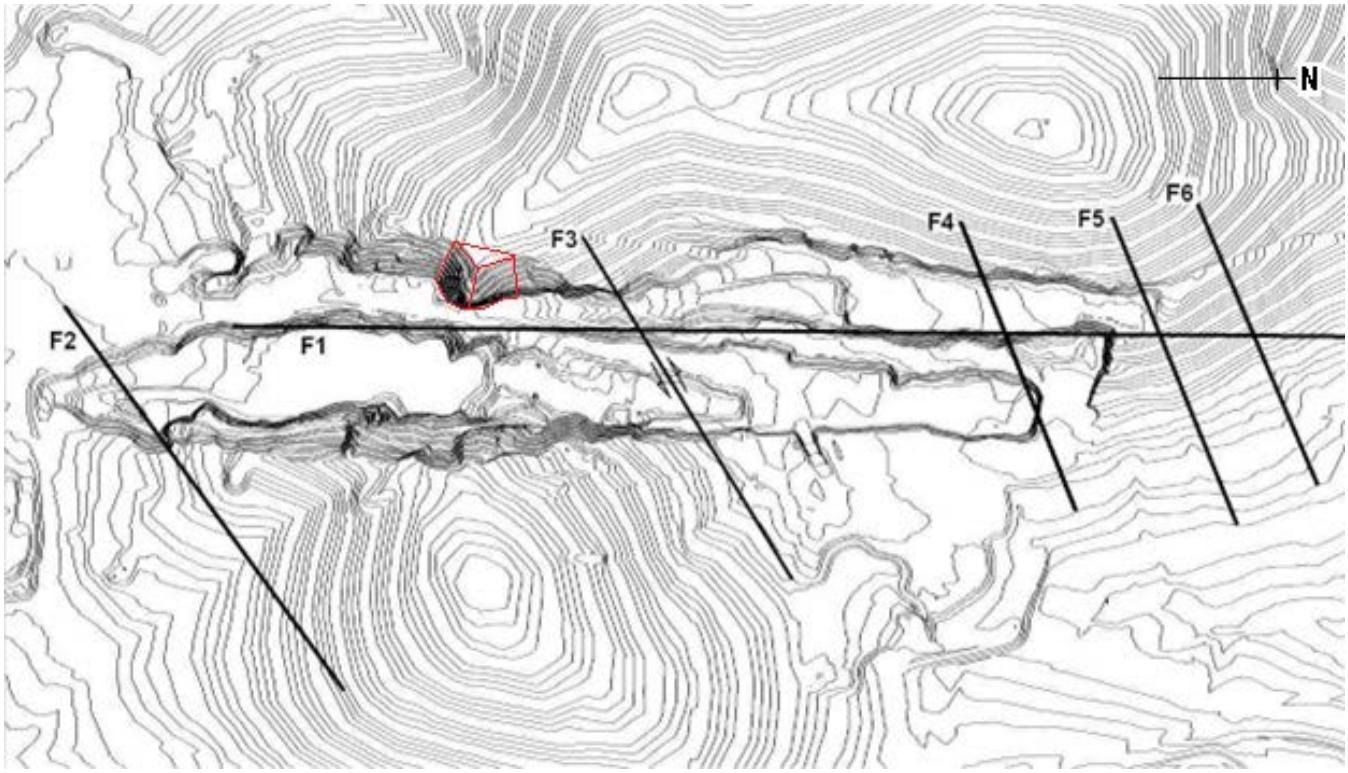


Figure 3. Approximate locations of major faults. Highlighted (red) is the pinnacle" excavated in 2014.

Figure 4. Examples of north-south striking faults in the west wall associated with fault F1 (refer Figure 3).

Figure 5. Mottling of moderately weathered limestone exposed in the north wall results from shearing along east-west striking fault F4 (refer Figure 3). Note the shallow cover of soil.

Figure 6. Highlighted is the base of the shallow cover of soil above highly- to extremely-weathered limestone at the north end of the west wall. Vegetation density is high behind the crest.

Figure 7. Highlighted is the base of the shallow cover of soil above moderately- to highly-weathered limestone midway along the east wall. Vegetation density is high behind the crest.

Figure 8. Example of andesite dyke intruded along a joint in the east wall.

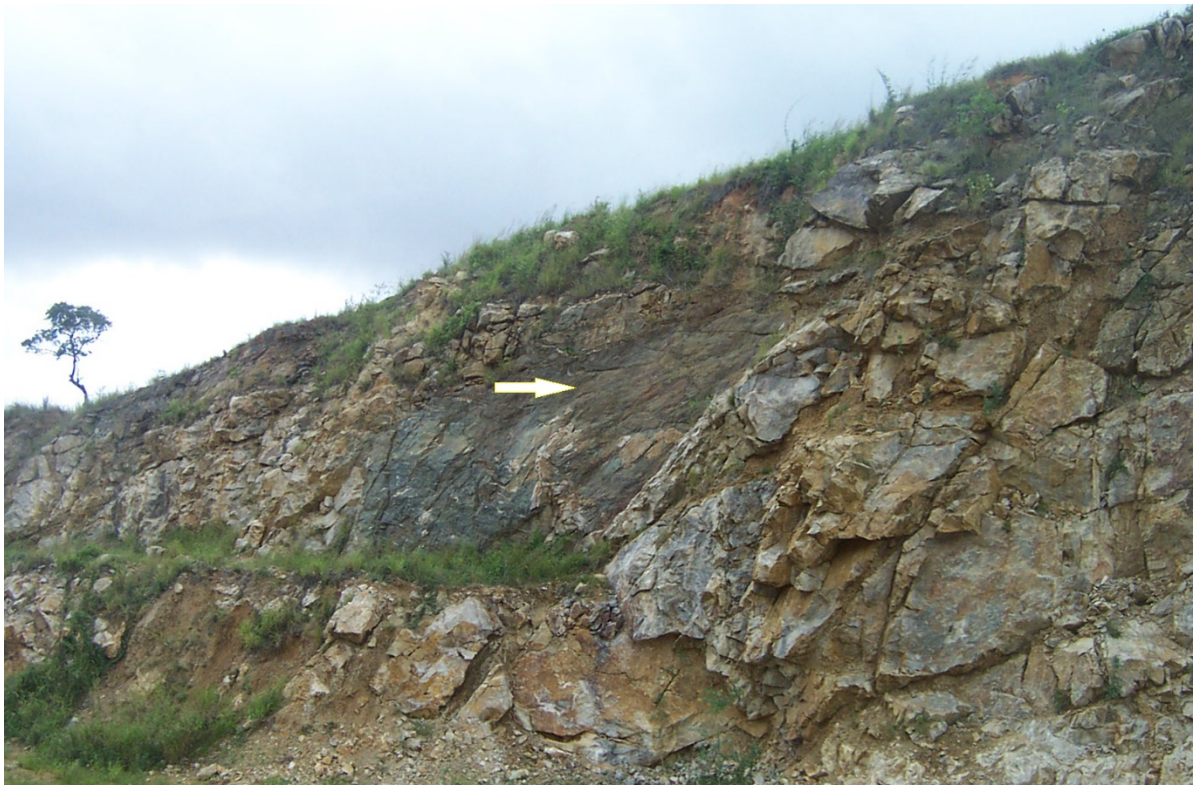
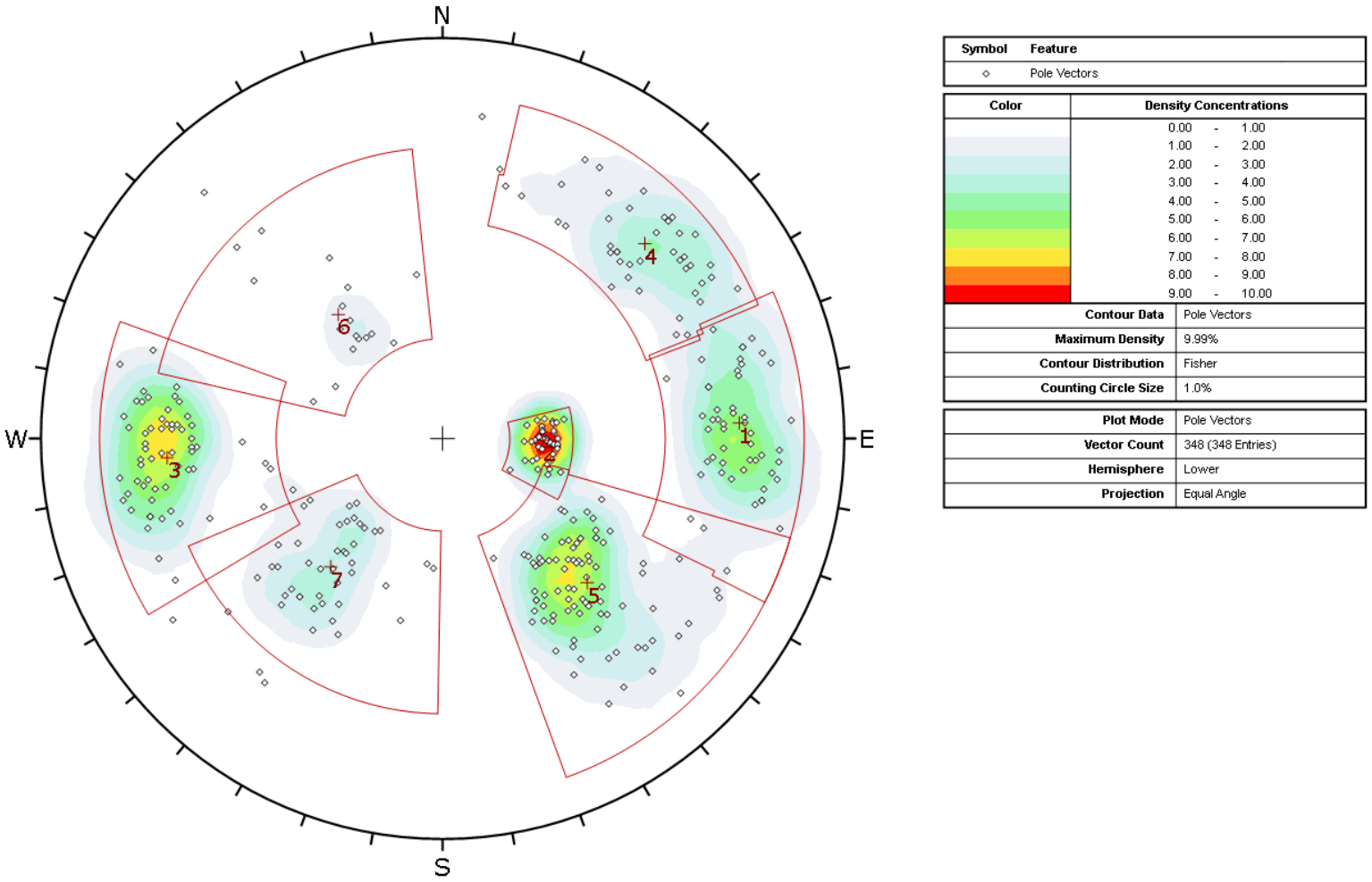


Figure 9. Example of an andesite sill intruded between beds of limestone in the east wall.

Figure 10. Examples of karst features in limestone on the west wall infilled with red-brown clay.

Figure 11. Weathering of clay infill within karst has contributed to the irregular sawtooth surface below the crest at the north end of the west wall.



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.00
	1.00 - 2.00
	2.00 - 3.00
	3.00 - 4.00
	4.00 - 5.00
	5.00 - 6.00
	6.00 - 7.00
	7.00 - 8.00
	8.00 - 9.00
	9.00 - 10.00

Contour Data	Pole Vectors
Maximum Density	9.99%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Plot Mode	Pole Vectors
Vector Count	348 (348 Entries)
Hemisphere	Lower
Projection	Equal Angle

Figure 12. Stereonet highlighting the orientations of poles to 348 discontinuities mapped within the limestone. Also highlighted are the boundaries of the 7 sets into which the discontinuities have been assigned and the mean orientation of each set.

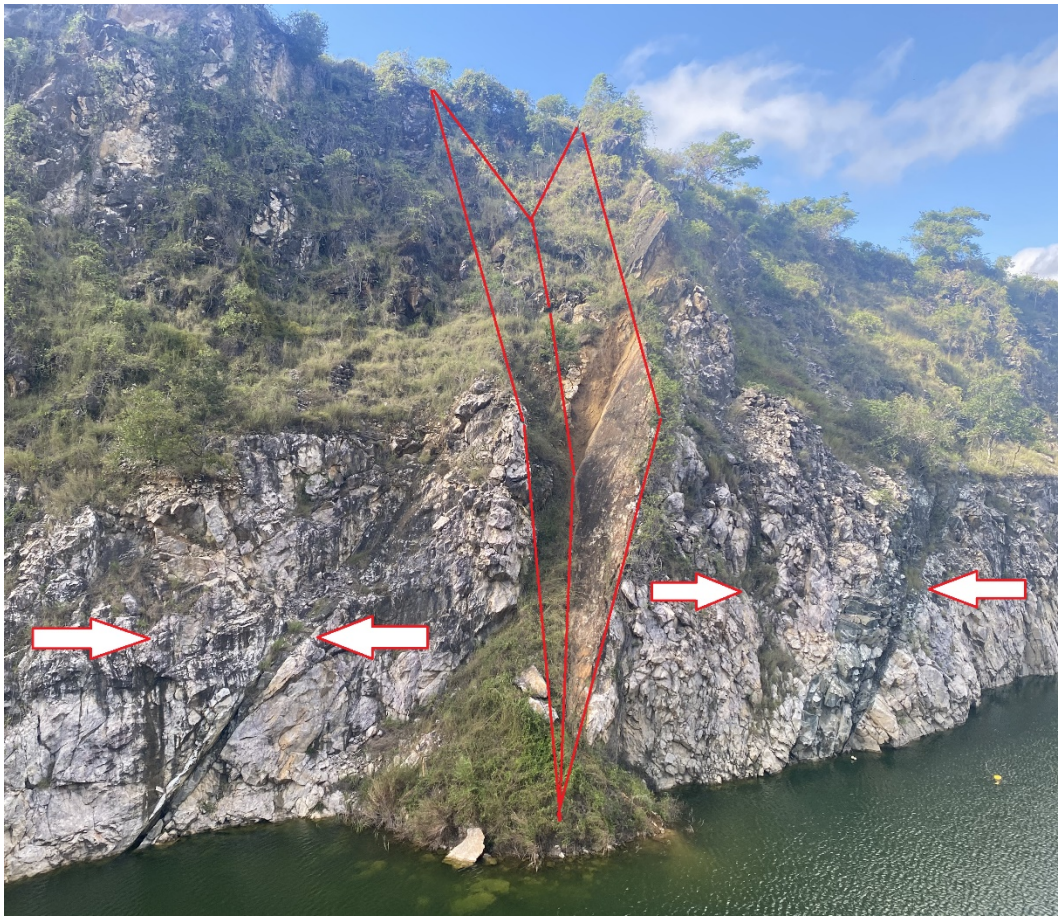


Figure 13. Examples of discontinuities having very high persistence daylighting within the east wall and underlying overall scale wedges.

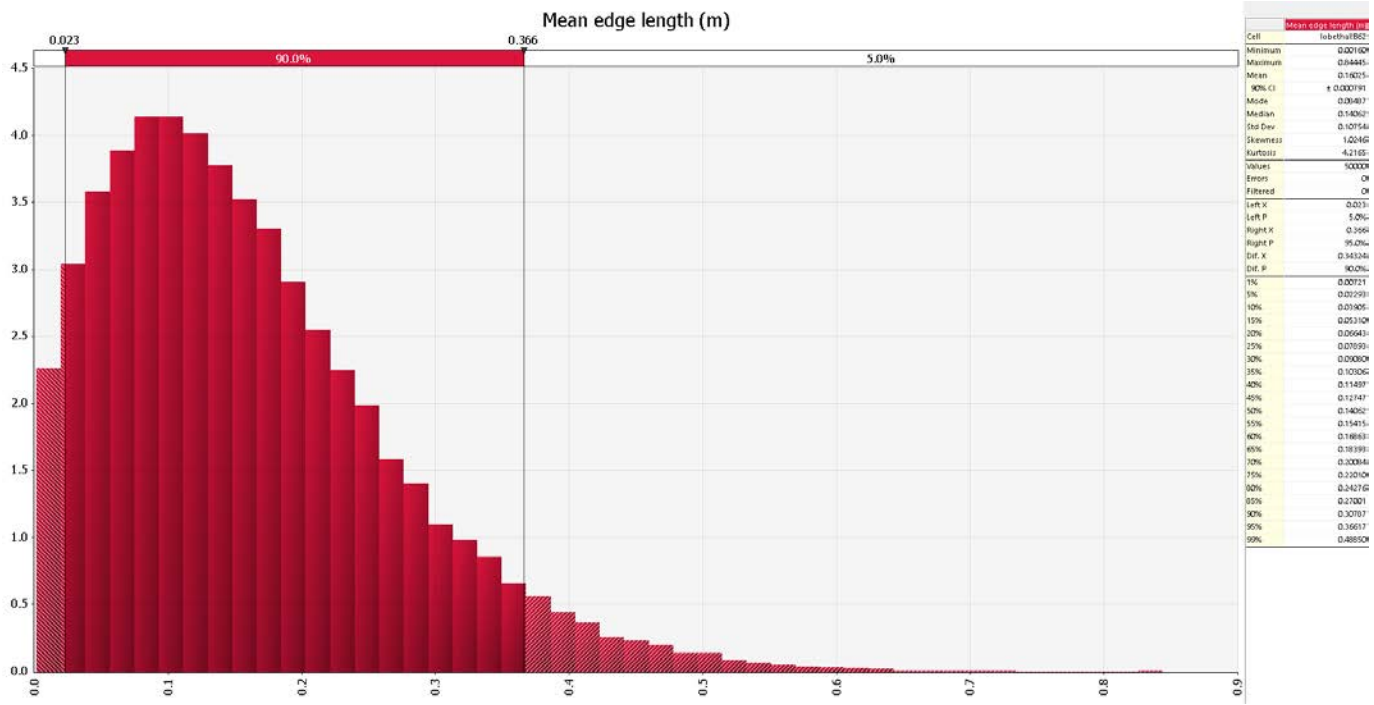


Figure 14. Distribution of rock sizes generated based on data listed in Table 1.

Figure 15. Most blocks of limestone are less than 50 cm in size, consistent with the results of rock size anaylses in Section 2.6.5. The surfaces of the discontinuities in the direction of sliding (i.e. down) are slightly rough and undulating. These characteristics contribute positively to their shear strengths.

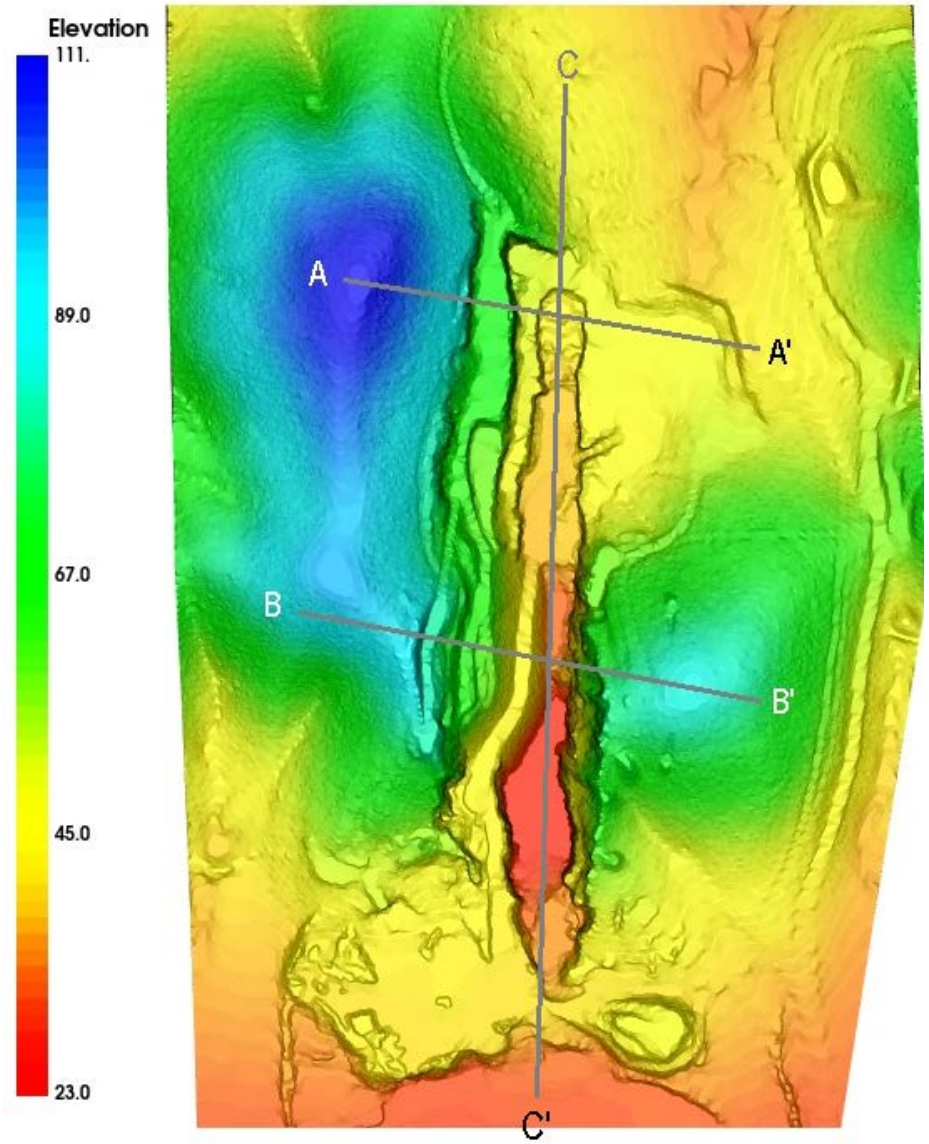


Figure 16. Elevations around the pit. Cross-section B-B’ is considered in the sliding stability analyses in Section 4.2.2.

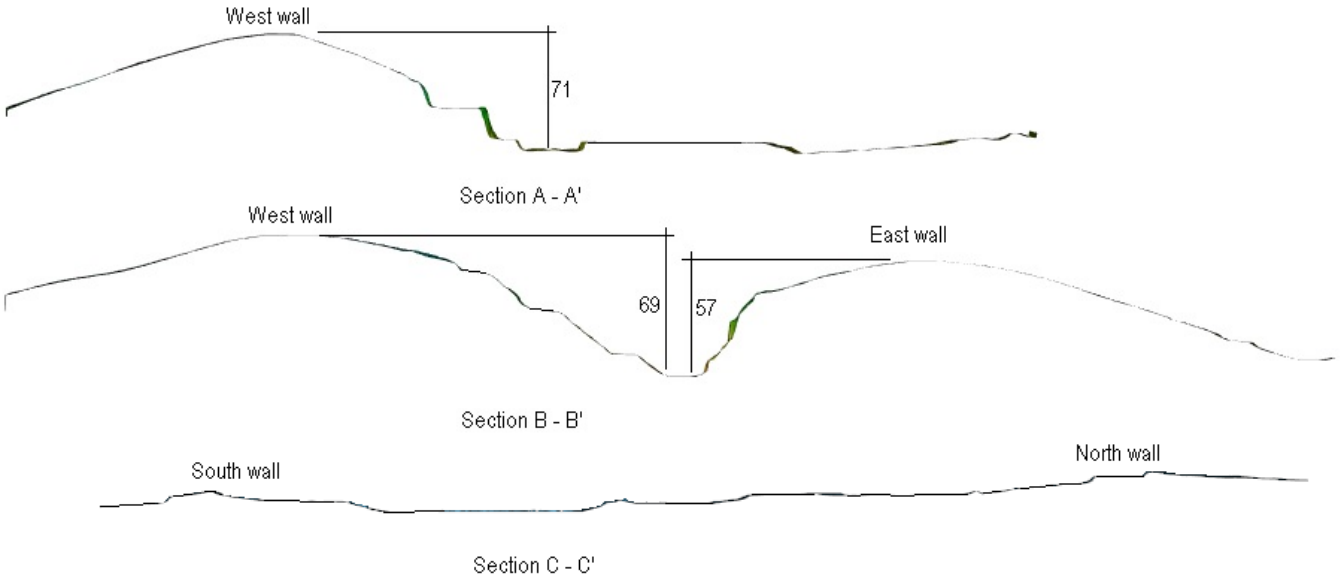


Figure 17. Cross-sections through the pit (Refer Figure 16). Cross-section B-B’ is shown in Figure 2.

Figure 18. In 2014, a protrusion of limestone and sandstone on the west wall was excavated and the wall benched to reduce risk applicable to vehicles traversing along the haulroad during proposed mining. Some of the loose material was used to form a short section of the haul road and to cover the lower bench.

Figure 19. In 2014, the crest of the east walled was cut back to ensure the risk applicable during proposed mining on the pit floor would be acceptable.

Figure 20. Rocks pushed over the crest of the east wall during the 2014 cutback triggered instabilites of individual rocks and masses of rocks on the wall that had marginal capacities. Doing so, and subsequent scaling, reduced the number of hazards.

Figure 21. View from behind the crest of the east wall looking towards the west wall. The density of vegetation behind the crests of all walls is high. It is moderate to high on the berms.

Figure 22. Pit floorlooking north. The density of vegetation on the floor is moderate to high. It is sparse to moderate on the east wall.

Figure 23. Vegetation is sparse below the crest of the section of the west wall where earthworks were undertaken in 2014.

Figure 24. West wall looking north. The density of vegetation on the berms is moderate to high. It is sparse to moderate on the batters.

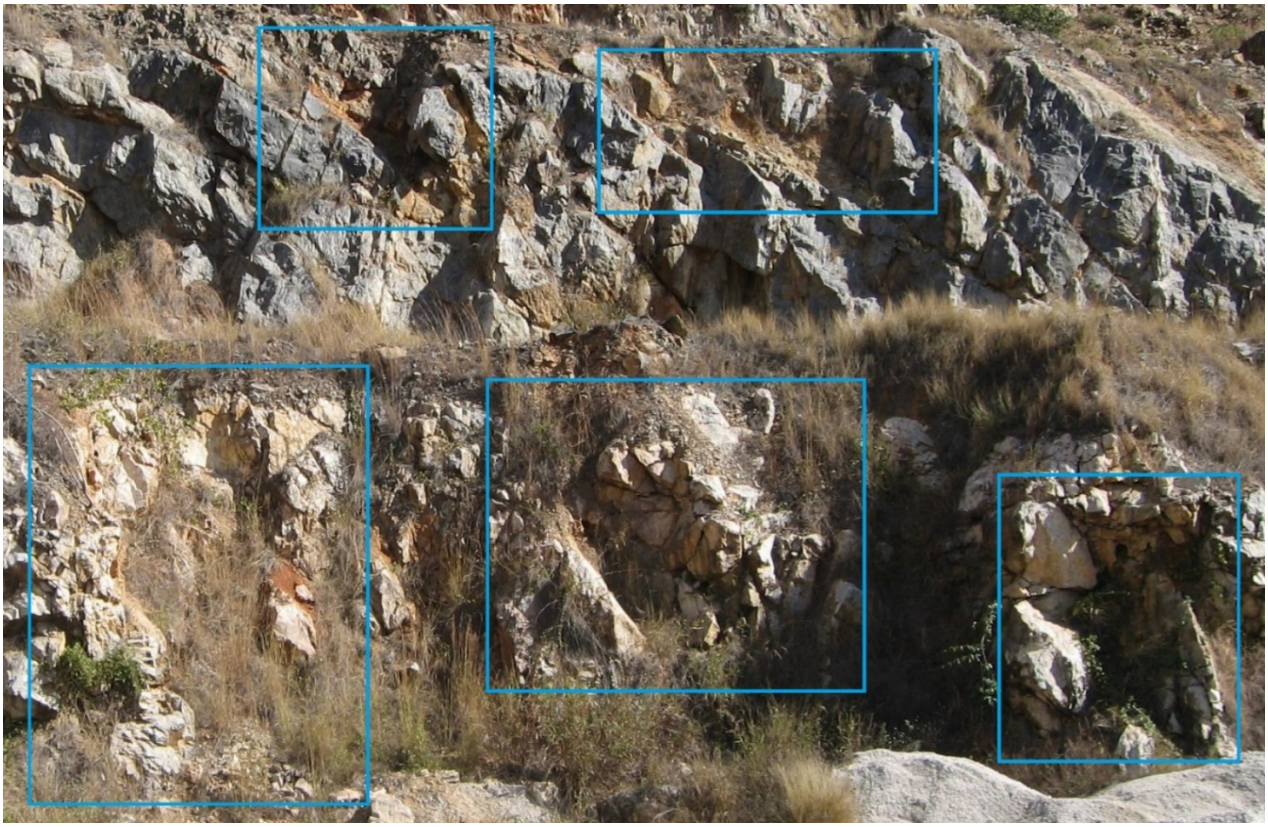


Figure 25. Highlighted at the north end of the west wall are examples of bench scale masses of rocks that have detached by toppling from, and sliding along, one or two discontinuities, predominantly from Sets 3, 5 and 7. Multibench (i.e., inter-ramp) scale instabilities have not occurred on this wall.

Figure 26. Highlighted midway along the east wall are examples of multi-bench (i.e., inter-ramp) and overall scale masses of rocks that have detached by toppling from, and sliding along, one or two discontinuities discontinuities, predominantly from Sets 1, 4 and 5.

Figure 27. Example of locations along the crest of the east wall where detachments of rocks of inter-ramp and overall scales resulted in the crest breaking back by up to 6.3 m.

Figure 28. Examples of locations along the crest of the westt wall where detachment of masses of rocks of bench scale reulted in the crest breaking back by up to 8.5 m.

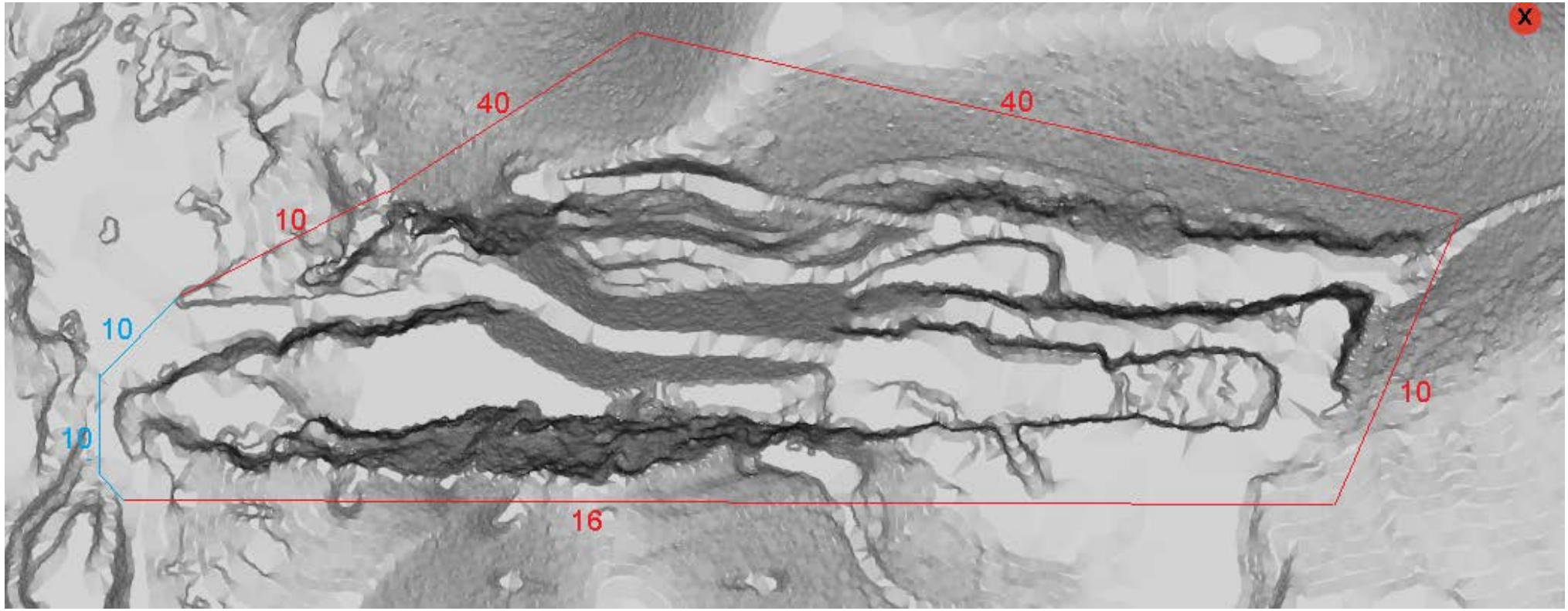


Figure 29. Recommended minimum offsets from the crests of the walls for the abandonment (red) fences and the (blue) bund.

Figure 30. Example of a 1.5m high, 10 kJ capacity, proprietary rockfall barrier. This style of barrier can have a 100 year design life.

ADDITIONAL INFORMATION

- The recommendations in this report have been based on certain assumptions and very few observations. It would be very rare if the conditions at the site did not vary from those observed even if exhaustive investigations had been undertaken. Hence, it is unlikely that the conditions observed will represent the extremes of conditions that exist. As such, even though the aim of this report is to address issues influencing long-term geotechnical related risks applicable to the landforms at the Marmor mine, it is possible for events to occur or conditions to exist that were not planned for and as such should not be unexpected.
- The report was prepared on completion of the field work and is based on conditions encountered and reviewed at the time of preparation. Natural developments in, and changes to, or surrounding a volume of geomaterials over time, which are out of the control of the Rocktest Engineer ("Engineer"), will change the stresses that act through the geomaterials and their engineering characteristics. Changes in these conditions may significantly alter the way in which the ground conditions behave. As such, the conclusions reached in this report will be less applicable over time and may not be applicable or relevant at a later point in time. Rocktest disclaims responsibility for any changes that might have occurred or the implication of these changes on the assessments or recommendations in this report.
- This report was prepared specifically for Graymont Australia Pty Ltd ("Client") and for a specific purpose. It was not prepared for the use by any party other than the client and its respective consulting advisers.
- It is not possible to make a proper assessment of the report without a clear understanding of the terms of engagement upon which it was prepared, including the scope of instructions, directions and information provided by the client to those who prepared the report and the assumptions made in the report. The report may not address issues that would need to be addressed if the intention, environment, circumstances, time requirements and brief were different from those for which the report was prepared. Only the Engineer has a true understanding of the affects that these limitations and the assumptions made in the report may have on the conclusion reached within the report. As such, no party other than the Client should use the data, contents of the report or the techniques used in it for application to conditions different from those for which the report was intended without an independent and detailed review being carried out as to its suitability, relevance, and accuracy.
- This report must be read in full. No responsibility is accepted for use of any part of the report in any other context or for any other purpose other than that for which it was prepared.
- Where engineering advice, recommendations and/or designs are provided, all elements/components of the advice, recommendations and/or designs are intended to function in combination. The Engineer accepts no liability arising out of their partial application.
- The Engineer will not accept any responsibility for negligence, nor any loss or damage suffered by the Client due to the occurrence of events or the existence of any factors which are out of the Engineer's control. The Engineer will indemnify the Client for claims or loss arising from a breach of professional duty in the provision of the professional services. The liability of the Engineer is reduced to the extent that the Client or other person(s) caused or contributed to the loss or occurrence which gave rise to the claim.
- This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

The above clauses do not in any way attempt to absolve the Engineer from any professional responsibilities in relation to the diligent and careful performance of duties in providing this report. Rather, they are intended to be a guide as to where the Engineer's responsibilities end, and where forces of nature assume responsibility for the composition of a volume of geomaterials and its performance.

APPENDIX 1 ROCKMASS CHARACTERISTICS

A1.1 Compressive Strengths

The compressive strengths of samples of limestone and sandstone were defined in terms of Point-Load Strength Indices, $I_{s(50)}$. Samples of each rock type were collected at random locations within the pit. No preparation of the rocks was required. They were tested at their moisture content at the time of testing. The tests were carried out in accordance with ISRM (1985[43]) and AS 4133.4.1 9 (1993[44]).

1. A rock was inserted into an ELE point-load test apparatus. The rock was aligned perpendicular to the dominant fabric.
2. The platens were closed to contact the smallest dimension and away from the edges.
3. The load was steadily and slowly increased until failure. Tests for which the failure plane did not fully intersect the rock were rejected. The pressure at failure was recorded.
4. The distance between the platens at failure and the width of the failure plane were recorded with a Vernier calliper. The width was calculated as (W1+W2)/2[45] if opposite sides of the failure plane were not parallel.

The results are summarised in Table A1.1.

Table A1.1. Summary of point load strength indices $I_{s(50)}$

Rock type	*Number of tests*	*Minimum (MPa)*	*Mean (MPa)*	*Maximum (MPa)*
limestone	4	2.0	3.8	6.0
metasandstone	11	2.9	3.6	4.0

A1.2 Specific Gravities

The densities of samples of limestone and sandstone were estimated as functions of their specific gravities.

1. The mass (M_d) of a dry rock was measured with a Nuweigh KK5000 electronic balance.
2. The rock was suspended in water and its saturated mass (M_s) was measured.
3. The rock was removed from the water and its wet mass (M_w) was measured.
4. The density of the rock was estimated from the following equation.

The results are summarised in Table A1.2.

$$\text{Density} = \frac{1000\, M_d}{M_w - M_s}$$

[43] ISRM (1985) International Society for Rock Mechanics Commission on Testing Methods. Suggested Methods for Determining Point Load Strength, Int. Jnl. Rock Mech., Min. Sci. & Geomech. Abstr. Vol. 22 No. 2 pp.51-60

[44] AS 4133.4.1 (1993) Australian Standard Methods of Testing Rocks for Engineering Purposes. Method 4.1 Rock Strength tests – Determination of Point Load Strength Index.

[45] ISRM (1985) and AS4133.4.1 suggest that the dimension W should be the minimum dimension of the sample perpendicular to the loading direction prior to testing due to the simplicity of obtaining this dimension. However, researchers and the German Standards argue in favour of measuring W as the minimum dimension of the failure surface after testing although obtaining this dimension is more time consuming than the former method. Rocktest adopts the latter method.

Table A1.2. Summary of density values.

Rock type	*Number of tests*	*Minimum (kg/m^3)*	*Mean (kg/m^3)*	*Maximum (kg/m^3)*
limestone	7	2610	2650	2679
metasandstone	3	1799	2325	2646

A1.3 Basic Friction Angles

The basic friction angles[46] (ϕ_b) of discontinuities within samples of limestone and sandstone were estimated were estimated using a tilt test i.e.

1. A diamond tipped saw blade was used to cut through the sample. The smooth cut surfaces were manually abraded to remove all roughness features.
2. The halves were reassembled.
3. The lower half of the sample was tilted slowly until the top half begun to slide. The tilting was stopped.
4. The tilt angle was recorded with a digital M&D "SmartTool" level.
5. The halves were realigned and the test repeated.

Table A1.3. summarises the results from the tests. Pitting of the surfaces contributes to the values for the weathered rocks being higher than those for the unweathered rocks.

Table A1.3. Summary of basic friction angles.

Grade	*Number of tilts*	*Minimum*	*Mean*	*Maximum*
limestone	16	20^o	23^o	28^o
sandstone	12	21^o	24^o	26^o

A1.3 Discontinuity Shear Strength

The friction angles for discontinuities with the limestone and the sandstone were estimated using a non-linear shear strength criterion described by Barton. and Bandis (1990) [47]. The criterion is defined in terms of the parameters:

- Joint Wall Compressive Strength (JCS), assumed to be equivalent to the compressive strength of the intact rock. This strength is estimated as a function of the point load strength index $I_{s(50)}$ values (Appendix A1.1) i.e., JCS = 18 x $I_{s(50)}$.
- The normal stress on a discontinuity which is a function of the density of the overlying rock (Appendix A1.2).
- The residual friction angles (ϕ_r), assumed to be equivalent to the basic friction angle[48] (Appendix A1.3).

[46] The basic friction angle quantifies the inter-granular friction after all roughness asperities have been abraded from opposing surfaces of a discontinuity.

[47] Barton, N. and Bandis, S (1990) Review of predictive capabilities of JRC-JCS model (B-B model) in engineering practice. In *Proc. Rock Joints*. Balkema pp.803-810.

[48] The basic friction angle quantifies inter-granular friction after all roughness asperities have been abraded from opposing surfaces of a discontinuity.

- Joint Roughness Coefficients[49] (JRC), which quantifies the roughness of the discontinuities. The coefficient was quantified by comparing the surfaces of the discontinuities to a standard chart of roughness profiles. Most discontinuities are slightly rough (Figure 15). Most surfaces undulate in the directions overlying rocks are likely to slide. A high proportion of the discontinuities above 10 mBGL have a sandy clay coating. Surfaces at greater depths are unaltered with some surface staining.

A1.4 Rock Mass Strengths

The shear strength of the rockmass was estimated using the Generalised Hoek-Brown Rock Mass Strength criterion[50]. The criterion is defined in terms of the parameters listed in Table A1.8:

- The Hoek-Brown intact rock constant m_i for limestone and sandstone.
- The disturbance factor D, which depends upon the degree of disturbance to which the rock mass at the depth of a potential surface of instability has been subjected to by blast vibration and stress relaxation[51]. A value of 0.9 is applied, which assumes some disturbance.
- The Geological Strength Index (GSI)[52] is a quantitative value that defines the quality of the rockmass in terms of the parameters[53]:
  - Rock volume as described in Section 2.6.5.
  - Joint Condition Factor (J_c), which is the ratio of the following qualitative parameters from the Q[54] rock mass classification system:
    - Joint Roughness number (J_r), which is a function of the Joint Roughness Coefficient listed in Table 3.
    - Joint Alteration number (J_a), which is based on a description of the characteristics of the infill within the discontinuities as described in Section 2.6.6.

Figure A1.1 shows the likely ranges in the GSI values based on the data described above. The average values decrease from 53 to 37 as the limestone weathers. Although the values are not definitive, they still provide an indication of the decrease in the quality of the limestone as the degree of weathering increases during the long-term.

[49] The Joint Roughness Coefficient (JRC) quantifies the roughness of the surface of a discontinuity. It is based on a comparison of the surfaces of the discontinuities with standard roughness profiles. It is linearly scaled from 1 for very smooth (slickensided) surfaces to 20 for very rough surfaces.

[50] Hoek, E. Carranza-Torres, C. & Corkum, B. (2002) Hoek-Brown failure criterion, 2002 edn. In *Mining and Tunnelling Innovation and Opportunity. Proc. 5th North American Rock Mech. Symp*. Toronto, vol. 1 pp.267-273 Uni. Toronto Press, Toronto.

[51] D varies from 0 for undisturbed rockmasses to 1 for very disturbed rockmasses.

[52] The geological strength index (GSI) produces quantitative values used to calculate the strength properties of a rockmass.

[53] Cai, M., Kaiser, P.K., Uno, H., Tasaka, Y., Minami, M. 2004. Estimation of rock mass deformation modulus and strength of jointed hard rock masses using the GSI system. *Int. J. Rock Mech. & Min. Sci*. 41:3–19

[54] Barton and Choubey (1977) The shear strength of rock joints in theory and practice. *Rock Mechanics* **6** 183-236.

Table A1.8. Estimated rock mass shear strength parameters.

Characteristic		*Limestone*	*Metasandstone*
Intact rock constant, m_i.		9	19
Unit weight (kN/m^3)		26	23
Uniaxial compressive strength, UCS (MPa)		52	35
Disturbance factor, D.		0.9	
Mean rock volume (cm^3)		9700	5000 (estimated)
Joint roughness number, J_r		3	2
Joint alteration number, J_a		1 (>10mBGL)	3 (<10mBGL)
Joint condition factor, $J_c = J_r/J_a$		3	0.6
Geological Strength Index, GSI. (Figure A1.1)		53	37
Rock mass shear strength	friction angle	37^o	40^o
	cohesion (MPa)	1.3	0.7

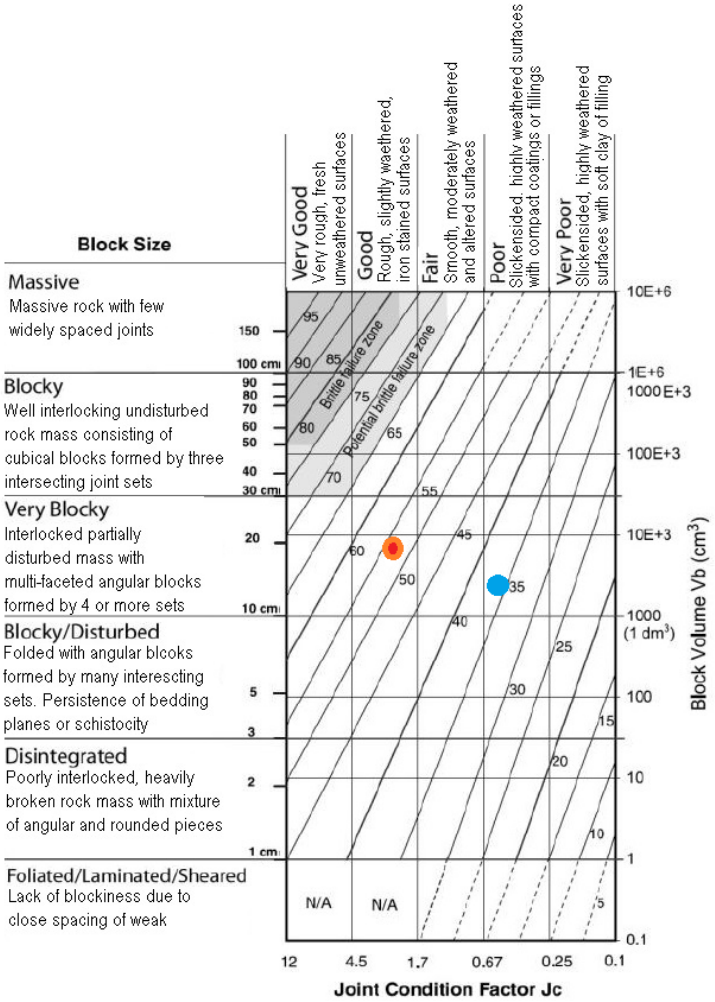


Figure A1.1. Estimated GSI values for (red) limestone and (blue) sandstone.

APPENDIX 2 KINEMATIC STABILITY ANALYSES

Stability analyses were undertaken to quantify the likelihoods[55] for discontinuity controlled modes of instabilities on the walls at inter-ramp and overall scales[56]. The analyses used the stereographic method, implemented in the software Dips[57], to assess whether the kinematics[58] applicable to the benches are conducive to instabilities. The method calculates the proportions of the logged discontinuities that are conducive to masses of rocks:

- sliding from the walls along underling single (planar) or multiple (wedge) discontinuities
- or toppling from the walls bounded to the rear by single discontinuities. Toppling modes are not typically applicable at overall scales.

Although significant limitations in the analysis method limit the veracities of the results, they are of a standard suitable for highlighting the possible dominant modes of instabilities and the relative likelihood for the modes to occur.

The assessments assumed the following:

- The discontinuities have the orientation characteristics listed in Table 1.
- The shear strengths of the discontinuities transition from a friction angle $\phi = 44^o$ to $\phi = 38^o$ over the long-term as listed in Table 3.
- A maximum inter-ramp angle of 60^o on the east wall and 30^o on the west wall as listed in Table 4.
- A maximum overall angle of 54^o on the east wall and 28^o on the west wall as listed in Table 4.
- The slopes dip towards the directions listed in Table 5.

The percentage of discontinuities having orientations conducive to sliding is defined as,

- for planar sliding and flexural and direct toppling, the percentage (P_{fp}) of the total number of poles[59] to discontinuities that are within "critical zones[60]".
- for wedge sliding and oblique toppling, the percentage (P_{fw}) of the total number of intersections between pairs of discontinuities that are within "critical zones".

The total percentage of discontinuities having orientations conducive to sliding or toppling (P_u) is a function of P_{fp} and P_{fw} based on decision tree theory.

The likelihood for failure (P_f) is defined as P_u x P_l where P_l is the proportion of discontinuities sufficiently persistent to underlie or bound to the rear an instability.

As discussed in Section 2.6.4, discontinuities daylighting on the east wall can have very high persistence. Value for P_l of 1.0 and 0.8 are assumed to characterise these feature i.e., 100% and 70% of discontinuities may have sufficient persistence to influence inter-ramp scale and overall scale instabilities respectively.

---

[55] The likelihood (P_f) is not equivalent to the probability of failure (PoF). A stereonet method cannot provide a definitive assessment of PoF due to fundamental limitations in the analysis method.

[56] Loss of one or more benches is a significant hazard. Loss of width from an individual berm is not a significant hazard.

[57] The kinematic analysis software, Dips, is produced by Rocscience Inc, Toronto.

[58] Kinematics describes the motion of rocks without considering their masses nor the forces that may cause the motion. It is primarily concerned with the orientations of discontinuities bounding rocks with respect to the orientations of slopes from which rocks may move.

[59] In a stereonet analysis, a discontinuity is assumed to be a planar feature represented on a stereonet as a "great circle". The "pole" to a discontinuity is a downward directed line orientated perpendicular to the plane. It is represented on a stereonet as a point.

[60] "Critical zones" are areas on a stereonet within which a pole is deemed to have the orientation characteristics conducive to sliding.

Discontinuities daylighting on the west wall generally have low to moderate persistence. Value for P_l of 0.7 and 0.2 are assumed to characterise these feature i.e., 70% and 20% of discontinuities may have sufficient persistences to influence inter-ramp and overall scale instabilities respectively.

Figures A2.1 to A2.4 shows example of the stereonets applicable to the various modes. The results of the analyses are listed in Tables A2.1 and A2.2 and discussed in Section 4.1.

Table A2.1. Results of IR scale analyses applicable to the short to medium terms ($\phi = 44^o$).

	Wall (dip direction)	
	East (60/275°)	West (30/094°)
Failure Mode	Poles in critical area/s (%)	
Planar sliding, P_{fp}	0.3	0.0
Wedge sliding, P_{fw}	4.5	0.0
Flexural toppling, P_{ff}	2.6	0.0
Direct toppling, P_{fd}	1.6	2.6
Oblique toppling, P_{fo}	8.7	14.1
Total, $P_u = f(P_{fp}, P_{fw}, P_{ff}, P_{fd}, P_{fo})$	16.7	16.3
Likelihood for failure, $P_f = P_u \times P_i$	16.7	11.4

Table A2.2. Results of IR analyses applicable to the medium to long terms ($\phi = 38^o$)

	Wall (dip direction)	
	East (60/275°)	West (30/094°)
Failure Mode	Poles in critical area/s (%)	
Planar sliding, P_{fp}	0.3	0.0
Wedge sliding, P_{fw}	7.1	0.0
Flexural toppling, P_{ff}	9.5	0.0
Direct toppling, P_{fd}	1.6	2.6
Oblique toppling, P_{fo}	5.5	9.3
Total, $P_u = f(P_{fp}, P_{fw}, P_{ff}, P_{fd}, P_{fo})$	22.0	11.7
Likelihood for failure, $P_f = P_u \times P_i$	22.0	8.2

Table A2.3. Results of overall scale analyses applicable to the short to medium terms ($\phi = 44^o$).

	Wall (dip direction)	
	East (54/275°)	West (28/094°)
Failure Mode	Poles in critical area/s (%)	
Planar sliding, P_{fp}	0.3	0.0
Wedge sliding, P_{fw}	2.7	0.0
Total, $P_u = f(P_{fp}, P_{fw})$	3.0	0.0
Likelihood for failure, $P_f = P_u \times P_i$	2.4	0.0

Table A2.4. Results of overall scale analyses applicable to the medium to long terms (ϕ = 38°)

	Wall (dip direction)	
	East (54/275°)	West (28/094°)
Failure Mode	Poles in critical area/s (%)	
Planar sliding, P_{fp}	0.3	0.0
Wedge sliding, P_{fw}	4.7	0.0
Total, $P_u = f(P_{fp}, P_{fw})$	5.0	0.0
Likelihood for failure, $P_f = P_u \times P_i$	4.0	0.0

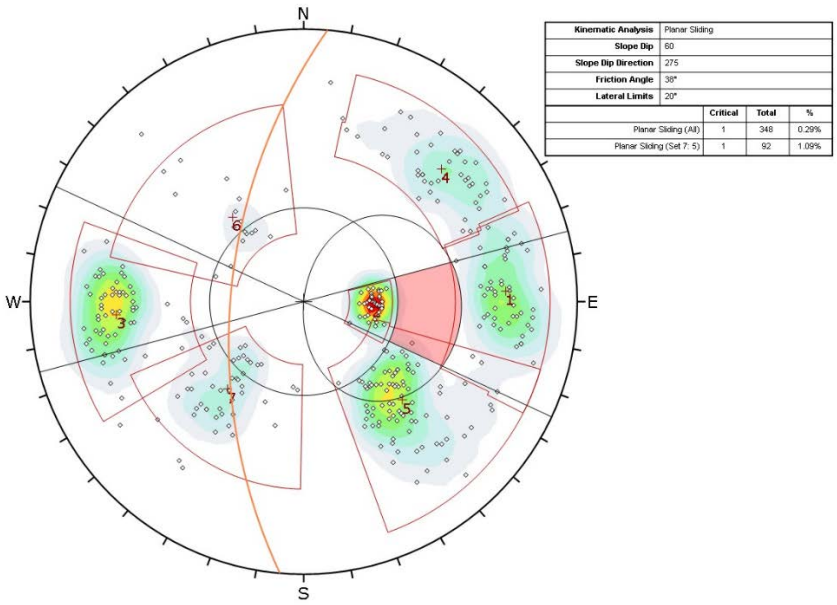


Figure A2.1. Stereonet applicable to planar sliding on the east wall at IR scale during the long-term.

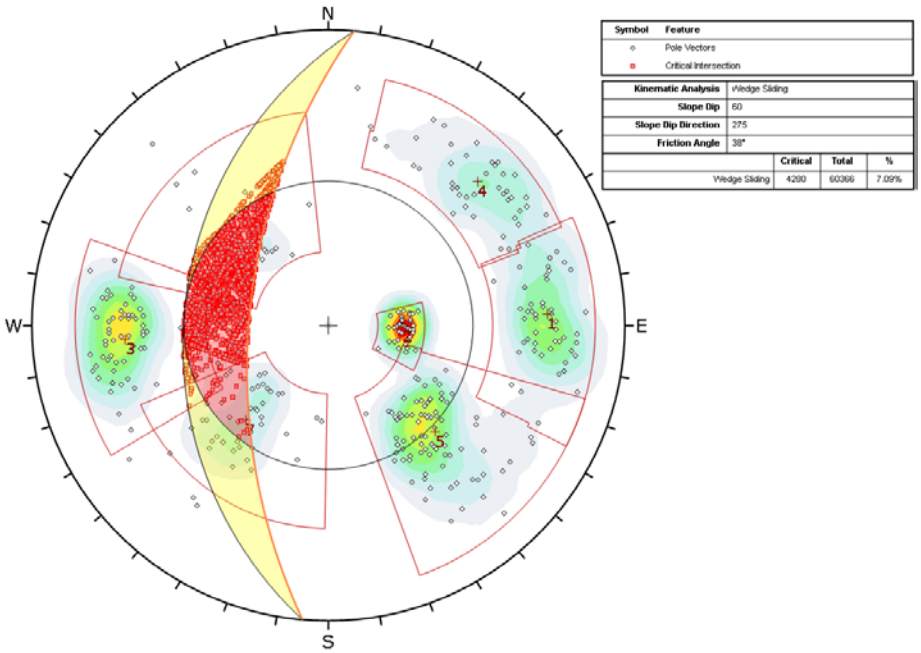
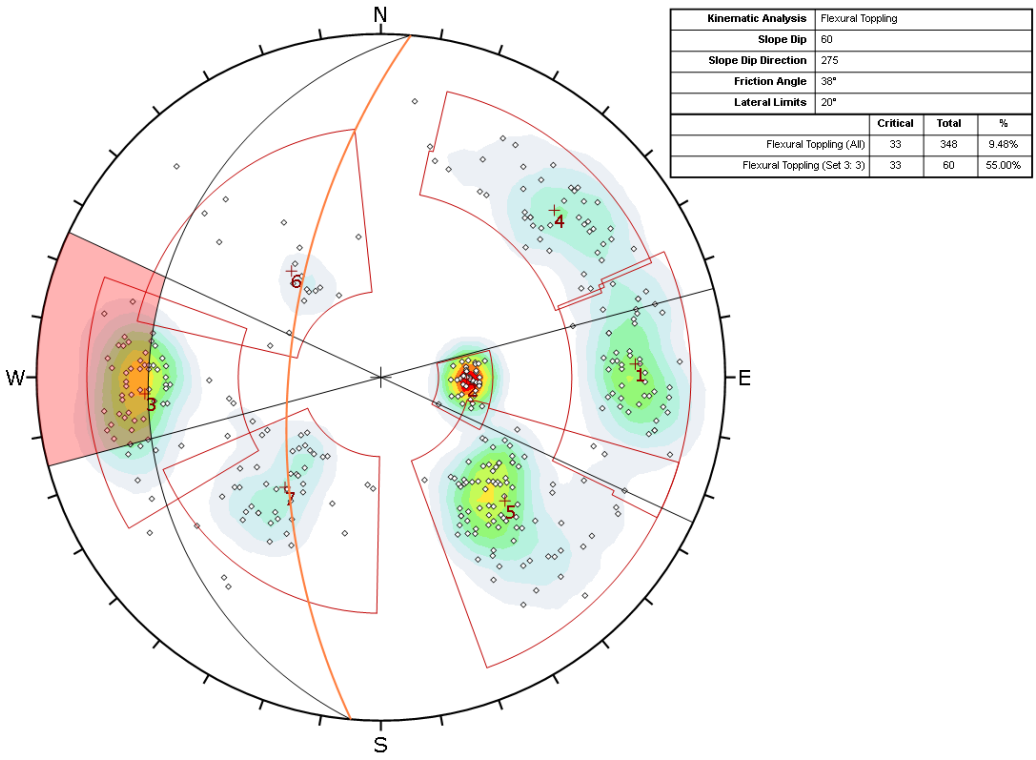
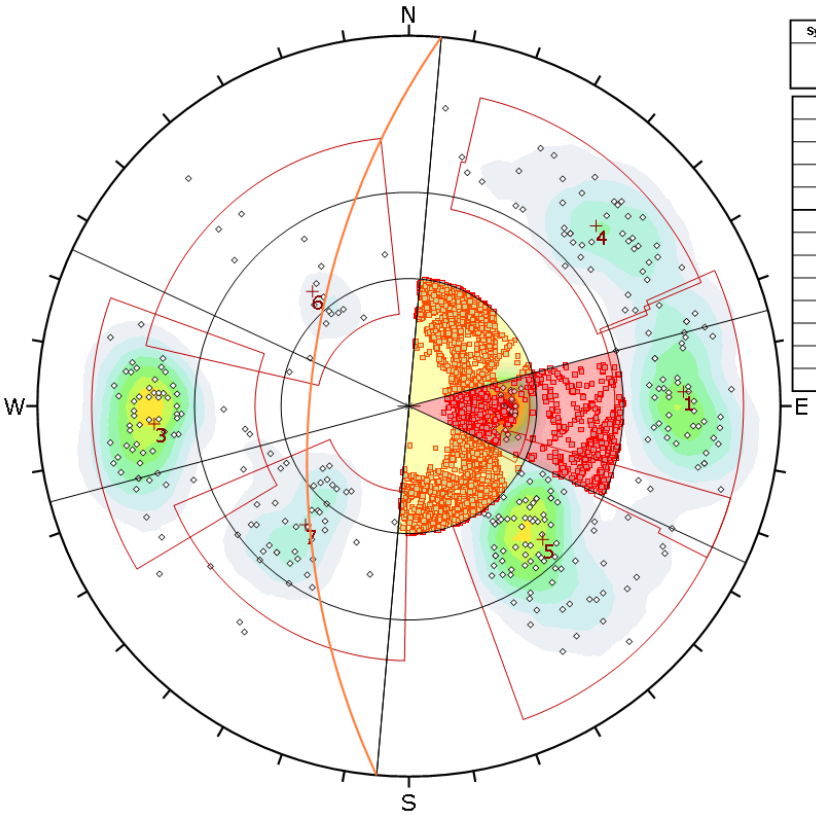


Figure A2.2. Stereonet applicable to wedge sliding on the east wall at IR scale during the long-term.



Kinematic Analysis	Flexural Toppling		
Slope Dip	60		
Slope Dip Direction	275		
Friction Angle	38°		
Lateral Limits	20°		
	Critical	Total	%
Flexural Toppling (All)	33	348	9.48%
Flexural Toppling (Set 3: 3)	33	60	55.00%

Figure A2.3. Stereonet applicable to flexural toppling on the east wall at IR scale during the long-term.



Symbol	Feature
◇	Pole Vectors
▫	Critical Intersection

Kinematic Analysis	Direct Toppling		
Slope Dip	60		
Slope Dip Direction	275		
Friction Angle	38°		
Lateral Limits	20°		
	Critical	Total	%
Direct Toppling (Intersection)	933	60366	1.55%
Oblique Toppling (Intersection)	3302	60366	5.47%
Base Plane (All)	48	348	13.79%
Base Plane (Set 1: 1)	1	48	2.08%
Base Plane (Set 2: 2)	40	40	100.00%
Base Plane (Set 7: 5)	6	92	6.52%
Base Plane (Set 8: 7)	1	43	2.33%

Figure A2.4. Stereonet applicable to direct and oblique block toppling on the south wall at IR scale during the long-term.

APPENDIX 3 PIT WALL SCALE STABILITY

The stabilities of overall scale surfaces through cross section B-B' were assessed using a limit-state equilibrium method implemented in the software *Slide2*[61]. The two-dimensional analysis code is applicable as the walls are wide relative to their heights and they are relatively straight.

The following characteristics were assumed:

- The walls have the specifications listed in Table 4 and shown in Figure A3.1. Limestone is interbedded in sandstone. The lower bench of the west wall comprises compacted fill.
- The shear strength characteristics of the rockmass are described by a Generalised Hoek-Brown shear strength model discussed in Appendix A1.4.
- An anisotropic model is applied for the limestone to allow for joints from Sets 3, 6 and 7 which dip steeply out of the west slope and joints and bedding from Sets 1, 4 and 5 which dip steeply out of the east slope.
- The shear strength characteristics of the joints and bedding are applied to sections of potential sliding surfaces within limestone that dip at between 30^o and 75^o. This strength is described by the Barton-Bandis (B-B) discontinuity shear strength criterion defined in terms of the parameters listed in Table 3.
- A peak ground acceleration of 0.0012g is represented as a pseudo-static horizontal force directed out of the walls. The horizontal component (A_H) of the acceleration is conservatively[62] estimated by $A_H = k_H \times A_e$ where $k_H = 0.45$. On this basis, $A_H = 0.0005g$.
- A water table occurs at RL28m.

The results of the analyses are quantified in terms of Factor of Safety (FoS) values for each of hundreds of surfaces assessed within the walls. The surfaces with the lowest capacities are highlighted in Figure A3.2. The results of the analyses are discussed in Section 4.2.2.

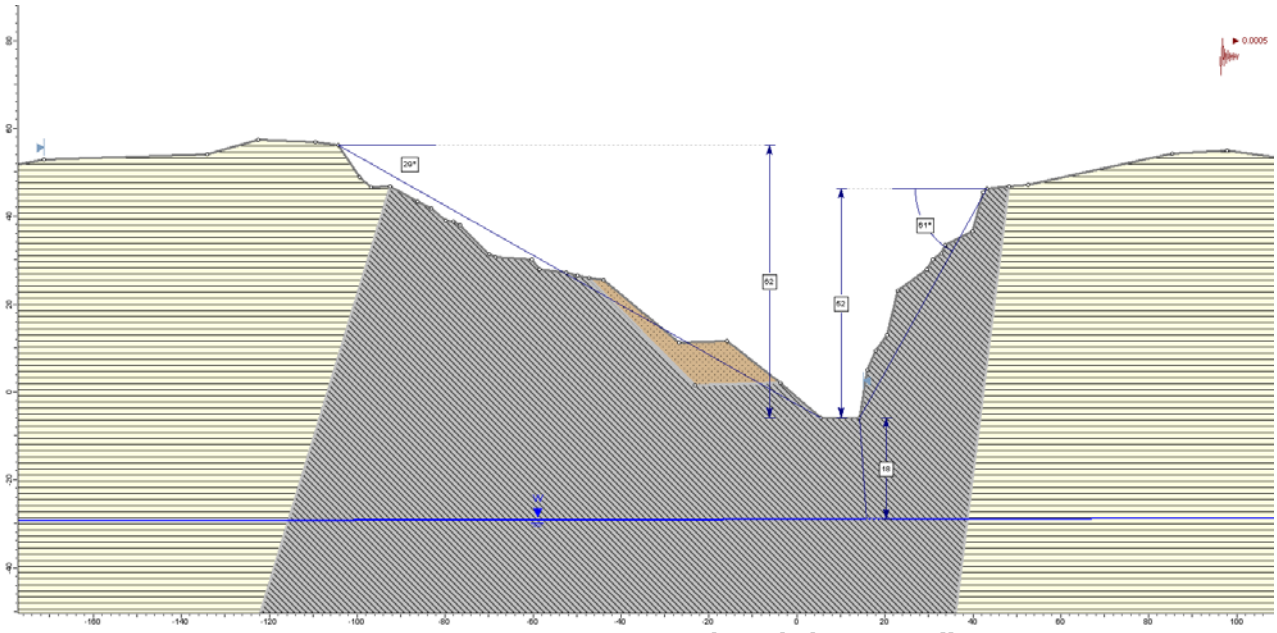


Figure A3.1. Cross-section B-B' through the west wall.

[61] *Slide2 Ver 9.02* is developed by RocScience Inc. Toronto, Ontario.

[62] Melo and Sharma (2004) suggest (*Seismic Coefficients for pseudo-static Slope Analysis*, 13th World Conference on Earthquake Engineering Vancouver, B.C., Canada August 1-6, 2004) that k_H values ranging from 40% to 45% of A_e should be used in slope stability design rather than the 50% as proposed by Hynes-Griffin and Franklin (*Rationalizing the seismic coefficient method*. U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi, 1984, Miscellaneous Paper GL-84-13).

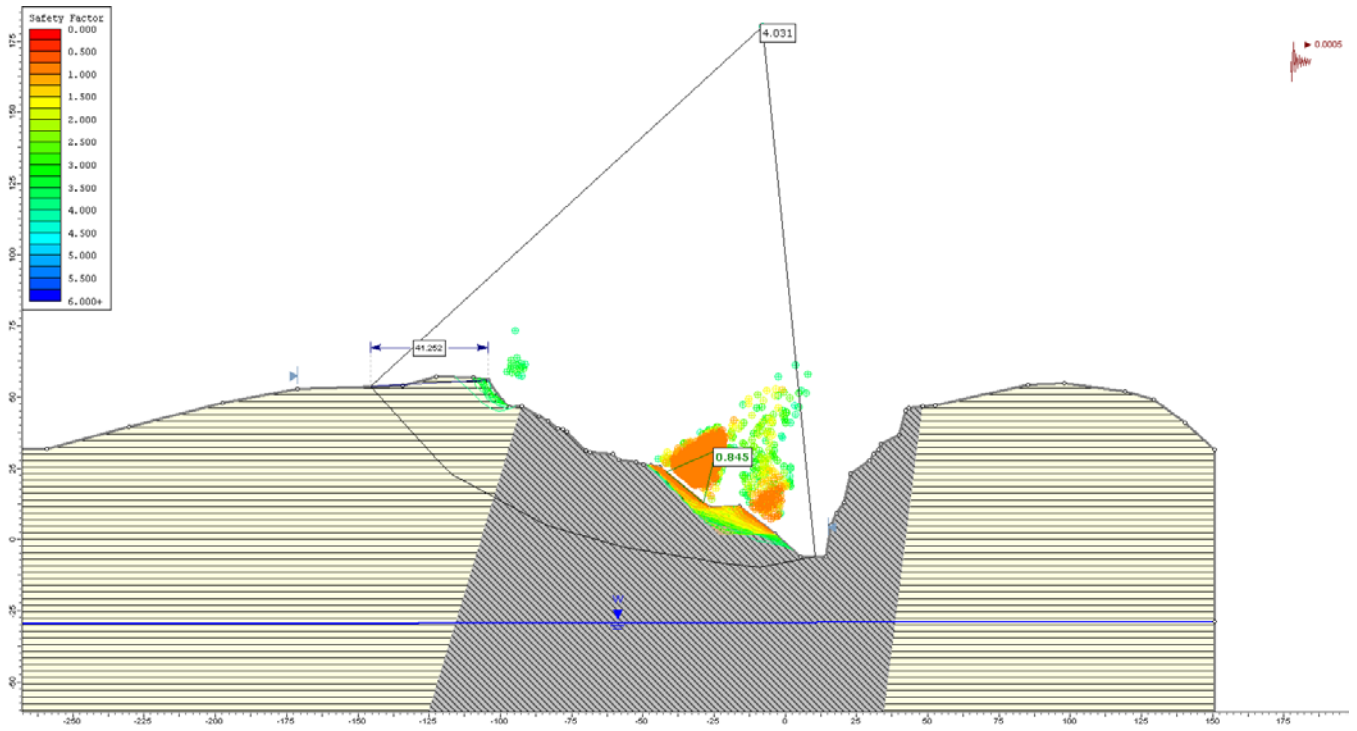


Figure A3.2. Highlighted are the lowest strength surfaces within the west wall.

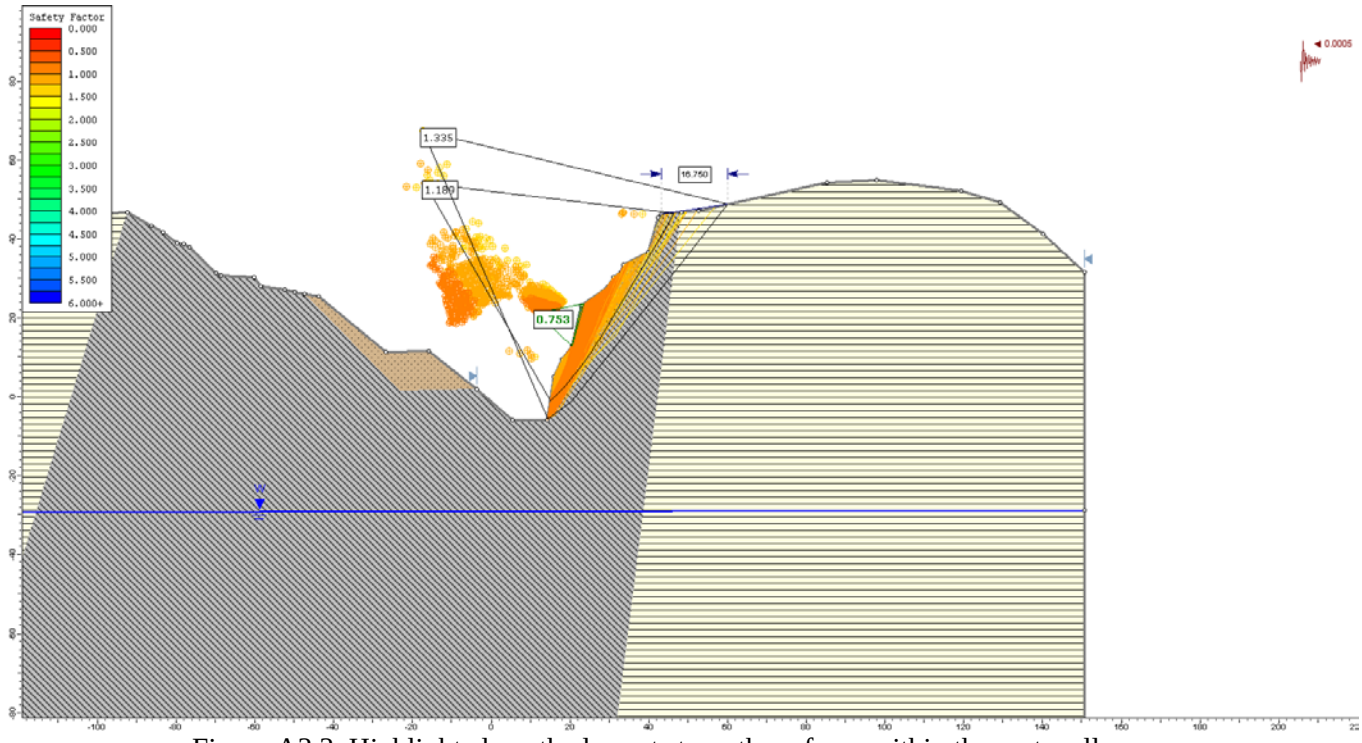


Figure A3.3. Highlighted are the lowest strength surfaces within the east wall.

Appendix G PRCP spatial data (supplied separately)

SPATIAL DATA

A separate file is submitted with PRCP containing the required content of spatial information (shapefiles) for the submission of a PRC plan.

The following information is provided:

- the location and maximum extent of disturbance footprint for the mine life
- the PMLU for the area within the resource tenure(s) (note there are no NUMAs)
- the rehabilitation areas within the resource tenure(s) (note there are no improvement areas).
- sensitive receptors (no sensitive receptors have been identified by Graymont)
- extent of a floodplain (the lease areas are not located in a floodplain)
- existing rehabilitation (if the PRC plan is for an existing EA) (No areas have been rehabilitated to date).

Table 21 contains details of the data supplied separately.

Table 21: Spatial Checklist

File	Spatial information requirements	File name
1	PRC plan - polygon	EPML00319713_PRCplan_PRCP_PY_211022

ecological AUSTRALIA
A TETRA TECH COMPANY

SYSTEM CERTIFICATION ISO 9001 SGS
SYSTEM CERTIFICATION ISO 14001 SGS
SYSTEM CERTIFICATION AS 4801 SGS

1300 646 131
www.ecoaus.com.au